Hi, I'm Vijay

Design Thinker

About me

To work in a firm with a professional work-driven environment where I can utilize and apply my knowledge, and skills which would enable me as a fresh graduate to grow while achieving organizational goals.

Profile

Favorite colors

SNS COLLEGE OF TECHNOLOGY
(An Autonomous Institution)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

INDIVIDUAL FACULTY PROFILE

Name	: Mr.R.Vijayakumar
Date of Birth	: 05.03.1988
Educational Qualification	: M.E., (Ph.D)
Contact Details	: 9787175667
Date of Joining	: 19.06.2013
Working Experience	
Teaching	: 9.7 Years
Research	: Nil
Industry	: Nil
Total	: 9.7 Years
Teaching Experience in SNSCT	: 9.7 Years
Area of Specialization	: Power Systems Engineering
Research Publications	
Number of Paper Published in	
International Journals	: 18
National Journals	: 0
International Conferences	: 10
National Conferences	: 0
Number of Projects guided	
Under Graduation Level	: 12
Post Graduation Level	: 6

Faculty outside Participation

Workshop/ Seminars	: 40
FDP/ STTP	: 6
Patents	: 9
Technology Transfer	: 5
Number of Books Published	: 0
Resource Person for / Workshop/ FDP/ Conference and Others	: 6
Any Other Awards and Achievements	: Nil

Signature

PATENT FILED

- No. of Patent Filed : **09**
- No. of Patent Published : **05**

S. No	Title	Application ID	Status	Details	Contribution
1.	Development of Test RIG for Automated Driving Test Track and Issuing License using LABVIEW	201741 030618	Published	The innovation is to monitor, analyze, record and report the driving skills of a person when applying for driving license test. This method is completely automated there is no need for manual introversion.	Patent Drafting and Claim Written. The Hardware Model was developed and implemented to Indian Army (Bangalore)
2.	Panel for Smart Direct Online Starter	297130	Waiting	The invention relate to a design for smart DOL starter with user friendly data display	Patent Drafting and Claim Written
3.	Antibiotic Herbal Toothpick	297131	Waiting	The invention relate to a design for Herbal Antibiotic Toothpick for Tooth Infection	Patent Drafting and Claim Written
4.	Kitchen Waste Disposal Unit	297133	Waiting	The invention relate to a design for kitchen waste disposal unit to convert kitchen waste into manure	Patent Drafting and Claim Written
5.	Method and system for automatically muting headphones when unused	311573	Waiting	The invention relate to a electrical circuit and small mechanical arrangement for automatic muting our headphones while removing from our ears.	Patent Drafting and Claim Written
6.	Development of AC Controller Smart watch for ICU Patients	201841 041074	Published	The innovation is to control the Temperature of ICU Room based on the Patient health condition. Successful surgery depends on optimizing working conditions for medical professionals and patients	Patent Drafting and Claim Written. The Simulation model was completed.
7.	Development of Portable and Inbuilt system for	201841 041073	Published	The innovation is to control the brightness level of television by standard 2D cameras or simple	Patent Drafting and Claim Written. The Simulation model was

	Brightness control in Televisions			PIR sensors for avoiding children's sitting near the Television to watch. This method is completely automated there is no need for manual introversion	completed.
8.	Development of portable semi-automatic coconut flesh scraper	201941 000936	Published	The innovation is to grate and expel the coconut substance from the inside of a coconut shell and has a rotatable shaft & moving blade arrangement for coconut. This method is semi automated with no need for manual intervention.	Patent Drafting and Claim Written. The Simulation model was completed.
9.	IOT based solar powered Self lawn bot for grass cutting system	201941 000937	Published	The present invention relates to lawn bots and lawn bot moving accessories. More particularly, the present invention relates to an automated solar powered lawn cutting and vacuum system having an automated lawn bot and a mower home base enclosure in which the lawnmower is kept when not in use for re-charging of the mower and in which grass clippings are removed from the mover.	Patent Drafting and Claim Written. The Simulation model was completed.

CONSULTANCY WORK

- No. of Consultancy Work Completed: **07**
- No. of Consultancy Work Inprogess : **03**

S.No	Name of the Industry	Consultancy Work	Status	Contact Person	Contribution
1.	Delving Research and Development	Smart Meter	Completed	Dr.Chithra	Simulation model and proof of concept was completed. Got Proposal from Government Agency
2.	Qubetronics	Super capacitor	Ongoing	Mr.T.Karthik	Simulation model work

		based Rechargeable LED			is going on.
3.	MM Kitchens	Electronic soft Lighter	Completed	Mr.L.Mahendren	Product was developed and product under testing
4.	MM Kitchens	Hot water Level indicator	Completed	Mr.L.Mahendren	Product was developed and product under testing
5.	Bindhu Pumps	IoT based Pump Test Rig for Industry	Ongoing	Mr.Nadarajan	Simulation work and proof of concept developed. PCB design process under progress
6.	Karthikeya Enterprises	Ethernet based Home appliances control	Completed	Mr.Thilak	Product was developed and submitted to industry
7.	Karthikeya Enterprises	Ethernet based Home appliances control	Completed	Mr.Thilak	Product was developed and submitted to industry
8.	Karthikeya Enterprises	WiFi ESP8266 based Home appliances control	Completed	Mr.Thilak	Product was developed and submitted to industry
9.	Karthikeya Enterprises	Smart Home control using Hybrid technology	Completed	Mr.Thilak	Product was developed and submitted to industry
10.	Kondaas Power Solutions	IoT based data monitoring system from remote inverters	Ongoing	Mr.Sam	Site visit under progress

PRODUCT DEVELOPMENT

Industrial:

- IoT based Pump Test Rig for Industry
- Automatic Retrofit model for commercial water heater
- Retrofit GSM kit for Star-delta Starter
- Automatic Vehicle Service Remainder for service company
- Distribution Transformer Data Monitoring

Commercial:

- ❖ Automated Lighter for gas operated shawarma making machine
- ❖ Automated Water Heater for Food dispenser Table
- ❖ Automatic Plastic storage with rewards dispenser
- ❖ Hybrid Algorithm for Smart Home Automation
- ❖ Ethernet based Home Automation
- ❖ WiFi ESP8266 based Home Automation
- ❖ Astrological Timer for Street Lights
- ❖ Finger print based Vehicle Ignition system
- ❖ Automatic DC Motor Load Test Kit

TECHNOLOGIES KNOWN

- ✓ IoT
  (By using Arduino, Texas Instruments, Node MCU)
- ✓ PCB Designing
  (Proteus, Dip trace (EAGLE, KiCad EDA, Altium Designer (Basic Level)))
- ✓ Automation in Agriculture
  (By using Microcontroller)
- ✓ Arduino IDE
- ✓ Texas Energia
- ✓ Microcontroller
- ✓ KEIL
- ✓ Proteus
  (Simulation and PCB Layout)
- ✓ MATLAB
- ✓ E-TAP

PUBLICATION DETAILS

- ▪ International Conference paper Presented : **10**
- ▪ International Journal Paper Published : **18**
- ▪ Scopus and Annexure 1 Paper Published : **08**

OTHERS

- Patent Drafting for design and Product
- Trademark
- Hardware Servicing and Mobile phone, Laptop Servicing

GOOGLE CITATION

vijayakumar.R

Assistant Professor

smart grid

	All	Since 2018
Citations	149	142
h-index	7	7
i10-index	6	5

TITLE	CITED BY	YEAR
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Design of renewable energy based PEVS charging station with energy management technique S Divyapriya, A Amudha, R Vijayakumar J Adv Res Dynam Cont Sys 9 (17), 856-69	16	2017
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Control and management scheme of PV integrated charging facilities for PEVs with texas CC3200 IoT technology R Vijayakumar, K Malarvizhi, S Divyapriya International Journal of Engineering Technology Science and Research 4 (9 …	8	2017
Plug-in electric vehicle supported DVR for fault mitigation and uninterrupted power supply in distribution system M Poornima, S Bharath, S Divyapriya, R Vijayakumar 2018 International Conference on Soft-computing and Network Security (ICSNS …	7	2018
Smart electric vehicle charging infrastructure using internet of things R Vijayakumar, A Amudha, S Divyapriya International Journal of Innovations & Advancement in Computer Science …	7	2017
Automatic Frequency Response for Autonomous Distributed V2G (Vehicle-to-Grid) Using IoT Technology	5	2018

TITLE	CITED BY	YEAR
S Divyapriya, A Amudha, R Vijayakumar Journal of Electrical Engineering 19 (1), 1-8		
Design of solar smart street light powered plug-in electric vehicle charging station by using internet of things S Divyapriya, A Amudha, R Vijayakumar Journal of The Institution of Engineers (India): Series B 102, 477-486	3	2021
Compensation of Voltage Variations in Distribution System during Fault Condition by Using DVR Based Separate Energy Storage Devices R Vijayakumar, R Subramanian Programmable Device Circuits and Systems 5 (2), 70-75	3	
Compensation of Voltage SAG and SWELL Using SMES Based DVR During Various Fault Condition R Vijayakumar, N Suparna International Journal of Advanced Engineering and Recent Technology, 19-25	3	
DVR Based Power Quality Improvement Using DFIG, Fuel Cell and Super Capacitor R Vijayakumar, M Poornima, S Sumithra	1	
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Electrical Demand Response using Electric vehicle and Renewable energy sources RVSD K.Malarvizhi International Journal of Pure and Applied Mathematics 116 (11), 191-199		2017
Electrical Demand Response Using Electric Vehicle and Renewable Energy Sources K Malarvizhi, R Vijayakumar, S Divyapriya International Journal of Pure and Applied Mathematics 116 (11), 191-199		2017
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COMPENSATION OF VOLTAGE SAG AND SWELL USING SMES WITH FUEL CELL BASED DVR IN TRANSMISSION SYSTEMS SD Priya, R Vijayakumar, V Divya		

JOURNAL PUBLICATION-SCOPUS

Automated Student Attendance Tracker for End Semester Examination using Face Recognition System

[1]R.Vijayakumar,[2]M.Poornima,[3]S.Divyapriya,[4]T.Selvaganapathi

[1] Department of Electrical and Electronics Engineering, SNS College of Technology, r.vijayakumarpse@gmail.com, Coimbatore.
[2]Department of Electrical and Electronics Engineering, Christ the King EngineeringCollege,poorni3710@gmail.com,Coimbatore.
[3]Department of Electrical and Electronics Engineering, Karpagam Academy of Higher Education, divyapriya.s@kahedu.edu.in, Coimbatore.
[4]Department of Electrical and Electronics Engineering, Karpagam Academy of Higher Education, Selvaganapathi.thangakaleeswaran@kahedu.edu.in

Abstract: The keeping and recording of a class attendance log manually is not very efficient for end semester examination hall tickets generation due to maintaining minimum attendance percentage for each subjects. Since offering proxies for absentees or skipping class has become amusing and a fantasy among students of the current age. Manually recording attendance in logbooks becomes challenging and vulnerable to manipulation. Therefore, the purpose of this project is to present the automatic attendance system. This system recognizes each student's face to automatically identify them in the classroom and record their attendance and also record wherever roaming inside the campus. By photographing students' faces in real time, this system was created. The reference faces in the dataset are compared to the detected faces, marking the attendees' attendance. At the end of the semester all the student's attendances are calculated automatically and give notification to students, parents and class advisors for the status of attendance percentage. Based on the detailed results, hall tickets are automatically generate in the college exam cell. The final project is completed and reports were generated.
Keywords: face Recognition system, Raspberry pi, IoT and camera

I.INTRODUCTION

The individual subject handling faculty members calls out each student's name personally to record attendance in the traditional approach, which typically entails pupils sitting in a classroom [1]. In most cases, pen and paper are used to indicate attendance [2]. The extensive attendance records that were kept are then used as references in the future. The manual attendance system has many disadvantages, like the upkeep of a massive database of records is laborious [3]. The number of records keeps growing as and when the class strength does. It becomes even more challenging to maintain it continually over time. It takes a lot of time [4]. Every time, the responsible instructor must interrupt his or her class to record attendance, taking away from instructional time [5]. It is not impenetrable. Due to the different student misconducts, a subject handling faculties could forget to note a student's attendance or might even have a tendency to mark a person's absence incorrectly [6]. It wastes resources since there is a lot of paperwork involved. Large records require a lot of maintenance. There the risk of the records being misplaced, stolen, or damaged [7].

Therefore, the main goal of the proposed method is to use humans face recognition to automatically record attendance with time stamped gio location. Mainly all the class rooms are surveillance by high definition CCTV camera with centralized network connectivity may be LAN or WiFi technology. And also that kind of CCTVs are fixed in main areas of campus like, Cafeteria, Lawn, Food court, parking area, etc.

II.PROPOSED SYSTEM

Awareness about the education system is improving day by day and also the selecting good institution from the parent's side is based on the quality of education and transparency of flow. The figure 1 shows the graphs about student's strength at a particular institution in each academic years. The number of students strength will make the manual system more complicate and also made the process in very tedious [8].

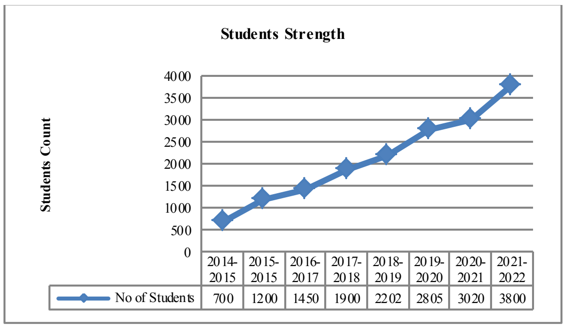

Figure 1: Students Admission Growth

The proposed attendance tracking system consists of the following block diagram with modern technology.

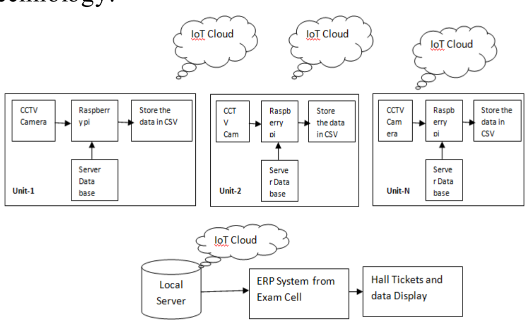

Figure 2: Proposed System Block Diagram

The figure 2 explains the process block diagram of the system. Each and every unit contains the High definition CCTV camera with Raspberry pi device connected Internet via Wi-Fi or Ethernet. Units are placed based on the requirements and need by the institution. Each units data's are stored in IoT cloud for further processing, at the final stage all the data's are may be stored in private server or local server. From the local server, each and individual students data's are stored and unwanted data's are deleted based on big data analytics. At the end of the semester all the student's hall tickets are generated based on the individual institution criteria.

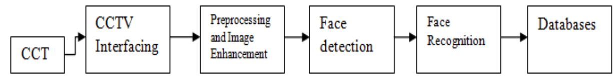

Figure 3: Process flow

As illustrated in Figure 3, the proposed method entails four key steps: a) Image Capture, b) Camera Interfacing process, c) Face Detection, and d) Face Recognition. For recognition tasks, system can used a variety of machine learning approaches, such as decision trees, random forests, K-Nearest Neighbours (KNN), and Convolutional Neural Networks (CNN). For Image Capture process obtain an image during this stage. The first process in the flow method is image restoration from the source camera, which is often a hardware source because processing is not an option.

Images are continuously read from our preprocessed input by our CCTV. The next Camera Interfacing process, Image acquisition is done using a Hikvision DS-2CD2T85FWD-15/18 Internet protocol (IP) camera. It has an 8-MP camera and records video at 15 frames / second in a 1248 x 720 resolution. The faces of individuals it will recognise are included in the face database. Each photo in the data is labeled since facial recognition uses categorization techniques. Each person's facial image has a different label that is specific to them. 90 people are represented by more than 41,320 photos. As a result, these classes' (people's) labels range from 1 to 90. It implies that each label has several photos.

Preprocessing the image after acquisition makes it ready for handling later. The two main preprocessing procedures are grey scale conversion and edge detection methods. After receiving the image from the camera, the following step is to use the Viola-Jones algorithm to separate the face from no face regions in order to identify faces in the photos. The face region is then removed and used for additional processing.

III.SYSTEM DESCRIPTION

The terms used to describe resolution in CCTV applications are shown in the table below. "Megapixel" refers to any resolution with more than one million pixels. The labels are approximate in the case of megapixel cameras. The 2 megapixel camera, for instance, really records 1,920,000 pixels per frame. 3,145,728 pixels are recorded by a 3 megapixel camera in each frame.

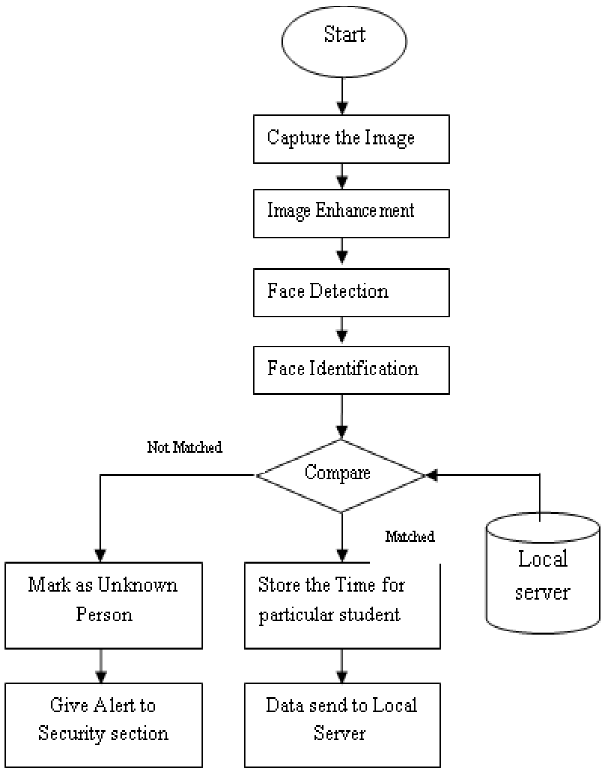

Figure 4: Flow chart diagram of the proposed System

The Figure 4 illustrates the flow chart of the proposed system, at first CCTV will capture the images, after the capturing images the system will identify weather image has human or any other animals, the human face image enhances after the perfect captures, face detection process will help the system to convert readable format for the system. The entire captured readable format will compare with the face identification. The face image compares with local server database and produces the result. If any unknown person detects the system, it will warn the system to security office.

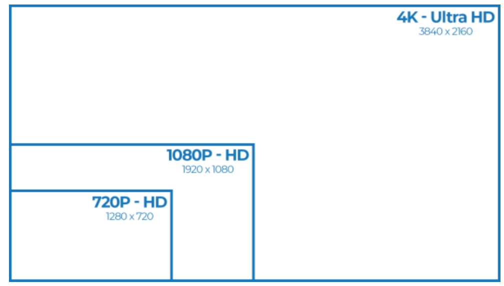

Figure 5: CCTV Resolutions

These phrases can be used to specify the size of a picture that has been taken at the camera and has since been communicated over the wire, shown on a full screen, or stored on a hard drive. Usercan find that megapixel counts differ slightly from those stated above when comparing megapixel camera characteristics. This is so that users can distinguish between cameras that specify the 'effective' pixels and those that specify the full number of pixels the all sensor was able to record. Some of the total pixels are used to store technical information rather than adding to the image's "effective" features.

Table 1: Comparison of Different Resolutions of CCTVs

Term	Pixels (W x H)	Notes
2CIF	704 x 240	2 times CIF width
4CIF	704 x 480	2 times CIF width and 2 times CIF height
D1	720 x 480	aka "Full D1"
720p HD	1280 x 720	720p High Definition aka "HD-SDI"
960p HD	1280 x 960	960p High Definition - a Sony specific HD standard
1.3 MP	1280 x 1024	aka "1 Megapixel" or "1MP"
2 MP	1600 x 1200	2 Megapixel
1080p HD	1920 x 1080	1080p High Definition
3 MP	2048 x 1536	3 Megapixel
4 MP	2688 x 1520	4 Megapixel
5 MP	2592 x 1944	5 Megapixel
6 MP	3072 x 2048	6 Megapixel
8 MP / 4K (Coax)	3840 x 2160	8 Megapixel
12 MP / 4K (IP)	4000 x 3000	12 Megapixel

From the table number 1, the camera selection for image processing can done.

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Figure 6: Network (IP) Cameras

Figure 6 illustrates the camera for using, DS-2CD2T85FWD-15/18, Up to 8 MPhighest resolution, Digital noise reduce, Max. Resolutionis 3840 × 2160.

All the students images are preloaded in server, if the institution has 10000 students' means, all the students images are loaded in server database mapping with Students unique register number along with bio data.

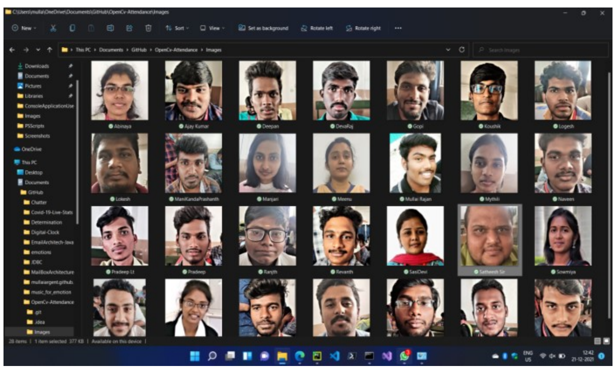


Figure 7. Uploading Students data in to server database

The figure 7 explains the students details uploading in to server database along with students name and register number.

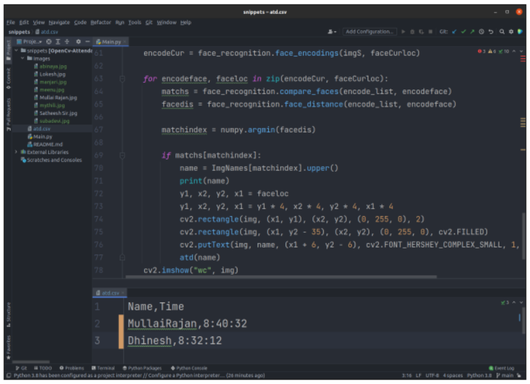
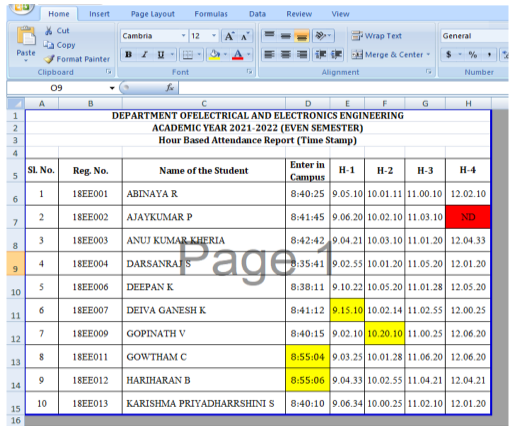


Figure 8. Uploading Students data in to server database

The figure 8 expresses the time stamp generation while detect the corresponding students face. if any anonyms face identified in CCTV camera results to popup notification to college security head regarding new face detected in camera number with gio tagged detail along with time stamps.

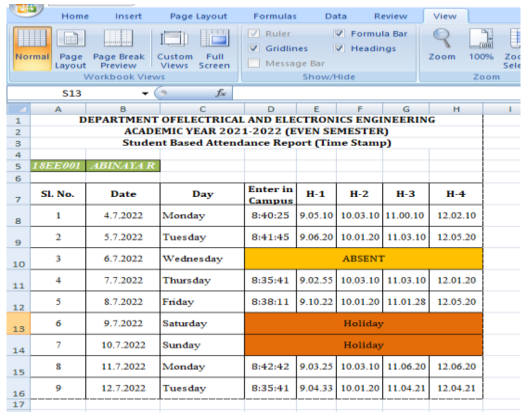


DEPARTMENT OFELECTRICAL AND ELECTRONICS ENGINEERING
ACADEMIC YEAR 2021-2022 (EVEN SEMESTER)
Hour Based Attendance Report (Time Stamp)

Sl. No.	Reg. No.	Name of the Student	Enter in Campus	H-1	H-2	H-3	H-4
1	18EE001	ABINAYA R	8:40:25	9.05.10	10.01.11	11.00.10	12.02.10
2	18EE002	AJAYKUMAR P	8:41:45	9.06.20	10.02.10	11.03.10	ND
3	18EE003	ANUJ KUMAR KHERIA	8:42:42	9.04.21	10.03.10	11.01.20	12.04.33
4	18EE004	DARSANRAJ S	8:35:41	9.02.55	10.01.20	11.05.20	12.01.20
5	18EE006	DEEPAN K	8:38:11	9.10.22	10.05.20	11.01.28	12.05.20
6	18EE007	DEIVA GANESH K	8:41:12	9.15.10	10.02.14	11.02.55	12.00.25
7	18EE009	GOPINATH V	8:40:15	9.02.10	10.20.10	11.00.25	12.06.20
8	18EE011	GOWTHAM C	8:55:04	9.03.25	10.01.28	11.06.20	12.06.20
9	18EE012	HARIHARAN B	8:55:06	9.04.33	10.02.55	11.04.21	12.04.21
10	18EE013	KARISHMA PRIYADHARRSHINI S	8:40:10	9.06.34	10.00.25	11.02.10	12.01.20

Figure 9. Hour Based Attendance Report (Time Stamp)-Report

The figure 9 shows that the report of hour based attendance report with image sensed time stamp, in this hardware testing 10students details were taken. The yellow color shaded data's are warning time delay, if more than 3 warning leads to make absent of the particular student. Red color indicates that particular student is not detected in camera.



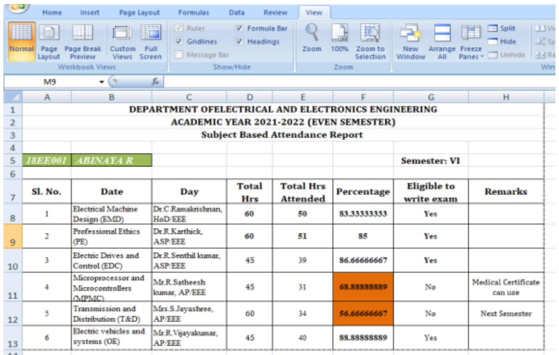
DEPARTMENT OFELECTRICAL AND ELECTRONICS ENGINEERING
ACADEMIC YEAR 2021-2022 (EVEN SEMESTER)
Student Based Attendance Report (Time Stamp)

18EE001 ABINAYA R

Sl. No.	Date	Day	Enter in Campus	H-1	H-2	H-3	H-4
1	4.7.2022	Monday	8:40:25	9.05.10	10.03.10	11.00.10	12.02.10
2	5.7.2022	Tuesday	8:41:45	9.06.20	10.01.20	11.03.10	12.05.20
3	6.7.2022	Wednesday	ABSENT				
4	7.7.2022	Thursday	8:35:41	9.02.55	10.03.10	11.03.10	12.01.20
5	8.7.2022	Friday	8:38:11	9.10.22	10.01.20	11.01.28	12.05.20
6	9.7.2022	Saturday	Holiday				
7	10.7.2022	Sunday	Holiday				
8	11.7.2022	Monday	8:42:42	9.03.25	10.03.10	11.06.20	12.06.20
9	12.7.2022	Tuesday	8:35:41	9.04.33	10.01.20	11.04.21	12.04.21

Figure 10. Student Based Attendance Report (Time Stamp)-Report

The Figure 10 indicates that the Student based attendance report for individual student, in this report user can view the day wise attendance report with exact time stamping. Yellow color marked as absent of particular day. Based on the report management can make a proof for any attendance shortage of corresponding student.



DEPARTMENT OFELECTRICAL AND ELECTRONICS ENGINEERING
ACADEMIC YEAR 2021-2022 (EVEN SEMESTER)
Subject Based Attendance Report

18EE001 ABINAYA R — Semester: VI

Sl. No.	Date	Day	Total Hrs	Total Hrs Attended	Percentage	Eligible to write exam	Remarks
1	Electrical Machine Design (EMD)	Dr.C.Ramakrishnan, HoD/EEE	60	50	83.33333333	Yes	
2	Professional Ethics (PE)	Dr.R.Karthick, ASP/EEE	60	51	85	Yes	
3	Electric Drives and Control (EDC)	Dr.R.Senthil kumar, ASP/EEE	45	39	86.66666667	Yes	
4	Microprocessor and Microcontrollers (MPMC)	Mr.R.Satheesh kumar, AP/EEE	45	31	68.88888889	No	Medical Certificate can use
5	Transmission and Distribution (T&D)	Mrs.S.Jayashree, AP/EEE	60	34	56.66666667	No	Next Semester
6	Electric vehicles and systems (OE)	Mr.R.Vijayakumar, AP/EEE	45	40	88.88888889	Yes	

Figure 11. Subject Based Attendance Report

Figure 11 shows that the report of individual subject based attendance report of the particular student, and also it gives the final suggestions to the exam cell. if the attendance percentage is between 65 to 75, student can submit the original medical discharge summary to the college in order to meet required attendance percentage, below the 65 percent attendance leads to decline the exam attempt of particular subject. In this report also explains the total hours attended with respect to total hours class taken.

Figure 12. Student Track Sheet

The Figure 12 shows that the student track history on particular day with Gio location based system stamped with Time. In this report management can track the student on particular day with particular places; this report will help the management if any malpractices or complaints registered on particular student. This report will generate based on the theme customer need.

V.CONCLUSION

From the above mentioned system will help the institution to make process easier and also reduce the burden to subject handling faculty members, not only the above mentioned advantages and also save paper to initiate green environment to society. The reports from the system will help to the examination center to take decision in good manner. The parents also can know and track their children for correct way of teaching. Even though it feel to the students looking over headache during college days, it help the students for unwanted punishment from college and faculties. All the data's are stored in college local server and also dilatable whenever needs with head of the institution's permission. This system suits for all kind of educational fields includes big industries also.

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RESEARCH ARTICLE

Design and Implementation of Grid Connected Solar/Wind/Diesel Generator Powered Charging Station for Electric Vehicles with Vehicle to Grid Technology Using IoT

S. Divyapriya[1,*], A. Amudha[2] and R. Vijayakumar[3]

[1]*Department of EEE, Divyapriya S, Karpagam Academy of Higher Education, Coimbatore, India;* [2]*Department of EEE, Dr. Amudha A, Karpagam Academy of Higher Education, Coimbatore, India;* [3]*Department of EEE, Vijayakumar R, SNS College of Technology, Anna University, Coimbatore, India*

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Abstract: In this paper grid connected Solar/Wind/Diesel generator powered Electric Vehicle (EV) charging station with Vehicle to Grid (V2G) is designed. Solar/Wind/Diesel generator powered charging station consists of a Photovoltaic array and Wind Energy system, three unidirectional converters, Maximum Power Point Tracker(MPPT), Raspberry Pi controller, 20 Bidirectional DC/DC converter associated with 20 Electric Vehicle charging station. Three phase bidirectional DC/AC (Direct Current/Alternating Current) converter is connected to the grid. The main contribution of this work is to design EV charging station, in addition to charging priority set with respect to State of Charge (SOC) level of EV's battery. If the availability of Solar/Wind power is sufficient to charge the connected EV's, then they are charged with Solar/Wind. If the demand is increased, power is extracted from the Diesel at peak load time and from the grid at base load time. Once the vehicle is plugged in charging station the customer can either buy or sell the power. If buy option is opted for, the priority of charging EVs battery is set in the ascending order of the battery's SOC level. As a result, Energy Management is effectively done and every customer can be satisfied. If sell option is opted for, the power is extracted from the vehicles to the grid, based on customers willingness of selling power. All control functions are done by Raspberry Pi controller. The whole process is monitored and controlled by using Internet of Things (IoT). Simulation is done through the MATLAB /SIMULINK and thus the results give good performance of the proposed method.

Keywords: Charging station, charging priority, electric vehicle (EV), internet of things (IoT), raspberry Pi controller, solar/wind/diesel generator, vehicle to grid (V2G).

1. INTRODUCTION

Nowadays, Electric Vehicles (EVs) have increased recharged enthusiasm for worldwide research and industrial outlook. The major factor drawing in the advancement of EVs is its contamination and outflow free transportation, which is an extraordinarily required worldwide need for supportable future [1]. As indicated [2], the number of EVs in the United States in 2020, 2030, and 2050 will reach 35%, 51%, and 62%, respectively. International Energy Agency (IEA) has anticipated that the offers of passenger light – duty/plug-in hybrid EV will increase from 2020 on and might achieve more than 100 million of EV/ plug-in hybrid EV sold every year worldwide by 2050 (Fig. **1**) [3]. Considering the developing number of these vehicles, it appears important to build up an appropriate charging station to give their required electrical demand request. Majority of the existing work deals with EV charging to accept that the charging happens at home. Nonetheless, given that vehicles utilizing inner ignition motors are refueled at gas stations, EVs can also be charged at Electric Vehicle Charging Stations (EVCSs) [4]. High electric energy demand of EVs from one perspective and their expanding number then again will force a critical load on the grid. The expansion in the infiltration of Renewable Energy Sources (RES) into the electric power framework is very engaging. Most of the studies explained that Wind energy conversion system (WECS) and PV solar system into the electric power network have developed [5]. Most of the literature uses solar energy solely or combined with other energy sources of charging station designed. The generator set(standby Diesel Generator(DG)) demand will continue to increase as industries such as oil and gas, electronics, semiconductors, textiles, food processing units, automotive, shopping malls, and data centers turn to diesel generators to deal with unexpected power outages. Due to seasonal variation, availability of Solar/wind power is not constant all the time. Hence, EVs are not charged from so-

*Address correspondence to this author at the Department of EEE, Divyapriya S, Karpagam Academy of Higher Education, Coimbatore, India; Tel: 9788140507; E-mail: divyapriyaaeee@gmail.com

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Current Signal Transduction Therapy

lar/Wind continuously. As a result, additional Energy sources need to be added for satisfying the demand of connected EVs. So in this proposed system, Diesel Generator added with Solar/Wind powered charging station is absent in the literature.

DG is regarded as backup energy [6], which is used when needed, while as one of the main power sources [7, 8], the DGs are operated in continuous-running mode to participate in maintaining the power balance of the whole system. The authors [9] proposed a Plug-in Hybrid Electric Vehicle (PHEV) solar carport charging station concept featuring a multi-port power electronic interface connecting photovoltaic modules, PHEVs, and the power grid. A solar carport with direct DC/DC interface to increase the overall efficiency was also proposed [10]. EVs are connected to the grid by bidirectional converters, based on the demand of the grid charging and discharging of EVs takes place. This concept is known as V2G (vehicle to grid) and, for the first time, it was used [11]. A novel grid-connected solar powered electric vehicle (EV) charging station with vehicle-to grid (V2G) technology has also been designed and constructed [12]. Novel grid-connected wind powered Electric Vehicle (EV) charging station with vehicle-to grid (V2G) technology has been designed and constructed [13]. In this system, for satisfying Grid and EVs demand, V2G technology is added to Solar/Wind/Diesel generator powered charging station. The maximum power is extracted from Wind / Solar by using MPPT Controller. In the literature, the MPPT has been observed to be done by different algorithms. Hybrid prediction-P&O method combines the direct-prediction and P&O techniques to find the MPPT [14]. Modified Perturb and Observe MPPT Algorithm is used to track maximum power from PV [15]. Furthermore, a genetic algorithm is used to get maximum power from wind turbine [16].

In the proposed charging station, all the 20 EVs have the capacity of V2G association that implies that every EV can be charged as well as likewise it might be even released to help the grid to give enough electric energy for consumers when load demand peaks in the grid. Based on the availability of Solar/Wind/Diesel power the connected EV's are charged. Once the EV is plugged in charging station, the customer can select either buy or sell the power option. If buy option is selected, the priority of charging EVs battery is set in the ascending order of the battery's SOC level. For example, least SOC value of EV is charged first then other EV's battery. If the customer is willing to sell, the vehicle to grid technology is adopted up to 80% of SOC. Hence, energy management is effectively done and every selling customer is benefited. All control functions are done by Raspberry Pi controller. The data is stored in the cloud. The whole process is monitored and controlled by using the Internet of Things (IoT). The rest of the paper is organized as follows: The second section described about the proposed system. Electric Vehicle Charging Scenarios are discussed in the third section. In the fourth section, simulations are carried out and the results are analysed. Finally, Conclusion and Future work are described.

2. PROPOSED SYSTEM

The proposed system consists of Photovoltaic (PV) system, Wind Energy system and Diesel Generator. Wind is

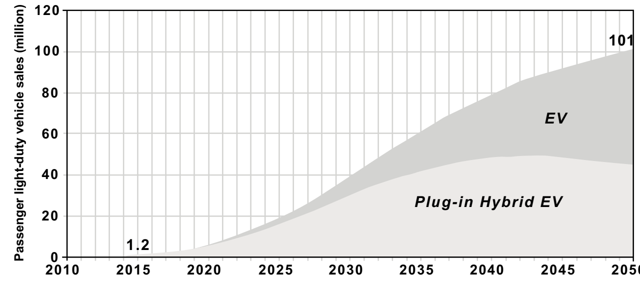

Fig. (1). Proposed solar/wind/diesel powered charging station.

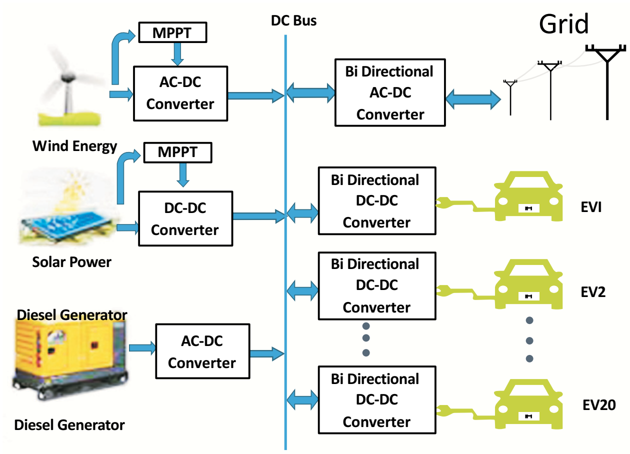

Fig. (2). Proposed solar/wind/diesel powered charging station.

connected to the DC bus through AC-DC converter. MPPT controller is used to track maximum power from the Wind. Wind MPPT is done by using Genetic Algorithm [16]. PV system is connected to DC bus through DC-DC converter. In the PV system, MPPT is done by modified P&O algorithm [15]. Diesel Generator is also connected to DC bus through AC-DC converter shown in Fig. (**2**).

2.1. Control Function

The control functions are done by using Raspberry pi controller. The block diagram is shown in Fig. (**3**).

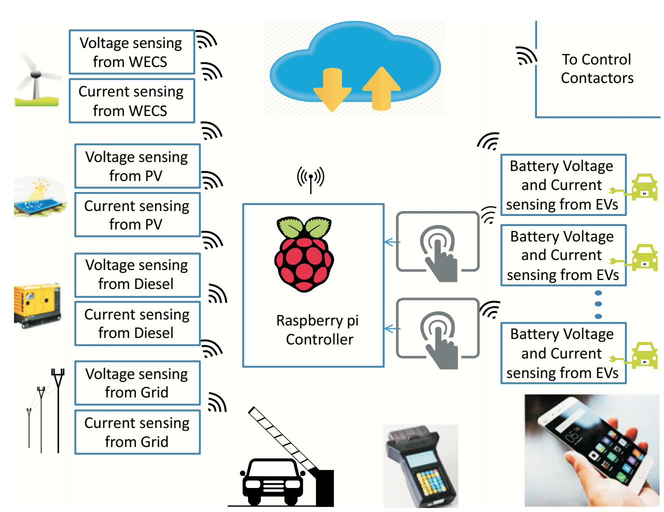

Fig. (3). Proposed control functions using raspberry pi with IoT.

Fig. (**3**) shows the concept of control function. The voltage and current value of Wind, Solar, EVs and Grid are measured by the use of voltage and current sensor. The voltage and current values are converted to the power value. All EVs battery voltage is given to the controller. The SELL option and BUY option are taken from customer by using touch LED display. All the data are stored in the cloud. All communications are done by IoT technology.

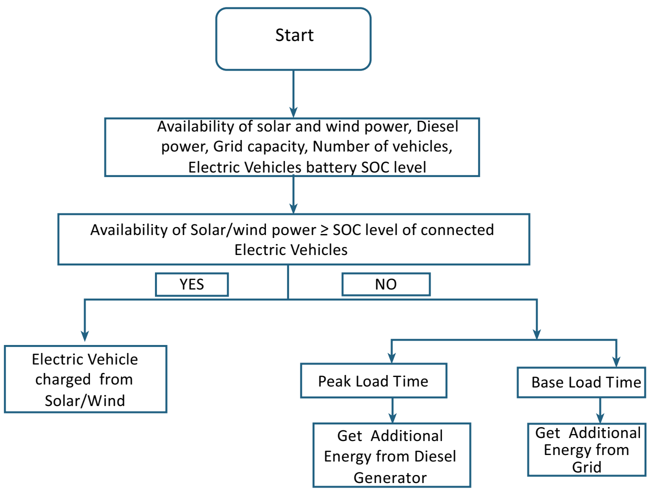

Fig. (4). Flow chart of the control function.

Fig. (**4**) shows the power from various sources to satisfying EVs demand.

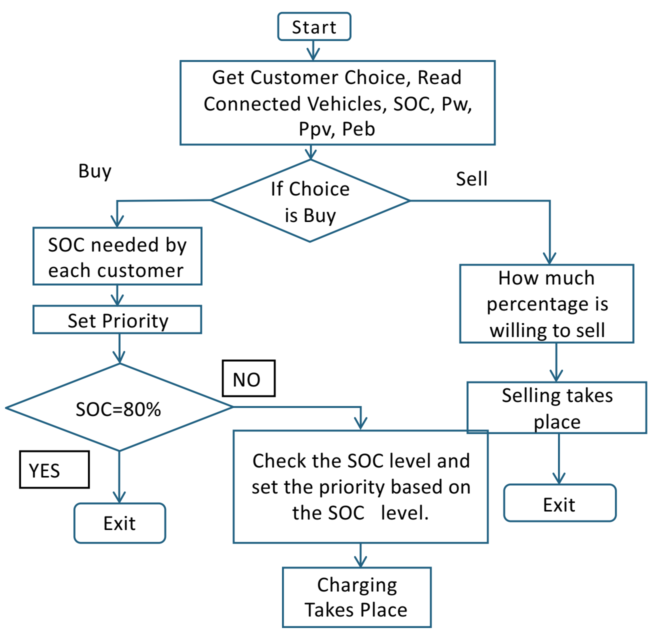

Fig. (5). Flow chart of EVs charging and discharging condition.

Fig. (**5**) shows the EVs charging and Discharging Condition. Based on the customer choice (BUY or SELL), the corresponding EVs can import or export the power.

2.2. Solar System

The solar system consists of Photovoltaic Array and unidirectional DC-DC converter. The output voltage and output current of PV system are sensed by MPPT controller. MPPT is done by Modified P&O algorithm to get maximum power [17]. MPPT flowchart is shown in Fig. (**6**).

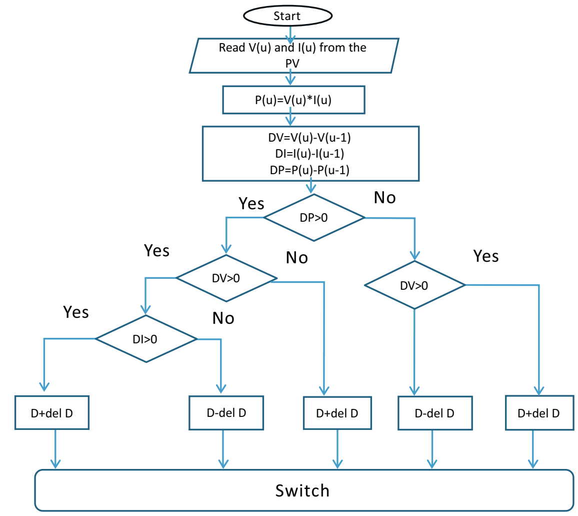

Fig. (6). MPPT for solar power conversion.

In this system, the output power of PV is 150KW.

$$P_{PV} = V_{PV} * I_{PV} \qquad \text{------------------} (1)$$

Where

P_{PV}= Output power from PV array.

$V_{PV=}$Output Voltage of PV array.

$I_{PV=}$Output Current of PV array.

2.3. Wind System

Wind system consists of Permanent Magnet synchronous generator with turbine model and unidirectional AC-DC converter connected to DC bus. Maximum power is extracted from wind by MPPT which is done by Genetic Algorithm. MPPT flow chart is shown in Fig. (**7**).

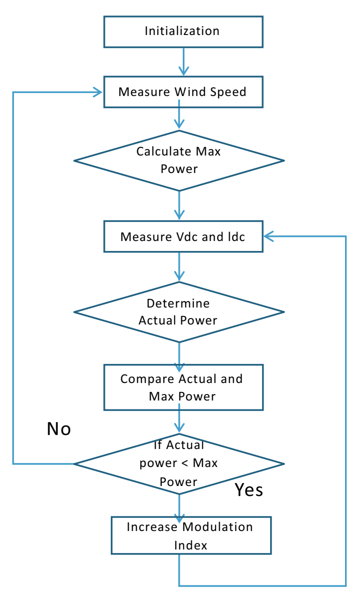

Fig. (7). MPPT for wind energy system.

In this system, the power output from wind is 350 KW.

2.4. Diesel Generator

The main parts of diesel generator are: internal combustion engine, electric synchronous generator, mechanical coupling, automatic voltage regulation system, speed regulator, battery and a small motor for dragging the rotor to rated speed in the start-up phase, automatic fuel injection and ignition system, fuel tank and command panel [18]. The speed of the engine is constant because of its speed regulator system, which ensures 50 Hz frequency of the AC voltage. The root mean square value of AC voltage is 230 V and rated power is 5.2 kW. Diesel Generator is connected to DC bus through AC-DC converter. The capacity of the proposed diesel generator is 375KVA.

2.5. Bidirectional EV Charger and Grid

In this system, maximum 20 EVs can be charged. These 20 EVs are connected to common DC bus through Bidirectional DC-DC converter. It consists of one Full Bridge Circuit and Voltage doubler circuit connected through two identical High-frequency transformers [19, 20]. This circuit is used to transfer power in both directions.

The Grid is connected to common DC bus through Bidirectional AC-DC converter. Excess power from Solar/Wind is transferred to the grid through this converter and also EVs can able to send power to the Grid [21, 22].

3. ELECTRIC VEHICLE CHARGING SCENARIOS

There are three charging scenarios discussed in this section:

The total power in the charging station is:

$$P^{TOTAL}(t)=P^{PV}(t)+P^{WIND}(t)+P^{DIESEL}(t)+P^{GRID}(t)+\sum_{i=1}^{n} P_i^{SELL}(t) \quad \text{--(2)}$$

Where

$P^{TOTAL}(t)$=Total power in the charging station at time period t.
$P^{PV}(t)$=Available solar power at time period t.
$P^{WIND}(t)$= Available wind power at time period t.
$P^{GRID}(t)$= Available Grid power at time period t.

$\sum_{i=1}^{n} P_i^{SELL}(t)$=Sum of selling electrical power from EVs at time period t, i=1,2,…n
n= Number of EVs in charging station.

3.1. Scenario 1

It is assumed that the four EVs are connected to the electric charger and also selected as BUY option. In this situation, the controller senses the individual SOC level of each vehicle and makes priority order. After that, the Wind/ Solar power is checked and the sum of individual EVs power is equated.

$$P^{PV}(t)+P^{WIND}(t)=P^{RES}(t) \quad \text{-----(3)}$$

Equation (3) is called as Renewable power. It is derived from Solar and Wind.

$$P^{RES}(t)+\sum_{i=1}^{n} P_i^{BUY}(t) = 0 \quad \text{-----(4)}$$

Equation (4) denoted the sum of Renewable Power is sufficient to charge the EVS.

$$P^{RES}(t)-\sum_{i=1}^{n} P_i^{BUY}(t) = P^{GRID(E)}(t) \quad \text{-----(5)}$$

The Surplus Power Exported into the Grid is expressed in Equation (5),

Where

$P^{RES}(t)$=Total power from Renewable Energy.

$\sum_{i=1}^{n} P_i^{BUY}(t)$= Sum of buying electrical power from EVs at time period t, i=1,2,…n

If this condition is satisfied, the EVs battery starts to charge. If any excess power is available in Renewable Power Sources, the power will transfer to Grid *via* Bi-directional AC-DC converter [23, 24].

3.2. Scenario 2

If any additional vehicle is connected to the charger and selected as SELL option, the controller checks the available SOC level of connected EVs battery. In this condition, DC-DC bidirectional converter is import power from the vehicle to the DC bus. The SOC level is limited to 80%. If they reach 80% , EVs stop the process of export.

$$\sum_{i=1}^{n} P_i^{BUY}(t)+\sum_{i=1}^{n} P_i^{SELL}(t)=0 \quad \text{----------------(6)}$$

In equation (6), sum of the buying power from EVs and sum of the selling power is the same. Hence, EVs can charge from the sum of selling power from EVs. And also $P^{RES}(t)$ power is exported into the grid.

$$\sum_{i=1}^{n} P_i^{BUY}(t)>\sum_{i=1}^{n} P_i^{SELL}(t) \quad \text{------------------(7)}$$

In equation (7), if the sum of the buying power from EVs higher than the sum of selling power, the remaining power is drawn from Renewable Energy source.

$$\sum_{i=1}^{n} P_i^{BUY}(t)=\sum_{i=1}^{n} P_i^{SELL}(t)+P^{RES}(t) \quad \text{---------------(8)}$$

In equation (8), addition of Exporting power from EV and Renewable power is sufficient to charge all connected EVs.

$$\sum_{i=1}^{n} P_i^{BUY}(t)<\sum_{i=1}^{n} P_i^{SELL}(t)+P^{RES}(t) \quad \text{----(9)}$$

$$\sum_{i=1}^{n} P_i^{SELL}(t) + P^{RES}(t) - \sum_{i=1}^{n} P_i^{BUY}(t) = P^{GRID(E)}(t) \quad \text{-(10)}$$

In equation (9) and (10), the charging of EVs are minimum. Hence, remaining or surplus power is exported into the grid.

3.3. Scenario 3

If Solar and Wind power is not sufficient to support the EVs, the controller checks the power from EVs and also checks peak load time or base load time. In the base load period, the grid support has the remaining power. Otherwise, Diesel Generator supports the power.

$$\sum_{i=1}^{n} P_i^{BUY}(t) > \sum_{i=1}^{n} P_i^{SELL}(t) + P^{RES}(t) \quad \text{--------(11)}$$

In equation (11), the sum of buying power is greater than available Renewable Power and selling power from EVs. Now, the controller checks the base load or peak load power.

$$\sum_{i=1}^{n} P_i^{BUY}(t) = \sum_{i=1}^{n} P_i^{SELL}(t) + P^{RES}(t) + P^{DIESEL}(t) \quad \text{--(12)}$$

In equation (12), at peak load time, the controller gets sufficient power from Diesel generator to maintain grid stability.

$$\sum_{i=1}^{n} P_i^{BUY}(t) = \sum_{i=1}^{n} P_i^{SELL}(t) + P^{RES}(t) + P^{GRID}(t) \quad \text{-----(13)}$$

In equation (13), at base load time, the controller gets sufficient power from Grid to reduce running cost.

4. SOFTWARE IMPLEMENTATION

The software is developed by the use of Raspberry pi controller. The customer can connect their vehicle to the charging point *via* the charger and also need to enter the vehicle number and select BUY or SELL option as shown in Fig. (**8**).

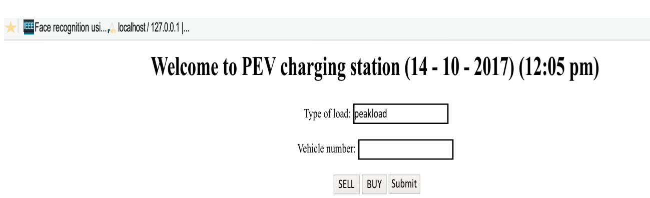

Fig. (8). Login page.

Then all the data are related to particular EVs obtained from the cloud. All the data are monitored and recorded to the server.

After disconnecting the cable from the charger, the controller calculates the cost based on EVs BUY and SELL power.

Customer data and system specification is shown in Fig. (**9**).

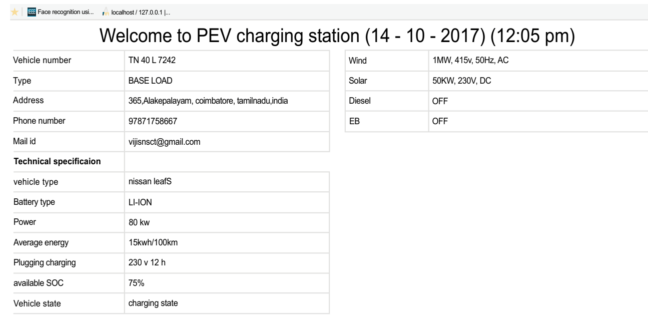

Fig. (9). User data and system specification.

Based on customer option (BUY or SELL) cost is calculated. It is shown in Fig. (**10**).

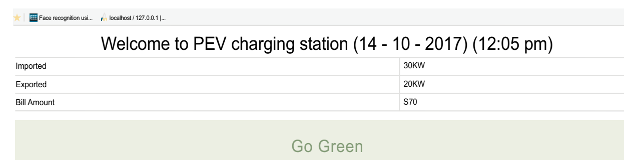

Fig. (10). Cost calculation.

4.1. Simulation Model

The simulation of the proposed system is shown in this section.

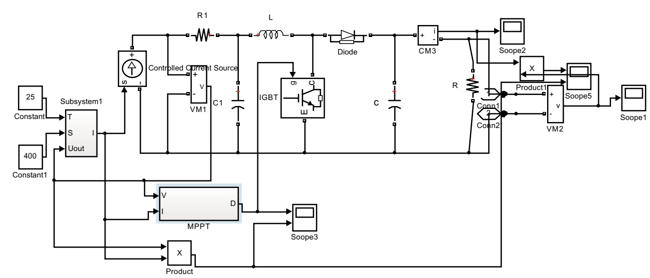

Fig. (11). PV with MPPT simulation.

Simulation model of PV system is shown in Fig. (**11**). Here, MPPT technology is implemented and also the rating of 150KW PV model is simulated. Modified P&O algorithm based MPPT is implemented.

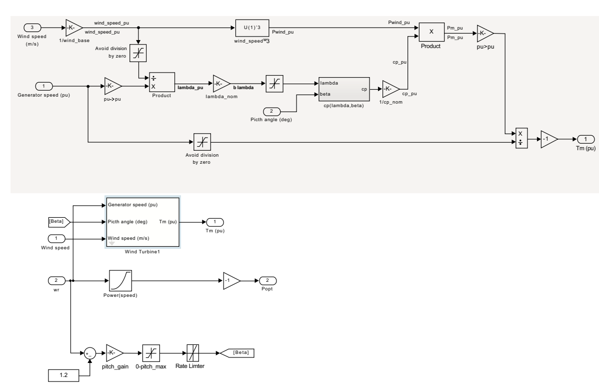

Fig. (12). Wind turbine model.

The wind turbine model is shown in Fig. (**12**).

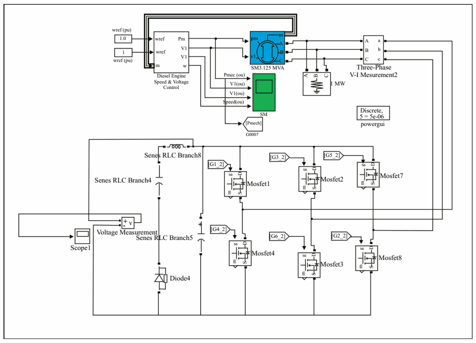

Fig. (13). Diesel generator model.

The diesel generator consists model is shown in Fig. (**13**). It of Permanent Magnet Synchronous Generator (PMSG) and Turbine model. PMSG is connected to DC bus through AC-DC converter. The capacity of Diesel generator is 370 KVA.

In Fig. (**14**), the bridge circuit and voltage doubler circuit are coupled with the help of high-frequency transformer. The bus DC voltage is stepped down to corresponding Battery voltage with respect to EV battery model and it also acts as a boost converter with Export Power from EVs to Grid.

The DC bus voltage is 500V and the voltage is converted to EVs battery voltage as 230 V DC by the use of DC-DC converter and charger circuit as shown in Fig. (**15**).

Fig. (**16**) shows that five EVs are connected to the charging port. Four EVs are selected as BUY option and the fifth EV is selected as SELL option. SOC level of vehicle 1 is 50%, vehicle 2 is 60%, vehicle 3 is 40%, vehicle 4 is 10%, and vehicle 5 is 100%. Now, the controller reads all the data and sets priority to each EV based on SOC. The final priority order is Vehicle 4,3,1,2. In Fig. (**16**), E V1, EV 2, EV 3 and EV 4 reach their SOC of 80% at 6 sec, 5 sec, 7 sec and 8 sec respectively. At the time of 8 sec, all vehicles reached 80 % of SOC. Now, Vehicle 1 again starts to charge. From the time period of 2 sec to 4 sec, the wind and solar power is high, hence that time the discharging vehicle is stopped to selling power.

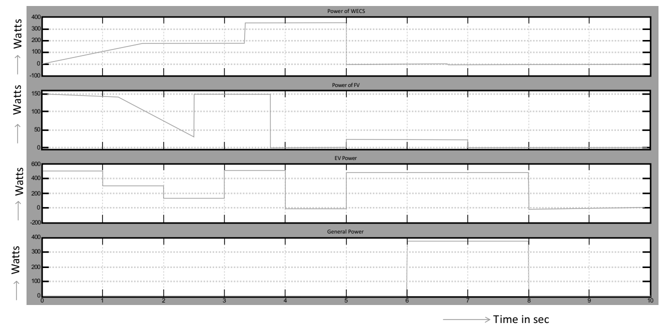

Fig. (17). Power output of sources and EVs.

Fig. (**17**) shows the power output of various sources at various instants. The first graph shows the power output of Wind Energy; the second graph shows the power output rat-

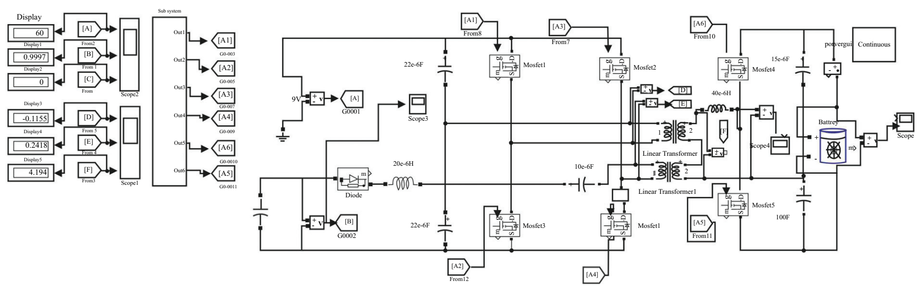

Fig. (14). Bi-directional DC-DC converter.

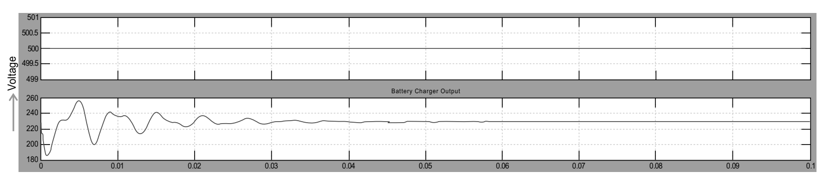

Fig. (15). Bus voltage to EV charging voltage.

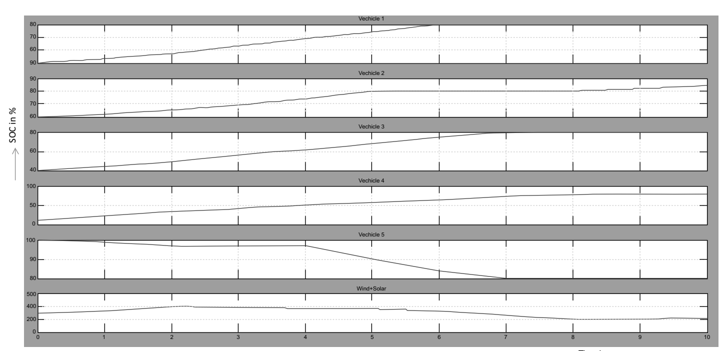

Fig. (16). Charging and discharging of EVs based on SOC.

Table 1. Specifications of electric vehicle.

Electric Vehicle Specification	
Plug-in charging	230V 12h
Quick charging	50 kW (30min 80%)
Power	80 kW
Average energy consumption	15 kWh/100km
Battery capacity	24 kW/h
PV System	
Model Number	SFS-PR-01
Output Voltage	220 V
Capacity	150 KW
Ambient temperature considered	20°C to 50°C
Humidity	95 % Non-condensing
Wind Energy Conversion System	
Rated power	350.0 kW
Cut-in wind speed	3.5 m/s
Rated wind speed	14.0 m/s
Cut-out wind speed	25.0 m/s
Survival wind speed	67.0 m/s
Diameter	33.4 m
Swept area	876.1 m²
Number of blades	3
Rotor speed, max	32.0 U/min
Diesel Generator	
ENGINE MAKE	CUMMINS
Model	QSL9-G5
Engine Speed in RPM	1800
Power Output	375 KVA
Compression Ratio	16.8:1
Governor	Electronic

ing of the PV system; the third one is the sum of EVs connected to the bus *via* DC-DC bidirectional charger at various instants. The last one shows the power delivered from the Diesel Generator. In this graph, at time period 0 to 1sec, the Wind Energy increased slowly and the PV power decreased from 150KW. At the time period 5 sec, the Wind Energy output became zero due to low wind. At that time PV, output power is also very minimum but EVs Load is maximum. Then the controllers check either base load time or peak load time. Now the load is as base load, so up to 6 second, the Grid supports EVs load. From 6 sec onwards, the time is changed to peak load time, so in order to maintain our Grid stability, the Diesel Generator is supported. The overall system specification are tabulated in Table **1**.

The prototype model of EV charging station is shown in Fig. (**18**). In this, four 6V battery is connected in series in order to achieve 24V. 12V, 100W PV panel is used to supply PV Power. 12V PMDC is used. It acts as a diesel generator at the rpm of 3000 with prime mover. Also, 230V, 50Hz, 12V Vertical Wind Turbine is used to supply wind power. 230V AC supply acts as a Grid. Three relays are used to

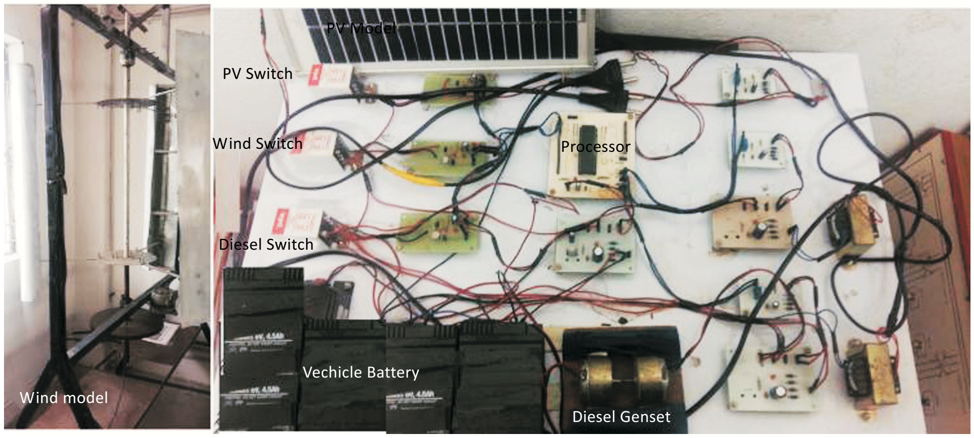

Fig. (18). Prototype model of design of grid connected solar/wind/diesel generator powered charging station for electric vehicles and vehicle to grid technology using IoT.

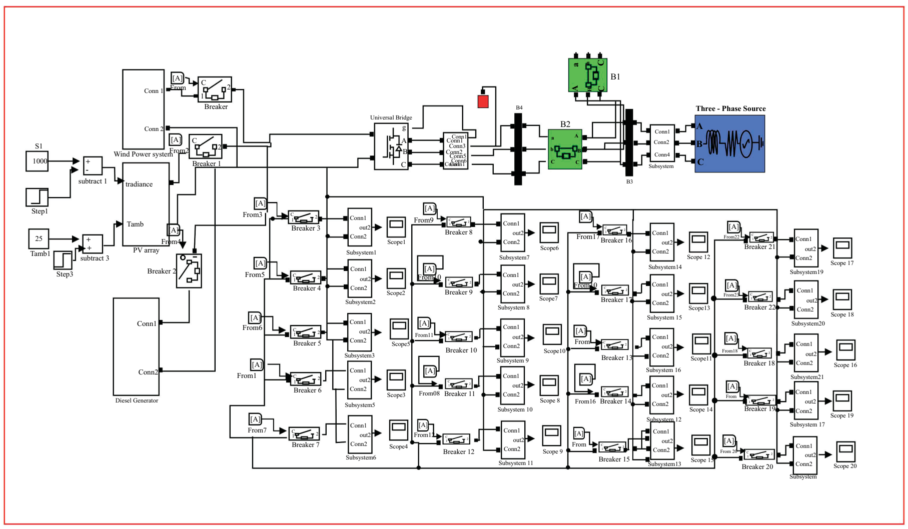

Fig. (19). Overall simulation diagram.

switchover energy sources for battery charging and discharging.

The overall simulation of the proposed work is shown Fig. (**19**).

CONCLUSION

In this paper, grid-connected solar, wind and diesel-powered EV charging station with V2G technology was designed. Solar, wind and diesel generator produces power to charge EVs. Charging of EVs is done by setting priority with respect to SOC level of EVs battery. Due to this, all customers are satisfied with their charging and Energy Management is effectively done. The whole control process is done by Raspberry pi controller, thereby accomplishing the prototype model.

FUTURE SCOPE

In Future work, Time based tariff may be added to improve customer benefit.

CONSENT FOR PUBLICATION

Not applicable.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

HUMAN AND ANIMAL RIGHTS

Not applicable.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

ACKNOWLEDGEMENTS

Declared none.

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Design of Public Plug-in Electric Vehicle Charging Station for Improving LVRT Capability of Grid Connected Wind Power Generation

R.Vijayakumar
r.vijayakumarpse@gmail.com
Department of Electrical and Electronics Engg.
SNS College of Technology
Coimbatore, India

Dr.K.Malarvizhi
drkmalarvizhi@gmail.com
Department of Electrical and Electronics Engg.
Kumaraguru College of Technology
Coimbatore, India

S.Divyapriya
divyapriyaeee@gmail.com
Department of Electrical and Electronics Engg.
Karpagam Academy of Higher Education
Coimbatore, India

***Abstract*- The growing worldwide mindfulness for a eco-friendly environment include with cost effective and greater accessibility of small scale generating units such as wind and PV which hoisted the interest in distributed generation. The promising emerging future transportation technology is Plug-in Electric Vehicle (PEV). But the issue coupled with the implementation of PEV is the utilities should upgrade the distribution system to meet the demand of this extra load. Thus the integration of microgrid and PEV with distribution system reduces the stress on distribution transformer to meet the demand of the extra load. In this work, the PEV charging station with small scale wind energy system as a primary source to this smart charging station. The control strategy proposed is the coordinate control based on DC link voltage to encourage the operation of PEV charging station in both standalone and grid connected mode. There is a drawback when using Doubly Fed Induction Generator (DFIG) based wind turbine is Low Voltage Ride Through (LVRT). In order to overcome from this issue the charged PEVs in the smart charging station is used to improve the LVRT capability.**

Keywords: Plug-in Electric Vehicle, Doubly Fed Induction Generator, Low Voltage Ride Through Capability, Uninterrupted Power Supply, Wind Energy System.

I. INTRODUCTION

Already the Plug-in Electric Vehicles (PEVs) entered into the automotive market and it becoming a part of electrical power system. In entrance of PEVs in market makes the genuine impact in the life span of distribution transformer. In order to reduce the load on distribution transformer there is a need of smart charging station with renewable energy sources [1]. Charging station of PEVs which is supplied by small scale wind energy system is reasonable option because of the following reasons:

- Immense advancement in the innovation of power converter technology for small scale wind energy system.
- Excess electricity productivity of the system from slow winds which are frequent.

A review of literature proposes that the number of thinks researched large scale, long term impact on PEVs and ability of electric grids to integrate the wind system on PEV.The effect of PEV with wind energy into US electricity is described in [4]. The amount of wind capacity is increased by the adoption of PEVs in the regional and national power system as described in [5]. Economics of wind energy system can be increased by absorbing excess wind production. The PEV can absorb that wind production. The unstable conduct of wind power, demand response algorithm by using PEVs is proposed in [6]. PEVs cause large voltage variation of the system more than recommended limit [7]. The surplus energy from the smart charging station which mitigates the voltage dip. On the whole, the investigation on PVEs can increase the wind system installation capacity in regional and national power system. This paper proposed a smart charging station of PEV with small scale wind energy system which can be installed as distributed generation in workplace environment like commercial places, universities, industries. The proposed system is shown in figure 1. In this proposed system, the PEVs are charged using DC power which are converted from AC power from wind energy system using efficient power conversion stages.

DC Bus signalling (DBS) concept has been executed in many researches for proper power management in DC system [8-12]. In spite of fact [9] and [11] have done broad work on controlling a grid connected DC microgrid using DC bus signalling the variation in sun's isolation is not considered. This paper stretches at on the comparative idea proposed by the authors but moved forward to re-enhancement results and control system depiction.

II. PROPOSED SYSTEM

The proposed PEV charging station is shown in figure 1. The system comprises small scale wind energy system as a source, PEVs as load, Energy storage Unit (ESU) and the controlling unit. The switch is connected with DC link through an AC/DC diode rectifier and DC/DC boost converter. The process of Maximum Power Point Tracking (MPPT) is performed by DC/DC boost converter which facilitates the wind turbine to operate in maximum power point. The energy storage unit (ESU) is connected with DC bus through bi-directional DC/DC buck-boost converter. The PEVs supported to charge by ESU when there is no power from wind turbine and distribution system. In peak off hours or the excess power in the wind turbine the ESU has been charged. Charging of

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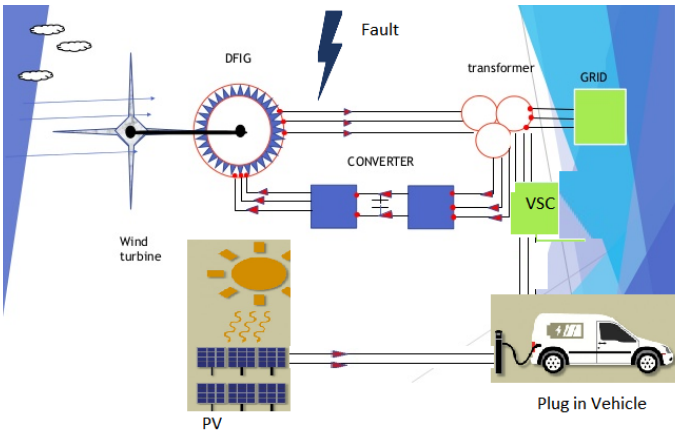
PEVS are controlled by the DC/DC buck converter. Via the bi-directional grid tied converter the charging station is connected with the distribution network.



The control strategy of the proposed smart charging station is shown in figure 1. It is based on the requirement of charger for a PEV. The rating of the components of charging station like power converters, wind turbine is increased by charging multiple PEVs. In each charging point there is a necessary of separate buck converter. This charging station can be installed at shopping malls, universities, freeways, etc. and so on the PEVs enter and take off the parking area at various time interval. Hence PEVs makes different demands in different time periods. Under this condition, because of variation in wind speed and demand of PEVs the fluctuation occurs in DC link voltage. Based on this DC link voltage the control unit in the proposed system monitors the power flow between the PEVs and wind energy system. As in figure 1, the seven inputs decides the operation of the control system which produces the switching signals to control the various converter and the direction of power flow in the system. Magnitude of the DC link voltage is denoted as V_{DC}. With this various modes of operation can be determined. The measure of State-of-Charging (SOC) is determined by the battery voltage of PEVs which is denoted as V_B. Voltage across energy storage unit (ESU) is denoted as V_{ESU}, the gird RMS voltage is V_{grid}, The current from the distribution transformer id I_{DDT}, the current from the DC/AC converter is I_{bk} and the current from the grid or to the grid is denoted by I_{GRID}.

III. CONTROL STRATEGY AND MODES OF OPERATION

The fast and dependable scheme for acknowledging the operation status of the system is necessary for wind powered charging station.From the use of communication system, DC link voltage indicates the operating status of the proposed Wind Powered Charging Station (WPCS) perfectly. In a grid connected WPCS as shown in figure 1. DC capacitor power can be expressed as,

$P_C=P_{DC}-P_{AC}$

Where,

P_{DC}- Total power on DC side of DC bus

P_{AC}- Total power on AC side of DC bus

The various transients generated by the wind energy source and PEV load there is a increase/decrease in the amplitude of voltage because of the wind powers charging station consists of wind turbine as a source and PEVs as load. With the principle of power balance the DC voltage dynamics can be expressed as,

$$\frac{d}{dt}\left(\frac{1}{2}CV_{DC}^2\right) = P_{DC} - P_{AC}$$

Therefore,

$$CV_{DC}\frac{dv_{DC}}{dt} = P_{WT} + P_{ESU} + P_{PEV} - P_{Grid}$$

Where,

P_{WT} - Power from the wind turbine

P_{ESU} - Power absorbed or delivered by ESU

P_{PEV} – Power demand of PEV

P_{grid} – Grid side power

From the above equation the change in wind power or PEV power results the variation in DC link voltage. The different operating modes can be found from the variation in DC link voltage. The switching between different modes of operation is determined by the variation in voltage level at DC link.

The variation in DC link voltage is shown in figure 2 and it also shows the wind power for various speeds of wind. Based on the cut-in and cut-out values of wind speed the reference voltage of DC voltage has been chosen. The voltage difference between the neighbouring thresholds should be selected to avoid malfunction during switching because of small variation and to avoid noticeable voltage variation of PEV because of too big difference. The DC link voltage VDC is chosen as 400V and the DC link reference voltage levels are set as V_{S-1}=360V and V_{S-2}=440V.

A. Operating modes of system

To ensure the reliable and secure operation of the smart charging station and for the satisfactory operation of wind powered charging station in various wind generation, load and grid connected conditions there is a need of considering different operating modes.

This modes of operation of the system are categorized into three modes such as

Mode 1: WPCS with grid connection

Mode 2: inversion operation

Mode 3: Rectification operation

The variables used to describe the various modes of operations are $V_{DC\text{-}link}$, V_{DC}, $V_{S\text{-}1}$, $V_{S\text{-}2}$, I_{DDT}, $I_{DDT\text{-}max}$.

$V_{DC\text{-}link}$ – Detected DC link voltage

V_{DC} – Nominal voltage of DC link

$V_{S\text{-}1}$, $V_{S\text{-}2}$ – Reference voltage levels of DC link

I_{DDT} – Load demand on distribution transformer

$I_{DDT\text{-}max}$ – Peak load condition of distribution transformer

The charging of PEV and ESU ought to be ended once the battery voltage reaches the threshold level.

IV.SIMULATION RESULTS

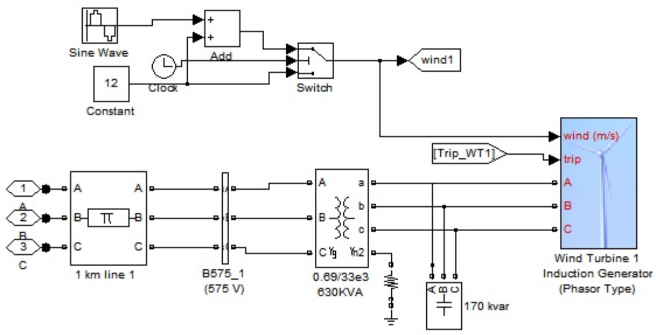


Figure 3 Simulation model of DFIG

Figure 3 shows that the phasor model of DFIG. In this simulation system we are using 630 KVA, 33KW DFIG system with 0.69/33KW transformer for coupling process. The pi model was indicating the transmission line. In order to improve power factor we are using 170 Kvar capacitor bank.

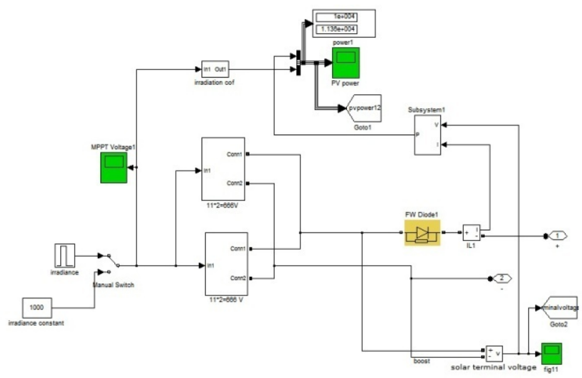


Figure 4 Simulation model of PV

Figure 4 shows that the MATLAB simulation model of PV system.In this model based on irradiance level the solar output will change.

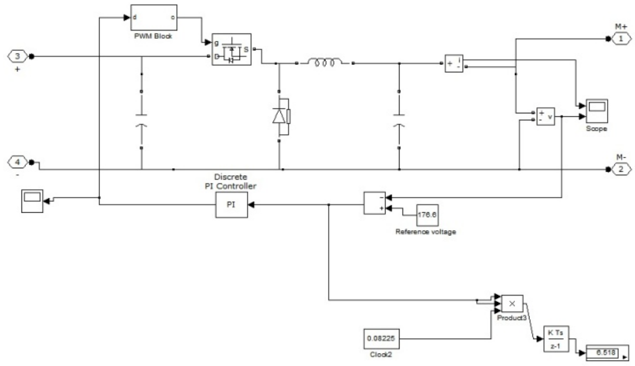


Figure 5 Simulation model of MPPT for PV

Based on the irradiance level the solar panel deliver discrete output voltage, so we need to make constant voltage by using MPPT technology with DC-DC boost converter. In this converter we are feeding reference voltage what we need.

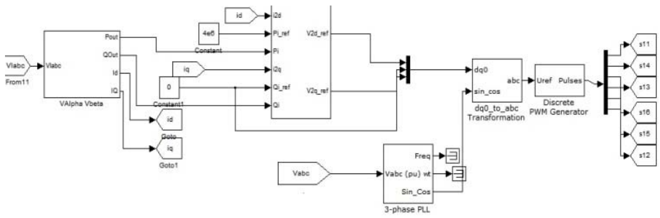


Figure 6 Simulation model of controller circuit

The figure 6 shows control circuit for DVR module, it will generate Discrete pulse with modulation to IGBT switches. The PWM generation done by PLL circuit.

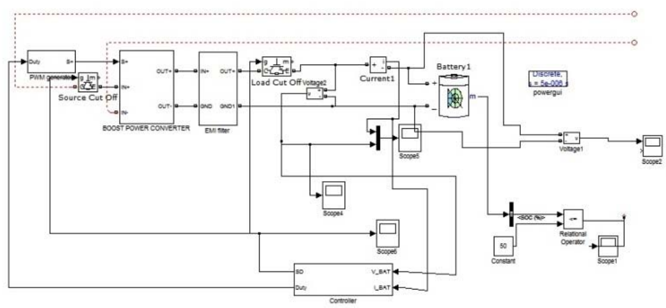


Figure 7
Simulation model of Plug in Electric Vehicle Battery

The Figure 7 shows that modelling of Plug in Electric vehicle battery with charge and discharge controller. Controller circuit will operate two modes, one is step down function and other one is step up function. Battery manager circuit will operate based on battery SOC.

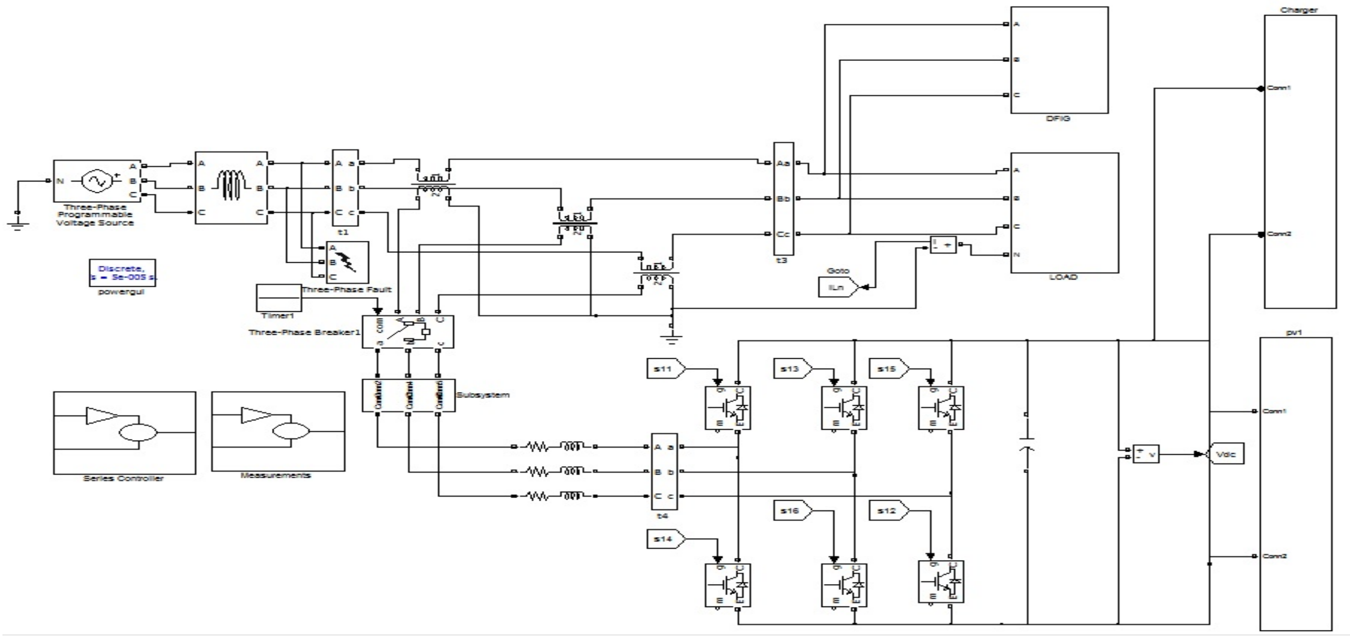


Figure 8 Simulation model of overall proposed system

Figure 8 shows overall proposed work by MATLAB simulink model.

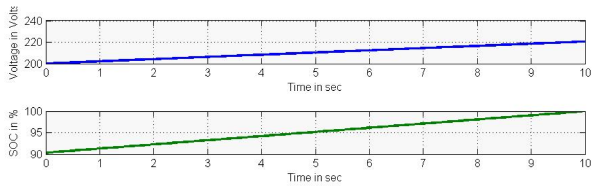


Figure 9 Battery charging output

Figure 9 shows the SOC level and voltage profile of battery during charging condition. The SOC level can't be measure directly, so based on the voltage level of the battery we can calculate. The maximum SOC level is 100 percent.

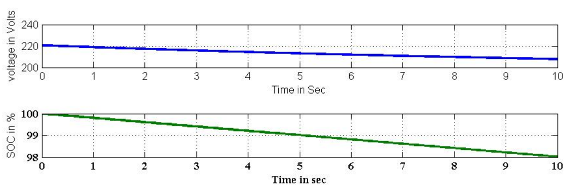


Figure 10 Battery charging output

Figure 10 shows the graph of SOC and voltage. During discharge condition the SOC will reduce from 100 percent.

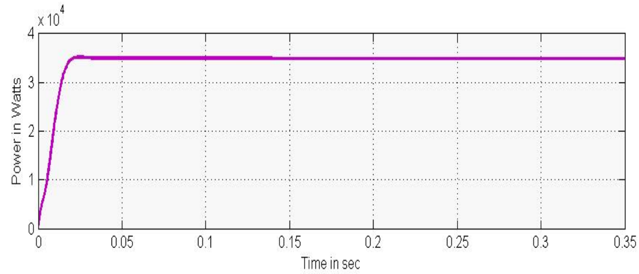


Figure 11 Output power of PV

Figure 11 shows the power value of PV module.

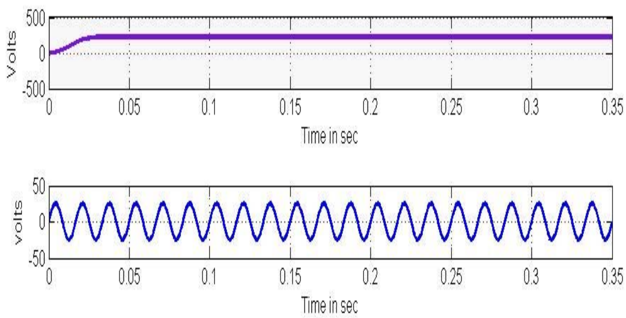


Figure 12 DC link voltage and Neutral current

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Figure 12 shows that the DC link voltage and neutral current flow

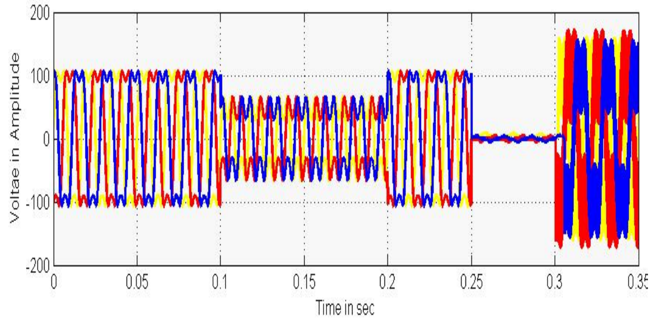

Figure 13 without DVR and PEV

Figure 13 shows the functions of proposed system without controller and zero percent SOC. We are manually creating different kind of faults with different time interval. At the time period 0.1 second to 0.2 second three phase fault was created with 10 percentage. Likewise 0.25 second to 0.3 second the fault was very high.

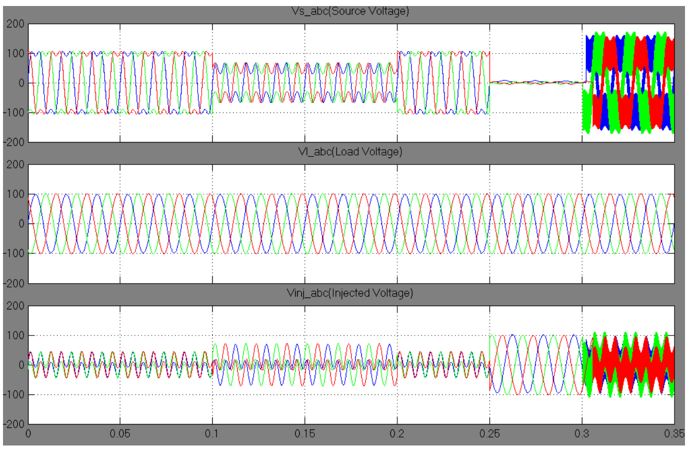

Figure 13 with DVR and PEV

Figure 13 shows that LVRT capability of wind turbine power. The proposed system will support the remaining voltage level. Based on the severity of the fault our plug in vehicle source will support.

RESULT

In this system consist 35 KW of PV panel, 250 KW of DFIG, 25 KW of plug in electric vehicle charger. Solar system was exclusively for vehicle charging. The DFIG system was directly connected to grid. In this system have DVR. The DVR system is used to inject voltage to grid connected system DFIG. If any fault occur in grid means the voltage profile will get reduce so the DFIG system try to disconnect from grid. Our DVR system will inject the fault current, the battery of plug in electrical vehicle will support the voltage to DVR.

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DESIGN OF RENEWABLE ENERGY BASED PEVs CHARGING STATION WITH ENERGY MANAGEMENT TECHNIQUE

[1]Divyapriya.S, [2]Dr.A.Amudha, [3]R.Vijayakumar

[1]Research scholar, [2]Professor, Department of EEE, Karpagam Academy of Higher Education, Karpagam University, Coimbatore, India.
[3]Assistant Professor, Department of EEE, SNS college of Technology, Coimbatore, Coimbatore, India.
[1]divyapriyaeee@gmail.com, [2]amudhac11@yahoo.co.in, [3]r.vijayakumarpse@gmail.com

ABSTRACT

Currently more attention is turned on Electric Vehicles (EVs) because of their low energy dependence, low emission and high fuel economy. In the near future, there is a need for more Electric Vehicle charging station. It will increase the demand of electrical energy. To power the charging station in future, the small-scale and renewable energy sources are needed. This paper proposes the design of Plug-in Electric Vehicles(PEVs) charging station with Super capacitor and different renewable energy sources like wind, PV and Fuel cell. These energy sources are controlled according to the demand of the charging station with embedded controller. In this controller the energy management is also obtained. This proposed system has simulated in MATLAB/SIMULINK environment.

Key Words: Charging station, Embedded control, Electric Vehicles, Renewable Energy Sources

INTRODUCTION

In current scenario, the concerns about high fuel consumption, air pollution and energy security are continue to motivate us to search alternative solution for the transportation. The solution is found that the implementation and mass production of Fuel Cell Electric Vehicles(FCEVs) are difficult because of high cost and other inherent problems. Internal combustion engine with hybrid source vehicles can provide partial answer for these problems. The Plug-in Electric vehicles (PEVs) which are powered by external energy source [1,2]. Comparing PEVs with Internal Combustion (IC) engine driven vehicles, the PEVs produce zero emission, possess high energy efficiency, low noise level and clean energies can be used as source to charge the batteries of PEVs. With these advantages PEVs are emerging as a solution to pollution caused by conventional transportation. However, large adoption of PEVs consume high power from the grid to charge large number of PEVs. It will strain the overall existing power system beyond its capacity [3,4]. The different manufacturers of electric vehicle is shown in table1. The battery model of Plug-In electric vehicle is shown in figure.1.

Figure.1 PEV battery model

Table 1. Eclectic vehicle make, model year

S.No.	Make and model year	Battery capacity (kWh)
1	2014 Chevrolet Volt	16.5
2	2014 Cadillac ELR	16.5
3	2014 Porsche Panamera S E	9.4
4	2014 Ford C-Max Energi	7.6
5	2014 Ford Fusion Energi	7.6
6	2014 BMW i8	7.1
7	2014 Honda Accord Plug-In	6.7
8	2013 Toyata Prius Plug-In	4.4
9	2013 Tesla Model S	85
10	2013 Tesla Model S	60
11	2013 Toyota RAV 4 EV	41.8
12	2013 Wheego LiFe	30
13	2014 Mercedes-Benz B	28
14	2014 Volkswagen e-Golf	24.2

15	2014 Nissan Leaf	24
16	2013 Ford Focus Electric	23
17	2014 BMW i3	22
18	2014 Chevrolet Spark EV	21
19	2013 Honda Fit-EV	20
20	2013 Smart for Tow Electric Drive	17.6
21	Mitsubishi iMiEV	16
22	Scion iQ EV	12

The battery capacity of different makes is shown in figure.2 as a graph.

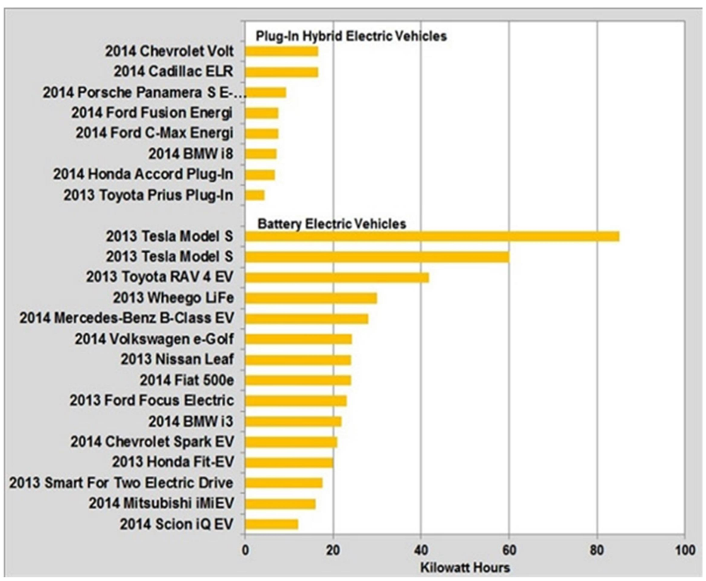


Figure.2 Capacity of Battery

In future, providing charging station with uninterruptable supply is an important problem with current grid system. The renewable energy based Distributed Generation (DG) is the solution to provide power to charging station without disturbing the existing grid system which is proposed in this paper. The Distributed Generation (DG) will postponed the transmission investment, decreases the greenhouse gas emission, reduces the primary energy consumption, reduces the global warming and also reduces the energy losses due to long distance transmission and distribution.

Different energy sources such as wind, PV, Fuel cell (FC) with these Supercapacitor (SC) are used as the sources of Distributed Generation (DG) to power the charging station. These different energies are also pollution free energies, reduces the global warming and there is no emission of greenhouse gases.

These energies should be used efficiently without wasting it. For that the implementation of energy management technique is more sufficient to manage different energy sources according to the demand of charging station. For this purpose, the embedded control is implemented in proposed system which sense the nature of the charging station and power of the station from different sources according to the demand. Each source is scheduled according to the demand of the charging station. The model of the proposed system is simulated and tested in the MATLAB/ Simulink software.

PEV CHARGING STATION

The proposed PEV charging station consists of different energy sources such as wind, PV, fuel cell and super capacitor which are used as Distributed Generation (DG) to power the charging station.

Wind energy is a renewable source which is available at free of cost. So, no matter how much it is used today. It will be same in future also. It is a source of non-polluting, clean which will produce electricity. It will not emit any air pollutants and greenhouse gases. It is a second fastest growing energy in the world and used since 2000BC.

Solar energy is the readily available source of renewable energy. Like wind energy it is also free and non-polluting energy. It is one of the sources of clean energy. In PV system, the solar radiation gets converted into DC electricity. It can be stored in battery. The radiation is depending on the location, time of day, weather condition and time of year.

Fuel cell which combines hydrogen and oxygen to produce electricity. It is compared to battery. Both converts the chemical energy into electrical energy. It will produce electrical energy as long as the fuel is supplied. The charge of this cell will not get down.

Super capacitor is also known as ultra-capacitor, electrical double layer capacitor, super condensers, electro chemical double layer capacitors and pseudocapasitors. It does not have dielectric. Instead of that it has plates which are filled with two layers of identical substance to allow the separation of charges. The common values of super capacitors are 0.22F, 0.47F, 1F and 400F and the rated voltage is between 2.3V to 11V, the most common rated voltage is 5.5V.

The switches are used along with every sources and loads to control the charging and power supply to the charging station. There are four different sources; five loads i.e. PEVs and eleven switches in the system. These are all connected in common DC bus which is rated with 240V DC. The 240V charger is shown in figure.3. This overall system block diagram is shown in figure.4.

Figure.3 240V charger

The controller used to control the proposed system is embedded controller. The input data to the controller is SOC level of each PEVs and the power demand of charging station and these are compared with reference values, then the switches in the system are opened or closed according to the control signal from controller. This controlling process are written as coding in embedded controller in C language and the coding is executed to control the switches according to the requirements.

The output of all sources used in the system is DC except the output of wind source as shown in figure.5. To convert the AC output of wind into DC the controlled rectifier is used.

Six number of phase controlled thyristors are employed in controlled rectifier circuit. In positive half cycle of the input supply three thyristors are forward biased and turned on by triggering gate pulses at gate leads of thyristors. In negative half cycle of the supply remaining three will turned on by giving triggering gate pulse. With this controlled rectifier, the output of wind is shown in figure.6.

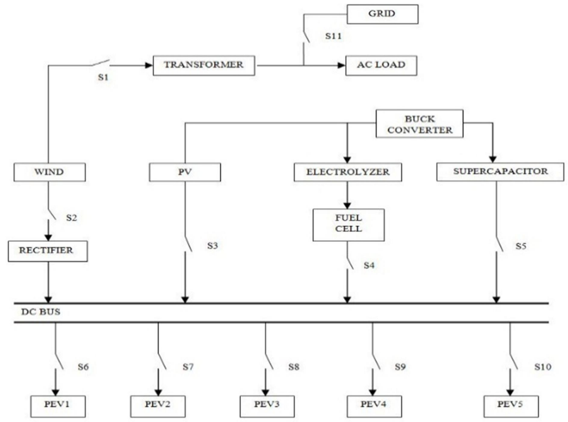


Figure.4 Proposed PEV charging station

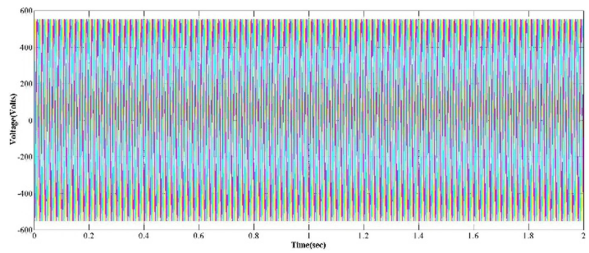


Figure.5 Output voltage of wind energy system

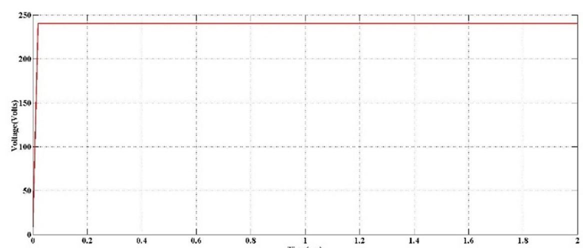


Figure.6 Rectified output of wind energy system

PV is also used to charge the supercapacitor and electrolyser to separate oxygen and hydrogen from the water which is given to the electrolytes of the fuel cell to generate the electrical energy as shown in figure.7.

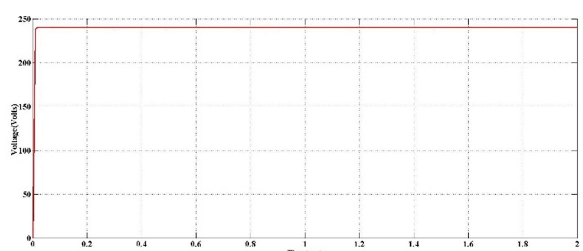


Figure.7 Output voltage of fuel cell

The output of PV is shown in figure.8 which is bucked to charge supercapacitor by using buck converter. It is a simple DC-DC converter as shown in figure.9 which works under the principle of storing energy in inductor.

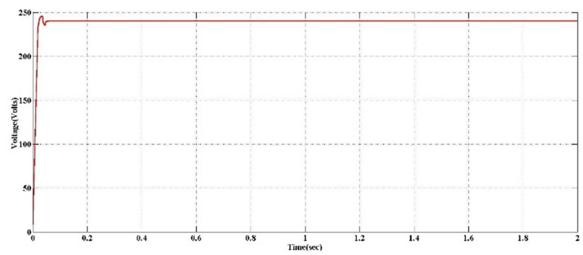


Figure.8 Output voltage of PV

It produces output voltage less than input voltage. The switching element used in buck converter is power MOSFET. This converter circuit will operate in two different states. One state is when the switch is closed i.e. MOSFET on state. In this state, the in-rush current creates potential across the inductor which opposes the main supply, it reduces the output voltage. The energy is stored in both inductor and capacitor and there is no current flow through the diode. Another state is switch opened state. In this state, the current to the inductor is interrupted and diode starts to conduct which gives the return path to the inductor current. This rapid change in current reverse the voltage drops across the inductor and it becomes the primary output source of this state. The output of the super capacitor is shown on figure.10.

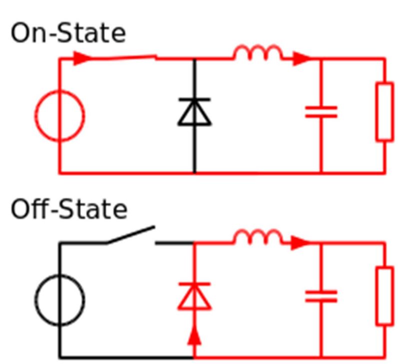


Figure.9 Operating states of buck converter

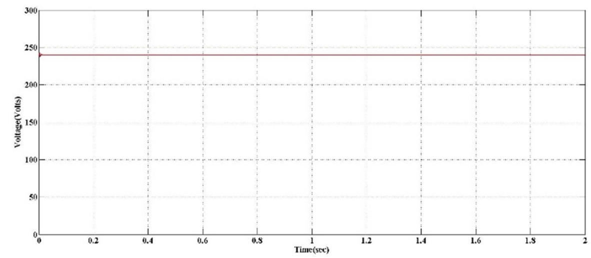


Figure.10 Output voltage of supercapacitor

ENERGY MANAGEMENT

Energy management is planning and operation of energy production and energy consumption. The objectives of energy managements are resource conservation, cost saving, climate protection with the permanent access to the users when they needed. According to the VDI-Guideline, the definition for energy management is that the energy management is the proactive, organized and systematic coordination of procurement, conversion, distribution and use of energy to meet the requirements, taking into account environment and economic objectives [5].

In this proposed system, each source is rated with 240V DC because the DC bus voltage is 240V which required to charge the batteries of PEVs and each source is rated with different power ratings as tabulated in table 2.

The power rating of PEV batteries will vary depends on different manufacturers from 17kW to 70kW. In test system consider average power rating as 25kW. the specification of each load is tabulated in table 3.

Table 2. Source specification

S.No.	Source	Specification
1	Wind	240V DC, 200kW
2	PV	240V, 100kW
3	Fuel cell	240V, 50kW
4	Supercapacitor	240V, 50kw

Table 3. Load specification

S.No.	Load	Specification
1	PEV1	Charging voltage = 240V Power = 50kW = 2 PEVs SOC = 98%
2	PEV2	Charging voltage = 240V Power = 50kW= 2 PEVs SOC = 98%
3	PEV3	Charging voltage = 240V Power = 100kW= 4 PEVs SOC = 98%
4	PEV4	Charging voltage = 240V Power = 100kW= 4 PEVs SOC = 98%
5	PEV5	Charging voltage = 240V Power = 100kW= 4 PEVs SOC = 98%

With this different source and loads the overall simulation is shown in figure.11. The wind energy will supply the charging station when the demand is high otherwise it will supply to the AC loads which are near by the station.

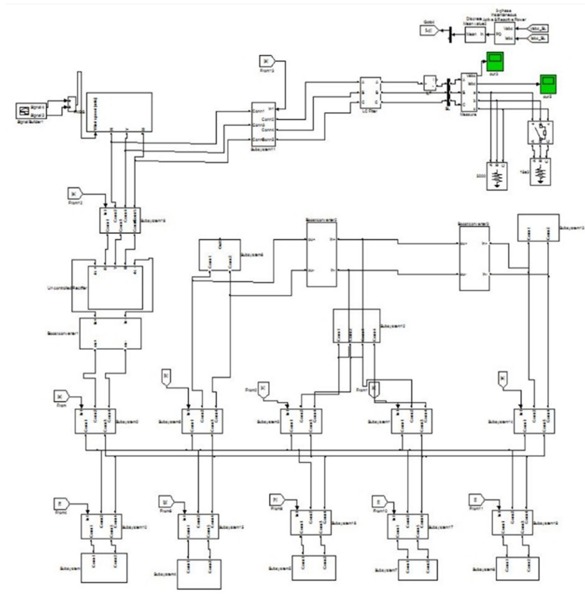


Figure.11 Overall simulation diagram

Consider all the PEVs are in the SOC level of 98% and plug-in with the charging station at different instants and it rises to 99%. The PEV1 is connected for charging at 0.1sec, the demand of this PEV is 50kW. Supply to this demand supercapacitor is added to the system by switching on the switch S5 i.e. switch S5 is closed. At the instant 0.3sec the second PEV i.e. PEV2 is connected, now the demand increases to 100kW. Let the switch S4 is closed to add the fuel cell with the system. The PEV3 is connected to the system at 0.5sec. Now the demand increases to 200kW. To meet this demand PV is added by switching on (switch closed) the switch S3. At the instant 0.8sec the remaining 2 PEVs i.e. PEV4 and PEV5 are connected to the system which increases the demand to 400kW. The demand is high so the wind energy is added by opening the switch S1 to stop supplying to AC load and switch S2 is closed. Rise in SOC level of each PEV is shown in figure.12.

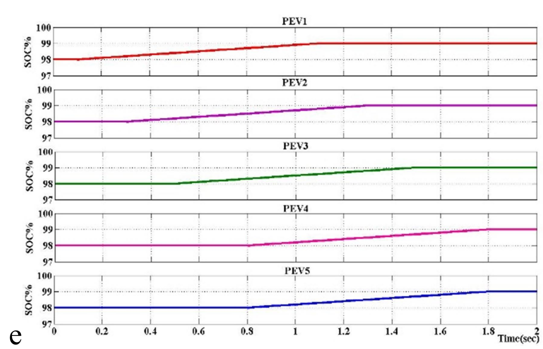


Figure.12 SOC level of each PEV

When the SOC level of each PEV is reaches 99%, they will be disconnected from charging by opening the corresponding switches and the SOC is maintained at 99%. The SOC of all the PEVs are shown in figure The PEV1 is disconnected by opening the switch S6 at the instant 1.1sec, it reduces the demand to 350kW. So, the supercapcitor is disconnected from the system by opening the switch S5. At the instant 1.3sec the PEV2 is disconnected and reduces the demand to 300kW, so the fuel cell is disconnected. PEV3 is disconnected from the system at 1.5sec by opening the switch S8. It reduces the demand of charging station to 200kW. To meet this demand wind is disconnected by opening the switch S2 and the remaining sources are added to the system. When all the PEVs are charged then the sources are act as standalone sources. This operation is tabulated in table 4 and the justification for the proposed system i.e. the achievement of energy management is given by the figure.13. Then the efficiency of the charging station is depending on the efficiency of each sources. In current, the efficiency of wind energy source is 40-50 percent that is it converts 40-50 percent of wind into electrical energy. The PV has the efficiency of 40-60 percent when concentrated panels are used. The fuel cell has 50-80 percent efficiency and the supercapacitor is 97% efficient. Thus, in average the proposed charging station has the efficiency of 75 percent. The technological growth in non-conventional energy sources will increase the efficiency of the system.

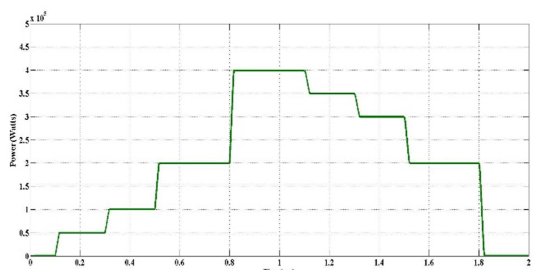
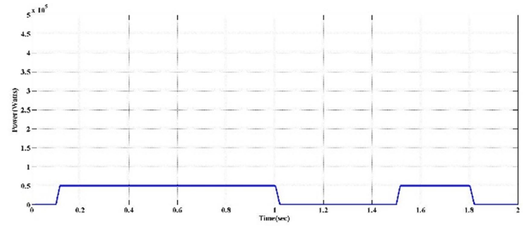
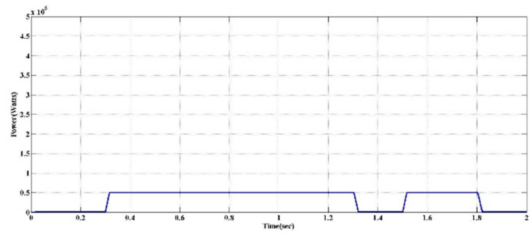


Figure.13 Total power consumption of the system

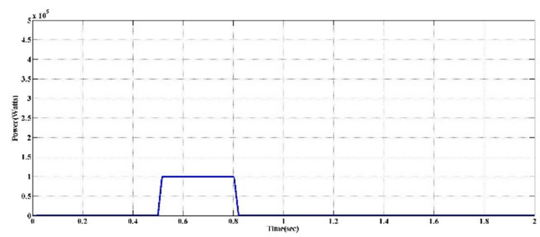
The individual contribution of each source to meet the demand of charging station is shown in figure.14 which shows the contribution of source with increasing and decreasing the demand.



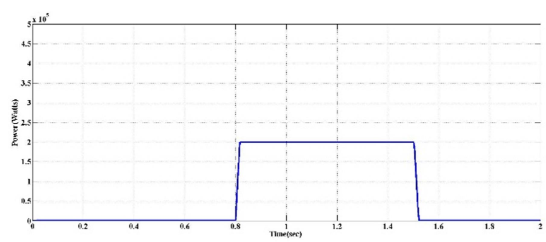
(a)



(b)



(c)



(d)

Figure.14 Individual contribution of each source: (a)Supercapacitor (b)Fuel cell (c)PV (d)Wind

Table 4. Operation of the system

Time period (s)	**Load**	**Demand (kW)**	**Source**
0.1 – 0.3	PEV1	50	SC

0.3 -0.5	PEV1, PEV2	100	SC, FC
0.5 -0.8	PEV1 to PEV3	200	SC, FC, PV
0.8 – 1.1	PEV1 to PEV5	400	SC, FC, PV, W
1.1 – 1.3	PEV2 to PEV5	350	FC, PV, W
1.3 - 1.5	PEV3 to PEV5	300	PV, W
1.5 – 1.8	PEV4, PEV5	200	SC, FC, PV

CONCLUSION

From the simulations and results, it can be concluded that the renewable energies and Super capacitor can be used as sources of Distributed Generation (DG).With this Distributed Generation unit the PEVs can be charged in future. Power to the charging station and charging of each PEVs can be controlled with embedded controller. Thus the energy management is obtained with this controlling process along with the charging station to PEVs.

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Design of Residential Plug-in Electric Vehicle Charging Station with Time of Use Tariff and IoT Technology

S.Divyapriya
divyapriyaeee@gmail.com
Department of Electrical and Electronics Engg.
Karpagam academy of Higher education
Coimbatore, India

Dr.Amutha
amudhac11@yahoo.co.in
Department of Electrical and Electronics Engg.
Karpagam academy of Higher education
Coimbatore, India

R.Vijayakumar
r.vijayakumarpse@gmail.com
Department of Electrical and Electronics Engg.
SNS College of echnology
Coimbatore, India

Abstract- Electric vehicles (EVs) pull in around the globe because it has a benefit of energy saving and environmental protection. High Penetration of Electric Vehicles in the world makes an additional demand on the power system at peak time. To overcome this problem, Smart Charging Station is designed for residential. At peak time the power required to charge Electric Vehicles is effectively handled by Grid connected PV generation and also Electric Vehicles acted as an Uninterrupted Power Supply (UPS) based on Time of Use (TOU) Tariff. All control functions are done by the Raspberry Pi controller. The whole process monitored and controlled by using Internet of Things (IoT).The proposed control system and their control functions are done in MATLAB/SIMULINK.
Keywords: EVs, Grid connected PV, Smart Charging Station, Raspberry Pi, Internet of Things (IoT), Time of Use (ToU) Tariff.

I. INTRODUCTION

Electric vehicle (EV) pulls in worldwide consideration of late and is anticipated that would get more noteworthy selection of transportation division into most nations because of its significant leverage of zero tailpipe emanations. EV was first presented in the nineteenth century yet soon supplanted by inner burning motor vehicles. The reasons were the development of suppressor and electric starter, which diminished the commotion of internal combustion engine vehicles and evacuated the need of hand wrenches to begin the internal combustion engine vehicles [1].The increased number of EVs could overload the existing power system especially at the distribution system which can cause voltage problems and frequency problems. Considering the increasing number of EVs, it appears important to build up an appropriate charging station to give their required electrical demand request. One solution is to charge EVs at home for Renewable Energy Sources (RES).Among all available sources PV system is the best solution. According to the report provided by the National Household Travel Survey (NHTS), vehicles are parked 5 hours of a day at a work place[2]. Electric vehicle charging with residential provides overloading of distribution transformer. As the upgrading of transformer is difficult one. Several literature to show the impact of EVs charging on the distribution transformer [3], [4].Hence to build an electric vehicle charging station at residential is to be effective. So some researchers motivate that, charging of EVs at night time. Night charging challenge is the use of the TOU (time-of use) pricing. Several papers presented residential distribution network.[5],[6].The charging station was fully automated by IoT technology [9],[10],[11].

II.NOVEL PLUG IN CHARGER DESIGN

The novel plug in residential charger contains solar power residential, bi directional vehicle charger and IoT technology, the solar power generation is directly connected to the grid with Smart meter. The Charging station, smart meter, and grid powered by IoT with the help of Rasberrypi-3. The solar power generation implemented by MPPT technology.

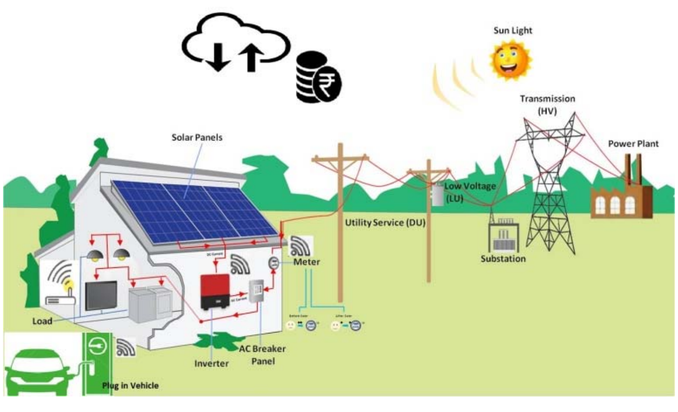

Figure 2.proposed block diagram

Case I: During day time solar power is more sufficient to charge the electric vehicle and residential load is supplied by Grid power supply. During this condition the smart will calculate the importing power value.

Case II: Now we are consider the vehicle was fully charged now the solar power was supplied to Grid. During this

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condition the smart meter will calculate the exporting power readings.

Case III: During the peak Load time The Battery of Vehicle is exporting power to Grid. Now our Vehicle will earn money for exporting power.

Case IV: During Grid Failure and Solar power failure our Plug in Electric Vehicle battery will act as a Uninterrupted Power supply.

All the above data will be stored in Cloud in using IoT technology. Time of use pricing is included in the proposed system. Smart meter is used to track the electricity use by the hour

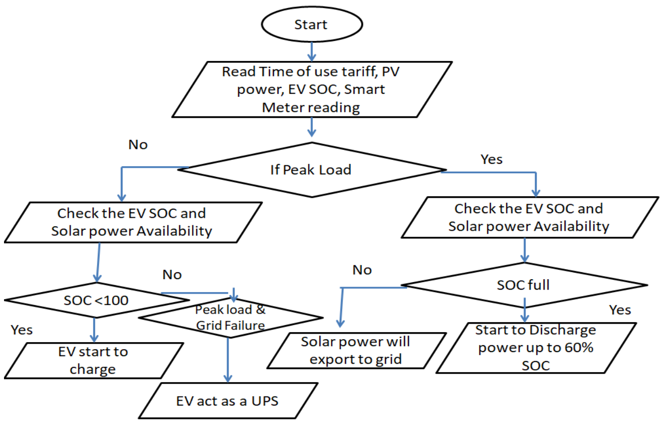

Figure 3.Flow chart

Figure 3 shows the flow chart for proposed work. Figure 4 shows the different modes of operation of our proposed work. To control of overall system the controller called Raspberry Pi is used. The Raspberry Pi is a progression of little single-board computers created in the United Kingdom by the Raspberry Pi Foundation to advance the educating of fundamental software engineering in schools and in developing nations. The first model ended up noticeably significantly more prominent than expected, offering outside of its objective market for utilizations, for example, apply autonomy. Peripherals (counting keyboards, mice and cases) are excluded with the Raspberry Pi. A few frill however have been incorporated into a few official and informal packs. To monitor and share the information about the status of charging station the technology called Internet of Things (IoT) is used in proposed system. The controller work under the condition of time based tariff is is also called Time-of-use Pricing (TOU).

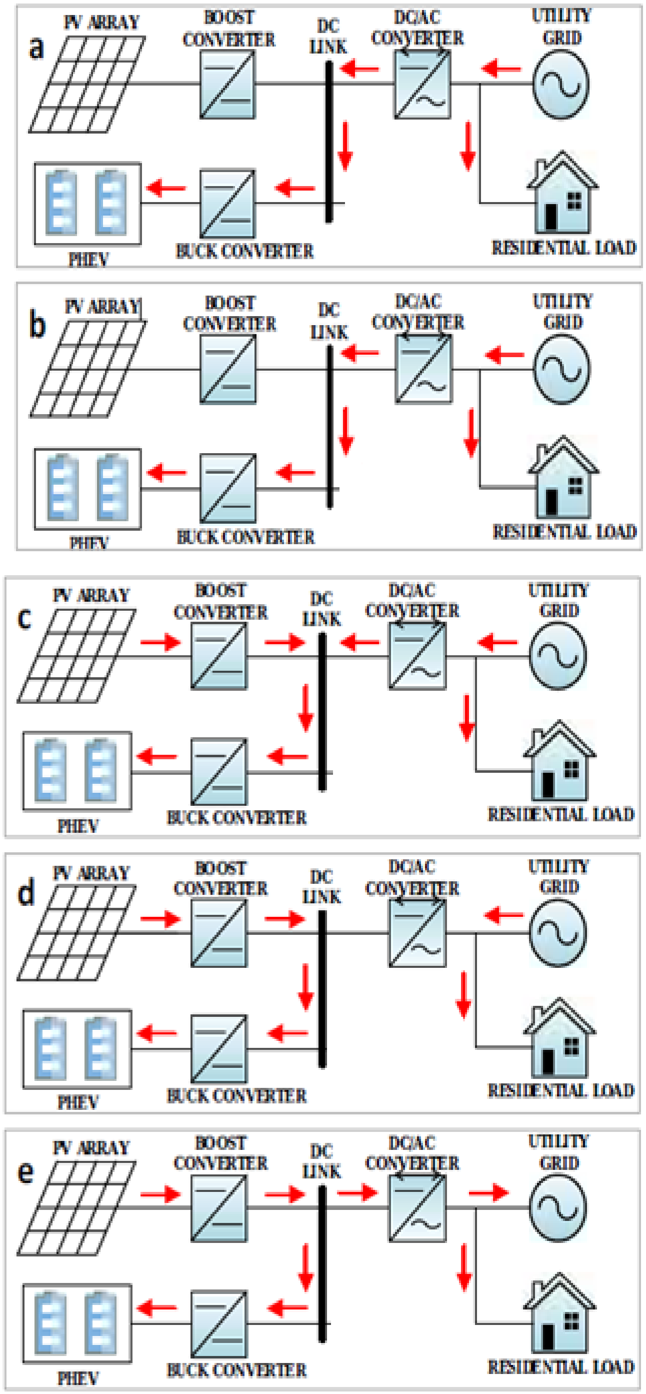

Figure 4. Power flow diagram of proposed system for each mode

II. RASPBERRY PI CONTROLLER AND IOT

Most photovoltaic systems contain parts, for example, the sun powered modules (panels) to give the electrical power, a battery charger for changing over the board yield to the battery voltage, a battery pack to store energy amid the day and give it amid the evening time, an inverter to change the battery voltage to the best possible line voltage for operating home apparatuses and a line source selector to switch between the sunlight based and grid power.

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At the point when the sun is sparkling amid the daytime, the sun powered photovoltaic cells change over the daylight falling on them into electricity. In spite of the fact that the productivity of the change might be just around 17%, sunlight based power can without much of a stretch achieve 1KW/m2 and reasonable panels can deliver 5000 Watts in these conditions.

Sun powered panels ordinarily create a high voltage, 120V DC being a typical figure. The battery charger needs to change over this to coordinate the battery voltage, for the most part 48V DC. Sun powered light power charges the batteries ceaselessly amid the daytime; hence, the charger needs to continue following the greatest power point to enhance the yield of the system. As the charger needs to charge the battery likewise, this gadget frames the most expound some portion of the system.

With the above game plan, the sun based panels charge the battery amid the daytime and the battery releases amid the night. The span of the battery relies upon one day of utilization in addition to some additional to hold over a cloudy day. That likewise chooses the span of the sun based board. Batteries are basically overwhelming and the lead-corrosive composes by and large have a life expectancy of around 7 years.

The batteries sustain the inverter, which changes over the 48V DC into the line voltage – typically 230V AC or 110V AC. With a 5KW nonstop appraising, inverters can basically run all family unit apparatuses, for example, the garments dryer, the clothes washer, the dishwasher and the electric kitchen broiler. At the point when the inverter is providing a vast load, the battery current may move up to 200A. The information of the proposed system is collected, monitored and shared though the technology Internet of Things (IoT).

The Internet of things (IoT) is the system of physical gadgets, vehicles, home machines and different things implanted with hardware, software, sensors, actuators, and system network which empowers these items to associate and trade information. Everything is exceptionally identifiable through its implanted registering framework however can between work inside the current Internet foundation.

III.RESULTS AND DISCUSSION

The simulation of the proposed work carried out by MATLAB Simulink model.

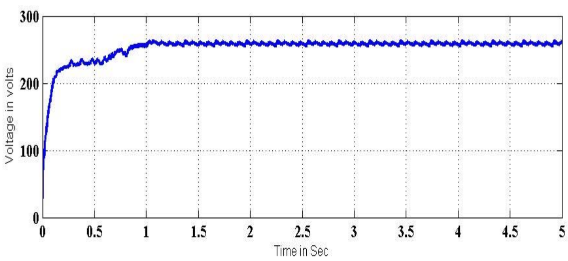

Figure 5.Output of Solar power

In the Figure 5 shows the output voltage of solar power generation. At the time period of 0 secs to 1 sec the output voltage will oscillate and finally settle down to 220V DC. In this above figuring the simulation carried out the time period of 5 Seconds.

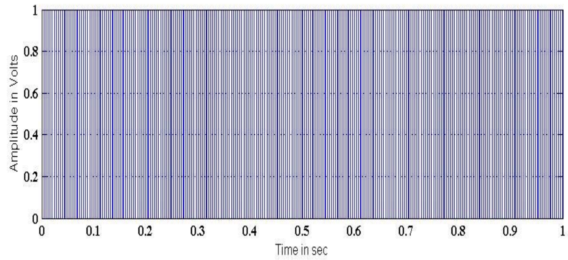

Figure 6.Output of MPPT

The figure 6 shows that the MPPT pulsed output for PV power generation. MPPT technology is used to track the maximum power output of solar power. The MPPT output is feed to the Boost converter.

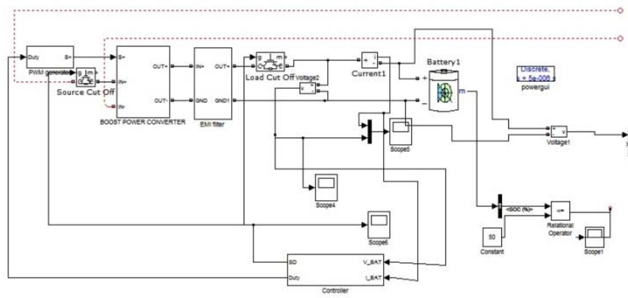

Figure 7.Plug in Electric Vehicle model

The figure 7 shows that the simulation model of Plug in Electric vehicle. The battery has the capacity of 220V Dc and 50Kw power ratings. The battery manager circuit is used to help the battery of charging and safe discharging. This converter is acted as a bi-directional converter based on the pulse pattern.

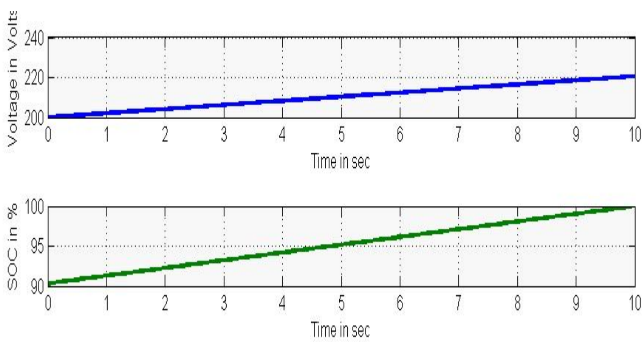

Figure 8.Plug in Electric Vehicle Charging

The above Figure 8 shows the characteristics of Battery during charging condition. The voltage level gradually increases the value of 200V DC to 220V DC rated value, at the same time The SOC level will increase 90 percentages to 100 percentages. We Don't have the instrument for measuring SOC level. Based on the voltage level only we can calculate the SOC. The charging process takes place in two conditions, one is daytime while solar power is available and second one is during base load time from Grid.

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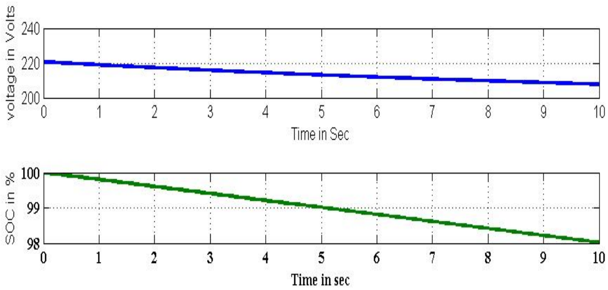

Figure 9.Plug in Electric Vehicle Charging

The figure 9 shows that the discharging process of battery of electric vehicles. During this discharging process the SOC level is reduced from 100 percent. Nominal voltage of Battery also comes down.

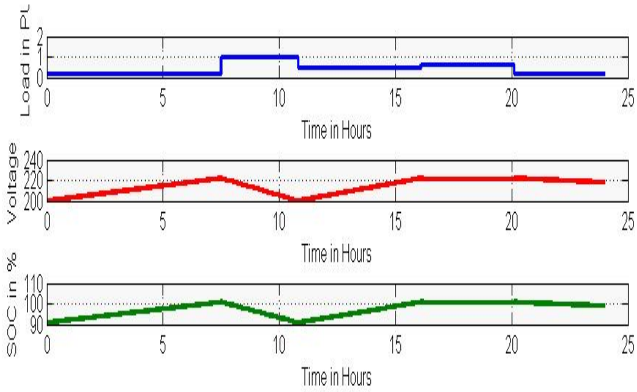

Figure 10.Overall operation

The figure 10 shows the overall process of proposed system. In this figure we are simulating as per one full day. The time period 0 to 7 o clock we are assuming as base loads, time period 7 to 11 o clock is maximum load period, time period 11 to 16 o clock again goes to second base load. Again 16 to 21 o clock maximum load happened. From the above graph during the base load time our plug in electric vehicles start to charge so the voltage values and SOC value is increasing, during the peak load time our plug in electric vehicles is discharging.

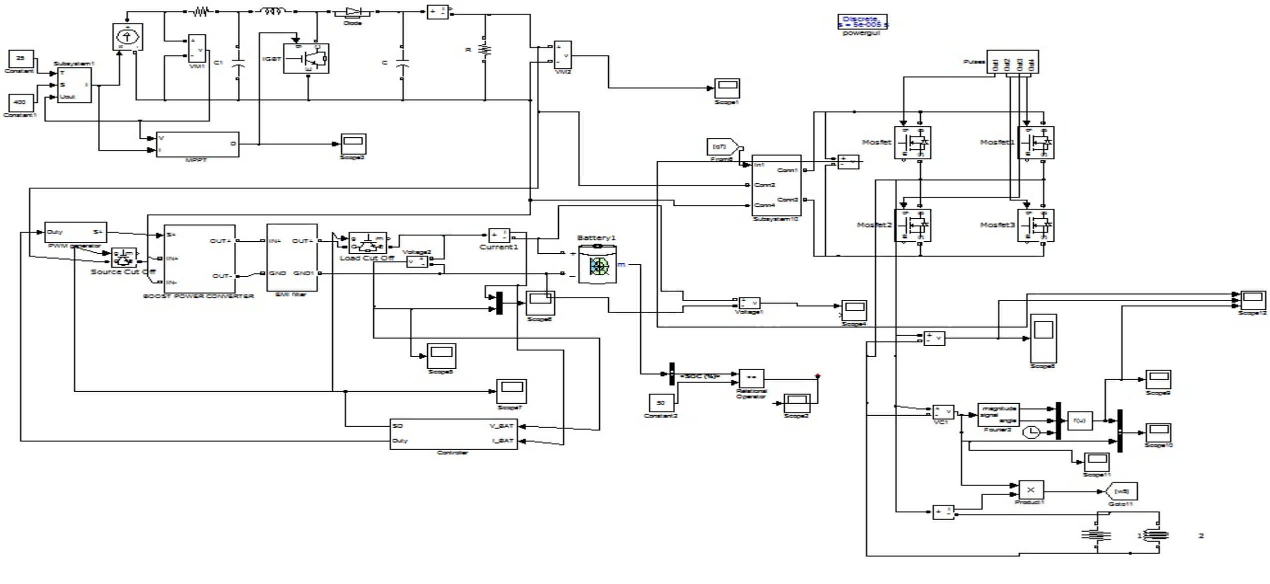

Figure 8.Overall simulation model

The MATLAB simulation of overall system was shown here. The PV model, Battery Model, Battery Manager model and Grid also shown.

CONCLUSION

From this proposed work we did simulation model of entire system . We are assuming the tariff of power is maximum during peak load time (Time of Use tariff) during this condition our 50KW plug in electric vehicle was support the grid for avoiding Maximum loading . During base load only our Plug in Vehicle will charge . During night time if any maximum demand occurs or grid power failure condition our Vehicle battery will act as an Uninterrupted power back up . The Time of Use tariff data will take from webpage . All the controlling process is done by High power Rasberrypi-3 controller.

FUTURE SCOPE

In this work may extend to Public Charging station and also Wind power based charging station. The time of use tariff will use to improve our system reliability and make grid to health.

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ORIGINAL CONTRIBUTION

Design of Solar Smart Street Light Powered Plug-in Electric Vehicle Charging Station by Using Internet of Things

S. Divyapriya[1] · A. Amudha[1] · R. Vijayakumar[2]

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Abstract The development of civilization increases the usage of transportation. This tends to more CO_2emission, which pollutes the air significantly. To overcome this issue an emerging technology called plug-in electric vehicle (PEV) was used which eliminates the consumption of fossil fuels. Instead of fueling, the vehicle is charged from electricity. The major issue in the implementation of PEV is the charging station to charge the batteries of the vehicles. Usage of conventional energies such as thermal and nuclear energy also pollutes the atmosphere. The renewable energies are the best alternatives for conventional energies. Nowadays the street lights are also converted as smart lights that is they are powered by solar energy which charges the battery of smart street lights. The capacity of the batteries installed for each light is more than enough to power it. So this excess energy is not used for any other purpose. In this paper, a new concept is introduced to utilize the excess energy from smart street lights, PEV is charged from series/parallel connection of all street light batteries. The entire process is monitored and controlled by using Internet of Things (IoT). This overall system is simulated by MATLAB/SIMULINK environment, and results are analyzed.

Keywords Charging station · Internet of things (IoT) · Plug-in electric vehicle (PEV) · Smart street lights · Solar energy

✉ S. Divyapriya
divyapriyaeee@gmail.com

1 Department of Electrical & Electronics Engineering, Karpagam Academy of Higher Education, Coimbatore, India

2 Department of Electrical & Electronics Engineering, SNS College of Technology, Coimbatore, India

Introduction

A number of nations have taken explicit activities to decarbonize their power system and transport segments by empowering renewable energy sources and supporting the utilization of plug-in electric vehicles (PEVs) [1]. International Energy Agency (IEA) has anticipated that the sales of passenger light-duty EV/plug-in hybrid EV will help from 2020 on and might achieve more than 100 million of EV/ plug-in hybrid EV sold every year around the world by 2050 [2]. In the literature [3], based on grid frequency, charging and discharging of EV are proposed. The EV improvement will result in increasingly more EV charging stations being worked soon [4–7]. In the previous literature [8, 9], smart electric vehicle charging station is designed for residential and based on Time of use Tariff, EVs acted as an uninterruptible power supply. The more number of EVs may increase the burden on power system and may influence the stability and safety of the power system. The perfect and suitable solution for this issue is the use of renewable energy sources such as wind, solar energies. National strategies in many countries have set goal-oriented focuses for the advancement of renewable energy source. In European Union (EU), the objectives are set for 35% of power generation from renewable energy sources in 2020 [10]. Renewable energy source right now gives 14%of the world's energy supply [11, 12]. Solar and wind diesel-powered electric vehicle charging station are designed with vehicle to grid Technology [13]. In the literature [14], Charging station for plug-in electric vehicle is designed by using different renewable energy sources with supercapacitor and also energy management technique is also implemented. In renewable energy, PV can be utilized to produce electricity in any place, where the sun-based radiation asset is good, rather than original power supply

[15]. Solar street lighting system is a successful method to reduce power consumption and CO_2 emission on environment [16]. In the literature [16], energy efficient smart street lighting system is designed by using low-cost microcontroller-based Arduino. The primary objective is to design energy efficient solar-based smart street light system for energy conservation in existing street light system. In PV (Photovoltaic) system, the solar radiation can be converted into electrical energy. This energy is stored in a battery and provided to the system when it is required to glow [18]. The goal of the Internet of Things is to enable things to be connected anytime, anyplace, with anything and anyone ideally using any path/network and any service. The IoT has the forthcoming to modify the techniques for different innovative services and applications, for example, watching ongoing things and furthermore work with their communication and interaction. [17, 18, 20].

In proposed system, the solar energy is used as the source for PEV. This solar power is fetched from the excess power in the solar-powered street light system. Around 50% of the energy is left excess every day in the battery of smart street light. This excess energy is collected together and utilized to power the charging station. In this, all solar-powered smart street light batteries are connected in series/parallel connection to make the PEV charging station.

Proposed System

Every street has battery with solar panel and street lights. Nowadays they became smart street light with solar energy, there are 60 number of LED in each light with the rating of 12 V, 2.5A. Each light consumes 30 W per hour. Normally street lights are in active for 6.00PM to 6.00AM, that is, they are active for 12 h. For these hours, they consume 360 W. During inactive state, the remaining 60% of battery capacity is unused. Each smart street light consists of one 12 V solar panel and 75Ah, 900 W capacity of battery. This is illustrated in Fig. 1. The battery takes 3 to 8 h to charge fully. After supplied to street light, there will be remaining power in each battery for every day. It is nearly 60% of its battery capacity. This is not used for any purpose. According to proposed concept, consider 100 street lights. The batteries of these street lights are connected in parallel / series by underground cable. The excess power collected by the series/parallel connection. This power is fed to the PEV charging station to power the PEV. The grid also supports the charging station, when there is a need. The operation of the system consists of four cases. They are,

Case(i): The State of Charge (SoC) of the battery is greater than 80% when all the batteries are almost fully charged. These batteries are ready to power the charging station, at that time the support from the grid is switched off.

Case(ii): When some of the batteries SOC level is between 50 to 79%, that batteries are isolated from the parallel connection and start to charge by getting energy from the solar panel. In this condition, the grid support was switched on and supports the charging station.

Case(iii): In cloudy days, if the energy from the solar panel is not enough to charge the batteries of street light, the grid will support to the charging station as well as gives energy to charge the batteries of street light.

Case (iv): It is based on tariff. If the owner of PEV is willing to discharge the power from PEV to grid then they can discharge through charging station to grid. The owner will get some incentive based on the power delivered.

All these operations are monitored and controlled in central control unit which collects the data such as the SOC level of each batteries of street light, SoC level of PEV, availability of grid, availability of solar energy and the power availability in all devices through the technology called Internet of Things(IoT). For these operations, there is a need of some supporting devices such as bidirectional AC/DC converter and bidirectional DC/DC converter. In this proposed system, street light batteries can get power from the grid and also supported to charging station by using bidirectional AC/DC converter. DC/DC converter is used between battery of the street light and charging port of PEV. It also works in bidirectional way. It is used to get power from the solar energy, when available and give the power back to the street light in cloudy days. The operation of these devices is also monitored and controlled through central control unit.

Astrological Location-based Retrofit Timer

The block diagram of astrological location-based retrofit timer is shown in Fig. 2. It consists of low-power microcontroller, real-time clock, relay driver, light depended resistor (LDR), proximity sensor (PIR), Wi-Fi device and relay.

In microcontroller, the location-based sunset and sunrise timing from internet is updated via Wi-Fi. The 10 years data will be stored in microcontroller memory. In addition, LDR is also used, in such a case that there is any sudden climate change, the sunset and sunrise may change, so the LDR port will enable 30 min before predefined sunset and 30 min after sunrise. PIR sensor is also used, it will activate after 22:00, and it will help to reduce the LED brightness or switch off half number of LEDs in Street lights. Therefore, it reduce the power consumption at unwanted timings. The SoC level of each battery is

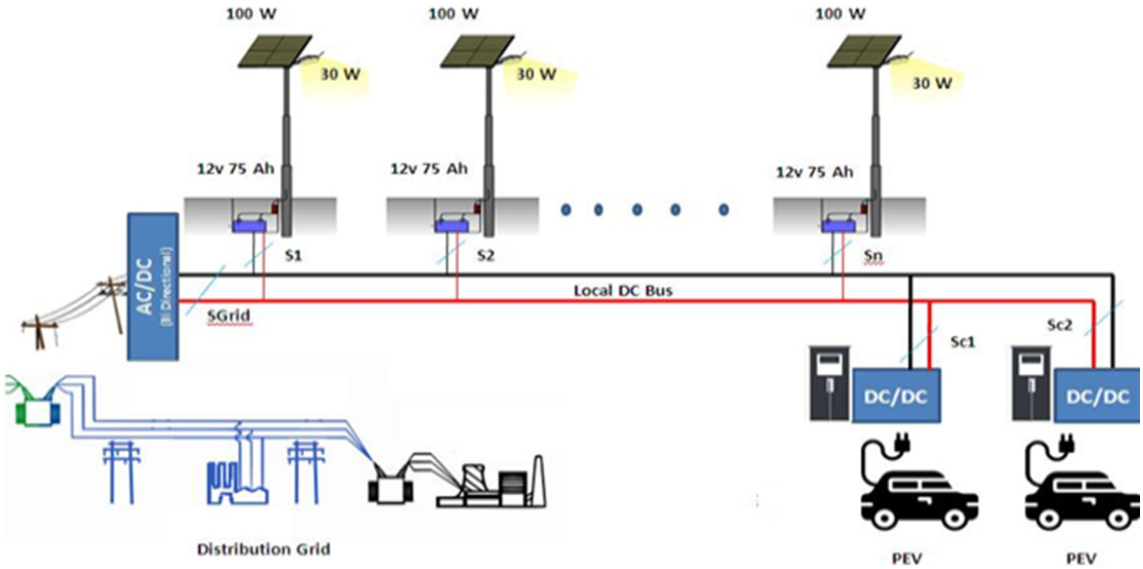
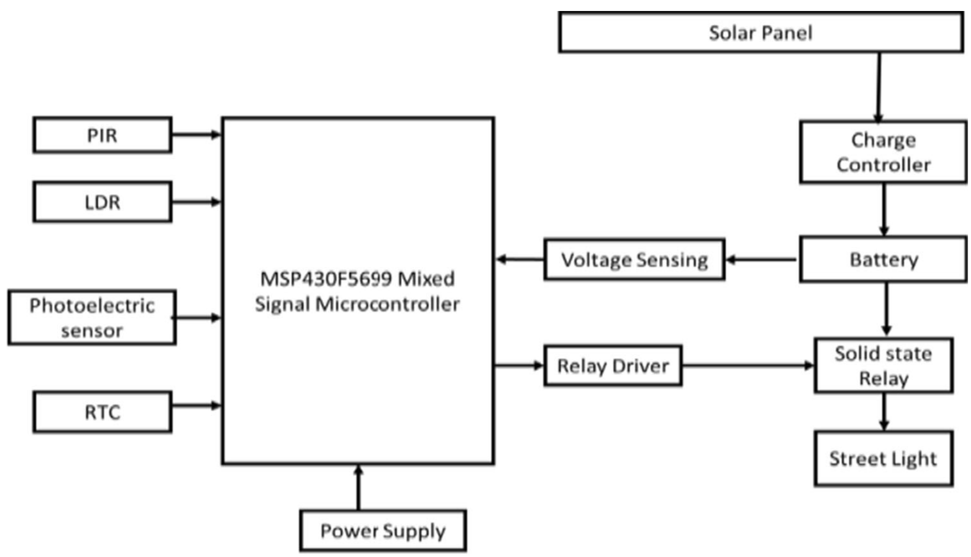


Fig. 1 Proposed system

Fig. 2 Block diagram of astrological location-based retrofit timer



calculated by voltage sensing method, and the level of SoC is stored in Cloud by IoT technology.

Fig. 3 shows the prototype model of retrofit timer based on astrological. It consists of 328 bit microcontroller for control entire process and also using real-time clock ds1301 used to set the real-world time. The relay module operating single pole single throw (SPST) mode, the relay module normally open (NO) terminal used to turn on the street light for required timing. The power supply used to provide 5 V for all electronic components. The 2*16 LCD module is used to show the timings to the user.

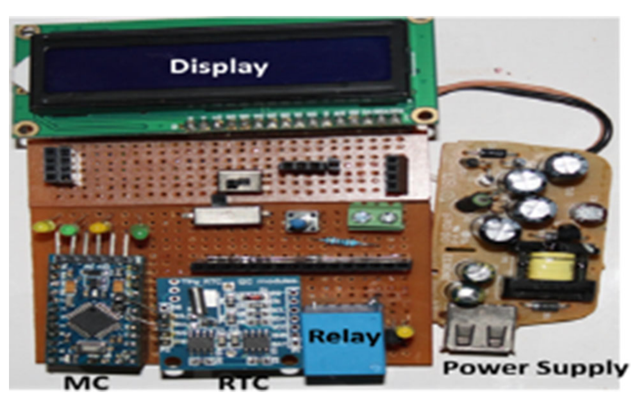


Figure.3 Prototype of astrological location-based retrofit timer

Design of Solar-powered Smart Street Light System

In every road between each 18–24 m, there is a street light for 30 W LED [19]. Assumed that, 100 street lights are taken into consideration, it is powered from the solar panel. It will increase the power demand on the power system from 18:00 to 6:00 every day. To reduce the demand, the renewable energy is used to power each light. The proposed system will not change any existing system, however included, one retrofit timer for street lighting system.

Current calculation There are 60 numbers of LED placed in each light with the rating of 0.5 W capacity each. So 30 W (60*0.5 = 30 W) power is consumed for full brightness. 12 V lithium or lead acid battery is used. Total current consumed by the single street light calculated in Eq. 1.

$$I_s = \frac{W_b}{V_b} = 30/12 = 2.5\ \text{A} \tag{1}$$

where.

I_s = Current consumed by street light.

W_b = Power rating of Battery.

V_b = Battery voltage.

Battery Capacity Calculation Assumed that, 100 street lights are taken in particular city. Each night, actually lighting with full load is 4 h out of 11 h.

Figure 4 shows lighting with 100% full load for 4 h. Lighting with 30% load for 6 h. Lighting with 60% load for 1 h. The lighting time of each solar street light is 11hours (4hrs + 6hrs + 1 hr) out of 24 h. For the selection of battery, it should reserve the capacity of 5 rainy days (5 rainy days + the last night, it is 5 + 1 = 6 days) with continuous lighting.

Total lighting current is

$$\left(\frac{4_{\text{hrs}} \times 30_{\text{Watts}}}{12V_b}\right) + \left(\frac{6_{\text{hrs}} \times 9_{\text{Watts}}}{12V_b}\right) + \left(\frac{1_{\text{hrs}} \times 18_{\text{Watts}}}{12V_b}\right) = 16\text{A}$$

$$\text{Then battery capacity} = 16\ \text{A} * 6(\text{days}) = 96\ \text{Ah.}\ (\text{Available rating}\ 105\ \text{Ah})$$

In order to avoid overdischarging of battery, battery should discharge up to 60%. In addition, it would have some power wasting consumption according to different loads, actual working current is influenced by constant flow source, rectifier, line loss, etc. Therefore, the actual battery capacity might be

$$105\text{AH}_b \times 125\% = 131.25\text{AH} \tag{2}$$

where $\text{AH}_b =$ Battery capacity in Ampere Hours.

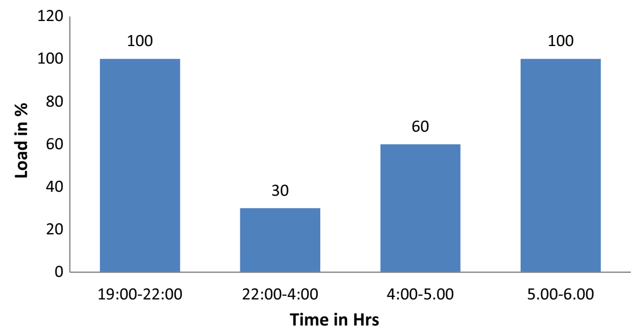


Fig. 4 Bar Graph representation of street light load

Calculation of Solar Panel Power (Wp)

Solar Street light need to work 11 h each night, while it is about average of 5 h that solar panel can touch enough sunlight [20]0.250-W solar panels and live in a place where you get 5 h of sunlight per day.

Solar panel watts x average hours of sunlight × 75% = daily watt-hours.

250 watts × 5 h x 0.75 = 937.5 daily watt hours.

5 h is taken as peak sun hours, accurate sunlight time is calculated according to Country or installation location. Moreover, it has difference in line loss, power consumption of controller, different power of rectifier or constant flow source. 937.5 W is also just theoretical value, the actual need is 15%-25%.Hence, 937.5 W*(115%–125%) = 1078 W–1171 W.

Existing street light system turns on at 18:00 regularly and turn off in the morning at 6:00. However, in summer days, Sunset will be at 19:30 and sunrise will be at 5:30. By using astrological location-based retrofit timer, reduce the full load from 4 h to 2.5 h. Therefore, we can save 45 W power from one street light per day.

45 W * (100 street lights) = 4500 W. This excess 4500 W power from the street light sent to electric vehicle charging station.

Design of Electric Vehicle Charging Station

Battery current rating is 131.25 Ah and voltage rating is 12 V. So the power rating is 131.25*12 = 1575Wh. If the battery SoC level between 80 to 100%, this 20% of power (315 W) is used to charge the Electric Vehicle. For 100 street lights, 100*315 W = 31500 W power send to charging station. So, the total power delivered to the charging station is 4500 W + 31500 W = 36000 W. This is represented in Table 1.

The powerful charging terminal can charge an electrical battery to 80% in half an hour. This time could be additionally diminished in the coming years. The producer

Tesla is as of now building up an electrical terminal able to do completely charging of the battery in only minutes. By supporting grid with renewable energy source, achieve 1-min charging. The charging time can be calculated by the following simple calculation.

Step1: Divide the load power by 1,000 for a value in kilowatts. Assumed that 3.7 KW electric vehicle charger in consideration.

Step2: Divide the power of battery (also in kW) by the figure obtained to get the charging time. Our power availability is 36 kW/ 3.7 kW = 9.73 h.

Step3: First calculate our load power (P), by multiplying the voltage (V in volts) by the current (I, in amps). Get a value in watts. P = V x I, 230 V x 16A = 3,680 W.

Charger input voltage at 230 V or 400 V DC input is chosen, it would deliver the current rating from 16 to 63A and deliver or charge the power from 3.7KW to 43KW. This proposed charger will work at the temperature from—20 to 60 degree. In addition, it will give maximum 94% efficiency and 0.9898 PF. DC current sent to the Electric Vehicle's battery directly via the DC charge port.

Level 1: Public DC Chargers at output voltage of 48 V/ 72 V, with power outputs of.

10 kW / 15 kW with maximum current of up to 200A.

Level 2: Public DC Chargers at output voltage of up to 1000 V, with power outputs of 30 kW / 150 kW. These will be called Level 2 DC Chargers.

In this system, Level 1 chargers are used. The brain of the charging station is the network controller. It empowers the station to communicate with its network.

Artificial Intelligence for IOT

Artificial intelligent (AI) system was effectively utilized with the help of Internet of Things (IoT) technology. Without human brain interferes, our AI technology is doing effective work. The calculation, which we have made, partitions every solar light data into little segments, which extend from ten seconds to a minute. The calculation, which works continuously which means a control signals is made each 0.1 s assesses progression of information (SoC level of each battery, Panel output, Selection Switching and all electrical parameters) and thinks about this data to current SoC output and how much fuel the vehicle needed to full charge. At that point, it communicates something specific, by means of the electronic control unit, to the energy management system, advising the control switch to act in precisely the equivalent was as in past segment.

In this system, modern Internet of Things is used for monitoring all the parameters like SoC, solar panel output, selection switching and all electrical parameters. Individual IoT device with internet connectivity and switching relay with driver is used. The SoC level of all batteries is continuously monitored based on the SoC level the switch will decide, whether to charge the battery or supply to charging station. All the data sent to cloud and analysis taking care of that part. The IoT technology will operate based on the flowchart is shown in Fig. 5. In this flowchart, 3 modes of operations are explained. They are.

Mode 1: During daytime, all the battery SoC is between 80 to 100% and the EV power is equal to utility and the charger will be fully supported by renewable sources like solar panel.

Mode 2: If they have sufficient power from battery and solar panel and if there is no EV means the power will be exported to grid. Otherwise, the available power is partially supported to EV and remaining power from grid.

Mode 3: If battery SoC level is below 79% up to 50% means, the battery power will be reserved for street light. Otherwise, emergency battery charging will take place from grid.

Results

The simulation of the proposed system is shown in this section. Simulation model of Solar Street light system is shown in Fig. 6. This simulation consists of five solar street light with PEV charging station. In this, 4 solar cell array are connected in series and parallel combination in order to achieve the desired power rating based on the voltage level.

Fig. 7 shows the battery discharge level by the means of SoC. At 0 s, the battery is in completely charged condition that is 100% SoC. The SoC level is decreased from 100 to 50% at 1500 s interval. Now battery supplied the voltage

Table 1. Total power to the charging station

S.No	Number of street lights	Power from the street light while using astrological location-based retrofit timer	Power from the street light when SoC of the battery between 80 to 100%	Total Power to the electric vehicle charging station
1	100	45 W from one Street Light. So 45*100 = 4500 W	315 W from one street light battery. So 315*100 = 31500 W	4500 W + 31500 W = 36000 W = 36KW

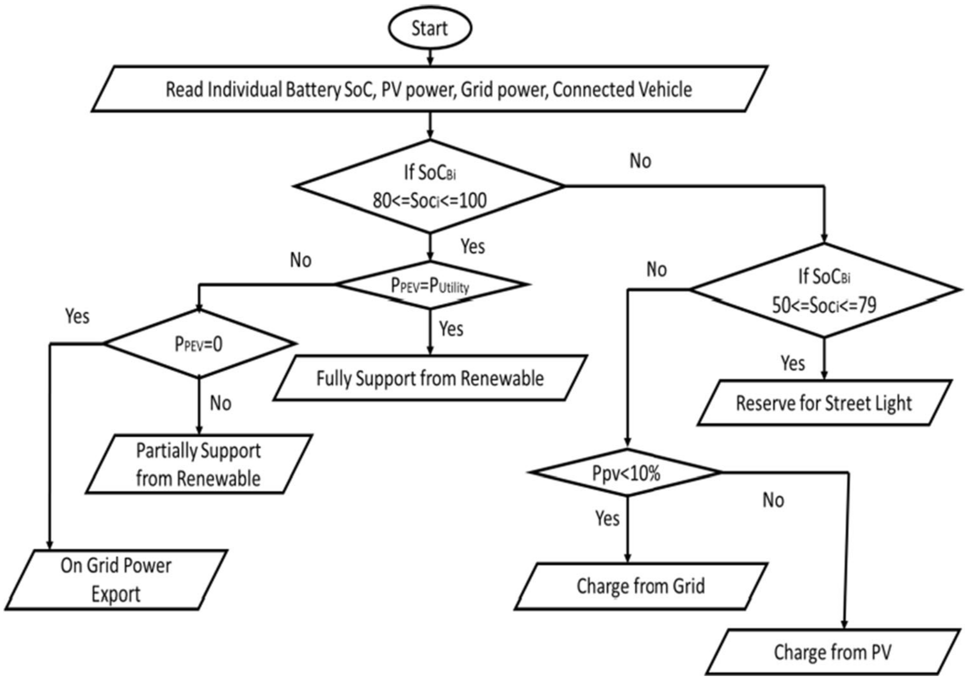


Fig. 5 Flowchart of proposed system

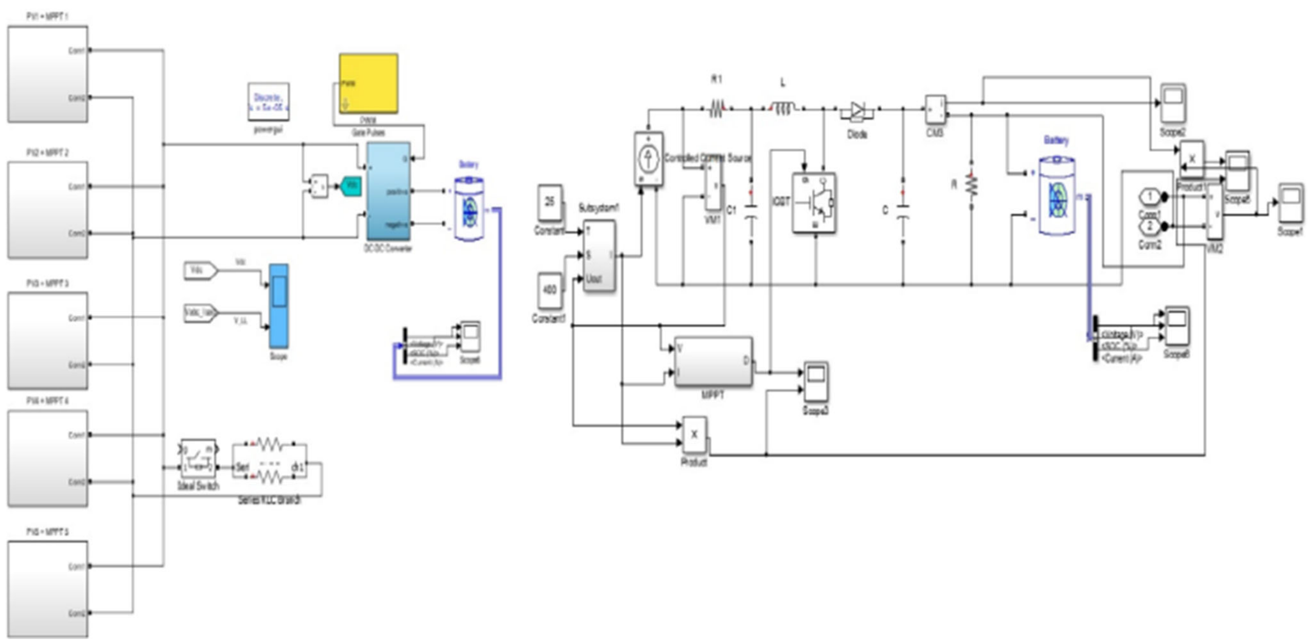


Fig. 6 Solar street light system with PEV charging station

12 V to 5 Amps Load. After 1500 s again load continuing drop the current so SoC level again decreasing 50% to below. At 3500 s, the SoC level goes to below 10% so voltage also goes to 0 V. In this condition, we are calling Dry battery Condition. In this simulation, we are taking Li-Ion battery for simulation environment, so it will deliver 100 percent SoC.

Figure 8 deals with the simulation output of PV panel. The graph shows solar output voltage, current, power and MPPT duty cycle. In this graph up to the point of 1.5 s, the voltage starts to increasing voltage and then it was settled 17 V. The current waveform also shown in second graph. At the time, 2 sec to 3.5 s time the irradiance level goes to

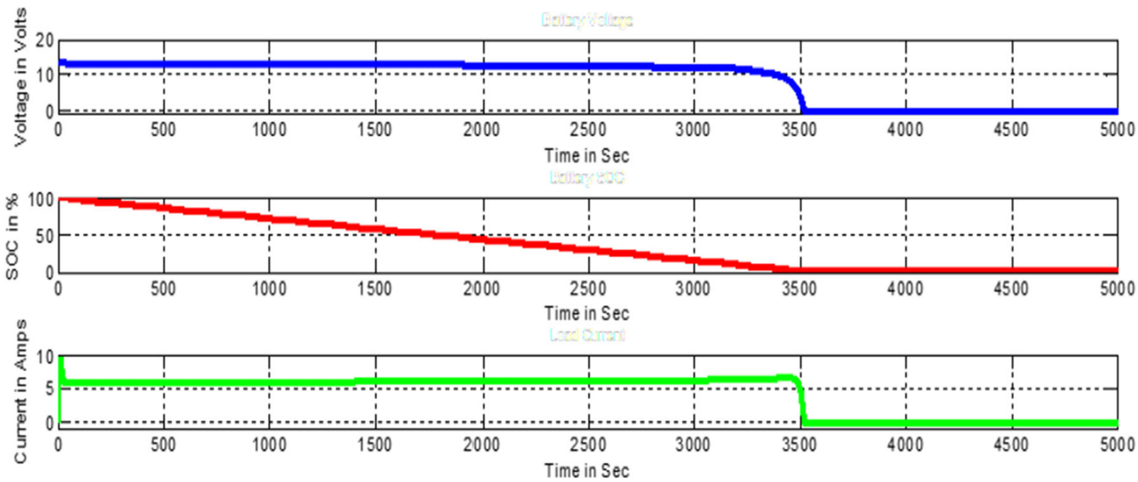


Fig. 7 Battery Discharging Condition

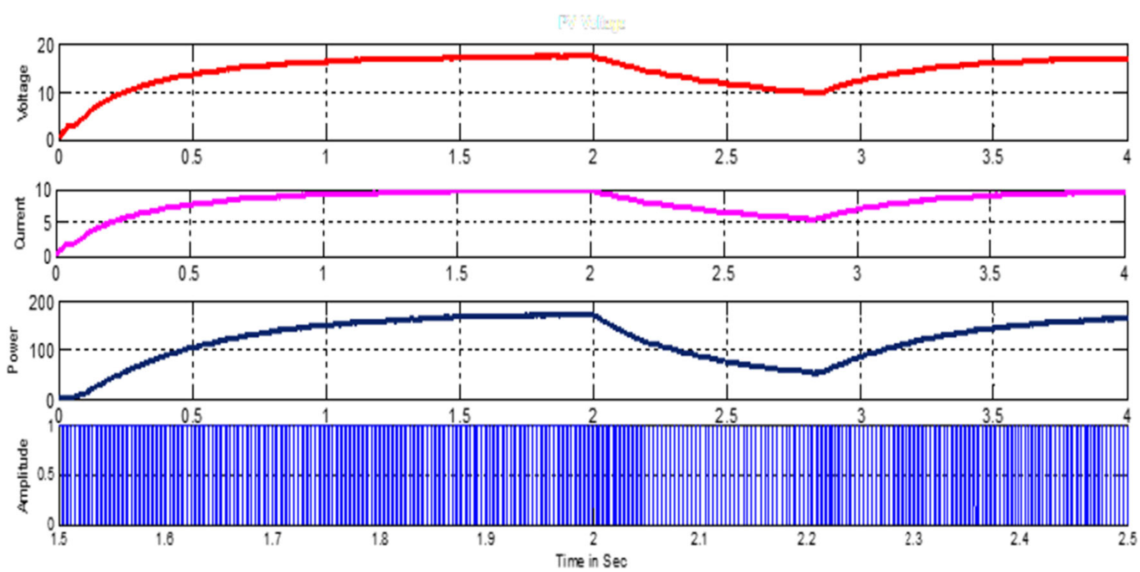


Fig. 8 Output of PV panel

very low. So the output voltage also goes to below 10 V. on that time duty cycle pattern was changed.

Figure 9 shows that single solar street light power dissipation or power flow from panel and battery to LED row1, row2, row3, vehicle1 charger, vehicle2 charger and supply to grid. In that, simulation model the help of MATLAB environment explains. The outputs are shown in scope.

Fig. 10 shows the solar panel output, LED operating time and switching. In graph 1 to 3, the LED row 2 is start to glows on 17.00 to morning 6.00. However, the 100% brightness only occurs on when needed. Therefore, the power consumption will saved. The vehicle charging condition will start only on daytime period because the battery power reserved for lighting system. During daytime, the vehicle charger 1 and 2 will loaded based on the charging vehicle availability so that example condition shown in graphs. The graph 6 will shows while 100% charging battery with solar panel output, the excess power will supplied to grid.

Figure 11 shows the battery cell arrangement in single stage. Fig. 12 shows the charging of battery from solar panel output voltage. The first graph shows that the panel is supplying maximum output of 17 V. Now 12 V Li-ion battery started to charge. In third graph, at initial condition, the battery capacity is 60%. From 0 to 0.5 s the solar panel started to supply the power but at the time of 0.5 s, it is delivering above 12 V supply. So that battery started to

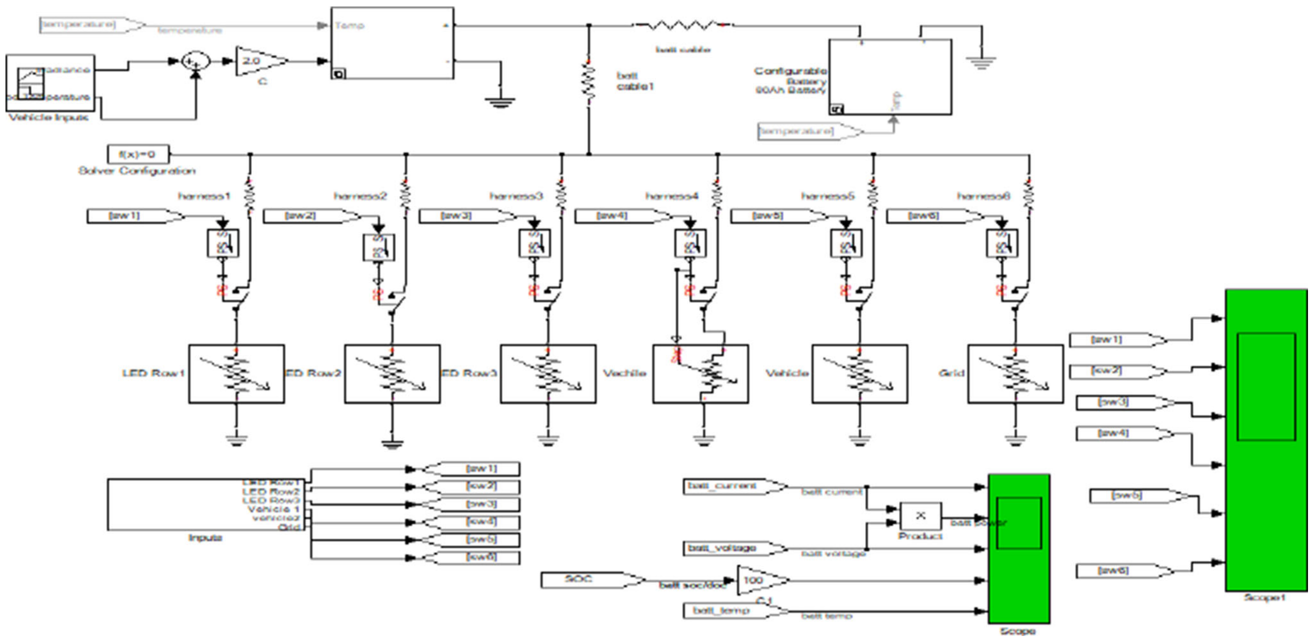


Fig. 9 Power delivered by the solar-powered street light battery

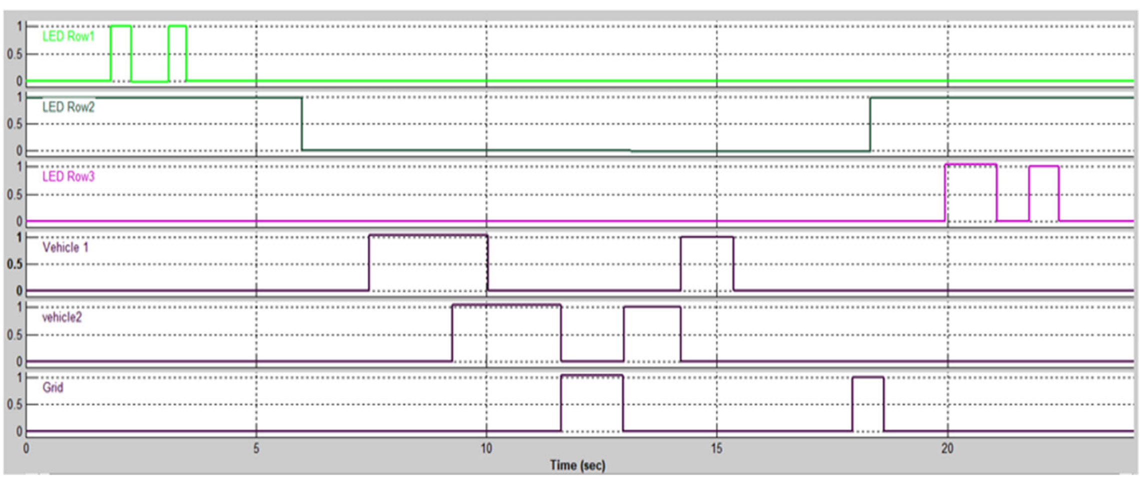


Fig. 10 Operating time of solar street light system

charge, the SoC level is increased from 60% to 60.02%. Assumed that, at the time of 2 s the irradiance level is started to reduce. So solar panel output voltage goes to below 12 V and battery will not charge. The SoC level goes to stable. After 3 s, the solar panel delivered maximum voltage and again the battery is charged from 60.02 to 60.03%.

Conclusion

In this proposed work, effectively utilized excessive available battery power from the solar street light system for PEV charging. All street lights are powered by microcontroller with IoT and smart retrofit timer. The efficient power management and power utilization were achieved. Normally the solar power to charge the battery is 4 to 5 h enough for 100 percent charging. The solar power available in nature nearly 8 h, therefore the remaining time of solar power also effectively utilizing for charge the electric vehicle as well as grid. In addition, the battery SoC level or charge level, only 40 percent utilized. The remaining

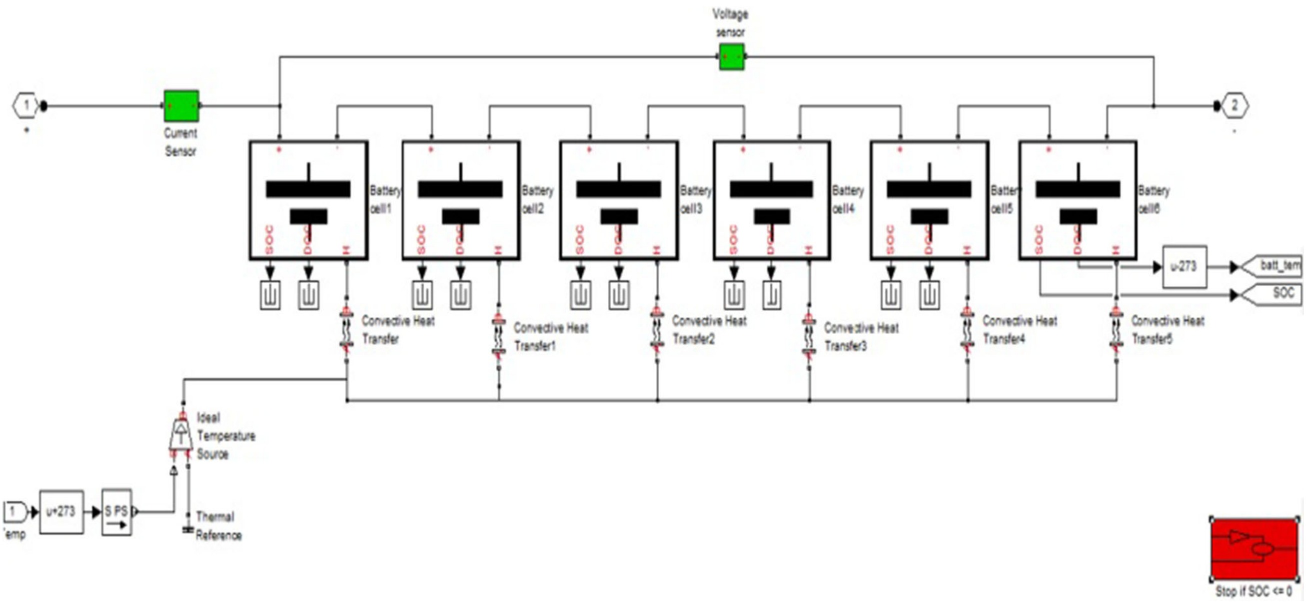


Fig. 11 Battery cell arrangement

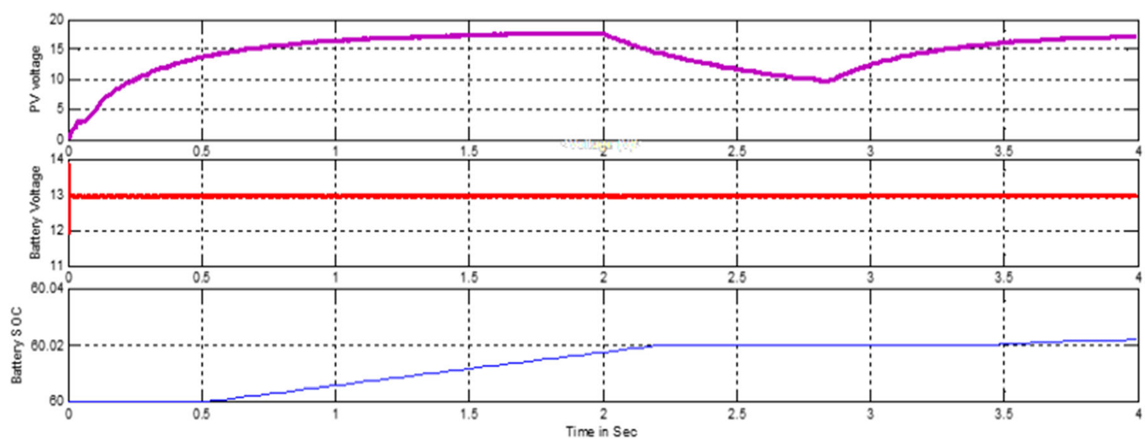


Fig. 12 Charging of battery from Solar Panel

power was stored as reserve, that power can be utilized with effectively and also save the life of battery. In this research, astrological location-based retrofit timer for smart street light is used, in order to reduce the power wastage from existing street light for earlier light glow and delayed light off.

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IoT Enabled Drip Irrigation System with Weather Forecasting

S.Divyapriya[1] , R.Vijayakumar[2] Dr.M.Siva Ramkumar[1] Dr.A.Amudha[1],P.Nagaveni[1]
Dr.G.Emayavaramban, [1] Dr. Viyathukattuva Mansoor[1],
[1,2]Department of Electrical and Electronics Engineering,
[1]Karpagam Academy of Higher Education,
[2]SNS College of Technology
*divyapriyaeee@gmail.com

Abstract: The requirement for astute cultivating particularly in creating nations like Indiahas developed to a more noteworthy degree. Additionally, investigate in IoT based remotesensor organizing agribusiness, for example, observing of ecological conditions liketemperature, Humidity of encompassing and soil dampness and so on. The reason forproposed framework is to enhance the water system arrangement of Indian horticultureand furthermore to give sufficient to water system to specific regionnow a days eachframework iscomputerized keeping in mind the end goal to confront new difficulties in thepresent days mechanized framework have less manual operation, adaptability, unwaveringquality and exactness. Because of this request each field incline toward mechanized controlframeworks.

Keywords: IoT, Wi-Fi, Arduino Mega 2560, ATmega 328, Soil Sensor

I.INTRODUCTION

Water scarcity plays a major barrier for developing agricultural sector. Each nation ranked by their agricultural growth. In agricultural field water consumption is main thing. In Figure 1 shows that the prediction of rainfall for 2017 to 2030. This rainfall prediction will help the farmers to develop their agriculture. But nowadays due to greenhouse effect, river dryness, high temperature, global warming and other reasons the climate was changes. This climate change leads to change the regular climatic rainfall. The ground water level based on climatic rainfall reflects. In survey says that 20 to 25 percent of water was wasted due to pipe leakage and theft. For example Delhi state alone wasted 40 percent of utilization of water.

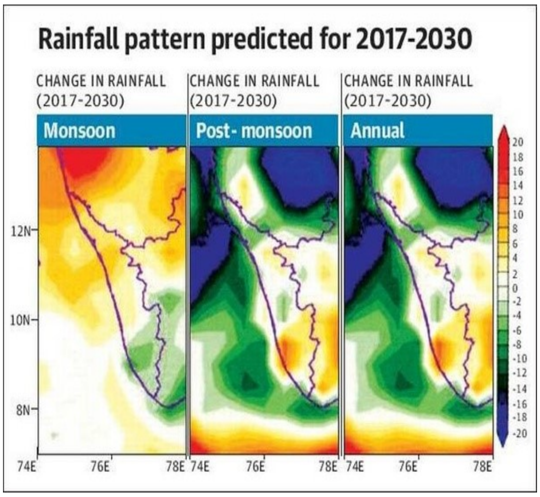

Figure 1 prediction of rainfall pattern

Figure 2 says that the water utilization chart from global level.in global level 70 percent of water is utilized by the agriculture. 80 percent of water is utilized for agriculture in India.

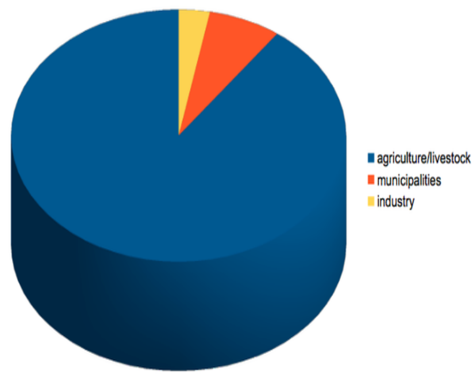

Figure 2Water utilization chart

Flood irrigation, water wastage and improper river management system leads to water scarcity. Figure 3 shows that the waterless countries in global wise. India consumes 19.33 percent of water, it shows major utilization. Source by state of world’s water 2018 report.

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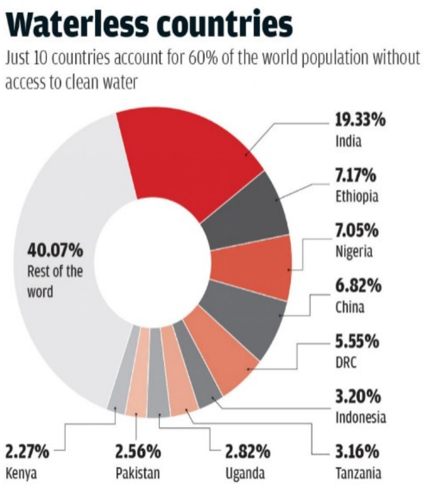

Figure 3Waterless countries pi chart

Figure 4 shows that the fall in ground water level by state wise due to the above reasons.

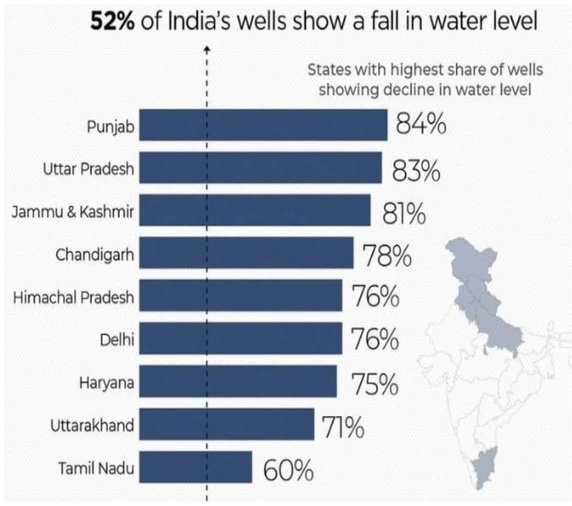

Figure 4Fall in ground water level

Many states struggling to get proper yield by availability of water. At the starting monsoon time the farmers are start to yield. At the end of yield time due to water scarcity they are fail to get proper result. Many farmers are spending more money for buying water. Some of the case farmers are buying water from external vendors and irrigating their fields, on the same day if any natural effects occur means it will lead to damage.

II.PROPOSED SYSTEM

In proposed system contains smart transmitter and receiver module, both the modules are wirelessly connected and consume low power rating.

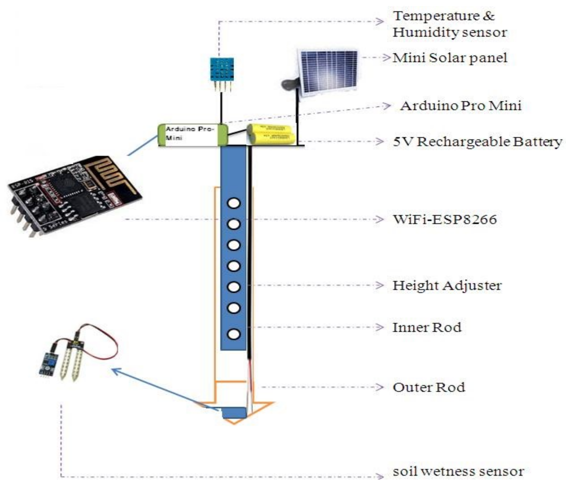

Figure 5Transmitter unit

In figure 5 shows that the proposed transmitter system. It was powered only 5V Li-ion battery which is charging by solar panel. Transmitter unit consist of esp8266 module or node MCU for wireless connectivity and also it can connected with internet of things. The height adjuster will help to increase or decrease the height of module. The humidity and temperature sensor will sense the climate temperature and humidity. In addition that anemometer will help to detect the wind velocity of air. All the data's stored in cloud or node MCU internal memory.

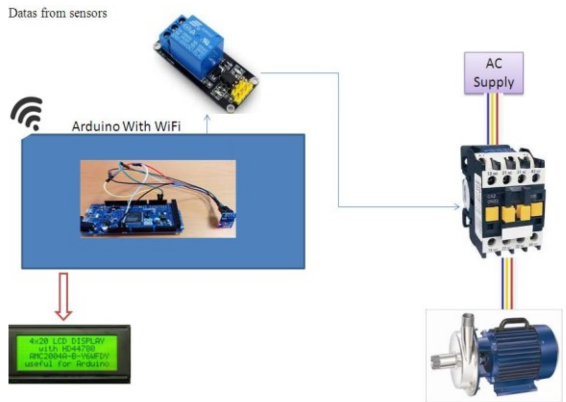

Figure 6Receiver unit

In figure 6 shows that the receiver module of proposed system. In receiver unit also contains microcontroller with ESP8266 slave unit or Node MCU. The output is drive by relay driver module, in relay driver transistor will drive the relay. The contactor connected with Direct Online Starter.

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Figure 7IoT View

The figure 7 shows that the overall operation of block diagram. In that block diagram transmitter unit transmit the all data to cloud or else user's mobile phone. The receiver unit also get the data from cloud or else manual mode by switch or mobile. The virtual cloud collect all the data and compare with previous year data and give better solution to customer.

Figure 8Top view of proposed system

In figure 8 shows that the proposed system of transmitter unit. It contains 50W solar panel for charge the unit, LCD for view some parameters. In figure 9 shows that the inner parts of transmitter unit with Li-ion battery unit, charge controller and soil moisture sensor unit.

Figure 9 Transmitter system with sensing unit

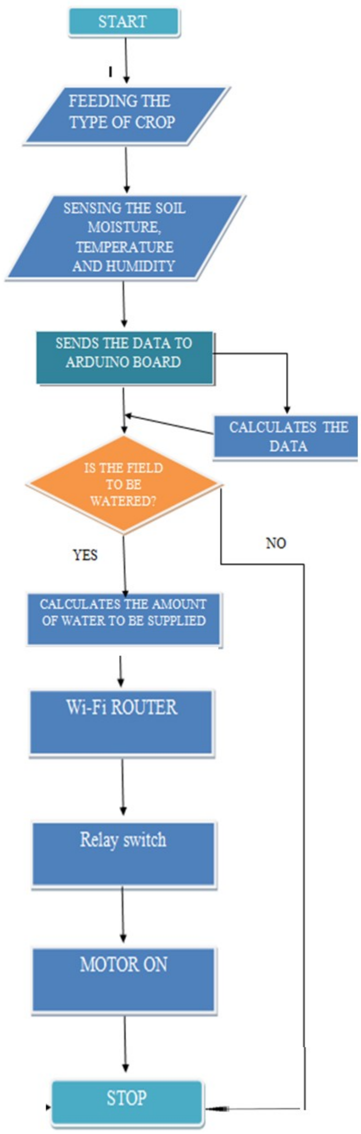

Figure 10.Flowchart for proposed system

In figure 10 shows that the flowchart of proposed system.

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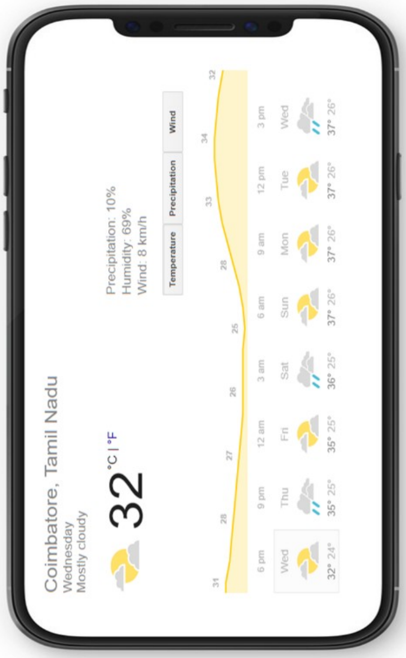

Figure 11Proposed Output

CONCLUSION

This venture can be utilized to water the field consistently and accurately when there is water required. Since it is connected to the Wi-Fi the datas can be seen at any time by connecting it to the Wi-Fi module and it can be monitored at any time with out going to the spot or field. It can likewise ration the water and stay away from over watering the products. This can prompt the creation of good quality products and also the water can be saved. The field can be watered equitably.

FUTURE WORK

This work can be further developed by linking with the IoT.The data logging technique can also be used to develop the project, by implementing this techniques the watering and the condition of the soil and plants can be monitored from anywhere with the help of the unique IP address generated.

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2018 International Conference on Soft-computing and Network Security (ICSNS)

Plug-in Electric Vehicle Supported DVR for Fault Mitigation and Uninterrupted Power Supply in Distribution System

M.Poornima
poorni3710@gmail.com
Department of Electrical and Electronics Engg.
SNS College of Technology
Coimbatore, India

S.Bharath
bharathbhadri@gmail.com
Department of Electrical and Electronics Engg.
SNS College of Technology
Coimbatore, India

S.Divyapriya
divyapriyaeee@gmail.com
Department of Electrical and Electronics Engg.
Karpagam academy of Higher education
Coimbatore, India

R.Vijayakumar
r.vijayakumarpse@gmail.com
Department of Electrical and Electronics Engg.
SNS College of Technology
Coimbatore, India

Abstract- -- **Now a days the electric vehicles usages is gaining popularity because of the pollution caused by existing and conventional IC engines. Electric vehicle integration to the distribution grid is increased at a faster rate because it can act as power backup to the grid. Thereby reducing the peak load and filling the valley point. This paper proposes the power backup of EV is utilized as an UPS to Software Company as well as used to support the Dynamic Voltage Restorer (DVR) to mitigate the fault occurring in the distribution system. It is known that most of the software engineers own a Electric car. The Batteries in the car is connected to the charging point (or) grid with monitoring of State of Charging (SOC) facilities in the parking area of company. When the Renewable power (solar energy) is available, the batteries will be charged to hundred percentage of SOC. Then excess power from PV will connected to load as well as grid. When the electrical power supply cutoff the car batteries will act as a battery bank of UPS and support to the critical load with condition based Allowable SOC. The total capacity of the batteries depends upon the no of cars available at a particular shift in a day. The entire system is modeled using MATLAB SIMULINK, the real time controllers are done by Raspberry pi development board and the results prove the feasibility of the proposed idea.**

Keywords: Plug in Electric Vehicles, DVR,PV,UPS

I. INTRODUCTION

In current situation, the worries about high fuel utilization, air pollution and vitality security are continue to rouse us to scan elective answer for the transportation. The arrangement is discovered that the execution and large scale manufacturing of Fuel Cell Electric Vehicles (FCEVs) are troublesome as a result of high cost and other inherent issues. Internal combustion engine with hybrid source vehicles can give incomplete response to these issues. The Plug-in Electric vehicles (PEVs) which are fueled by outside vitality source [1]. Comparing PEVs with Internal Combustion (IC) engine driven vehicles, the PEVs create zero discharge, have high vitality proficiency, low clamor level and clean energies can be utilized as source to charge the batteries of PEVs. With these points of interest PEVs are emerging as an answer for pollution caused by customary transportation. In any case, substantial reception of PEVs devour high power from the network to charge extensive number of PEVs. It will strain the general existing force system past its ability [2].

The interest for charging system, incorporating charging stations in parking structures also, carports is more basic as the EVs out and about. For long detachment laborers, an open charging station may be a fundamental essential to ensure the ability to finish the round trek furthermore, influence it to home. While charging isn't basic, various EV drivers may plug in to condense the charge release cycle and decline battery wear. A deficiency of charging stations may make EVs less supportive and add to expand apprehension bringing about less individuals grasping the usage of electric vehicles. Also, if charging system is available at work, tinier batteries and along these lines more moderate vehicles are required to address customer's issues [3]. Past the physical nearness of charging stations, a couple of fundamental needs ought to be filled to deal with the expanding interest for charging system, including as far as possible and the electrical circuits that make charging possible. One plan is charging stations that administration diverse vehicle in the interim with a given system. Various parts of the establishment ought to be shared all together for a charging station to truly profit different vehicles at a similar time. The charging system needs to share the interface port by safely stopping to different vehicles immediately, it needs to share the circuit by apportioning the open energy to not over-load the circuit, and it needs to share as far as possible by acutely booking charging keeping in mind the ultimate objective to maintain a key remove from peak use. To deal with this request, an EV charging system has been created that safely increase the amount of EVs that can be related with a circuit by proportioning the power assigned to each EV [4].

Power systems have been encountering great changes in electric power generations, transmissions, and distributions. For electrical load development and higher power transfer in a to a great extent interconnected system prompt perplexing and less secure power system operation. Power system engineers confronting challenges look for answers for work the system

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in increasingly an adaptable and controllable way. So part of energy storage devices assume critical part as Energy storage seems, by all accounts, to be valuable to utilities since it can decouple the immediate adjusting amongst supply and demand. Accordingly expanded resource usage is permitted, that encourages the renewable sources entrance and enhances the adaptability, unwavering quality and proficiency of the grid long and short-duration voltage variations by sudden increments in loads, for example, blames or short circuits, beginning of motors, or turning on of electric heaters or they are caused by unexpected source impedance is increment, which are caused by a free association. Power quality issues are separated into two classifications voltage quality and frequency quality. Voltage quality issues are connected with voltage sag, voltage swell, under voltage and over voltage while frequency quality issues are connected with harmonics and transients. A standout amongst the most basic power quality issues is voltage sag which is happen because of its usage of voltage sensitive devices [5].

Energy storage devices can be ordered into two diff classes, contingent on their application: short term response energy storage devices and long-term response energy storage devices. Short term response energy devices which incorporate flywheel, super capacitor, SMES though long term response energy storage devices incorporate compress air, hydrogen fuel cell, batteries, Redox flow. Here we are more worry with short term response energy devices. For Long and Short-Duration Voltage Variations remuneration, the DVR which goes about as arrangement associated topology is a more practical arrangement [6][7].

All primary AC power sources encounter states of voltage transients amid clearing of faulty load hardware, when high inrush currents are drawn as load gear is placed on the power line, when energy is bolstered back to the power line or amid failure of the power feeder lines. Expansive negative transients or power dropouts can last as meager as one-half cycle of the primary AC power or insofar as seconds to minutes, before an optional, standby, AC power source can be activated , or notwithstanding for a considerable length of time, where the primary AC power source gear must be adjusted a t a remote area . There are two essential classifications of power supplies for critical loads: "Crisis Power with Time Limited Voltage Dropout" where transitory dropouts in the request of seconds or minutes are permitted and "Uninterrupted Power with Controlled Voltage Transients" where the yield voltage is never permitted to stray from a predefined direction band.

In the main classification fall correspondence, therapeutic, and mechanical handling load hardware where transient dropouts won't create any breakdowns. In the second classification fall PC correspondence and life bolster applications where flitting power dropouts or out-of-resistance power supply voltages can cause loss of information, wrong in information and loss of life. In software industry the Uninterrupted Power Supply is more important. The proposed system ensures the uninterrupted power to the software company by meeting the demand with PV system as well as Electric vehicle during the interruption in power grid. Supply of power from the Electric Vehicle to grid is known as vehicle to grid technology which is depicted in [8].

II. PLUG-IN ELECTRIC VEHICLE WITH PV

In few cases, makers have proposed embedding a DC/DC battery charger at the dc association of the grid related PV structure. By estimating the power made by the PV and the power demand of the PEV, the control estimation ensures the charging of the PEV battery from the best possible source. In perspective of the inconsistency between the PV control what's more, the store ask for, various possible circumstances are portrayed. In the event that there ought to emerge an event of, the power stream in a PV stopping territory is regulated through a game plan of PC controlled exchanges. PV sheets of different assessments are interfaced with PEV chargers and the power arrange through PC controlled exchanges. Dependent upon the light levels, the exchanges direct the entire PV energy to the PEVs or the grid or both. A couple of PV sheets are interfaced with the dc transport through a course of action of DC/DC converters. The DC/DC converter splendidly controls the power stream to the PEVs in perspective of a particular preset points of repression of the dc transport voltage. In light of beyond what many would consider possible the imperativeness change unit energizes three way essentialness stream among the power arrange, PV modules and PEVs. The possibility of dc transport hailing has been proposed by a couple of makers to design energy to dc stacks in a micro grid. Possibly several they have extended this plan to charge PEVs in a micro grid area. The splendid charging station can work in free mode and system related mode. The trading between various modes is energized by the assortment in dc interface voltage levels incited as a result of the adjustment in sun situated protection. In the midst of the season of low sun based protection and zenith stack on course transformer, the controller moves the charging of PEVs to non-top period. The proposed control figuring is clear as it incorporates only a single parameter i.e. dc associate voltage to bargain with the course of energy stream in the charging station. It empowers the charging of PEVs using slightest imperativeness from the grid with no hostile impacts on the spread transformer. The going with zones clear up the possibility of dc interface voltage recognizing and its application for control and organization of PV controlled charging workplaces. a couple strings of PV sheets interfaced to their own particular DC/DC converters which share a commonplace dc transport.

The DC/DC converter plays out the limit of Maximum Power Point Tracking (MPPT) toward energize the operation of PV board and no more extraordinary power point. The essentialness Energy Storage Unit (ESU) is related with the dc transport by implies of a bi-directional DC/DC buck-help converter. The ESU will support the charging of PEVs when there is no power available either from the cross section or the PV. The battery pack in the ESU can be charged either from the lattice in the midst of off zenith hours or from the PV after all the PEVs have been charged in the charging office. DC/DC buck converter related with the dc transport controls the charging of the PEV. The control portrayal showed up for the charging relies upon the essentials for PEVs. Different PEVs can be charged by having separate buck converters presented for each charging point. The charging office is related with the power allocation orchestrate through a DC/AC bi-directional

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system tied converter. The control unit screens and controls the power stream between the source and PEV. The control unit creates the changing signs to control the distinctive power converters in the charging in light of the voltage and current regards identified by the voltage and current identifying units. VPV, voltage over the PV exhibit and IPV, the present spilling out of the PV bunch are used to execute MPPT by techniques for incremental conductance estimation.

III. DYNAMIC VOLTAGE RESTORER

The series controllers for control of the principal voltage are named as a series connected PWM regulator in, a static series regulator in and, however for the most part the devices are named dynamic voltage restorers. On the off chance that the gadget just injects reactive power the gadget can be named as series var compensators. Taking the same rearranged model of supply and load, yet now with a series controller embedded to support the load. A 0.5 pu voltage sag can by a series gadget be reestablished by a 0.5 pu DVR and just 0.5pu of the energy absorbed by the load must be provided by the DVR. The supply keeps on being connected and no resynchronization is essential as it is the situation with a shunt connected converter. The series voltage controller is connected in series with the protected load. Normally the association is made through a transformer, yet designs with coordinate association by means of power electronics likewise exist. The subsequent voltage at the load bus bar squares with the aggregate of the grid voltage and the injected voltage from the DVR. The converter generates the reactive power required while the active power is taken from the energy storage. The energy storage can be unique contingent upon the requirements of compensating. The DVR frequently has impediments on the profundity and duration of the voltage sag that it can adjust. Accordingly right estimated must be utilized as a part of request to accomplish the wanted assurance. Alternatives accessible for energy storage amid voltage sags are regular capacitors for brief duration yet profound, batteries for more however less extreme size drops and super capacitors in the middle. There are additionally different mixes and setups conceivable.

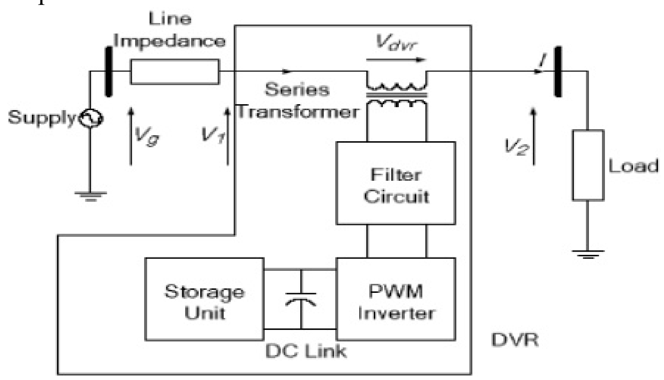

Figure 1 Schematic diagram of DVR

Dynamic voltage restorer (DVR) shields the load from voltage disturbances. DVR keeps up the load voltage at a foreordained level amid any source voltage strange conditions, for example, voltage sags/swells or distortion. The working rule of the DVR can be clarified through the figure 1. Under ordinary working conditions, let the three phase voltage phasors Va1, Vb1 and Vc1. Amid anomalous conditions, the phase voltage vectors might be adjusted to Va2, Vb2 and Vc2. DVR does not supply any real power in the relentless state. This infers that the phase angle contrast between DVR voltage phasor also, current phasor must be 90 in the enduring state.

DVR injects the required compensating voltage through transformer. The transformer is connected in series to the load. DVR works just amid the irregular conditions and stays sit still amid ordinary working conditions. Amid operation, DVR has an ability to supply and absorb active and reactive power. Dynamic voltage restorer redresses the load voltage by supplying reactive power created inside other event of small fault. DVR creates active power when it is required to adjust bigger faults. It requires dc energy gadget to build up the active power. As a rule, dc capacitor banks are utilized as the dc energy storage gadget, the proposed system utilizes PV system. Frequently caused voltage disturbances are voltage sags as they can cause load stumbling. Dynamic voltage restorer (DVR) is a series controller connected in series to the load. DVR injects voltage in series to the load through the infusion transformer furthermore, voltage source converter. The infusing transformer injects the required voltage vector (greatness and angle) which adds to the source voltage to reestablish the load voltage to pre-irregular condition.

IV. UPS AND EV SUPPORTED DVR

UPS or an Uninterruptible Power Supply is a device which quickly gives reinforcement power amid power failure. An UPS is regularly utilized for computers or different gadgets, for example, networking gear. This will enable the clients to spare everything to maintain a strategic distance from data loss and appropriately close the PC down. It is extremely an unquestionable requirement to have an UPS for software companies keeping in mind the end goal to forestall downtime. This is likewise used to avoid harms to hardware and gadgets particularly with electric vacillations. This crisis power is relies upon the size of the UPS and its current load.It is very costly also difficult to maintain the batteries of the UPS. It need more space to accommodate the batteries. In order to overcome this issue in proposed system the Electric Vehicles parked in the parking are of the company is used as an UPS during power failure.

Most of the employs will own the Electric Vehicle. To charge those vehicle the need of power from will increase. It will produce more stress in grid. To overcome this issue, the alternative source should be used to supply power to charging station. The renewable energy is the great alternative to the conventional energy sources. In proposed system the company owned roof top solar energy is taken to supply the power to its charging station.

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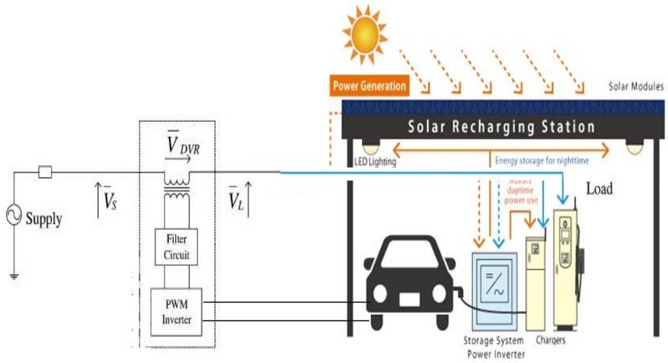

Figure 2 Schematic diagram of the proposed system

When the company is working with the power from the the grid the quality of power is very essential to ensure the safety of the electronic devices and equipment. Because the electronic components are easily affected by small voltage fluctuations. The faults occurring in the distribution system will fluctuates the voltage. The voltage is the most common power quality problem in distribution system. To compensate the voltage sag, required amount of voltage should be injected in series with the grid voltage. For this purposes the one of the custom power device Dynamic Voltage Restorer is used in series with the grid which restores the voltage. The DVR need DC energy source or Energy storage device to compensate the voltage fluctuation. The solar energy available in the company. The schematic diagram of this proposed system is shown in figure 2.

The simulation diagram of the PV system is shown in figure 3 and the output voltage of the PV system is shown in figure 4 as waveform.

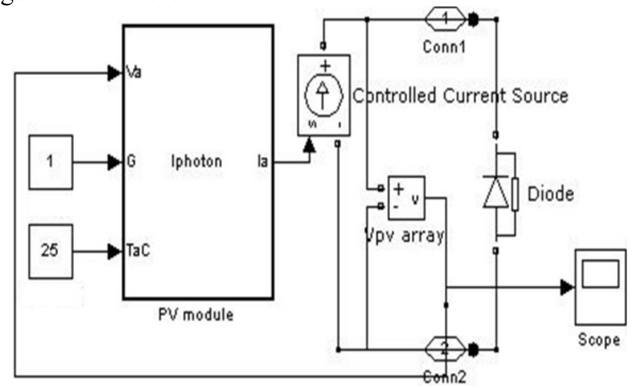

Figure 3 Simulation diagram of the PV system

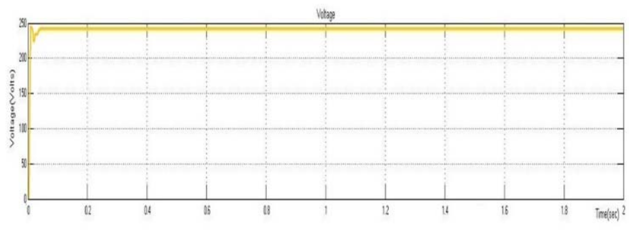

Figure 4 Output voltage of PV system

The controller designed to control the proposed system which is designed in simulation software is shown in figure 5.

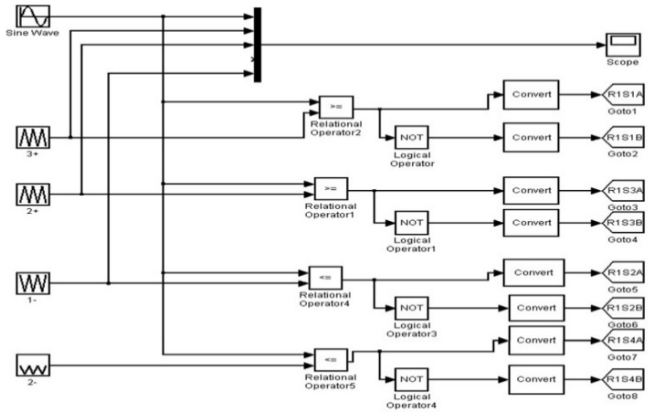

Figure 5 Simulation of Controller

Working of DVR is evident by the simulation results shown in the figures. The voltage sag occurred due to single phase fault during the period 0.3sec to 0.5sec is shown in figure 6. The distribution voltage after the compensation is shown in figure 7. It takes a very small time to sense the fault.

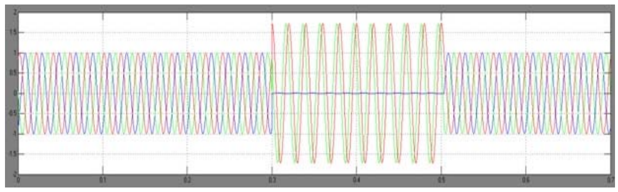

Figure 6 Single phase fault

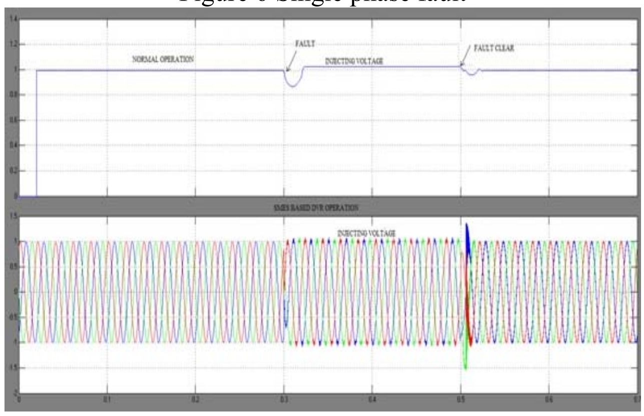

Figure 7 Distribution voltage after compensation

The quality of the power is very important in the software company. TO ensure the quality of the power the THD analysis is carried out for voltage and current at load terminal is 11.24% and 4.24% respectively. The THD analysis of voltage is shown in figure 8 and the THD of current is shown in figure 9.

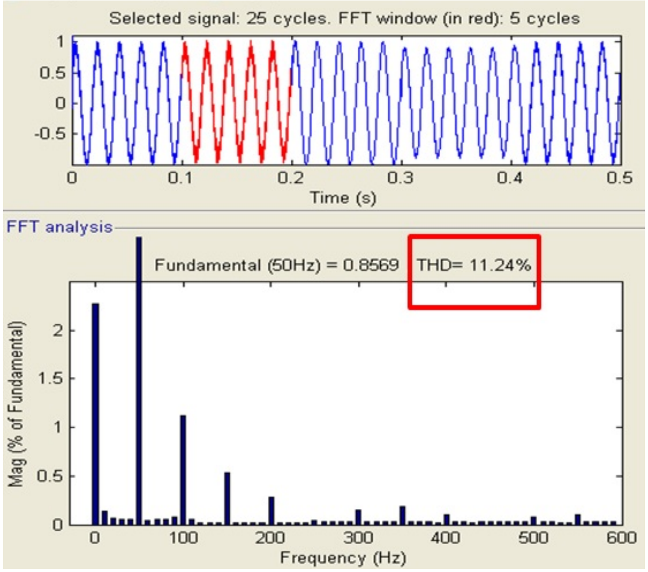

Figure 8. THD analysis of voltage at load terminal

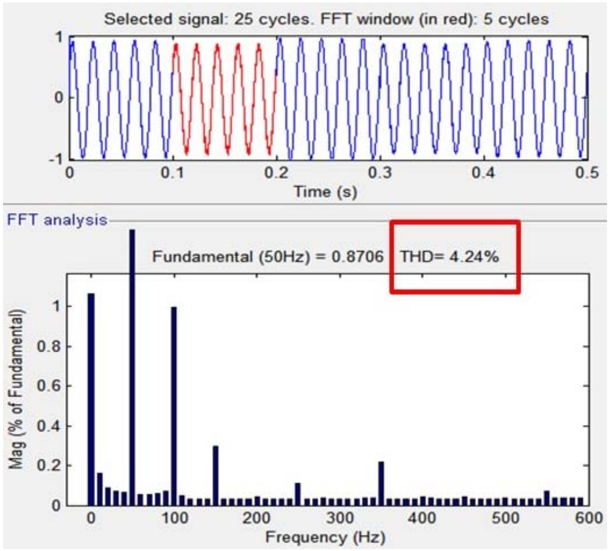

Figure 9 THD analysis of current at load terminal

V. CONCLUSION

Increase in use of conventional vehicles increases the air pollution. The alternate to this issue is Electric Vehicle which emerging now a days. It is used as an UPS to reduce the maintenance and cost barrier of the software company with conventional batteries. For the emerging EVs the charging station is one of the issue. It can overcome with the renewable energy source as power supply to the station. In proposed system PV is used as a power supply to the charging station. The quality of the power is endured with the Electric Vehicle supported Dynamic Voltage Restorer. Thus the proposed system was analysed in MATLB Simulink software.

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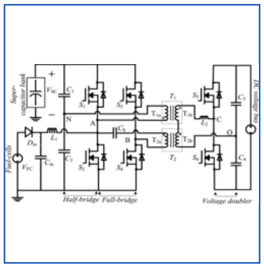

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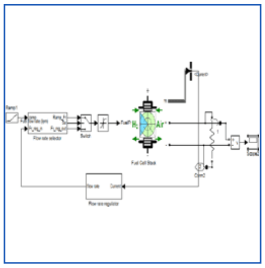

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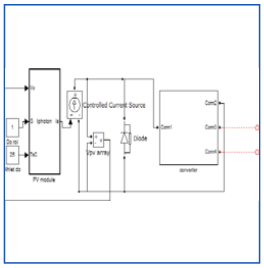

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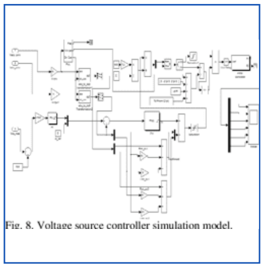

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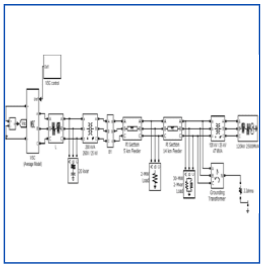

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AUTOMATED ATTENDANCE SYSTEM WITH FACE RECOGNITION

Akash Singh
SCSE, Integrated BCA + MCA
Galgotias University
Greater Noida, India

Shreya Bhatt
SCSE, Integrated BCA + MCA
Galgotias University
Greater Noida, India

Abhishek Gupta
SCSE, BCA
Galgotias University
Greater Noida, India

Abstract: **Face is the representation of one's identity. So, we have prepared an automated student attendance system based on face recognition. This system is very useful in daily life applications especially in security and surveillance systems. The security systems on airport uses face recognition to identify suspects and the CBI (CentralBureau of Investigation) and FBI (Federal Bureau of Investigation) uses face recognition for criminal investigations. In our project also video framing is performed by accessing the camera through user friendly interface. The Face is detected and segmented from the video frame by using HOG (Histogram of Oriented Gradient) algorithm.**

In the first step or we can say in pre-processing stage, scaling of the size of the image is performed in order to prevent or reduce the loss of information.

Then in next step, the 'median filtering' is applied to remove noise followed by the conversion of colour imageinto grayscale image.

After that, CLAHE (Contrast Limited Adaptive Histogram Equation) is applied on the images to enhance the contrastof the image.

Overall, we have created a program in python that take theimage from the database and make all the necessary conversions for recognition and then verifies the image in the videos or in the real time by accessing the camera through user friendly interface. After the successful match is found then it marks the name and time of the person in attendance sheet.

Keywords: Face Detection, Face Recognition, Attendanceautomation.

I. INTRODUCTION

There are various software's or technologies are so advanced that even blurred images are sometimes rendered enough and investigated to know the personalityof the individual.

What is Face Recognition?

Facial recognition technology is a framework or software which is capable enough to verify the identity of an individual by analysing a picture or video footage.

The main objective of this project is to make face recognition based automated attendance system. In order to obtain better performance, the test images and training images of this project is limited to frontal and upright facial images which consists of single face only.

Both the test and the training images have to be captured through the same device to ensure no quality difference or if possible, the owner or the person having the rights to access the database can add the images of high quality captured from high quality camera and later on add that image to the database, but as I have mentioned only the administrator or the person having the rights to access database can only enrol or remove the students or faculty data from it.

In addition, the students have to register in the database to be recognised. The registration can be done by the IT cellor from the admission office.

II. REAL TIME IMPLEMENTATION:

The human face is a unique representation of individual's identity. Thus, the face recognition is a type of biometric method through which identification of an individual is performed by comparing the real time captured image withthe stored images of that person in the database.

Currently, Facial Recognition System is widely spread due to its simplicity and fast performance. Some examples that represent implementation of this system are,the airport protection system and the FBI that uses face recognition system for criminal investigations by tracking suspects, missing children's etc. On the other side, Facebook a popular social media site implements face recognition that allows the users to tag their friends in the photos for entertainment purpose. Apple allows users to unlock their mobile phones by face recognition.

III. PROBLEM STATEMENT:

1.1. Existing Attendance System:

Currently manual student attendance marking technique is often facing a lot issues and a very slow process. Teacher's or faculty calling names of student from their data sheet and student responding to them. But this existing process becomes very complex in large classes that consists so many students. Many times, students also mark proxies by responding to fake name. This makes disturbance in class and distracts the students during the exam times.

Also, verifying the total students present by counting them after attendance, which takes a lot of time consuming. Apart from calling names attendance sheet is passed around classroom during lectures especially the classes consisting large number of students might find it hard to have attendance sheet being passed around the class.

Douglas Ahlers, Bernie DiDario, Michael Dobson, in 2006 gave the concept of attendance tracking system. This framework consists of identity tags, with wireless communication capabilities, for each attendee and the scanners for detecting the attendee's tags as they enter in that allocated room.

O.A. Idowu and O. Shoewu: Development of Attendance Management System by using Biometrics. Attendance is taken with the help of a finger print device and the records of attendance are stored in the database. Attendance is marked after successful identification.

1.2. Proposed Automated Attendance System:

The face recognition student attendance system emphasizes its simplicity by removing classical attendance marking technique such as calling the studentsname or checking their respective ID Cards.

Thus, attendance system through facial recognition is proposed in order to replace the manual marking of student's attendance.

Furthermore, the automated attendance system based on face recognition is able to overcome the problems of fraudulent approach and faculty does not have to count thenumber of students several time to verify the presence of students.

The proposed framework uses OpenCV library. It is an Open-Source Computer Vision Library that is free for both scholastic and business use. It has python, and PyQt interfaces and supports various platforms like Windows, Linux, MacOS. It has a strong focus on real time application. The library has more than 2500 improved algorithms, these algorithms can be utilized to detect and recognize faces, objects, and so forth OpenCV has a FaceRecognizer class library for face recognition. This recognizes and controls faces from Python or from the command line. It is a basic library constructed using dlib's cutting edge face recognition built with deep learning. The Dlib is a cross-stage open-source software library that is executed on various computing platform. The model has a precision of 99.38%. This provides a basic face recognition tool that allows you to perform face recognition on folder of pictures from the command line.

IV. AIMS AND OBJECTIVES:

The objective of this project is to design an automated attendance system based on face recognition. Some expected steps in order to fulfill the objectives are as follows:

- To identify the face segment from the video frame.
- To extract the useful features from the identified face.
- To classify the features in order to recognize the identified face.
- To record the attendance of the identified students.

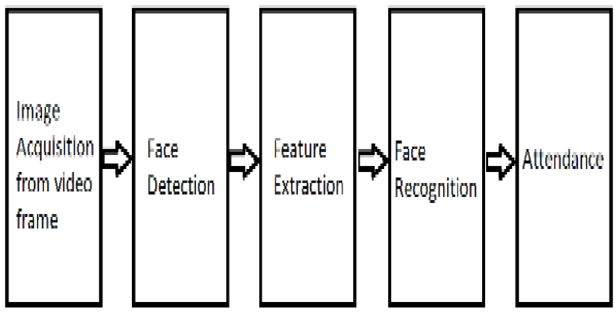

Figure: Block Diagram of the General Framework

V. LITERATURE REVIEW:

1.3. Student Attendance System with face recognition:

Face recognition-based attendance system proposes that the system is based on face detection and recognition algorithms, which automatically detects and recognizes the face and when student enters the class. There are various algorithms which have been made to detect the human face. When it is compared to existing attendance marking technique this system is much accurate and less time consuming.

There are various biometric systems developed for various cause. Some of them are Radio frequency Identification (RFID) card system, Fingerprint system, iris recognition system, Voice recognition system.

RFID card system is used due to its simplicity. However, it can be used for attendance system because it has a silicon microchip in which the student data is stored. It can be encapsulated within any object. The user tends to checkin as long as they have their friend's ID card.

Fingerprint System is truly effective but not much efficient as it's more time consuming for verification process due to which everyone has to line up and check infor verification one by one.

Iris recognition system which stores more detail might capture the privacy of the user.

Voice recognition is also available, but its less accurate compared to other techniques.

Hence, Face recognition system should be implemented for the student attendance system.

Let's compare various biometric systems and to knowtheir advantages and disadvantages.

6.2. Non- Functional Requirements:

Non-functional requirements are qualities or traits of the framework that can pass judgment on its activity. The following point explains them:

- **Accuracy and Precision:** the framework should perform its process in accuracy and Precision in order to avoid problems.
- **Security:** For saving the student's privacy, the framework should be secure as data privacyplays important role in software development.
- **Modifiability:** the system should be easy to modify, in case any attendance or any record contains wrong or incorrect data can be easily corrected.
- **Usability:** the framework should be easy to deal with and simple to understand.
- **Speed and Responsiveness:** the execution of operations must be fast.

Biometric Type	Advantages	Disadvantage
Radio Frequency Identification (RFID) card system	Simple	Fraudulent Usage
Iris recognitio nsystem	Accurate	Privacy Invasion
Fingerpri nt recognitio nsystem	Accurate	Time Consuming
Voice recognition System	-	Less accurate compared to others

Table: Advantages and disadvantages of variousbiometric system.

VI. REQUIREMENTS:

The prerequisites are the descriptions of the system services and limitations.

1.4. Functional Requirements:

The system functional requirement describes activitiesand services that must provide:

- Tracking and marking student attendance by facial recognition in specific time.
- Allowing the faculty to modify the student absent or late arrivals.
- Showing the names of students with the exact time stamp i.e., exact time of entering the class.

6.3. System Requirement:

There are specific prerequisites for each platform that run applications based on the Face Verification. Minimum requirements that the clients must have in order to run thisprogram and acquire great outcomes are as follows:

- **Hardware Specification:**
  Processor: - 7th generation
  i5.RAM: - Minimum 4
  GB.
  Hard Disk: - Minimum 500
  GB.Camera: - High quality.
- **Software Specification:**
  Platform: - Windows 8 or 10,
  LinuxLanguage Used: - Python
  Frontend tools: - PyCharm IDE, or Visual Studio
  Backend: - Database Directory, Attendance Excel Sheet.

VII. IMPLEMENTATION:

1.5. Front End:

For frontend development, we have used the python language and some of its famous libraries and toolkits thatare explained below:

- **Python:**

Python is an interpreted, high level and general-purpose programming language used all over the world.

I have chosen python language to design this project because of its simplicity and code readability. Whereas, there are various other modules which make it easier for any programmer to develop a software using this language.

- **OpenCV:**

Open-Source Computer Vision Library (OpenCV) is a library of python binding which is designed to solve computer vision problems.

- **PyQt:**

PyQt is a GUI widgets toolkit. It is a Python interface for Qt, which is one of the most powerful, secure and popular cross-platform GUI libraries. PyQt is a combination of Python programming language and Qt library.

- **User Interface after execution of code:**

After execution of program user will have a simple and clean user interface. That contain two buttons, one for initiating face detection and recognition and another button to stop the program.

Figure: User Interface

- **After starting facial recognition:**

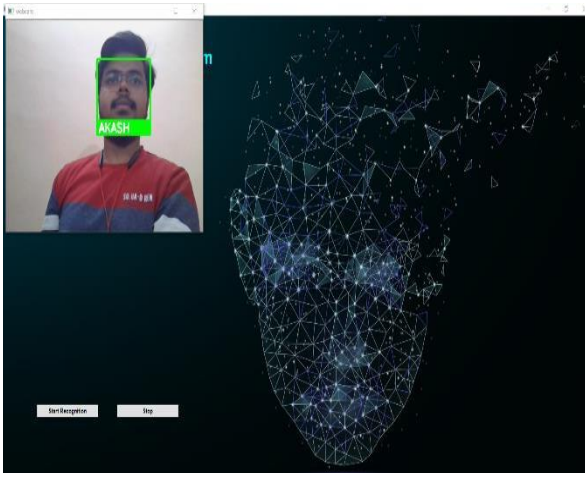

Figure: Face Detection

- **Attendance sheet after successful recognition of face:**

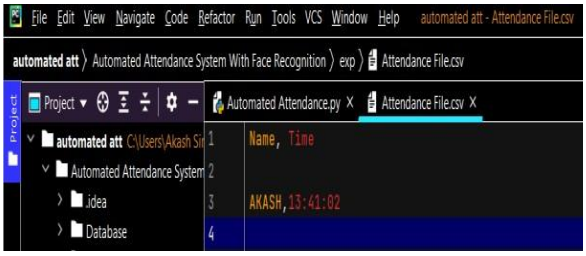

Figure: Attendance Sheet

1.6. Back End:

Moving further, for backend development i.e., for data storage and attendance marking we have used a folder and an excel sheet whose functions are explained below:

- **Dataset:**

Image dataset: Dataset includes pictures or recordings for tasks like face acknowledgment, object detection and so on. So, in the image dataset we have stored the image of the students with their names who are currently enrolled in that particular subject and section. See below figure.

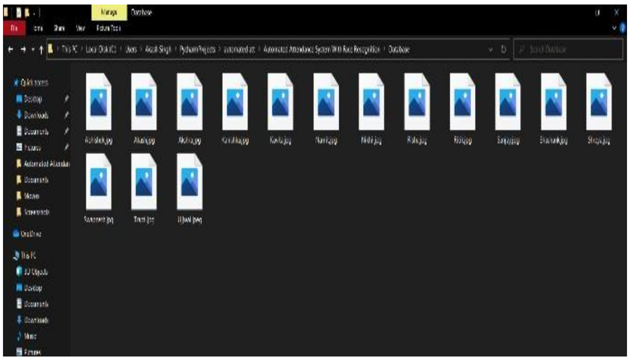

Figure: Image Dataset

- **Attendance File:**

This program marks or store the attendance automatically in a file with **.csv** extension or we can say in excel file. Whenever any student face is recognised, the program marks the attendance of that particular student with propername, date and time in the excel sheet.

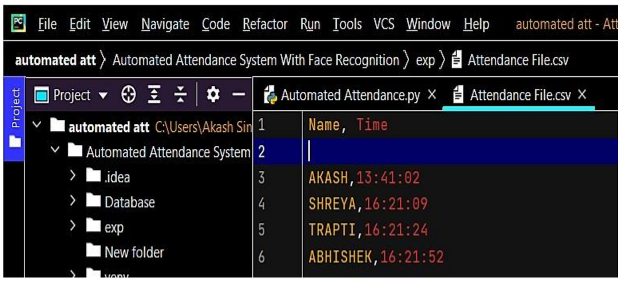

Figure: Attendance File

2. Face Recognition Process:

The following block diagram represents all the processesinvolved in face recognition.

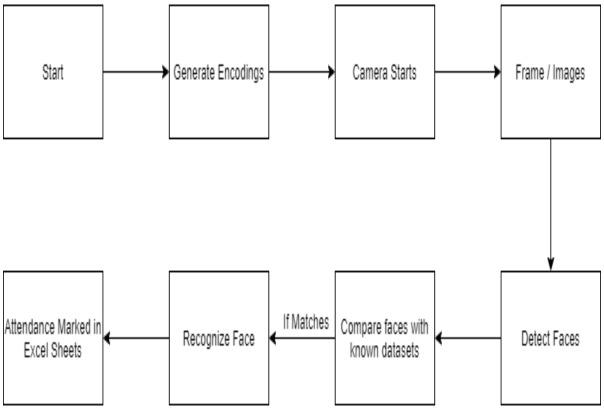

Figure: Block Diagram

- **Face Detection and Extraction:** Face detection is necessary as the image taken through the camera given to the system, face detection algorithm applies to identify the human faces in that image, the number of image processing algorithms are introduced to detect faces in an image and also the location of that detected faces. We have used Histogram of Oriented Gradient method to detect human faces in given image.

Figure: Face Detection

- **Face Positioning:** There are 68 specific locations or we can say there are 68 face landmarks in a human face. The main function performed in this step is to detect landmarks of faces and to position the image. A python script automatically detects the face landmarks and position's the face as much as possible without distorting the picture. Below is our test image to detect landmark of face:

Figure: Test image to detect landmark of face

The basic idea is to detect these 68 specific points (called landmarks) that exist on each face like at the top of the chin, the external edge of each eye, the internal edge of every eyebrow, and so on. At this point we will train our machine learning algorithm to track down these 68 specific points on any face.
Here is the output of our test image for which 68 face landmarks are generated as shown in picture below:

Figure: Landmarks generated for test image

- **Face Encoding:** When the faces are recognized in the given picture, the next stage is to extract the unique identifying facial element for each picture. Fundamentally, at whatever point we get localization of face, the 128 key facial point are extracted for each picture given info which are highly accurate and these 128-d facial points are stored in data file for face acknowledgment. So, all we need to do is to scan our face pictures through their pre-trained network toget the 128-measurement for each face. Here's the estimations for our test picture:

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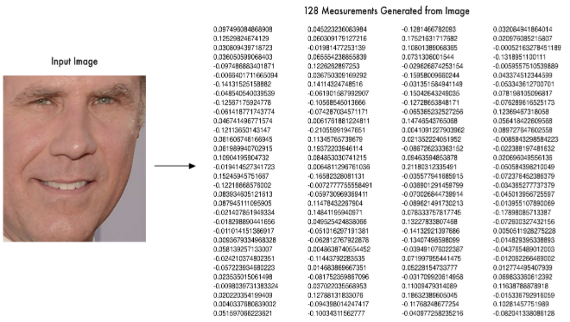

Figure: Encoding our Face Image

- **Face matching:** Our framework ratifies the faces, building the 128-d embedding (ratification) for each. Inside face comparison function is used to calculate the Euclidean distance between face in picture and all appearances in the dataset. If the current image is matched at least 60% with the current dataset, it willmove to attendance marking.
- **Attendance Marking:** Once the face is identifiedwith image stored in the database file, python automatically marks the attendance of the students present at that time. When the data is returned the system generates attendance table which includes the name, date, day and time and then the data is stored into the excel sheet automatically.

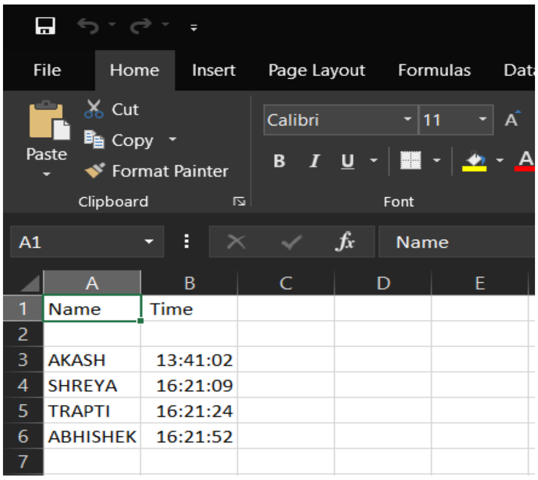

Figure: Attendance Sheet

3. System Privilege:

Our system provides various functionalities at organizational level's:

1. **Functionalities at student level:**
   - Students can only view their attendance.

2. **Functionalities at faculty / lecturer's level:**

The following are the privileges of the lecturer:

- Start the attendance.
- View the attendance.
- Retrieve queries.
- Can manually update the attendance sheet.

3. **Functionalities at administrator's level:** The following are the privileges of administrator:

- View attendance.
- Retrieve queries.
- Register new students.
- Control over the system.
- Access to modify /update the database.

VIII. DISCUSSION AND EXPLANATION:

Under this topic we would see how this project works, requirements of modules, how the data set is created, face being recognised and how the marking of attendance takesplace. As our project is still on going so there can be various issues and bugs. So, keeping that aside let's see what are the process going on in this project.

Hoping that python being installed on the system, first you have to import all the required modules like "cv2" from OpenCV, face recognition module, "os" module, NumPy and Datetime module, let me explain a little bit about thesemodules.

- **OpenCV*:***

  It stands for Open-Source Computer Vision library, which was developed by intel. This library is cross platform and is free for use under the open-source Apache 2 license. This library mainly focuses at real time computer vision and features GPU acceleration for the real time operations.

- **CV2:** It was the old interface in old OpenCV versions named as "cv". The OpenCV developers had chosen the name "cv2" when they had createdthe binding generators.

- **Face Recognition Module:** This module recognizes and manipulate faces through Python or through the command line. It was build using dlib's state of the art face recognition build with deep learning. This model has an accuracy of 99.38% on the "labeled faces in the wild" benchmark. Where the "Labeled Faces in the Wild" is a public benchmark for face verification, also called as pairmatching.

- **"Dlib" library:** It is a general-purpose crossplatform software library developed in C++. It's a cutting-edge toolbox in C++ that incorporates different AI algorithms and tools for creating complex software programs to solve real world problem.

- **"OS" Module:** The OS module in python provides the facilities to establish a link between the user and the operating system. It has various useful OS functions that are used to perform OS- based tasks and get all the related information about the operating system.

- **NumPy Module:** It's a python package that stands for "Numerical Python". NumPy is a library that contains multidimensional array/cluster objects and the records for processing of arrays. Using NumPy a developer can also performs logical and mathematical operations on arrays and many more operations.

- **Datetime Module:** This module supply classes for manipulating dates and time or through this module a user can include current date and time intheir program.
- **PyQt5 Module:** This is a complete set of Python bindings for Qt v5. Because of the tools and simplicity provided by this library anyone can design an interactive desktop application with so much ease.

IX. FUTURE SCOPE:

Practically all academic institutions require attendance record of students and maintaining attendance physically can be hectic as well as time consuming task. Hence maintaining attendance automatically with the help of face recognition will be exceptionally useful and less prone to mistakes or errors as compared to manual procedure. This will also reduce the manipulation of attendance record done by students and reduces time consumption too. The future extent of the proposed work can be, catching numerous definite pictures of the students and utilizing any cloud innovation to store these pictures. This framework can be designed and utilized in ATM machines to identify frauds. Also, the framework can be utilized at the time of elections where the voters can be distinguishedby perceiving the face.

4. Advantages and drawbacks of facial recognition system:

4.1. Advantages of Facial Recognition System:

- **Easy to manage.**

Since the AI based attendance system is completely automatic, dealing with the records and monitoring everyday activities will turn out to be a lot simpler than the manual system. Everything will be done by the system. Numerous products are customized so that it shows the specific time of how many hours or minutes an individual worked at his/her work area in the day. All activities can be easily monitored to maintain a record.

- **Time and cost saving.**

This framework can be advantageous in saving lots of time and cash for organizations. Since the face recognition framework monitors employees or students working hours and access to different zonesin the premise, organizations will not need to utilize an extra labour force to do this work. The automated framework likewise helps in preventing human mistake and monitors exact hours.

- **Easily monitor and detect students.**

Schools, universities and colleges have adapted face recognition both to record attendance and prevent any mischievous activity in premises.

- **Strengthens security measures.**

This framework also helps to improve security and safety measures. Facial recognition has become a regular part of Airport security evaluating since a long time, helping to identify lawbreakers and possible dangers to carriers and travellers.

Banks and different foundations additionally utilize facial recognition to prevent fraud, as the innovation can identify individuals who've been recently accused of wrongdoings and alert the bank or the institution.

- **Automatic and seamless verification process.**

It's not important to wait for your turn like checking fingerprint scanner or other safety efforts, facial recognition for attendance framework offers aspeedy, programmed, and consistent verification experience.

- **Reduces interaction or touching of devices during pandemic situations.**

The entire world is experiencing COVID-19 and it's about time that we should offer regard to social distancing. Having a safe distance with others has become a need these days. Conditions such as this can be hazardous if you have manual attendance system, having a Face recognition-based attendance system won't just permit you to register the attendance of an individual but also keep you at a safedistance from them as you can work distantly and still see who all are coming and going. This requires the point that, this entire framework is a lot more secure, efficient, and faster method to record attendance.

4.2. Drawbacks of Facial Recognition System*:*

- **Image Quality:**

  The resolution of the reference picture plays a significant part in the identification process. If the resolution of any picture is not high or good, then it can cause cameras to be tricked into believing that theperson being scanned is not the same as in the photo. A simple arrangement for this issue is to ensure that both the reference pictures and scanning are performed by same cameras.

- **Produces data vulnerabilities.**

  There is concern about the storage of facial recognition data, as these data sets can possibly be penetrated or breached.

- **Performance may vary from system to system.**

  This framework requires fast and good quality of processor for smooth and lag free execution of program. Low configuration PC or devices might face lag issues or might face slow data processing.

- **Technology might be fooled. (In rare case).**

  Some variables might affect this framework's ability to recognize individuals' appearances, including camera angles, lighting levels and picture or video quality. Individuals wearing masks or slightly changing their appearance can throw off facial recognition technology too. But there is very rare probability for occurrence of this issue.

X. CONCLUSION:

The Face Recognition based Automated Attendance System is simple, accurate and works efficiently. This system works automatically once the registration of individual student is created by the administration. There is a need to utilize few algorithms that can perceive the appearances in order to improve the system performance and recognition accuracy.

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Automatic Frequency Response for Autonomous Distributed V2G (Vehicle-to-Grid) Using IoT Technology

S.Divyapriya[1], Dr.A.Amudha[2], R.Vijayakumar[3]
[1]Karpagam University, Karpagam Academy of Higher Education, Coimbatore, Tamilnadu.
[2]Karpagam University, Karpagam Academy of Higher Education, Coimbatore, Tamilnadu.
3SNS college of Technology, Coimbatore, Tamilnadu.
[1]divyapriyaeee@gmail.com, [2]amudhac11@yahoo.co.in, [3]r.vijayakumarpse@gmail.com

Abstract

Nowadays, the use of electric vehicle has been increased, due to the increase in fossil fuel and decreasing in its resources. On the other hand environmental pollution is the major concern. On the power systems the charging of Electric Vehicles (EVs) has been imposed. The deregulation of power system with new and major loads introduces the uncertainties of grid which is new challenges of frequency control and stability of power system. In order to overcome this problem EVs as moving batteries are imposed. In this method based on the Grid frequency the charging and discharging of EVs takes place. This technology is so called Vehicle to Grid (V2G). The Arduino microcontroller development board is used to make decisions over the controlling operations. The Internet of Things (IoT) is used for the communication purposes such as collecting data from all sensors and giving information to the authorizers. The simulation is done through the MATLAB / SIMULINK and thus the results illustrate good performance of the proposed method.

Key words: Electric Vehicles, Vehicle to Grid (V2G), Arduino, Internet of Things (IoT).

I. INTRODUCTION

Renewable energy has the significant increase in the energy system because of global changes in climate change, energy security and the environmental pollution. For the promotion of renewable energies the ambitious target are set in many countries. The electricity generation from the renewable source in 2020 is set for 35% of its goal in European Union[1]. The world's energy supply provides 14% of renewable energy [2-3]. The spinning reserve is required for the compensation of generation and the demand unbalance. For the compensation of unbalance, the batteries can be used as charge storing devices. But, the increase in size of batteries is the restriction of this solution.

By converting conventional power systems into deregulated power systems, the new uncertainties have been introduced in the power systems. In traditional power systems (VIU) Vertically Integrated Utility which are owned by single entity. A distribution company is contracted individually in independent of power producers for the different areas [4]. Therefore, in deregulated power systems the frequency control is more complex.

The electric vehicles have gained interest in global research and industrial sector in recent years. The promotion of EV is because of pollution free and emission free transportation which could be sustainable in future [1]. From [2], in United States the EV is from the period of 2020, 2030, and 2050 that will reach 35%, 51% and 62% respectively. For the frequency control of power systems, the control of EVs are as the load controllable and their use of batteries with the spinning reserve is the one of the solution. In this method, the EVs are connected to the grid through the bidirectional converter. Charging and discharging of EV batteries takes place based on the load in the grid. The concept of V2G was used in [5] for the first time. EV availability is shown in Fig.1 the EV are charged at day through proper manner. Hence in ancillary services the V2G concept is used. The V2G concept is employed in frequency ancillary services because of its high charging rate [6]. V2G concept is used in many papers in the frequency control of the grid [7-12]. In [7], for grid frequency control the V2G concept was used with scheduled charge method.

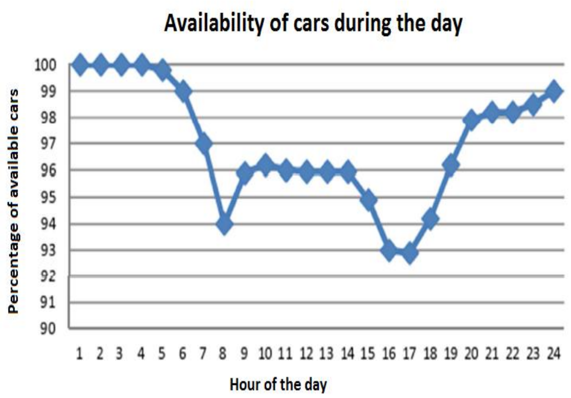

Fig. 1 EV availability

Thus the proposed paper describes about the control of frequency through the load scheduling method. The load scheduling is done based on the priority of the load. Thus for the process of controlling frequency a controller adopted is called Arduino Mega 2560(AT Mega2560). It is an open source electronic platform which can perform the easiest way for hardware and software. The concept of Arduino is used because of it has the advantage of easy and fast prototyping, display message in a minute, power and convenient tool and can optimizes the code. In order to control from anywhere at any place and also at anytime the IoT concept is used. The basic characteristics, the key technologies, the network architecture and security problems of the Internet of things is explained in [8]. IoT is the Internet of Things which is the internetworking of physical devices, vehicles, buildings and other items. The IoT has the advantages of tracking behavior for real time marketing, enhanced situational awareness, process optimization, optimized resource consumption, instantaneous control and response in control. Because of such advantages the AT Mega2560 and IoT are used to control the frequency by load scheduling. The remainder of this paper is organized as follows. Section II introduces EV system. Section III introduces Synchronous SOC control. Then Frequency control is explained in Section IV. Communication system is explained in Section V. Result is expressed in Section VI. In section VII conclusion is explained.

II. EV SYSTEM

The motor vehicles that are recharged from the external source of electricity is called Plug-in Electric Vehicles (PEVs). The external source of electricity can be of wall sockets. The wheels are driven by the rechargeable battery packs with the stored electricity. The PEV serves many advantages that it has low operating maintenance cost and no local air pollution. The PEVs are utilized to the utility power by recharging the batteries. The power to the motor is controlled by motor controller which is the simplest configuration of PEV as shown in Fig. 2**.** The electric battery or traction battery can be used as the battery for the propulsion of power of the electric vehicle.

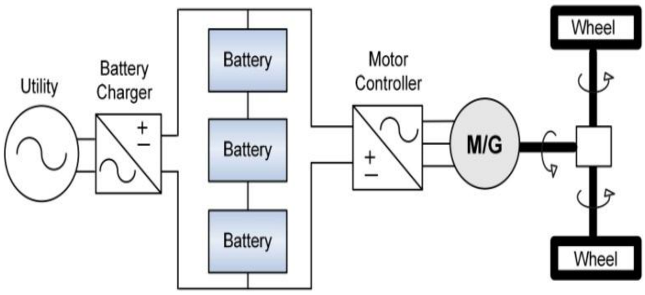

Fig. 2 Plug-in Electric Vehicle

III. SYNCHRONOUS SOC CONTROL

In general, to the contrast to the total number of cars, few cars are driving on the load. Generally all the cars are being parked. The some situation is expected in future with large discretion of EVs. When gasoline vehicle are used, the travel to the longer distance are limited. On the other hand, the charging can be done everywhere through the support of EVs. On expectation, it is indented the EV users charges frequently. According to the parking, the EVs are plugged nearly to full State of Charge (SOC).

As shown in Fig. 3, there are totally 3 main states of EV i.e driving state, charging and controllable states respectively.

a) Driving state

When it is plugged out for the trip an EV enters the driving state. The EV changes from the controllable state to driving state. Each EV is equipped with the battery voltage rating of 360V.

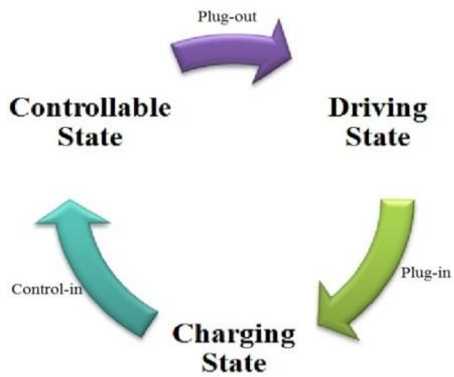

Fig. 3 EV state

b) Charging state

The charging state is entered by EV when it is plugged in to charge the battery. The EV cannot respond to LFC signal when the charging period is one hour i.e. not controllable.

c) Controllable state

When EVs entering the controllable rate per second is called control-in rate as shown in Fig.4.

It is assumed that to the EV the central load dispatching centre sends and receives control signal from the EV through the local centers. There are of total 500 local control centers. The control of 100 EVs is assumed for each local control centers. The EVs are of 50, 000 controllable in which is 10% of the EVs equipped with V2G. SOC synchronous control is explained in [13].

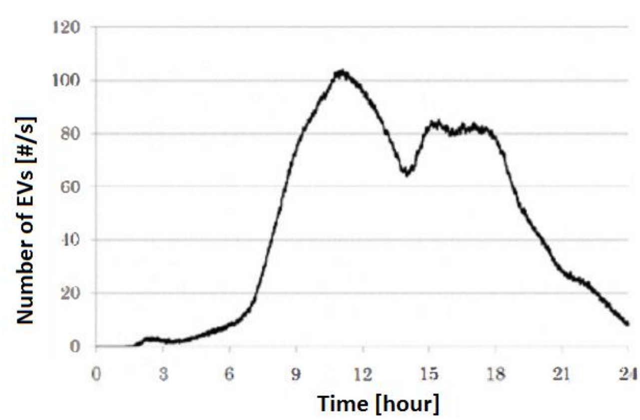

Fig. 4 Control-in rate

LFC signal to EVs is sent from control centre that is arranged in area of every 1second. The restriction of charging and discharging is in MW limit and MWh limit(80% - 90%) of SOC. Whether the local control centre is controllable or not is explained by the EV. The information about the local control centre is controlled in or plugged out is sent through the EV for every 30sec, the EVs sends the information on SOC for 30sec each**.** The SOC of EVs are assigned in the area which receives the information from local control centre. The control signal of local control centre dispatch is as follows. The priorities of charging and discharging of EVs are determined according to SOC of every 30sec. The charging signal is dispatched in ascending order whereas the discharging is in descending order as shown in Fig. 5.

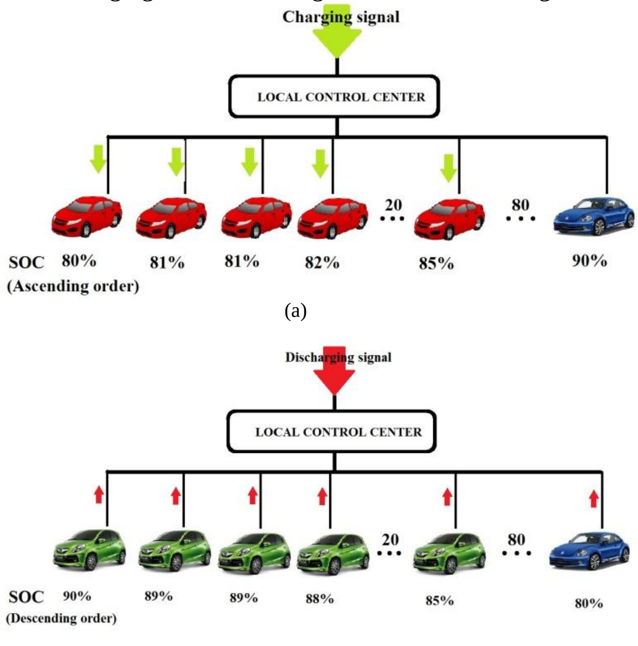

Fig. 5 Examples of dispatching signal method (a) Charging signal (b) discharging signal

IV. FREQUENCY CONTROL

Let us consider the different types of loads. The loads are based on the certain priority. The Load1 is set as first priority which is a critical load and an essential load. The Load 2 is the second priority which is the lighting loads and finally the PEV charge station. The total capacity of the utility is 1000kVA. The rating of the critical load is 800kVA. The rating of the lighting load is 100kVA. The need of power by the charging station is 100kVA. The batteries used in PEVs are laminated Lithium-ion battery with the voltage rating of 360V. The schematic diagram of the proposed system is shown in Fig. 6**.**

The power system delivery frequency is an electrical system will affect inductive and capacitive reactance and will have very little effect on purely resistive loads. It will affect the power factor of the delivered voltage. There are some types of equipment that can handle the change in frequency but some types of equipment that is running on the exact frequency that it was designed to most efficiently and some equipment should not be run outside the manufacturers target frequency. So maintaining the frequency as constant is important for the better performance of the utility as well as load. But the frequency is inversely proportional to the demand of the system. In the proposed system the base power is 1000KVA. When the power demand increases more than 1000KVA the frequency will be reduced less than 50Hz. When the power demand is less than base power then the frequency will increase more than 50Hz. The load scheduling technique is used to maintain this frequency as constant even variation in demand. In proposed system six switches (S1, S2, S3, S4, S5, S6) are used to schedule the load which are controlled by AT Mega2560 as per the requirement of the load.

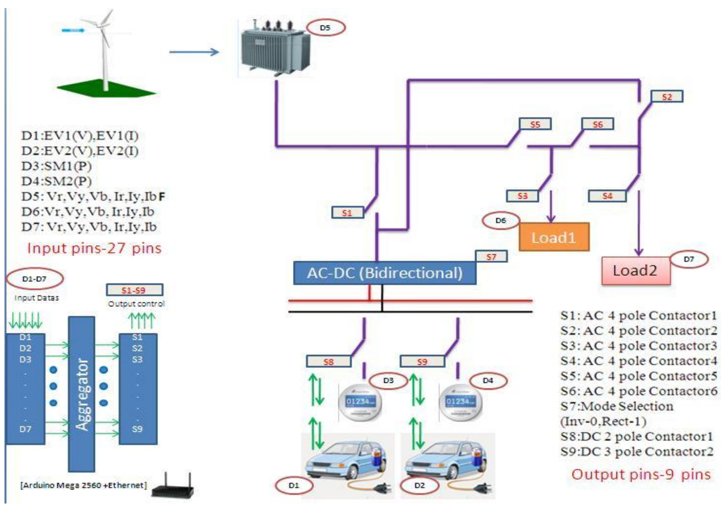

Fig. 6 Schematic diagram of the proposed frequency control system

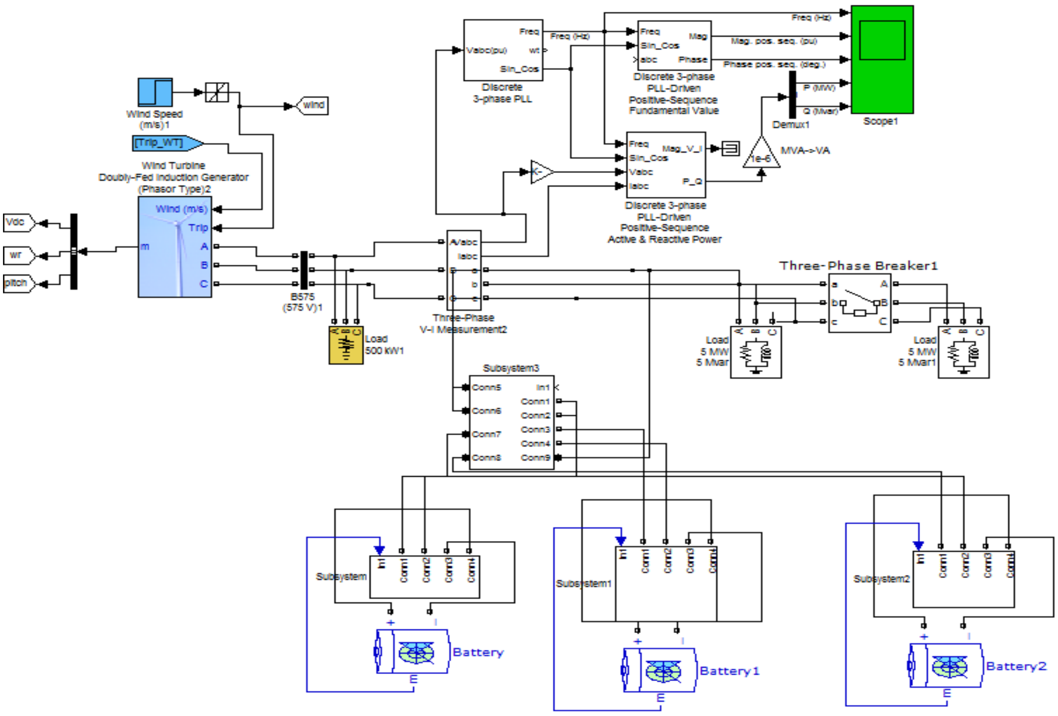

Fig. 7 Proposed frequency control system

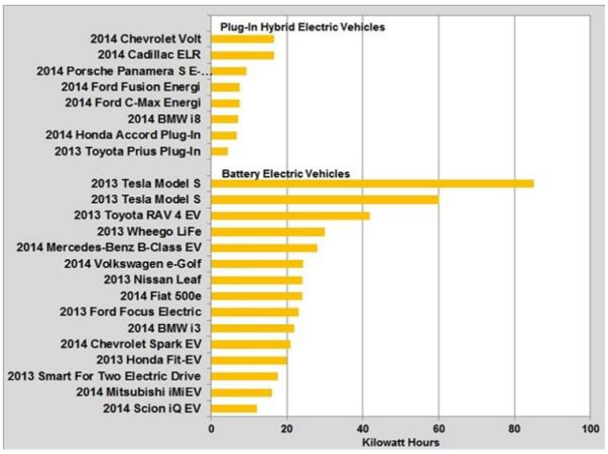

Fig. 8 Battery capacity of different PEVs

Case (1) Demand is more than 1000kVA

The Switch 1(S1) will be opened and the frequency is checked by AT Mega2560. Still the frequency is low then Load2 is isolated by closing Switch 6 (S6) and opening Switch 2 (S2). Then PEVs are used as service provider for Load2. For that the SOC level of the PEV battery and PEV owners willing are checked. The vehicles which have the SOC of above 80% with owner acceptance the vehicles are used as service provider for Load2. It is called inverter mode of operation, because of the DC supply of battery is converted into AC supply for lighting loads. The battery of a car can deliver power from 12kWh to 85kWh as per the manufacturing. It differs from one manufacturer to another as shown in Fig.8. As average 30kWh capacity battery is considered in proposed system. By converting kWh to kW using the equation 1 a battery can supply 25.5kW when the system power factor is considered as 0.85. In average four vehicles are enough to meet the demand of the Load2. The smart meter reads and records the kWh consumed by and from the PEVs.

$$P_{(kW)} = S_{(KVA)} \text{ X pf} \tag{1}$$

Where

$P_{(kW)}$=Real Power in Kilo Watts

$S_{(KVA)}$=Apparent power in Kilo Volt Ampere

Pf=Power factor

Case (2) Demand is less than 1000kVA

The Switches S1, S5, S6, S3 and S4 are closed and Switch S2 is opened. This mode is called rectifier mode. In this mode the AC supply from the service provider is used to charge the batteries of the PEVs.

To achieve the inverter and rectifier mode of operation there is a need of special device which is called back-to-back (bidirectional) converter. This comprises the both rectifier and inverter. It can convert AC to DC in rectifier mode and DC to AC in inverter mode. The bidirectional converter is shown in Fig.9.

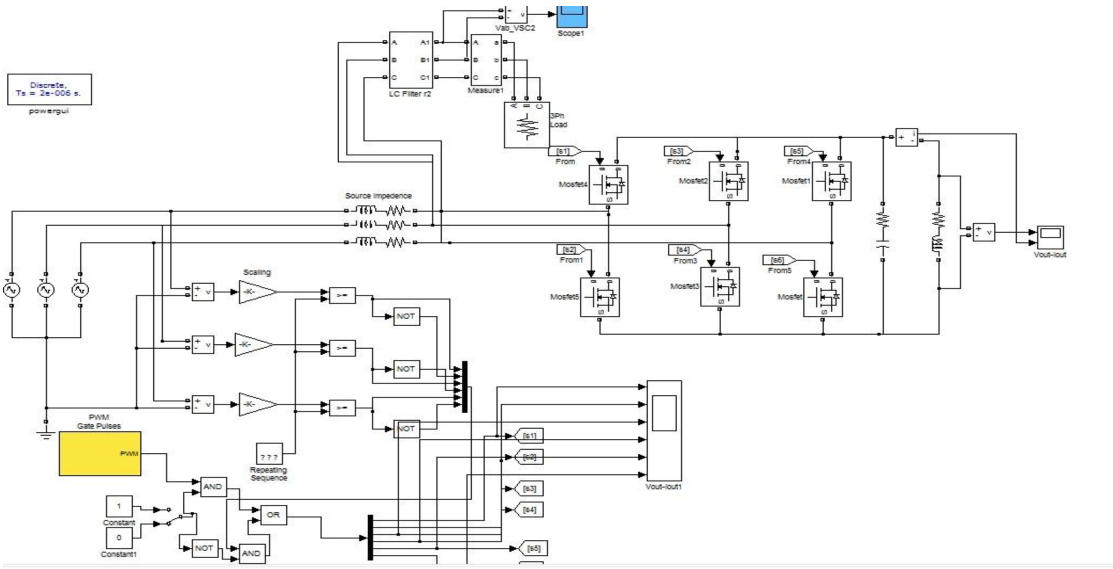

Fig. 9 Back-to-back converter

The switching operations are controlled and the system status are observed and controlled by the AT Mega2560 and the monitoring and sending control signals are send through IoT by the authority. By using IoT technique the authority can monitor and control the system from anywhere and anytime. The overall simulation of the proposed frequency control system is shown in Fig 7.

V COMMUNICATION SYSTEM

The three layers of the communication system architecture are

- Home environment
- Home Gateway
- Remote environment

Remote environment are an authorized user who can access the system on their phone and computer app using the internet via data connection to 4G/ 3G network and Wi-Fi. Home environment are router and the home gateway is a micro web server which is embedded with microcontroller based Arduino Ethernet as shown in Fig.10 and 11. Managing, controlling, monitoring are the main task of the server. This system enables hardware interface module to execute their task which is assigned. This can be done by sensors such as the sensors from the input D1 to D7 and actuators through cables. This system has the control over the load scheduling switches, charging station and SOC of the electric vehicle. For monitoring and controlling the system it supports sensors such as voltage sensor, current sensor, SOC of batteries, and the demand of loads.

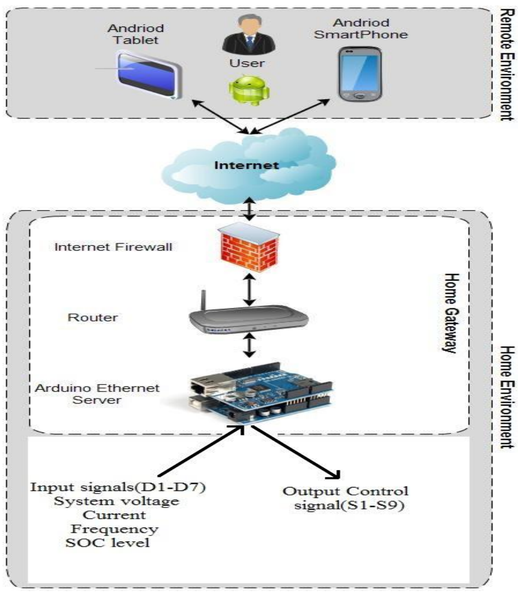

Fig. 10 Conceptual Architecture

If the end user enters the correct real IP address and password then the micro web server is connected successfully. The response code will be received when the android web server grants permission if the response time indicates the password is correct. The application will be synchronized to reflect the real time status of the proposed system. The space is used for the separation of response code and the system status the colon (:) is uses for the separation of system and its status.

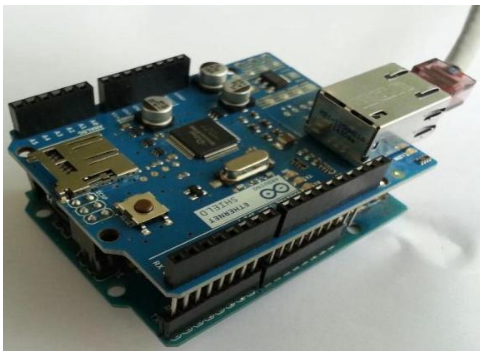

Fig. 11 Picture depicting the Arduino with Ethernet

(b) Software development for Gateway

The two parts of software web server are server application software and microcontroller firmware. For successful communication between the proposed system and gateway, the sensor control stage and config stage are implemented on the AT Mega2560. The data is received in <ethernet.h> libraries and Java Script Object Notation(JSON) format the output are displayed. Fig. 12 shows the flowchart of the established connection between Arduino and the Internet.

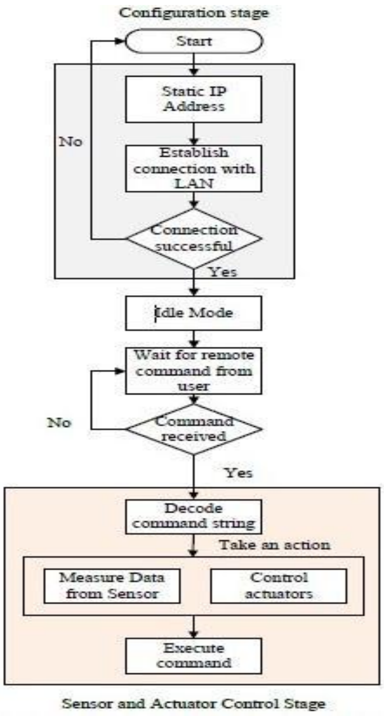

Fig. 12 Gateway flowchart

To the Internet TCP/ IP protocol the gateway is connected. Arduino Ethernet supports TCP/ IP stack. Now the design is focused on software connection to the remote user. At initial phase, once gateway is started it enters to the conFiguration stage. In next phase, the conFiguration stage establish the connection with the LAN (Local Area Network) by the use of static IP address. The use of static IP instead of Dynamic Host ConFiguration Protocol (DHCP) optimizes the process. When the gateway is initialized, it enters into an idle state till the command receives from the remote system. The control action is taken as required when the control command is given from the system.

VI RESULTS

The simulation of proposed system is carried out using MATLAB/SIMULINK which verifies the feasibility of the proposed system. The performance of the system is investigated for the both inverter and rectifier mode of operation. The inverter mode is carried out up to 1.5sec and from that instant to 3 sec it works in rectifier mode as shown in Fig. 13**.**

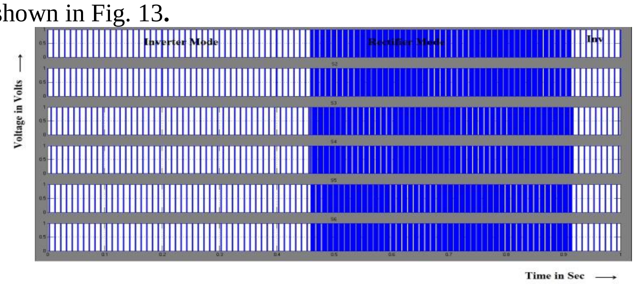

Fig. 13 Pulse pattern of rectifier and inverter mode

When the demand is equal or less than the base power then the service provider supplies to all the loads as well as it will charge the PEVs. This is called rectifier mode where the AC supply of service provider is converted into DC. Fig. 14 shows the inverter mode of operation where the DC voltage is converted into AC voltage.

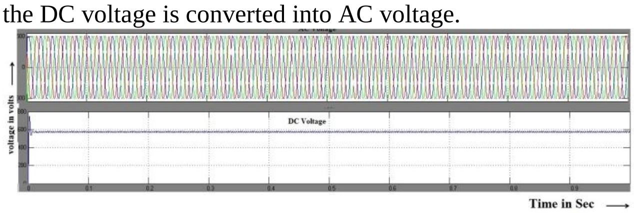

Fig. 14 Waveform of Rectifier mode of operation

When the demand is more than the base power then the Load2 is isolated and the DC supply from the PEVs is converted into AC supply to support the Load2 which is called inverter mode of operation. It is shown in Fig. 15 where the AC voltage is converted into DC voltage.

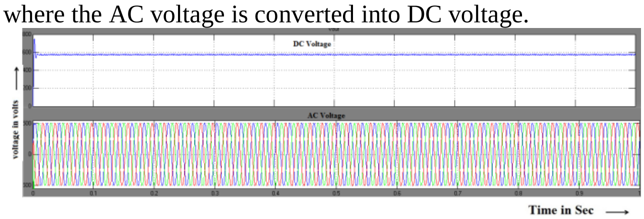

Fig. 15 Waveform of Inverter mode of operation

The load is added to the system at 0.5sec to 3sec. At that instant the system voltage drops from 500V to 480V. As voltage and current are inversely proportional, the current increases at the time period of 0.5sec to 3sec. Due to the addition of load the power demand increase from. This is shown in Fig. 16.

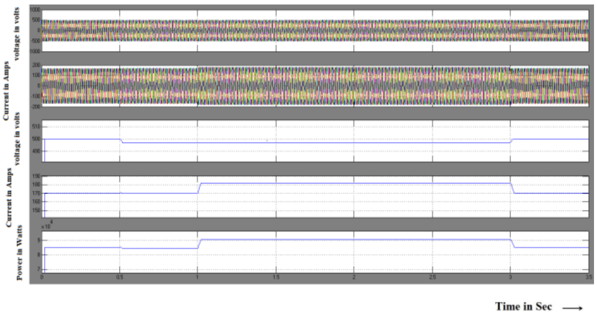

Fig. 16 System voltage, current and power waveform

Since the frequency and power are inversely proportional, the increase in the power demand reduces the frequency from 50Hz to 47Hz at that particular instant say 0.5sec -3sec . It is shown in Fig. 17.

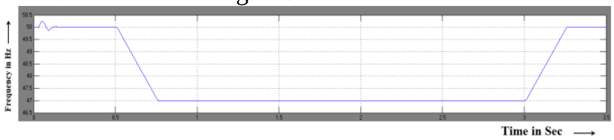

Fig. 17 Frequency drop at increase in power

As it is said earlier when there is increase in power decreases frequency. At that state, the PEV checks the SOC. The PEV which has the SOC as 80% and above supports the system by discharging it the batteries from 1.5sec to 3sec. From 0.5 sec to 1.5sec there is no PEV has the SOC of 80% and above so that there is no PEV to support the system as shown in Fig. 18. Even though the PEV in control-in state without owner’s willingness the PEV cannot support the system.

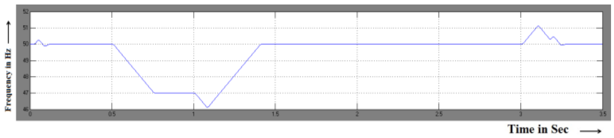

Fig. 18 Frequency compensation by PEV

The SOC level of the battery cannot be measure directly so that the voltage of the battery is used to indicate the SOC level. Because of the Voltage and SOC are directly proportional. Fig. 19 shows the voltage and SOC level of PEV's battery when it starts to support the system by discharging the power.

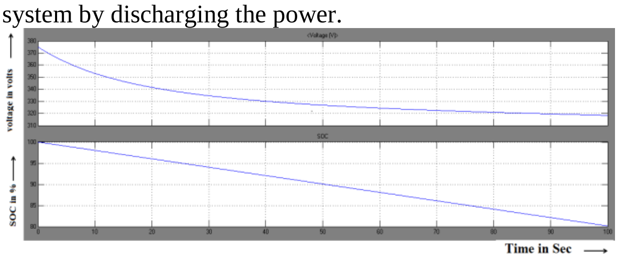

Fig. 19 Voltage and SOC level of PEV's battery at discharging state

When many PEVs are considered according to its SOC level that supports the system to meet its demand by maintaining the system frequency and voltage as constant. As shown in Fig. 20 at the instants 1sec to 1.5sec and 2sec to 3sec the PEVs supports the system so that the system voltage is constant at that instant. From 0.5sec to 1sec and 1sec to 1.5sec the PEVs may be in driving state or charging state.

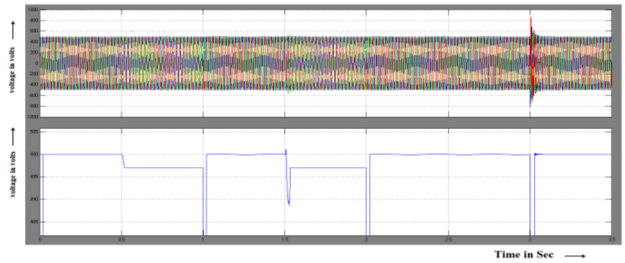

Fig. 20 Multiple PEVs supports the system to maintain constant frequency

VII CONCLUSION

Thus the advancement in power system has increased in its demand based. The change in demand changes the system frequency. This change in frequency will affect the power system performance thus the frequency control based on load scheduling is adapted and controlled. This done by the controller called AT Mega2560 and the monitoring action was done through IoT.

FUTURE SCOPE

In the future, on the one hand we need to study the Modern Technology for the electric vehicle joining in the frequency adjustment; On the other hand, in order to better data communication to Control centre we can use ESP8266.Because ESP8266 module does not require any wired communication.

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COMPENSATION OF VOLTAGE VARIATIONS IN DISTRIBUTION SYSTEM BY USING DVR BASED SEPARATE ENERGY STORAGE DEVICES

R.Vijayakumar[1], R.Subramanian[2]

[1] Department of Electrical and Electronics Engg, SNS College of Technology, Coimbatore
[2] Department of Electrical and Electronics Engg, SNS College of Technology, Coimbatore

[1]r.vijayakumarpse@gmail.com,[2]rama.smani@gmail.com

Abstract— **The Separate Energy Storage Device (SESD) based Dynamic Voltage Restorer (DVR) used to protect consumers from the grid voltage fluctuations like Long and Short-Duration Voltage Variations. This paper analyses the operation principle of the SESD based DVR and its design is based on simple PI control method and decision making switch to compensate Long and Short-Duration Voltage Variations. During short-duration voltage variation super capacitor and fuel cell hybrid system is used to compensate the fault. In the same way during long-duration voltage variation photovoltaic (PV) system or backup battery or other grid is used to compensate the fault based on the availability. Using MATLAB/SIMULINK, the models of the SESD based DVR is establish, and the simulation tests are performed to evaluate the system performances.**

Keywords- **DVR; Long and Short-Duration Voltage Variations; Pulse-width modulated (PWM); Decision making switch; Grid; Bidirectional Isolated DC–DC Converter, SESD.**

I. INTRODUCTION

Power systems have been experiencing good changes in electric power generations, transmissions, and distributions. For electrical load growth and higher power transfer in a largely interconnected network lead to complex and less secure power system operation. Power system engineers facing challenges seek solutions to operate the system in more a flexible and controllable manner. So role of energy storage devices play important role as Energy storage appears to be beneficial to utilities since it can decouple the instantaneous balancing between supply and demand. Therefore increased asset utilization is allowed, that facilitates the renewable sources penetration and improves the flexibility, reliability and efficiency of the grid long and short-duration voltage

Variations by abrupt increases in loads such as faults or short circuits, starting of motors, or turning on of electric heaters or they are caused by abrupt source impedances is increase, which are caused by a loose connection. Power quality issues are divided into two categories voltage quality and frequency quality. Voltage quality issues are related with voltage sag, voltage swell, under voltage and over voltage while frequency quality issues are related with harmonics and transients. One of

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the most imperative power quality issues is voltage sag which is occur due to its usage of voltage sensitive devices.

Energy storage devices can be classified into two diff categories, depending upon their application: short term response energy storage devices and long-term response energy storage devices. Short term response energy devices which include flywheel, super capacitor, SMES whereas long term response energy storage devices include compress air, hydrogen fuel cell, batteries, Redox flow. Here we are more concern with short term response energy devices.

For Long and Short-Duration Voltage Variations compensation, the DVR which acts as series-connected topology is a more cost-effective solution. In this paper, a SESD unit is introduced as the energy storage unit of the DVR. Application of SESD for power conditioning with DVR is put forth. The dynamic response of the SESD based DVR on voltage sag and swell is evaluated using MATLAB simulation.

The energy storage devices are split in to two Types direct energy storage and indirect energy storage as shown in Fig.1.

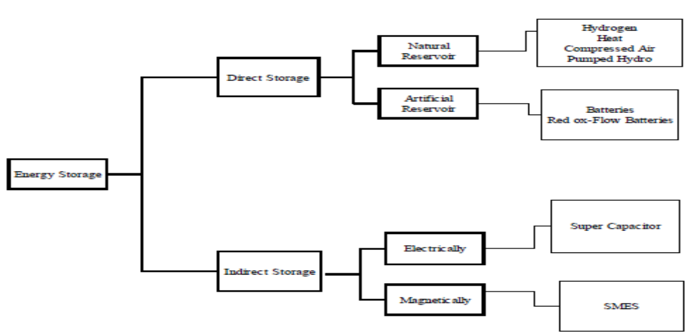

Fig.1. energy storage devices

Energy storage devices are split into three categories:
(i) Small categories (<10MW):
Fly-wheel batteries, ultra capacitors & capacitors (combined with DG devices) are comes in small categories.
(ii) Medium categories (10MW < energy < 100 MW):
Large-scale batteries, lead-acid, NAS and Redox are come in medium categories.
(iii) Large categories (≥ 100 MW):
Compressed Air Storage (CAS), Pumped Storage are comes in large categories.

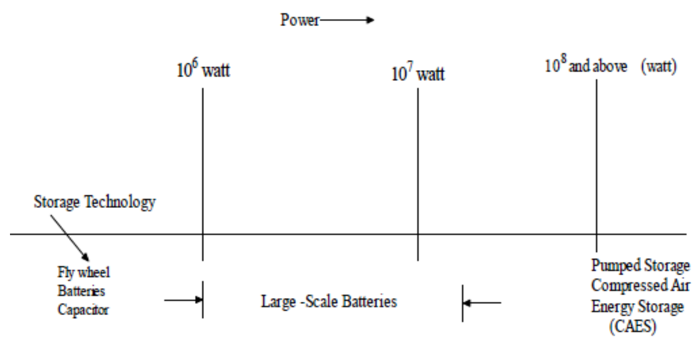

Fig. 2 Technical Capability of Energy Storage devices

II.SESD WITH DVR

The basic structure of a DVR based SESD is shown in Fig.3. It consists of Battery storage, capacitors bank, voltage source inverters (VSI), low pass filter and a voltage injection transformer, Decision making switch, grid, PV.

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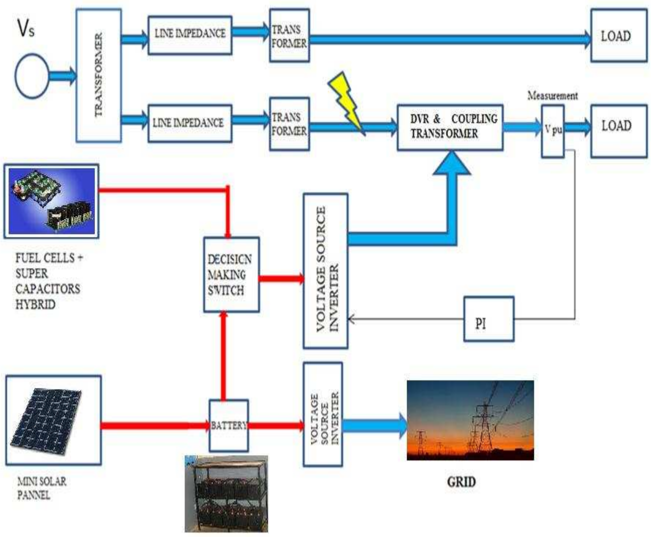

Fig.3. Basic structure of SESD based on DVR.

In order to mitigate the simulated voltage variation in practical application, a discrete Pulse Width Modulation-Based control scheme is implemented, with reference to DVR as shown in Fig 4. The aim of the control scheme is under the system disturbance to maintain a constant voltage magnitude at the sensitive load point,. The control system only measures the rms voltage at load point; Long and Short-Duration Voltage Variations is created at load terminals by a various phase fault as shown in Fig.4. Load voltage is converted into per unit quantity and is passed through a sequence analyzer.

The magnitude is then compared with reference voltage through which error signal is fed to PI controller. This voltage is then fed to triggering circuit. PWM control technique is applied for inverter switching so as to produce a three phase 50 Hz sinusoidal voltage at the load terminals. The range of Chopping frequency is a few Kilo Hertz. The PI controller is controls the IGBT to maintain 1 per unit voltage at the load terminals that is considered as base voltage is equal to1 per unit. The DVR control system exerts a voltage angle control as follows:

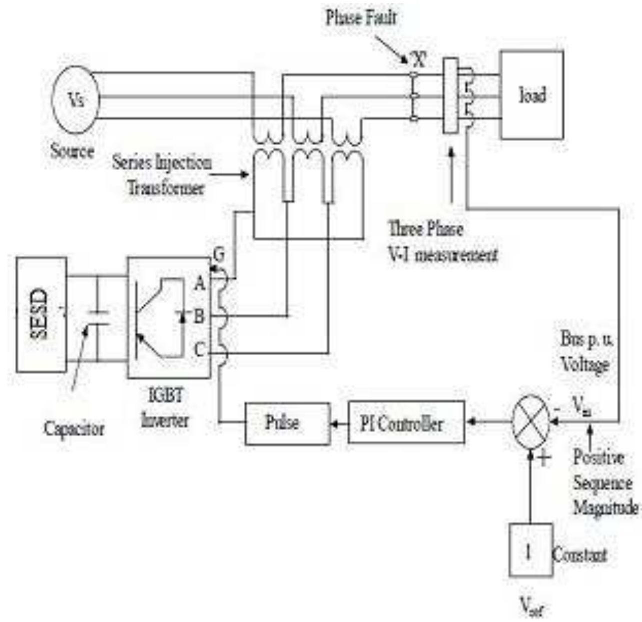

Fig.4 DVR with SESD

The PI controller processes the error signal and generates the required angle δ that drives the error signal to zero, for eg; the load rms volt is brought back to the reference volt. Here we need to make an assumption of balanced network and operating conditions. The modulating angle δ is applied to the pulse width modulation generators in phase A, here the phase angles B and C are shifted by 240° or -120° and 120° respectively.

$$V_A = \sin(\omega t + \delta) \quad (3)$$
$$V_B = \sin(\omega t + \delta - 2\pi/3) \quad (4)$$
$$V_C = \sin(\omega t + \delta + 2\pi/3) \quad (5)$$

An advantage of a proportional plus integral controller is that integral term causes the steady-state error to be zero for a step input. The input for PI controller is an actuating signal which is the difference between the Vref and Vin. The controller block output is of the form of an angle δ, in the three phase voltages which introduces additional phase-lag/lead. The error detector output is

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$$Vref - Vin. \qquad (6)$$

Vref equal to 1 p.u. voltage
Vin voltage in p.u. at the load terminals.

The controller output when compare at PWM signal generator results in the desired firing sequence.

III. HYBRID BIDIRECTIONAL DC–DC CONVERTER TOPOLOGY

The hybrid system based on fuel cells (FCs) and super capacitors (SCs) as an environmentally renewable

energy system has been applied in many fields, such as hybrid electric vehicle, uninterruptible power supply (UPS), and so on

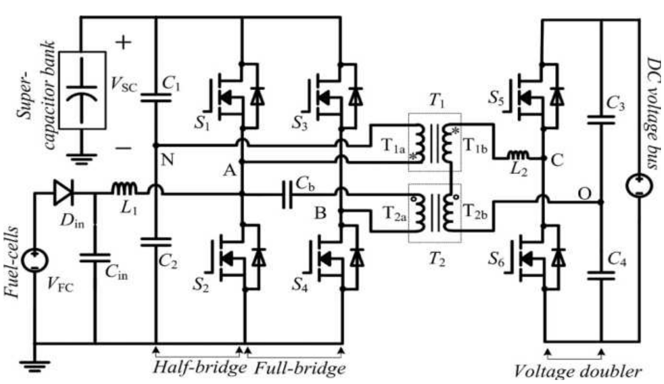

Fig. 5. hybrid bidirectional dc–dc converter topology.

As shown in Fig. 5, a BHB structure locates on the primary side of the transformer T1 and it associates with the switches S1 and S2 that are operated at 50% duty cycle. The SC bank as an auxiliary energy source is connected to the variable low voltage (LV) dc bus across the dividing capacitors, C1 and C2. Bidirectional operation can be realized between the SC bank and the high-voltage (HV) dc bus. Switches S3 and S4 are controlled by the duty cycle to reduce the current stress and ac RMS value when input voltage VFC or VSC are variable over a wide range.

The transformers T1 and T2 with independent primary windings as well as series-connected secondary windings are employed to realize galvanic isolation and boost a low input voltage to the HV dc bus. A dc blocking capacitor Cb is added in series with the primary winding of T2 to avoid transformer saturation caused by asymmetrical operation in full-bridge circuit. The voltage doublers circuit utilized on the secondary side is to increase voltage conversion ratio further. The inductor L2 on the secondary side is utilized as a power delivering interface element between the LV side and the HV side. According to the direction of power flow, the proposed converter has three operation modes that can be defined as boost mode, SC power mode, and SC recharge mode. In the boost mode, the power is delivered from the FCs and SCs to the dc voltage bus.

In the SC power mode, only the SCs are connected to provide the required load power. When the dc bus charges the SCs, the power flow direction is reversed which means the energy is transferred from the HV side to the LV side, and thereby the converter is operated under the SC recharge mode.

Fuel cell design is modeling shown in in Fig.6

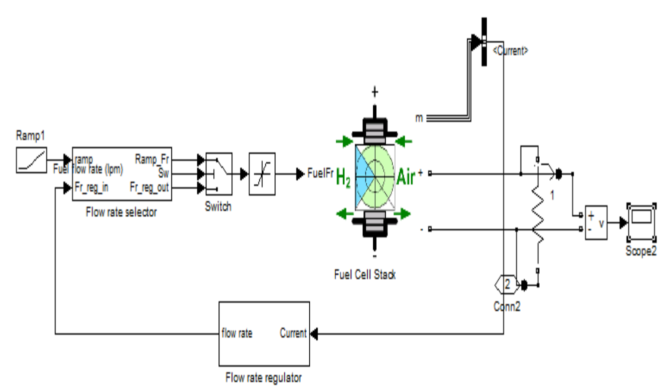

Fig. 6. Fuel cell simulation model.

IV.MINI PV 500V WITH GRID CONNECTION DESIGN

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Due to the advantages of low emission and little mechanical parts, the PV power generation becomes a promising renewable energy technique. However, the PV current changes with the solar irradiations level, whereas the PV output volt changes with the temperature of the PV module. So, there is fluctuation in the PV output power due to the stochastic climatic conditions. To compensate the inherent fluctuation of PV output power and provide the electricity with high quality, the energy storage system such as the battery system must be used. PV with converter simulation model is shown in Fig.7.

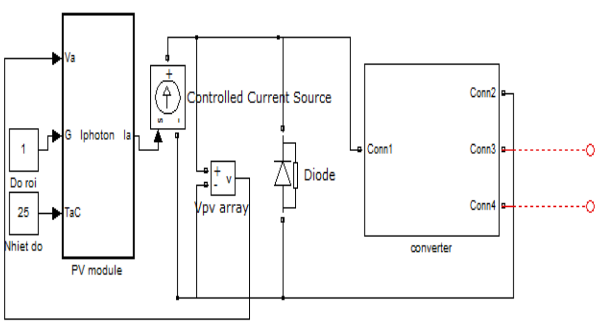

Fig. 7. PV with converter simulation model.

Mini PV system was designed for 30V. That 30V output is fed in to isolated DC-DC converter that converter output is 500Vdc. And then Battery is connected to floating condition and with connected grid by via VSC converter.

Fig.8. Voltage source controller simulation model is shown.VSC converter is used to act as a inverter and rectifier operation based on the source availability. For voltage source controller get the grid voltage, current and DC voltage. Compare the dc and grid side voltages pulse patterns are varied.

Based on the pulse angle converter acts as a inverter and rectifier. Fig. 9. Shows Grid connected VSC converter simulation model

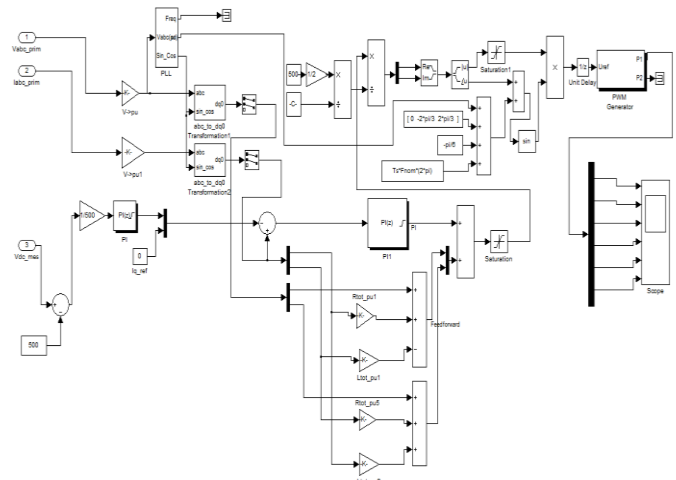

Fig. 8. Voltage source controller simulation model.

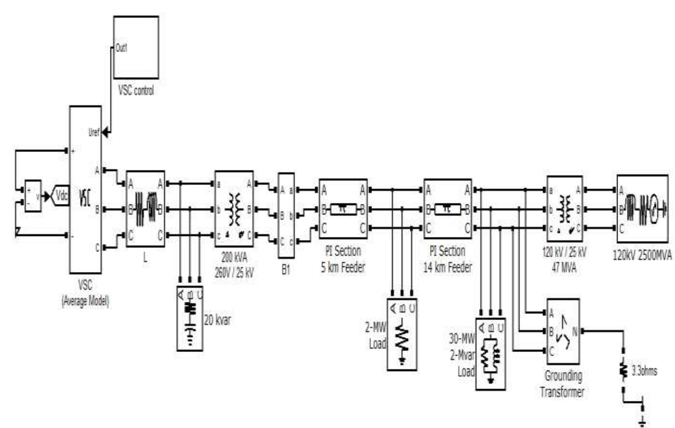

Fig. 9. Grid connected VSC converter simulation model.

V. DECISION MAKING SWITCH

Decision making switch simulation model is shown in Fig.10.This decision making switch control is used to allow which energy source is supply for compensation during fault condition. The short duration voltage variation is compensated only by using fuel cell and super capacitor hybrid combination in the same way for long duration voltage variation compensated by various

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choices like battery alone, PV alone and grid alone based on the availability.

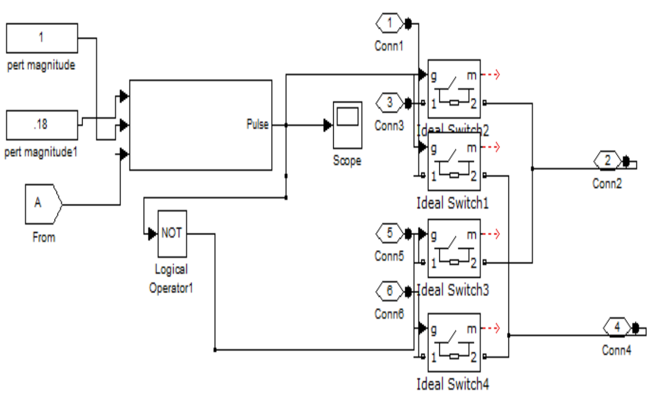

Fig. 10. Decision making switch simulation model.

VI. SESD BASED DVR TEST SYSTEM

Single line diagram of the test system 13 kV composes DVR Based on SESD, 50 Hz generation system, feeding two transmission lines through a 3-winding transformer connected in star/delta/delta, 13/115/115 kV. Such trans lines feed two distribution networks through two transformers connected in delta/star, 115/11 kV and then 11KV/500V. We verify the working of DVR for voltage compensation at 0.44 ohms fault resistances for fixed time duration of .08 and .3 secs. The DVR performance in presence SESD is analyzed for symmetrical three phase to ground fault.

Fig.11 is MATLAB/SIMULINK diagram of SESD based DVR for compensating Long and Short-Duration Voltage Variations. The first simulation was carried out without SESD based DVR and a three phase to ground fault is applied to the system at point with fault resistance of 0.44Ω for time duration of .08 and .3 secs. which result voltage sag as shown in Fig.5. The second simulation is carried out at the same scenario as above but now in this case SESD based a DVR is introduced to compensate the voltage sag occurred due to the three phase to ground fault which is as shown in Fig. 11.

The backup battery voltage for fully charged condition shown in Fig.12. Mini photovoltaic array output (30V) shown in Fig.13. PV with DC-DC converter output(500V) shown in Fig.14. Fuel cell for hybrid system output(30V) was modeled corresponding output shown in Fig.15. hybrid bidirectional dc–dc converter topology output is shown in Fig.16.

For fault condition in transmission line the voltage level is shown in Fig.17. The decision making switch controller pulse output is shown in Fig.18. Fault clearing for only short voltage variation by used SESD based DVR is shown in Fig.19.

Fault clearing SESD Based DVR (Battery Source alone) in this condition only backup battery support for clearing long voltage variation and absents of Grid and PV system, short voltage response is compensating super capacitor and fuel cell hybrid system shown in Fig.20.

Fault clearing SESD Based DVR (PV Source alone) in this condition only PV support for clearing long voltage variation and absents of Grid and Battery short voltage response is compensating super capacitor and fuel cell hybrid system shown in Fig.21. Fault clearing SESD Based DVR (Grid Source alone) in this condition only Grid support for clearing long voltage variation and absents of Battery and PV system short voltage response is compensating super capacitor and fuel cell hybrid system shown in Fig.22.

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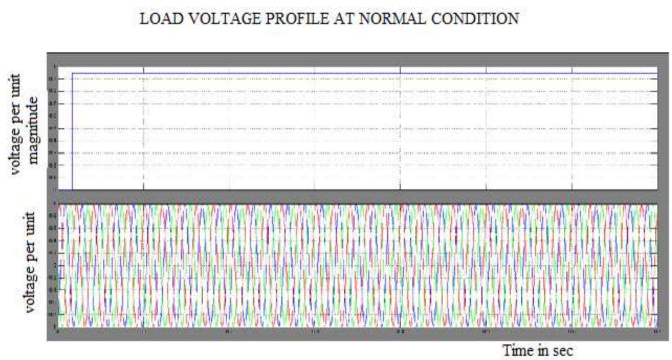

Fig.11. phase-phase voltage without any fault.

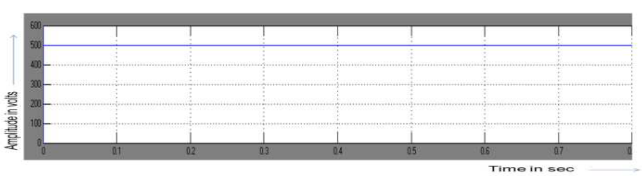

Fig.12. Backup battery voltage output.

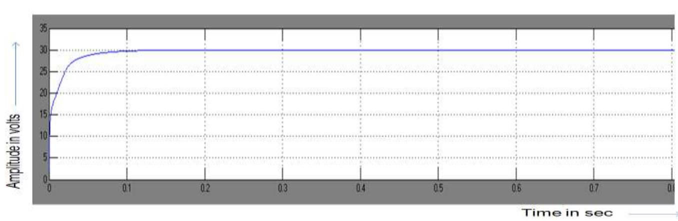

Fig.13. PV output voltage.

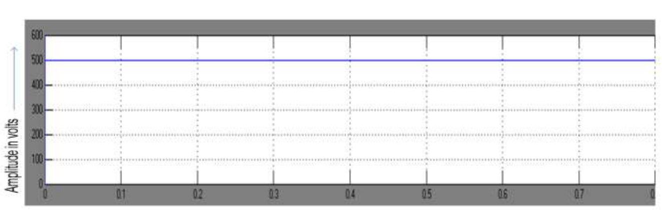

Fig.14. PV output with converter output voltage.

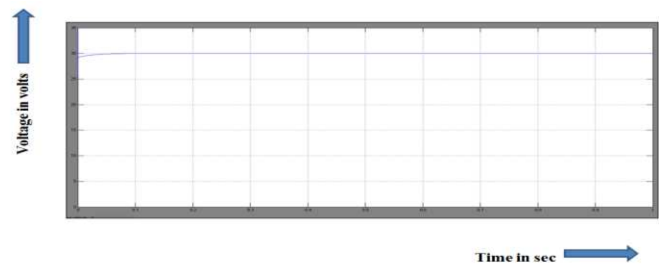

Fig.15Fuel cell output voltage

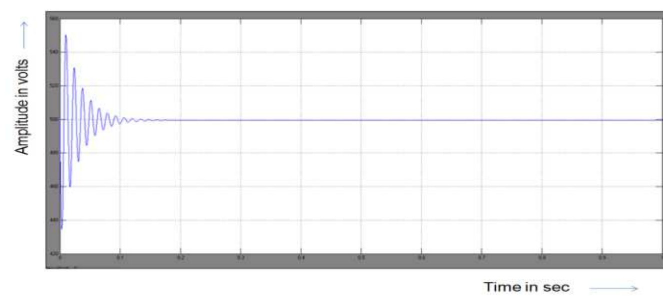

Fig.16. hybrid bidirectional dc–dc converter topology output

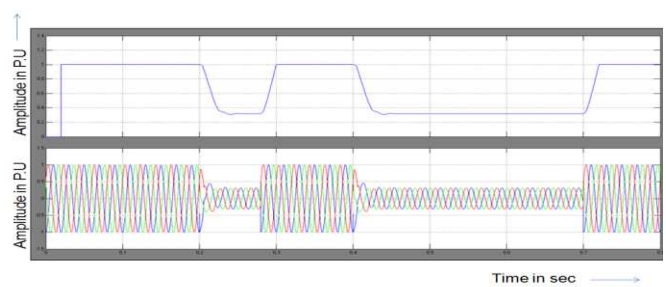

Fig.17. phase-phase voltage with fault condition.

Fig.18. decision making switch pulse output.

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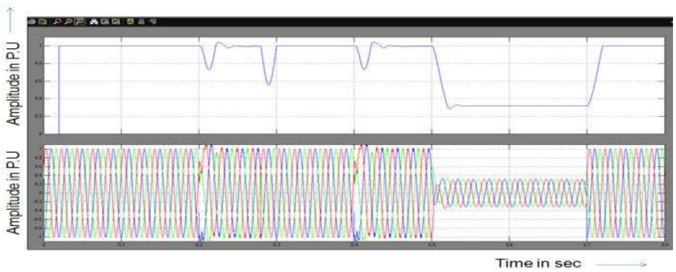

Fig.19. fault clearing (Short voltage variation).

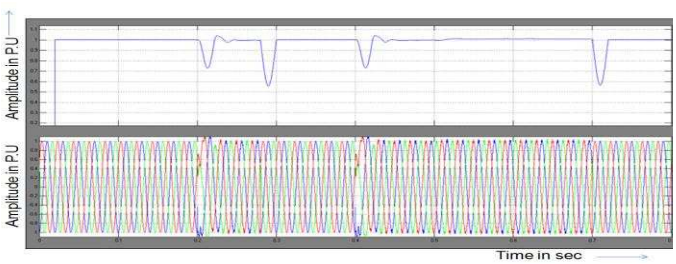

Fig.20. Fault clearing SESD Based DVR (Battery Source alone)

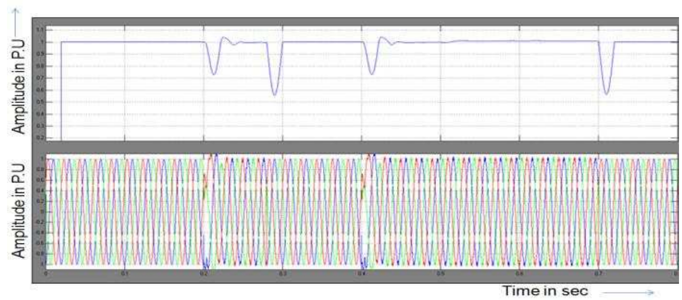

Fig.21. Fault clearing SESD Based DVR (PV Source alone)

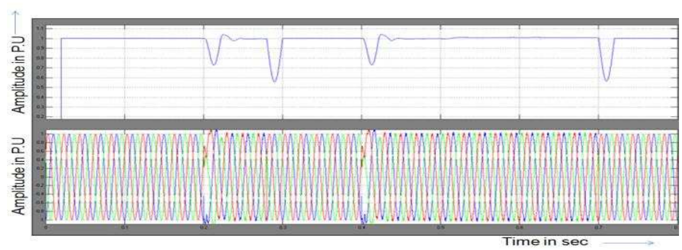

Fig.22. Fault clearing SESD Based DVR (Grid alone).

CONCLUSION

A new design which incorporates a separate energy storage device (SESD) as to mitigation Long and Short-Duration Voltage Variations and enhances power quality of a distribution system. SESD based on DVR has been presented. The Simulation results prove that the SESD can be a useful alternative DC source for the DVR.

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Control and Management Scheme of PV Integrated Charging Facilities for PEVs with Texas CC3200 IoT Technology

R.Vijayakumar[1], Dr.K.Malarvizhi[2], S.Divyapriya[3]
[1]SNS College of Technology, Coimbatore, Tamilnadu.
[2]Kumaraguru college of Technology, Coimbatore, Tamilnadu.
[3]Karpagam University, Karpagam Academy of Higher Education, Coimbatore, Tamilnadu.

Abstract- The progressing research in the field plug-in electric vehicles (PEVs) and the developing worldwide mindfulness for a contamination free condition, will prompt an expansion in the quantity of PEVs sooner rather than later. The expansion of these PEVs will add worry to the officially over-burden control lattice making new difficulties for the dispersion organize. To relieve this issue a few scientists have proposed charging PEVs utilizing renewable combined with brilliant charging methodologies. This paper audits the present writing on the best in class foundation proposed for PEV accusing offices incorporated of photovoltaic framework. The proposed control calculations, different keen charging procedures and distinctive power electronic topologies for photovoltaic charging offices (PCFs) are looked into. Studies evaluating the capacity of photovoltaic charging stations to limit the stacking on circulation transformers are surveyed. At last, a basic and one of a kind vitality administration calculation for a PV construct work environment charging office situated in light of dc connect voltage detecting is introduced. The power expected to charge the module electric vehicles originates from lattice associated photovoltaic (PV) era or the utility or both. The adequacy of the proposed calculation is approved through re-enactment and exploratory outcomes. This proposed work is controlled using Texas CC3200.

Keywords: Plug-in electric vehicles (PEVs) , Photovoltaic charging facility (PCF), Distribution network, Taxes CC3200.

I. INTRODUCTION

With the developing worldwide mindfulness for a contamination free condition, rising vitality costs, PEVs are being presented by numerous car producers. It is realized that if 25% of the 176 million armadas of light vehicles in U.S were changed over to PEVs, it will match the whole U.S control era limit [1]. The multiplication in PEVs requires charging stations to satisfy their battery necessities. In spite of the fact that PEVs are being showcased with the objective of limiting the contamination from vehicles, the vitality prerequisites for charging the batteries is still met by control produced by petroleum product sources. Henceforth numerous scientists have proposed charging PEVs utilizing sustainable power sources like breeze and photovoltaic. Many pilot ventures are additionally in progress to charge PEVs from sun powered photovoltaic framework [2– 5]. Charging stations in light of wind control is still in the beginning stages however few endeavours have been declared [6]. Because of the social and financial advantages, inquire about on charging stations highlighting photovoltaic framework has pulled in analysts around the globe.

Utilizing sun based energy to charge batteries is not another thought. It is a dependable hotspot for charging light obligation electric vehicles, for example, golf trucks, bikes and air terminal utility vehicles [7]. Extensive scale sending of photovoltaic chargers in a parking area is broke down in [8]. A 2.1 kW photovoltaic accusing station coordinated of the utility at Santa Monica is portrayed in [9]. A trial control methodology for electric vehicle charging framework made out of photovoltaic cluster, imitated control network and programmable dc electronic load speaking to lithium particle battery emulator is introduced in [10]. PV parking area charging and different plans of action to accuse PEVs of sun powered vitality are examined in [11]. Financial matters of PV fueled working environment charging station has been considered in [12, 13]. The investigation demonstrates the practicality of a PV based working environment parking structure with advantages to the vehicle proprietor when contrasted with home charging, to such an extent that the carport proprietor will get the payback of establishments and upkeep cost and benefit inside the lifetime of the PV boards. As per [13] incorporating a sunlight based authority into a parking garage would bring about a considerably more quick payback-period, empowering far reaching establishment of sun powered limit. Reference [14] depicts how brilliant control methodologies can help PEVs and PV to coordinate with the present power frameworks. Co-advantages of huge scale sending of PEVs and PV frameworks has been examined in [15]. The investigation presumes that PV gives a potential wellspring of noontime era limit with respect to PEVs, while PEVs give a dispatchable load to low esteem or generally unusable PV era amid times of low request (especially in the spring).

According to the National family travel study vehicles are stopped for no less than 5 h in working environments [16]. Subsequently these spots are positive for creating charging station foundation however this would prompt genuine over-burdening issues at the dispersion level. Since overhauling of transformers is a costly choice for the utilities, this issue needs close consideration as the PEV infiltration increments. A few papers have been distributed to address the over-burdening of circulation transformers while charging the PEVs [17– 19]. All things considered, very little investigation has been accounted for to be firmly identified with the instance of diminishing the stacking on dispersion transformers utilizing a photovoltaic framework. In spite of the fact that few papers exist in the writing, they are for the most part limited to private circulation systems [20, 21]. There is a lot of stopping region in the U.S—a sensible portion of which is reasonable for PV establishment. This part surveys the present writing on the best in class framework proposed for PEV accusing offices incorporated of photovoltaic framework. The proposed control calculations, different savvy charging strategies and the financial advantages of photovoltaic charging offices (PCFs) are surveyed. Different power electronic topologies, control calculations and charging systems will be talked about. It will be demonstrated that a system of PCFs will quicken the arrangement of PEVs through financial and ecological advantages to the utilities and vehicle proprietors. The effect of matrix associated photovoltaic framework on the utility circulation systems is investigated. The reasonableness of utilizing PV control for charging PEVs is gotten to in this part.

Table 1. PV characteristics

PV type	Module price ($/Wp)	Efficiency (%)	Peak energy (Wp)	Total cost of PV ($)
Crystalline silicon	2.14	22	264	565
Polycrystalline silicon	1.74	15.5	186	324
Thin film	0.93	12	144	134

Deciding the size and sort of PV board is an essential thought for a sun powered parking space. Barely any papers [22, 23] have suggested the utilization of monocrystalline silicon as the most financially savvy sun powered cell sort for PV charging offices. Table 1 demonstrates the PV attributes of different modules, the pinnacle vitality created and the aggregate cost of the PV module. The PV board can be measured by taking the best and most exceedingly terrible months into thought. As portrayed in [24], the underlying expense of the PV board would be $20,000 when it is outlined in light of the most exceedingly terrible month of the year and $10,000 when it is planned in light of the greatest month of the year. Nonetheless, for the main case, surplus vitality can be infused into the network, to adjust the last cost.

The SimpleLink™ Wi-Fi® CC3200 LaunchPad™ improvement unit (with QFN-bundled gadget) is an assessment advancement stage for the CC3200 remote microcontroller (MCU), the industry's initially single-chip programmable MCU with worked in Wi-Fi availability. The board highlights on-board copying utilizing FTDI and incorporates sensors for a full out-of-the-case understanding. This board can be specifically associated with a PC for use with improvement instruments, for example, Code Composer Studio™ Cloud incorporated advancement condition (IDE) and IAR Embedded Workbench. This LaunchPad has driver bolster and a product improvement unit (SDK) with 40+ applications for Wi-Fi conventions, Internet applications and MCU fringe cases. Features of CC3200 are,

- CC3200 Wi-Fi remote microcontroller (MCU) in QFN bundle
- Industry's first gadgets to be Wi-Fi CERTIFIED™ at the chip level by the Wi-Fi Alliance™

- USB interface to PC for CCS/IAR utilizing FTDI USB drivers
- Streak refresh over the USB utilizing SimpleLink Programmer
- 2 20-stick connectors empowers similarity with BoosterPacks with included capacities (BoosterPack headers)
- Independent advancement stage including sensors, LEDs and push-catches
- Power from USB for the LaunchPad and in addition outer BoosterPack
- Works from 2 AA basic batteries
- On-board recieving wire and U.FL connector selectable utilizing a capacitor re-work
- Backings 4 wire JTAG and 2 Wire SWD
- GNU Debugger (GDB) bolster over Open On chip debugger (OpenOCD)

II. PROPOSED ARCHITECTURES FOR PV BASED PEV CHARGING FACILITIES

The charging units for PEVs can be either on-board or off-board. If there should arise an occurrence of an off-board charger, the charger is an outer unit while on account of an on-board charger it is a segment of the vehicle. On-board chargers are provided with air conditioning force and they comprise of an AC/DC rectifier, DC/DC support converter for control factor amendment and a DC/DC converter to charge the battery as appeared in Fig. 1. At present AC charging is being utilized to charge PEVs by methods for on-board chargers. The real disadvantage of this innovation is that it doesn't bolster quick charging as it is required to expand the power ability of the on-board charger in this manner expanding the cost and weight of the PEV. Subsequently to help quick charging of PEVs off-board chargers are proposed which specifically supply dc energy to the PEV charging channel. It is to be noticed that in the event of an off-board charger the whole power change (AC/DC) happens in an outside unit and in this way it is doable to build the appraisals of the power converters keeping in mind the end goal to help quick charging.

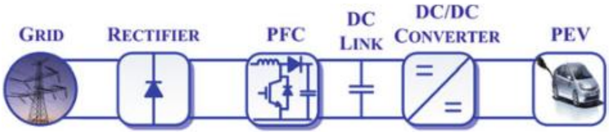

Figure 1. Conventional PEV charger

Air conditioning framework is being utilized since years for control dissemination and there are all around created foundation norms and advances. DC framework then again has many favourable circumstances, beginning with the way that general proficiency of the framework could be higher and it encourages the reconciliation of sustainable power sources with less power converters. Since PV exhibits produce dc control, a charging office including PV control encourages the charging of PEVs from a dc transport which is more viable, temperate and proficient since it doesn't include more power change stages not at all like AC charging. Different strategies have been proposed for coordinating PEV chargers inside a photovoltaic framework. A few power electronic topologies for a PCF have been proposed in the writing in view of the sort and the quantity of converters which are delegated:

A. Brought together design

B. Conveyed design

C. Single stage change with Z-converter

A. Brought together design

Itemized piece outline speaking to the concentrated design is appeared in Fig. 2. It comprises of a focal DC/DC help converter which plays out the capacity of most extreme power point following. The DC/DC chargers are coordinated with the PV charging office at the dc interface. Different PEVs can be charged by expanding the relating appraisals of PV boards and the related power converters. Each parking space must have a committed DC/DC buck converter which is associated with the dc connect. This setup is reasonable for charging stations in the scope of a few kilowatts. It is material for charging vehicles like golf trucks, grounds utility vehicles and so on which drive for short separations with low battery limits. Battery switch station fuelled by PV is a decent contender for embracing brought together engineering. In any case, this sort of arrangement does not bolster quick charging since establishment of a powerful DC/DC converter is exceptionally costly and it is helpless against single blame shutdown.

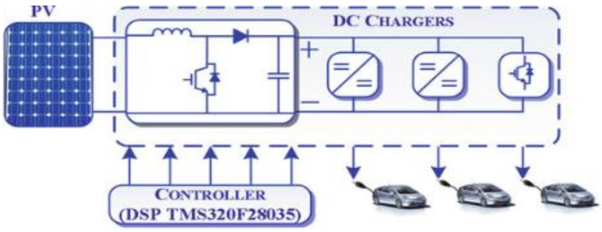

Figure 2. Centralized architecture

B. Conveyed Architecture

Nearness of DC/DC converters with high power evaluations is an imperative standard for quick charging of PEVs. This can be accomplished financially through appropriated engineering as appeared in Fig. 3. For this situation a few strings of PV boards are associated in arrangement. Each parking space has a committed PV board to help the charging of PEV and each string of PV boards is interfaced with their own DC/DC converter and offers a typical dc transport, which associates with an AC utility lattice through a bi-directional DC/AC converter. The DC/DC battery chargers are associated with the dc transport. Each parking space requires an individual DC/DC converter to charge the PEVs. The proposed design is appropriate for establishment at spots, for example, working environment, colleges, shopping centres and so forth where the request of PEVs and their length of remain in the parking garages are exceedingly probabilistic in nature. It is more dependable since the PEVs can be charged from the network amid the times of low insulation or overcast climate. Likewise, take note of that the additional vitality produced by PV can be infused into framework, which can be utilized to adjust the PV costs.

A PCF requires steady power from the PV or the network to take care of the popularity of PEVs. The unwavering quality of a PCF can be enhanced by including a vitality stockpiling unit, for example, a battery bank, ultra capacitor, energy unit and so on. For example in [35] the power created by rooftop top photovoltaic framework is put away in VRLA (valve-controlled lead-corrosive) batteries and energy components in a PEV docking station. The PEVs touching base at the docking station can be charged from two separate tracks i.e. utilizing the vitality from the VRLA batteries or the power devices. The utilization of capacity limit in PCFs has the accompanying focal points [36]:

- Efficient utilization of sustainable power sources
- Maximization of sustainable power sources commitment
- Better request and creation coordinate, better helper benefit supply and enhanced general unwavering quality

The centre thought of including an ESU (vitality stockpiling unit) is that the power request by PEVs can be either provided by the PV or the utility or through a nearby vitality stockpiling unit. Vitality got from the ESU can charge the PEVs amid specific possibilities, for example, islanding condition without the accessibility of PV control. It encourages the charging of PEVs utilizing least vitality from the framework. The charging station shows up as a dc microgrid with neighbourhood era from the PV framework, PEVs' as burdens and battery bank speaking to the capacity framework.

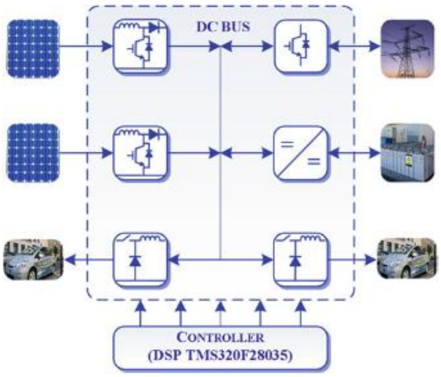

Figure 3. Distributed architecture

C. Single stage transformation with Z-converter

The twofold phase transformation portrayed in the above models is supplanted by a solitary stage utilizing a Z-converter [22] as appeared in Fig. 4. It doesn't require an extra DC/DC converter for each charging spot and a solitary DC/DC converter is utilized to give galvanic disengagement. The Z-converter has twofold tweak ability, and can shape the network current while at the same time managing PEV battery charging. The unit can be utilized for both power assimilation and infusion, with all the while controlled battery charging. This guarantees near solidarity control factor for every single working mode and power stream ways; accomplishing this with a solitary transformation stage can be viewed as a special preferred standpoint of the Z-converter. Besides, this topology has inalienable buck-help ability, permitting expanded voltage run on the PV or matrix. Notwithstanding the single transformation arrange, dependability, as opposed to proficiency or cost, is the solid purpose of the Z-topology. Likewise the single stage control handled by the Z-converter comprises of 120 Hz twofold line recurrence swell. This swell can be relieved by setting an extra decoupling capacitor over the PV source which presents conceivable deviation from consummately steady power extraction at the PV boards.

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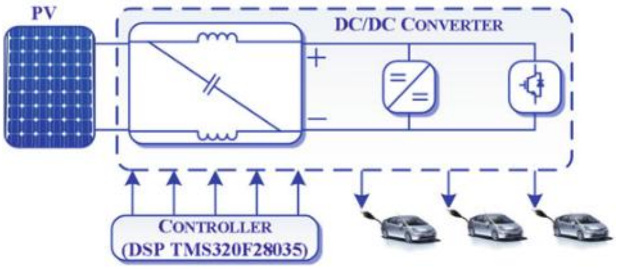

Figure 4. Single stage conversion with Z-converter

III.CONTROL STRATEGIES

Work environment based photovoltaic charging offices and private PV charging are the two accessible alternatives for charging PEVs utilizing sun oriented power. Contingent upon the sun based light, PEVs can be charged either from the photovoltaic or the conveyance network or both. The sunlight based charging station ought to circulate the power accessible at the PV boards to the PEVs viably and securely. Normally PEVs touch base at the accusing office of various State-of-Charge (SOC). More than frequently, the measure of PV control accessible to charge various PEVs is constrained. Moreover, the PV source is stochastic in nature, its energy trademark is nonlinear and the PEV batteries to be charged ought to be inside sure voltage and current breaking points. Thusly, this procedure requires smart control of the power molding unit to deal with the heading of energy stream in PV incorporated charging stations. A few calculations have been proposed in the writing which vary altogether in view of the sort and area of the PCF. The calculations likewise contrast in light of the different control parameters, for example, PV control, stack request, condition of-charge and so forth. In like manner they can be delegated takes after:

A. Private Photovoltaic Charging

B. Battery Switch Stations

C. Working environment Photovoltaic Charging

A. Private Photovoltaic Charging

Barely any creators [37– 40] have proposed a design for a matrix associated private photovoltaic framework that can be utilized to charge PEVs and additionally to supply the current family unit loads. The control calculations rely upon the power produced by the PV and the SOC of the PEV battery. Raul et al. proposed a private load coordination component to charge PEVs. Contingent upon the heap request of the circulation transformers, the PEVs can be charged utilizing sustainable power source (PV/Wind) or the power from the lattice. Every family is introduced with a housetop PV framework and a little scale wind turbine. A private microgrid made out of housetop boards and a biodiesel generator to charge PEVs and supply AC/DC family unit loads. To share the heap among the sources, master slave control technique is utilized. The operation of the private microgrid relies upon the PV control, stack request, SOC of the battery stockpiling and levy set by the utility. The vast majority of the PEVs are not accessible for charging amid daytime at private offices. Henceforth, this procedure requests for an extra part as a vitality stockpiling unit which won't not be monetarily alluring for an individual mortgage holder. Private charging is favourable for families with more than one PEV.

B. Battery Switch Stations:

A PV based battery control technique for charging numerous batteries in a sunlight based battery charging station (SBCS). The engineering of the SBCS is like the one appeared in Fig. 2.6 yet the DC/DC chargers are supplanted by bi-directional switches. The proposed control technique initially charges every individual battery until the point that they achieve a similar voltage level and afterward charges the different batteries in parallel at the same time as indicated by the battery charging period and the accessible sun powered vitality. This control system dispenses with the utilization of different DC/DC converters per battery association, making the SBCS less confounded and temperate. Despite the fact that being conservative, the proposed engineering does not consider the situations when the PV board is not creating any power or producing power in overabundance. Consequently it can't be considered for charging PEVs. The vitality trade system relies upon the battery swapping interest of the PEVs and power produced by the PV. A calculation is proposed to charge PEV batteries utilizing the most extreme vitality from PV.

C. Work environment Photovoltaic Charging

In few cases, creators have proposed embeddings a DC/DC battery charger at the dc connection of the lattice associated PV framework. By measuring the power created by the PV and the power request of the PEV, the control calculation guarantees the charging of the PEV battery from the proper source.

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In view of the irregularity between the PV control and the heap request, different conceivable situations are depicted. If there should arise an occurrence of, the power stream in a PV parking area is overseen through an arrangement of PC controlled transfers. PV boards of various evaluations are interfaced with PEV chargers and the power network through PC controlled transfers. Contingent upon the light levels, the transfers guide the whole PV energy to the PEVs or the lattice or both. A few PV boards are interfaced with the dc transport through an arrangement of DC/DC converters. The DC/DC converter brilliantly controls the power stream to the PEVs in view of a specific preset points of confinement of the dc transport voltage. In light of as far as possible the vitality change unit encourages three way vitality stream among the power network, PV modules and PEVs.

The idea of dc transport flagging has been proposed by a few creators to plan energy to dc stacks in a microgrid. Maybe a couple of them have stretched out this idea to charge PEVs in a microgrid domain. The brilliant charging station can work in independent mode and network associated mode. The exchanging between different modes is encouraged by the variety in dc connect voltage levels prompted because of the change in sun oriented insulation. Amid the time of low sun based insulation and pinnacle stack on circulation transformer, the controller moves the charging of PEVs to non-top period. The proposed control calculation is straightforward as it includes just a solitary parameter i.e. dc connect voltage to deal with the course of energy stream in the charging station. It encourages the charging of PEVs utilizing least vitality from the lattice with no unfriendly effects on the dissemination transformer. The accompanying areas clarify the idea of dc connect voltage detecting and its application for control and administration of PV controlled charging offices.

IV. POWER MANAGEMENT ALGORITHM

The definite circuit design for the proposed work environment based charging office is appeared in Fig. 2.11. The engineering comprises of a few strings of PV boards interfaced to their own DC/DC converters which share a typical dc transport. The DC/DC help converter plays out the capacity of greatest power direct following (MPPT) toward encourage the operation of PV board at the most extreme power point. The vitality stockpiling unit (ESU) is associated with the dc transport by means of a bi-directional DC/DC buck-help converter. The ESU will bolster the charging of PEVs when there is no power accessible either from the lattice or the PV. The battery pack in the ESU can be charged either from the matrix amid off pinnacle hours or from the PV after all the PEVs have been charged in the charging office. DC/DC buck converter associated with the dc transport controls the charging of the PEV. The control depiction appeared for the charging office in Fig. 5 depends on the prerequisites for two PEVs. Various PEVs can be charged by having separate buck converters introduced for each charging point. The charging office is associated with the power appropriation arrange through a DC/AC bi-directional network tied converter.

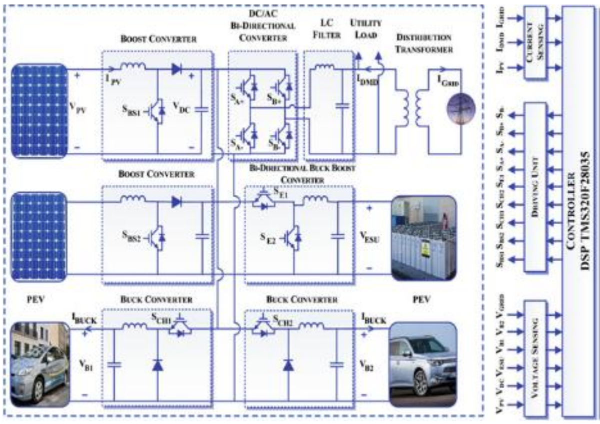

Figure 5. Detailed circuit configuration of the proposed architecture

The control unit screens and controls the power stream between the source and PEV. As appeared in Fig. 5 the control unit produces the changing signs to control the different power converters in the charging office in light of the voltage and current esteems detected by the voltage and current detecting units. V_{PV}, voltage over the PV exhibit and I_{PV}, the present spilling out of the PV cluster are utilized to execute MPPT by methods for incremental conductance calculation. V_{DC} is the greatness of the voltage at the dc transport, V_{B1} and V_{B2} are the distinguished battery voltages of the PEVs which give a measure of the condition of-charge (SOC) while VESU gives the measure of the SOC of the ESU. IDMD speaks to the stacking state of the circulation transformer, I_{grid} is the present sustained into the network by the DC/AC converter and V_{Grid} is the matrix side voltage.

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V. MODES OF OPERATION

The operation of the charging station can be sorted into four modes: Mode-1 (framework associated correction), Mode-2 (PV charging and lattice associated amendment), Mode-3 (PV charging) and Mode-4 (matrix associated reversal). An arrangement of factors I_{DMD}, $I_{DMD-max}$, V_{DC-1}, V_{DC-2}, $V_{DC-3,}$ V_B and V_{BH} are utilized to depict the methods of operation. I_{DMD} speaks to the appropriation transformer load and $I_{DMD-max}$ speaks to the pinnacle stack state of the transformer. VDC is the voltage at the dc transport. V_{DC-1}, V_{DC-2} and V_{DC-3} are the three picked reference voltage levels of the dc transport. V_B and V_{ESU} are the distinguished battery voltages of the PEV and the ESU. V_{BH} is the battery voltage relating to the limit estimation of the condition of-charge (TSOC). The charging of PEV ought to be ended once the battery voltage V_B is equivalent to V_{BH}. Fig. 6 demonstrates the course of energy stream amid different methods of operation of the charging station.

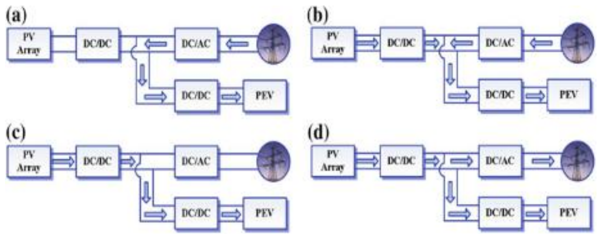

Figure 6. Direction of power flow during the operation modes

The four methods of operation are portrayed as takes after:

Mode-1: $V_{DC} < V_{DC-1}$: Grid-associated amendment

Case-1: $V_{DC} < V_{DC-1}$ and $I_{DMD} < I_{DMD-max}$

In this mode the photovoltaic framework does not create any power either because of low radiation or terrible climate conditions. The DC/DC support converter is secluded and the power required to charge the PEV is given by the framework. Whenever amid this mode if the dc interface voltage surpasses V_{DC-1}, the control movements to Mode-2. The DC/DC buck converter controls the yield voltage to charge the PEV. As the lattice is at off pinnacle, it keeps on providing power till the vehicle is totally charged. The controller ends the charging of PEV by handicapping the DC/DC buck converter when V_B surpasses V_{BH} and the framework supplies energy to charge the battery pack in the ESU.

Case-2: $V_{DC} < V_{DC-1}$ and $I_{DMD} \geq I_{DMD-max}$

This mode is like Case-1 yet with an expansion in neighbourhood request on the dispersion transformer. To decrease the weight on the matrix, the charging of PEV is ended briefly by de-actuating the lattice associated bi-directional DC/AC converter. As the appropriation transformer is mitigated from the extra weight of charging the PEV, it can keep providing energy to the neighbourhood loads amid the pinnacle time. Amid this period the PEV can be charged by the ESU if the put away vitality is adequate to provide food the requirements of PEV charging. Once the lattice has returned to off pinnacle condition (i.e. $I_{DMD} < I_{DMD-max}$) the charging of the PEV is re-established and the controller screens its charging.

Mode-2: $V_{DC-1} \leq V_{DC} < V_{DC-2}$: PV charging and matrix associated amendment

In this mode the power produced by the photovoltaic framework is not as much as the power required to charge the PEV. In this manner all the power created by the PV is exchanged to the PEV and the shortage is provided by the network. The dc connect voltage differs with the adjustment in illumination. This prompt change in the dc connect voltage is detected by the controller to produce an equivalent voltage at the yield of the DC/AC bi-directional converter through the procedure of amendment. On the off chance that anytime I_{DMD} surpasses $I_{DMD-max}$ the bi-directional DC/AC converter is disengaged from the lattice. The PV framework keeps charging the PEV though the lattice caters the pinnacle stack request.

Mode-3: $V_{DC-2} \leq V_{DC} < V_{DC-3}$: PV charging mode

In this mode the PV framework produces all the power required to charge the PEV. As the framework does not supply any power it is confined by the bi-directional DC/AC converter. The controller guarantees that the PEV is not over charged by ending its charging once V_B surpasses V_{BH} (voltage comparing to 95 % condition of charge of the PEV battery). This mode happens as long as the dc connect voltage is in the middle of V_{DC-2} and V_{DC-3}.

Mode-4: V_{DC}-connect $\geq V_{DC-3}$:

PV charging mode and Grid reversal mode The PV exhibit produces abundance control once the dc connect voltage surpasses $_{VDC-3}$. This extra power created by the PV exhibit is sent to the framework through the bi-directional DC/AC converter. Once the PEVs are charged, all the power from the PV source is sent to the matrix. The mode at that point takes after typical operation of PV era frameworks.

VI. SIMULATION STUDIES

In order to validate the proposed control calculation re-enactments were done in Matlab Simulink utilizing the simpower systems tool stash. The reference dc transport voltages i.e. V_{DC-1}, V_{DC-2} and V_{DC-3} are set at 50, 250 and 350V. The reference dc interface voltage levels are chosen in view of a preparation mode wherein the PEV stack is kept steady and the sun oriented light is permitted to fluctuate in steps. The estimations of $I_{DMD-max}$ and Tsoc are set at 80A (top to crest) and 95 %. Toyota Prius module cross breed has been picked as the PEV which has an aggregate battery limit equivalent to 4.5kWh and ostensible voltage equivalent to 48V. The rms estimation of AC network voltage is 240V. A PV board of rating 5.5kW has been displayed taking the battery limit of the PEV into thought. The reference dc transport voltages have been picked contemplating the adjustment in sun conditions from early morning to late night. As the dc transport voltage shifts, the source from which the PEV is charged likewise fluctuates as needs be. Reproduction comes about portraying the advances between different modes are demonstrated as follows.

Fig. 7 demonstrates the progress of the matrix from off crest to on crest when the charging station is working in mode 1. The stacking condition is gotten to by measuring the current (I_{DMD}) on the optional side of the dispersion transformer. At first the matrix is at off pinnacle and consequently the AC network conveys the power required to charge the PEV and other nearby loads. As appeared in Fig. 7, from 1.5 to 2.0 s the Fig. 7 Matlab simulink yields for change from mode-1 case-2. a DC transport voltage. b Current spilling out of the circulation transformer to the heaps and the PEV. c Power conveyed to the PEV (charging power). d Output voltage of the DC/DC buck converter current streaming in the auxiliary side of the circulation transformer is under 80A. With the expansion in utility load at 2.0 s, I_{DMD} surpasses 80 An ($I_{DMD-max}$). The charging of the PEV is ended when the present spilling out of the dissemination transformer, I_{DMD} surpasses $I_{DMD-max}$. This is done to diminish the anxiety being forced on the AC network amid the pinnacle time. Consequently the power devoured by the PEV lessens to zero amid the pinnacle time as appeared in the figure.

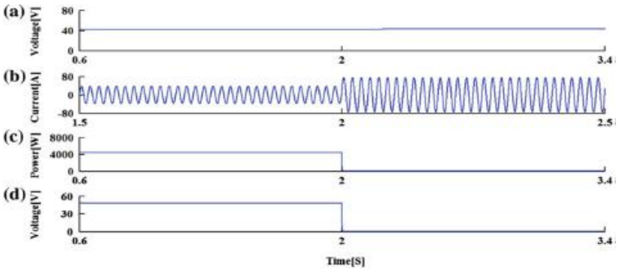

Figure 7. Matlab simulink outputs for transition from mode-1 case-2. a DC bus voltage. b Current flowing from the distribution transformer to the loads and the PEV. c Power delivered to the PEV (charging power). d Output voltage of the DC/DC buck converter

The re enactment comes about for the progress from mode 2 to mode 3 are appeared in Fig. 8. Amid the underlying stages the dc transport voltage is under 250V and framework keeps on providing the deficiency energy to charge the PEV. Once the dc transport voltage surpasses 250V, the PV framework alone provides food the charging of PEV. The power spilling out of the PV and the Power Grid is appeared in Fig. 8. As appeared in the figure, the shortfall energy of 1,000 W to charge the PEV is provided by the lattice in mode-2 and it doesn't supply any power in mode-3 as the PV alone obliges the request of the PEV.

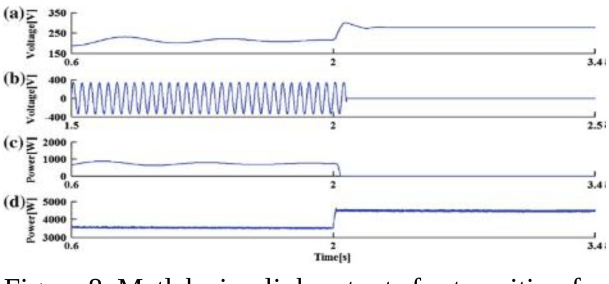

Figure 8. Matlab simulink outputs for transition from mode 2 to mode 3. a DC bus voltage. b Voltage of the grid. c Power delivered by the grid. d Power delivered by the PV array

The progress from mode 3 to mode 4 is appeared in Fig. 9. With the dc transport voltage surpassing 350V there is an expansion in control spilling out of the PV in mode 4. The PV framework bolsters this overabundance energy to the lattice notwithstanding charging the PEV. The sinusoidal yield of the DC/AC bi-directional converter demonstrates that it goes about as an inverter for this situation. So as to keep up the vitality adjust the dc connect voltage is kept consistent at 360V. At last Fig. 10 demonstrates the end of the vehicle charging when SOC = Tsoc.

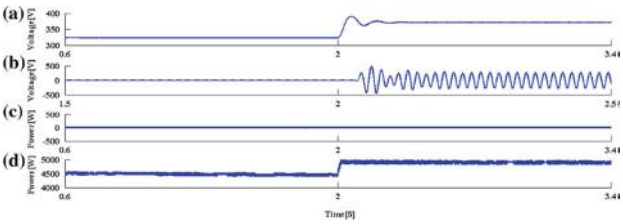

Figure 9. Matlab simulink outputs for transition from mode 3 to mode 4. a DC bus voltage. b Output voltage of the DC/AC bi-direction converted (inverter). c Power delivered by the grid. d Power delivered by the array

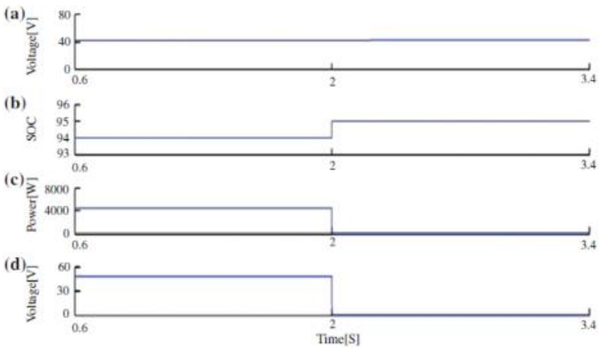

Figure 10. Matlab simulink outputs for transition in state-of-the-charge during mode-1. a DC bus voltage. b State-of-charge of the PHEV battery. c Charging power delivered to the PHEV. d Output voltage of the DC/DC buck converter

VII. CONCLUSION

To relieve the stacking on dissemination transformers because of PEV charging, savvy accusing systems coupled of sustainable power source assets are the need of great importance. This section talked about the present condition of the foundation for PV fuelled charging offices for PEVs. A few power electronic topologies are exhibited and analyzed. Control techniques are evaluated for private and working environment based photovoltaic charging. The part proposed a charging station design in view of dispersed topology. A remarkable control procedure in view of dc interface voltage detecting, which chooses the course of energy stream is displayed and the different methods of operation have been depicted. The reasonable plausibility and adequacy of the proposed control technique has been approved by recreation and test comes about. The proposed control technique in light of the adjustment in dc connect voltage level because of the adjustment in illumination of the sun, is basic and one of a kind. The vitality administration calculation encourages charging of the PEVs utilizing least vitality from the utility with a sort of interest administration to enhance the vitality productivity. Brilliant charging strategies like the one proposed in this section will cause stay away from real cost to redesign circulation transformers and other substation hardware with the expansion in PEV stacks on the dissemination framework.

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Demand Response of the Hybrid System Supported Vehicle to Grid Technology

[1]V.Divya, [2]R.Senthilkumar and [3]R.Vijayakumar,
[1,2,3]Department of Electrical and Electronics Engineering, SNS College of Technology, Coimbatore, TamilNadu, India

Abstract - This paper proposes the response of lighting load supported by plug-in electric vehicle with the combination of hybrid system. The hybrid system is comprised of solar and wind. The hybrid system is connected to the DC bus of the service provider, where it acts as uninterrupted power supply unit. Maximum utilization of the hybrid system is achieved by power point tracking system and converters. The service provider supports the charging system of the batteries, while the vehicles are parked. Similarly if any interruption occurs, the power of battery also supports the service provider. This two way power transfer is achieved by using back-to-back converter. The results obtained illustrate the better power transfer form hybrid system to grid to battery of the vehicles.

Keyword- *Vehicle to Grid(V2G), Plug-in Electric Vehicle(PEV), Hybrid system, Back-to-back converter, State of Charge(SOC), Depth of Discharge(DOD).*

I. INTRODUCTION

Increase in pollution level and global warming are the major area of concern as the era in current century. The emission of greenhouse gases such as Carbon dioxide(CO_2), Nitrogen oxide(NO_X), Carbon monoxide(CO), and unburned hydrocarbons in large amount causes the environmental pollution and global warming. These emission are caused by the basic human requirement such as transportation, industrial purpose, commercial purpose and electricity generation. In India 87% of greenhouse gases ore emitted by the transport sector. the modern transport sector comprises Internal Combustion(IC) engine which emit the toxic gases which are harm to environment and human health. Eventually, there has been a search for alternative clean and efficient vehicle. The continuous rise in price and decreasing level of fuel availability the Electric Vehicles(EVs) and Hybrid Electric Vehicles(HEVs) are evolving as alternative to reduce the pollution and reduce the consumption of fuel.

In Electric Vehicles(EVs) the battery pack is connected with an electric motor and provides traction power through transmission. The batteries in the electric vehicles are charged primarily by the battery charger which receives power from the external electrical source. During regenerative braking, the motor act as a generator and provides power back to the batteries and during this process the vehicle slow down compared to battery discharging. It is simple in construction. The speed range and driving range is limited according to the size of the battery and recharge time. It depends on the battery type and charging method.

In Hybrid Electric Vehicles(HEVs) the source to drive the vehicle is the combination of both energy storage device that is battery and Internal Combustion(IC) engine. Batteries are charged primarily by the Internal Combustion(IC) engine and generator. In Plug-in Hybrid Electric Vehicles(PHEVs) the batteries are charged by the external electric source through the battery charger. It reduces the run time of the Internal Combustion(IC) engine and allow the vehicle to run in electric power from the batteries only. The batteries are charged by the battery charger which is plug in to the external electric source such as utility or other energy sources. The Plug-in hybrid Electric Vehicles(PHEVs) has more battery pack than a Hybrid Electric Vehicles(HEVs). The Plug-in Electric Vehicles(PEVs) reduces the consumption of fuel through Internal Combustion(IC) engines due to the external battery charging. To eliminate the use of fuel and emission through the transportation the Plug-in Electric Vehicles(PEVs) are emerging now-a-days. The is no Internal Combustion(IC) engine in Plug-in Electric Vehicles(PEVs). The batteries are charged via battery charger which is powered by the external electrical source. Thus major automotive manufacturers began to launching Plug-in Electric Vehicles(PEVs) in 2010.

II. PLUG-IN ELECTRIC VEHICLE (PEV)

The Plug-in type electric vehicles are utilize the on-board battery chargers to recharge the batteries of Plug-in Electric Vehicle(PEVs) using utility power. The simplest configuration of the Plug-in Electric Vehicle(PEV) is shown in fig. 1. The simplest configuration of Plug-in Electric Vehicle(PEV) consists of motor controller to provide power to the motor, which supplies in-turn power to the vehicle wheels for the traction. The permanent magnet electric motors are in most of today's Electric Vehicles(EVs) which can also act as a generator when brakes are applied. The generator will recharge the batteries. When the vehicle is must to be stopped then the friction brakes are used. In regenerative braking the permanent magnet electric motor act as a generator and generates the electric power which is power back to the batteries to charge it. This process will slow down the vehicle.

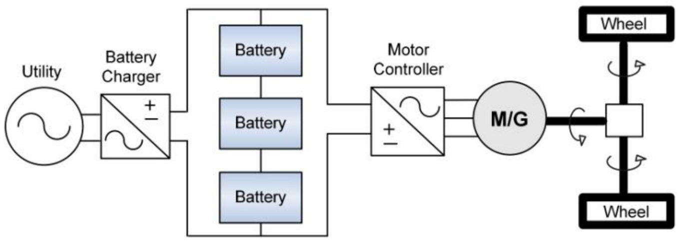

Fig. 1. Typical EV configuration

In proposed system the external source that is energy utility used to charge the batteries is Hybrid Energy System(HES). The hybrid system is the combination of two energy sources, one is renewable energy source and another one is either renewable or non-renewable energy source. In other words the hybrid system can be defined as the energy system is fabricated to extract the power from two energy sources called hybrid system. In most of the hybrid systems the two energy sources are renewable energy systems. Advantages of the hybrid energy system are efficiency, reliability, low cost and low emission.

In this proposed system combination of solar and wind energy systems are used as a Hybrid Energy System(HES) to generate the power. Solar energy and wind energy has the advantages over other conventional energy sources such as greater availability in nature, pollution free and no need of specific location for the erection of the system.

III. VEHICLE TO GRIG(V2G) TECHNOLOGY

The Vehicle to Grid(V2G) is an interconnection between electrical network that is grid or utility companies and Plug in Electric Vehicle(PEV) to sell electricity or store electricity in order to meet the demand response of consumers.

When vehicle is connected within the electrical network it help to balance the electrical demand of the network is known as "valley filling" that is storing power and "peak shaving" that is sending power back to the network which defines the value of Vehicle to Grid(V2G) technology. By utilizing this technology utilities can provide stable, regulatory power to meet sudden increase in the demand and store the energy when it is high.

The Vehicle to Grid technology can be classified into two types as unidirectional V2G and bidirectional V2G. Unidirectional V2G means that the power flow is in only one direction that is the electric vehicle can charge by utility power. Bidirectional V2G means that the direction of the power flow in both forward and backward direction. In forward direction the batteries in the PEVs are charged via battery charger which is fed from the grid. In backward direction the grid is supported by the batteries of PEVs to meet the demand of the grid. thus the power can flow from grid to vehicle(G2V) as well as vehicle to grid(V2G).

IV. PROPOSED SYSTEM

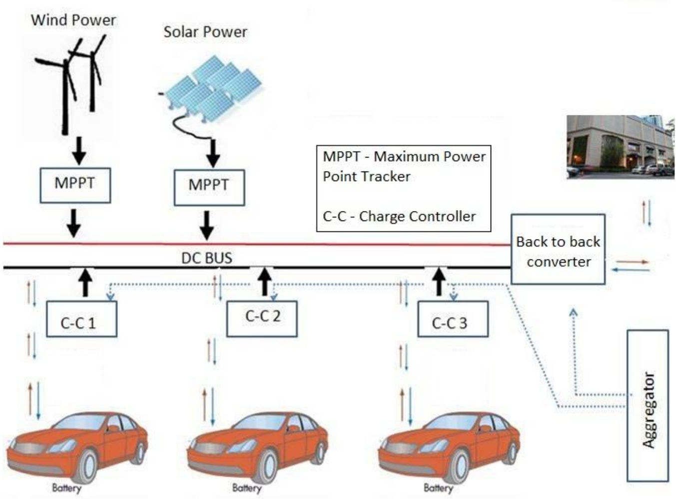

Fig. 2. Proposed system of V2G technology

The fig. 2 shows the proposed system that is the hybrid system supported Vehicle to Grid(V2G) technology to support the lighting loads of the commercial building. The proposed system consists of hybrid system, PEVs, back to back charging controller and DC bus. The hybrid system comprises of wind energy system and solar energy system. The output of the wind energy system is AC and it is converted into DC by rectifier unit and fed to Dc bus. The output of the solar system is DC. It is connect with the DC bus which has the rating of 500V DC through the Maximum Power Point Tracker(MPPT) which tracks and provides the power to the DC bus according to the requirement of DC bus. The MPPT is controlled by the Perturb and Observe(P&O) controller. It is the common algorithm used in MPPT. This uses a simple feedback arrangement and measured parameters. The voltage of the module is give perturbation periodically and the corresponding output power is compared with the reference power. The error signal is observed and the array is arranged according to the error signal. It may increasing or decreasing signal. This is called Perturb and Observe algorithm. The flow chart of the algorithm is shown in fig. 3. Because of its high efficiency this algorithm is used in proposed system.

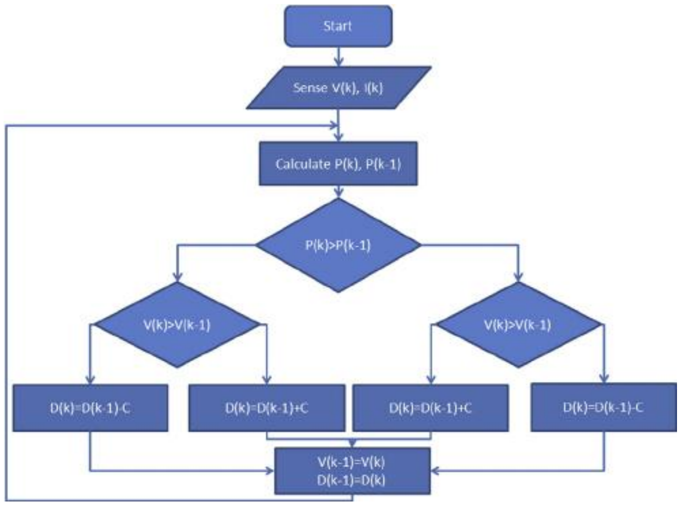

Fig. 3. P&O Algorithm

The batteries used in the Plug-in Electric Vehicles(PEVs) has the charging voltage as 24V, but the DC bus voltage is 500V, so the 500V of DC bus is need to step down into 24V of DC. When the power is reversed that is V2G flow the 24V of batteries are need to step up into 500V of DC. For this conversion process the proposed system uses the back to back/ DC-DC bidirectional charging controller as shown in fig. 4. By this bidirectional DC-DC converted the energy stored in Plug-in Electric Vehicles(PEVs) can be fed back to the grid. This is called V2G process.

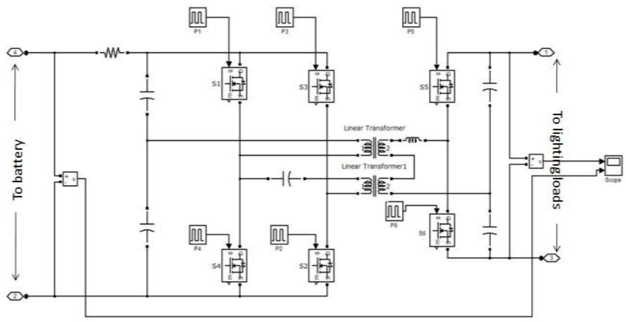

Fig. 4. Back to back charge controller

When the number of Plug-in Electric Vehicles(PEVs) connected in parking is large and the power from the hybrid system is not enough to charge the batteries then the vehicles are charged by the energy from the grid which need to convert the single phase 230V AC into 500V DC. When the demand of the service provider rises the batteries which has the State of Charging(SOC) as 90% will start to discharge and supports the lighting loads. It is in need of converting 500V of DC bus voltage into 230V of AC. For this purpose the back to back converter is used which is comprised the both inverter and converter.

V. SIMULATION RESULTS

The simulation results for the proposed vehicle to grid technology using hybrid system is the DC bus voltage is 500V. The hybrid system of PV and wind voltage is optimized to 500V using MPPT based P&O algorithm. It is shown in fig. 5. Therefore the DC bus voltage is 500 volt that includes the PV and the PMSG. In normal operating condition of the system the bidirectional charge controller step downs the 500V of DC bus into 24V as shown in fig. 6. Similarly, when there is a need of battery to discharge to support the lighting loads of the commercial building it is discharged and 24V of battery is step up to 500V by using bidirectional charge converter, it is shown in fig. 7.

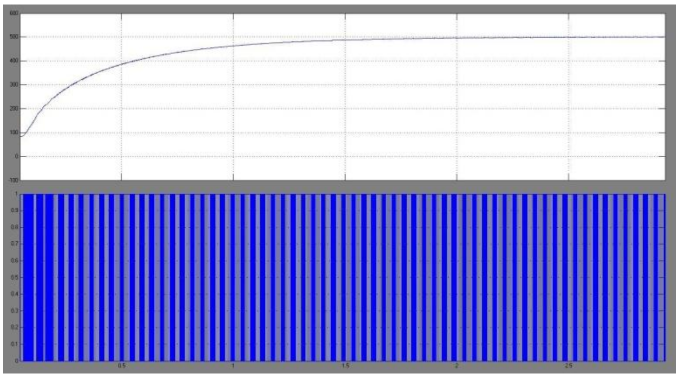

Fig. 5. Output waveform of MPPT

The back to back converter is used which will work as a bidirectional converter. When the battery is charging it converts 230V AC to 500V DC. During fault, the back to back converter converts the DC bus voltage into AC to support the lighting loads of the commercial building. Fig. 8 shows the single phase voltage waveform that is converted by the back to back converter from the 500V of DC bus. Fig. 9 shows the DC voltage waveform from the back to back converter to DC bus.

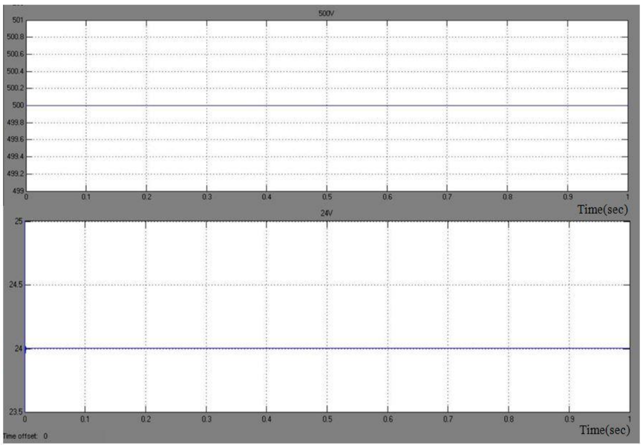

Fig. 6. Conversion from 500V DC to 24V DC

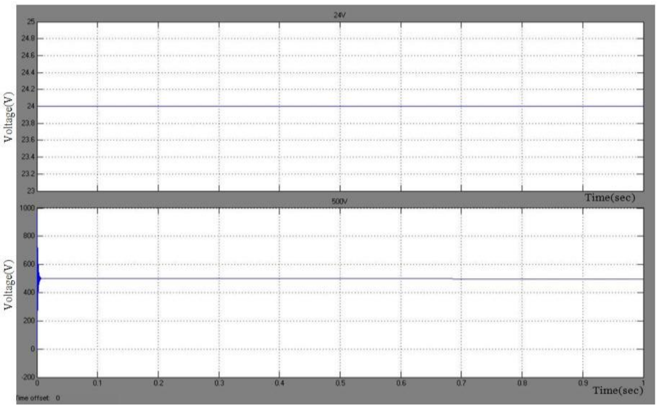

Fig. 7. Conversion from 24V DC to 500V DC

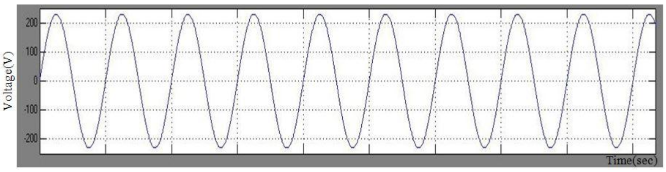

Fig. 8. 230V AC from the back to back converter

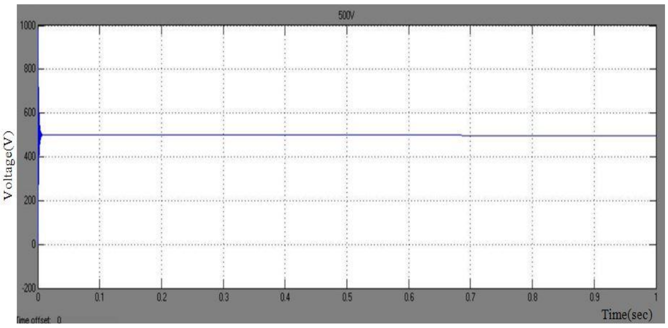

Fig. 9. 500V DC from back to back converter

CONCLUSION

In this paper the combined system of hybrid and electric vehicle is proposed. The combined system is supported for lighting loads at commercial building for uninterrupted power supply. The electric vehicles are charged during the normal operation. When any interruption occur in the building, the vehicles that are charged by 90% will support the lighting loads. The back to back converter is used in this propose system which works bi-directionally. The DC output from the vehicle is fed to back to back converter which converts DC to AC and supports the lighting loads during any interruption. Similarly when the power from the hybrid system is not sufficient to charge the battery, the power from the grid can be used by converting AC to DC by using back to back converter and the battery can be charged.

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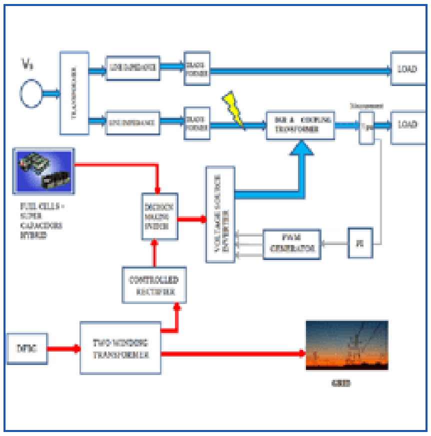

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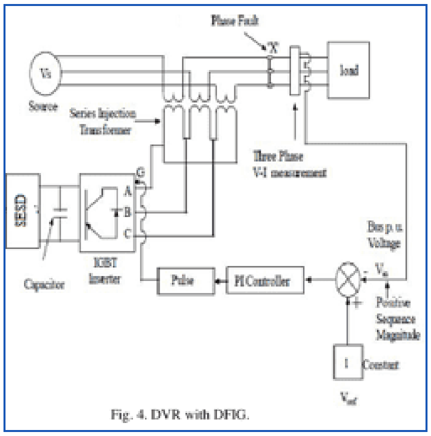

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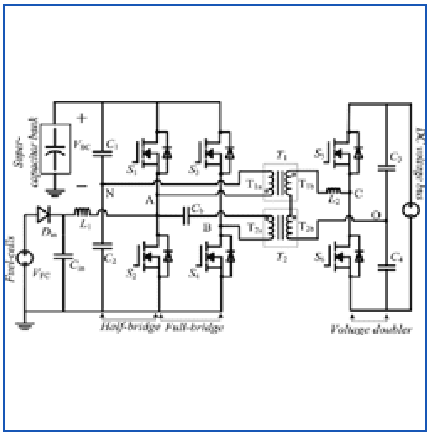

Figure 5

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USING ELECTRIC VEHICLE AND RENEWABLE ENERGY SOURCES

K.Malarvizhi[1], R.Vijayakumar[2] and S.Divyapriya[3]
[1]Kumaraguru college of Technology, Coimbatore, Tamilnadu.
[2]SNS College of Technology, Coimbatore, Tamilnadu.
[3]Karpagam University, Karpagam Academy of Higher Education, Coimbatore, Tamilnadu.

Abstract

The modern civilization and urbanization has led to the increase in conventional transportation and industrialization. This has created enormous CO_2 emission which drastically degrades the environment. Hence, this is a urgent need to find alternate sources of energy for transport and industry. This paper proposes a new energy management system for controlling electric vehicles and renewable power sources which are considered as alternative solution for CO_2 emission. The system includes standalone PV system and plug in electric vehicle. The demand side management is designed such a way that the load is splitted in the two modes namely online and offline mode. During online mode based on pricing and demand like Time of use pricing, critical peak pricing, real time pricing, peak load reduction credit criterias to be used. In offline mode based on previous and forecasting data we are classified in to peak hours and off peak hours. Smart meter is used to calculate import and export powers and IoT technology is used to manage all the things like data logging online price fetching process. In this paper we are dealing with MATLAB/SIMULINK model for PV and Electric vehicle and their corresponding simulation results
Keywords: Plug-In Electric Vehicle(PEV), Photovoltaic system(PV), Online mode, Offline mode, Peak demand, Off peak demand, Time of Use(TOU), Critical Peak Pricing(CPP), IoT, Smart meter.

1. Introduction

The advancement in urbanization and civilization has increase the demand of electrical energy as fast as the consumption of electrical energy in the world is increase. This has also led to increase in industrialization and transportation. These factors produces enormous CO_2 emission which will drastically increase the environmental pollution.

In proposed system these two alternate sources are connected with the existing grid for the better utilization of the system. Controlling of each source is based on the system demand. Based on this the system response to the demand is splitted into two types. One is online mode. In this mode the response of the conventional source is based on pricing such as Time of use pricing, critical peak pricing, real time pricing, peak load reduction credit criteria[3]. Another mode is offline mode. In this mode the response is based on previous and forecasting data such as peak time and off peak time[4]. In both the modes the alternate energies are managed efficiently to support the grid. This system is beneficial for the owner of PV system as well as for the owner of PEV. It is achieved by recording the energy consumed from the grid and delivered to the grid from the PV and PEV by the new generation energy meter is called Smart Meter. All the data of this system is recorded and processed in IoT because of it has the advantage of tracking real time marketing.

2. Types Of Management

Based on the demand the response of the system is managed by two types. They are offline mode and online mode.
offline mode management

3. Electrical Demand Response

Consider the single phase grid which supplies for different types of loads. The PV and PEV is connected with the grid through inverter to convert the DC output of PV and PEV to single phase AC supply. In this proposed system the PEV is charged by the energy from the PV. It will not fetch energy from the grid. Both the sources are support the grid when the demand is high. The block diagram of the proposed system is shown in figure 2.

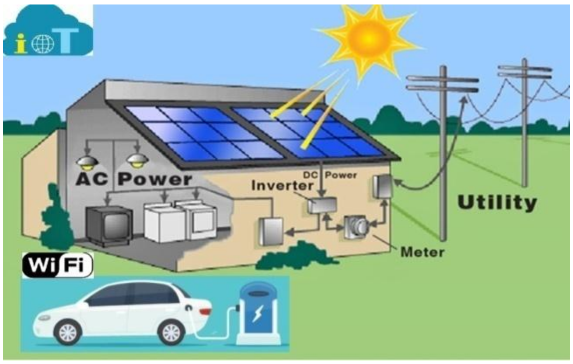

Figure 1. Schematic diagram of the proposed system

Let consider the 230V single phase grid as shown in figure 2. The specification of PEV battery is 25kW power rating, charging voltage is 240V DC, the output voltage is converted into 230V AC. The DOC of battery is 35% and when it reaches 99% it stops from charging. When it reaches 75% it is ready to support the grid. In PV system there are two panels connected in series to produce 240V DC which is need to charge PEV is shown in figure 3

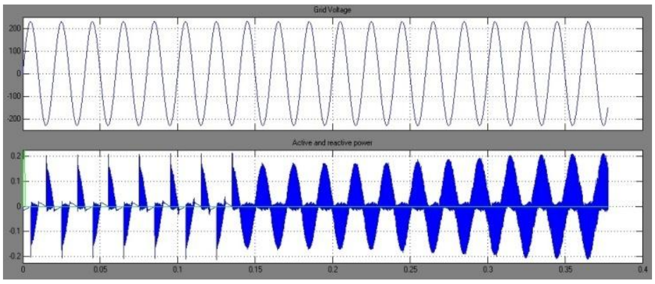

Figure 2. Single phase grid voltage

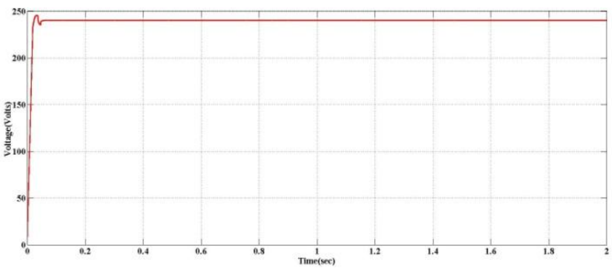

Figure 3. Output voltage of PV

. Each panel consists of 80cells each cell is modelled to produce 1.5V. To get maximum power from the PV, Maximum Power Point Tracking is implemented with this PV. Consider the power rating of load, grid, PV and PEV as 100kW peak and 50kW base, 30kW and 25kW respectively. The PEV can support from 17kW to 70kW based on manufacturers. In average it is taken as 25kW.

Offline mode of operation

It is based on forecasting. In this mode of operation the peak time and peak off time is predicted and programmed the source to support the grid at peak time and disconnected at off peak time automatically. This calculated by the forecasting data which is recorded in IoT. The peak time of the day is 6A.M. to 9A.M. and 4P.M. to 8P.M., remaining are considered as off peak time. In off peak time the PV supplies to PEV to charge the battery. In peak time it tend to support the grid. If any sudden peak arises it will not support because the controlling is pre programmed.

Consider the SOC of PEV is 98% in off peak time then the PV supplies to PEV to increase the SOC. The figure 4 shows that increase in SOC from 98% to 99%.

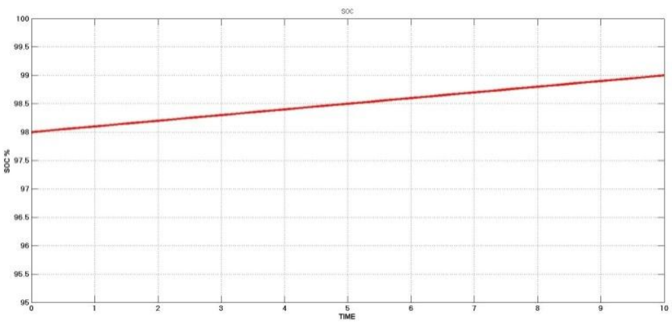

Figure 4. SOC level of PE

The figure 5 shows the response of the system at peak and off peak time. Consider the duration 6.a.m. to 9.a.m. and 4p.m. to 8p.m. as peak time and remaining are off peak time. At off peak time the PV charges the battery of PEV i.e. at the incident 10a.m to 3p.m. At peak time PV will not charge it starts to support the grid. If the SOC of PEV reached 75% at that time it is also starts to support. In this proposed system SOC is considered as 98% so, it is also support the grid. consider the duration 6.a.m. to 9.a.m. and 4p.m. to 8p.m. the demand is peak. Consider the sudden peak arises at the duration of 1p.m. to 2p.m. the system will response to meet the sudden demand because of its pre-programmed nature. It is shown in figure 6.

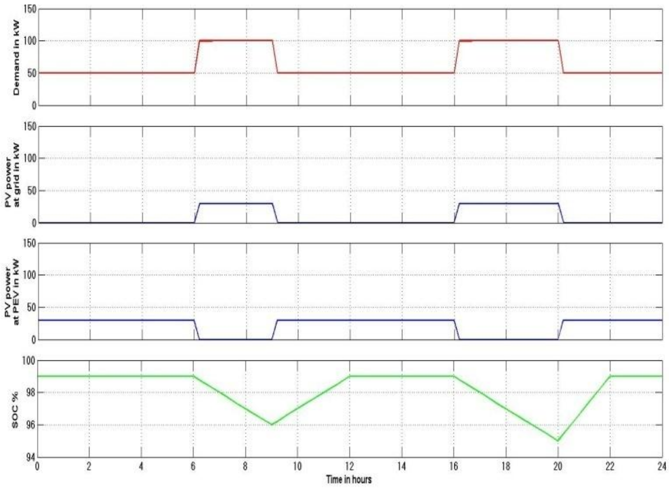

Figure 5. Offline mode case-I

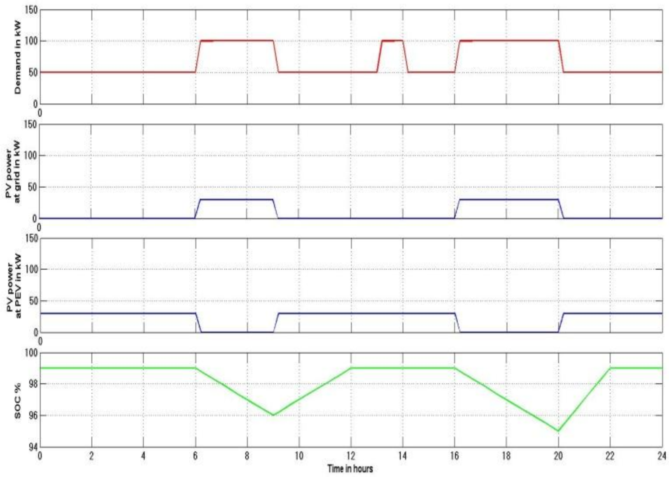

Figure 6. Offline mode case-II

Online mode of operation

It is based on pricing. When the demand increases the tariff also increase at that time if PV and PEV supports the grid then the owner of PV and PEV will get profit. In low demand the tariff also low so owner will not be willing to support the grid. So that in this mode of operation whenever there is a sudden increase in the demand and the in the usual peak demand events the PV and PEV starts to support the grid. Otherwise they act as a standalone system, PV charges the PEV. Consider there is a sudden increase in demand in the interval 1p.m. to 2p.m. At that time PV and PEV will support the grid to meet the demand that is they give response to the demand. In remaining duration is act as standalone system. It is shown in figure 7. In results that the tariff is directly proportional to demand.

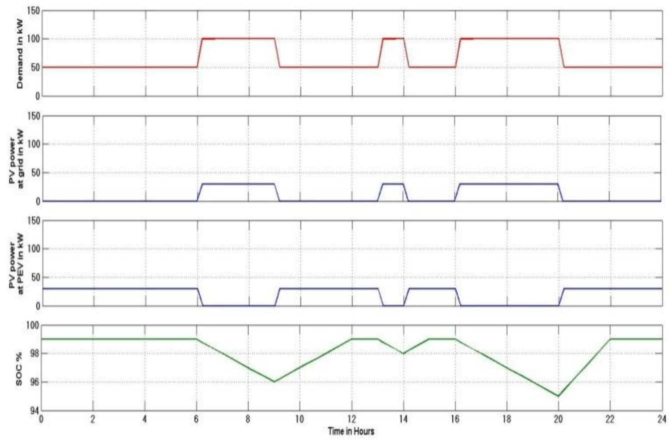

Figure 7. Online mode of operation

The energy exchange is recorded in smart meter. It is shown in figure 8.This all data will be recorded and processed to control the source and load according to the demand through IoT. With IoT the system can be controlled from anywhere in the world. The power delivered and consumed by the PEV and grid is recorded in smart meter. With this reading the profit to the owner of PV and PEV will be calculated. The simulation of the proposed system is shown in figure 9 and the PEV charging controller is shown in figure 10. The simulation of PV connected grid system is shown in figure 11.

Figure 8. Smart meter

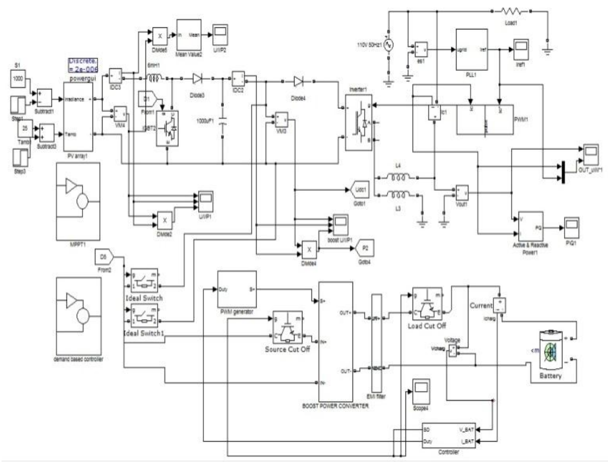

Figure 9. Overall Simulation diagram of the proposed system

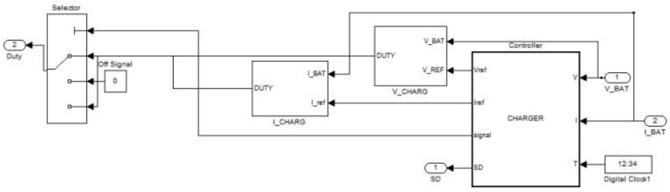

Figure 10. PEV charging controller

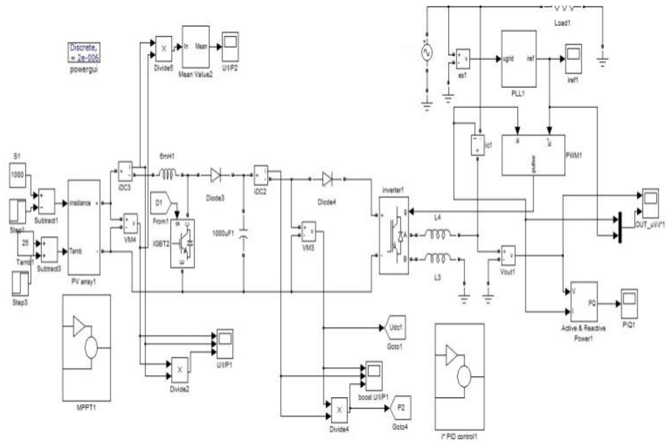

Figure 11. Grid connected PV system

4. Conclusion

In this proposed system the electrical demand response of the grid with PV and PEV is implemented and analysed in two modes of operation. With this analysis it can be concluded that in online mode of control the controlling is complex but it ensures the profit of owner of PV and PEV because it depends on pricing. They supports the grid when the tariff is high so the profit is ensured. In offline mode of operation the system control is easy because the system is pre-programmed with the forecasting data. But the profit for the owner is not sure because the in predetermined peak time may not match with the real peak time. If sudden increase in demand the system cannot be used to support the grid when it work in offline mode.

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EV Battery Swapping Decision Model By Fuzzy Logic Controller

R. Vijay Kumar[1], J. Meenu[2], K. Deepan[3], R. Pradeep[4]

B.E. Electrical and Electronics Engineering

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ABSTRACT

Electric vehicles are an important option for reducing emissions of greenhouse gases. Electric vehicles not only reduce the dependency on fossil fuel but also diminish the impact of ozone depleting substances and promote large scale renewable deployment. Many ideas were proposed to overcome the charging time of the batteries. In which battery swapping is one of the fastest ways to receive a fully charged battery for an EV. In this method, the EV's owner replaces the discharged battery with a newly charged battery at a battery swapping station. This method significantly reduces the charging time for the EV's owner and benefits the battery swapping station by managing charging, discharging, and battery swapping. A web page will be developed to manage the users with the nearest battery swapping stations (BSS), the availability of charging/charged batteries with the percentage to be charged which will enable the user to pre book the battery to make the battery available for the user when they reach the battery swapping station.

I. INTRODUCTION

Petrol vehicles are not particularly energy efficient and they are not environment friendly which emits toxic gases. To make the world less polluted electric vehicles were emerged, but it is not popularly used by most of the population because of its less convenience to own an Electric vehicle, certainly charging the E-Vehicle is one of the major issues faced by an E-vehicle users mainly in least developed countries like India. Enhancing the Charging stations and E-Vehicles might improve the convenience to use a E-Vehicle, ultimately vehicular emissions can be eradicated to a considerable factor. On the course of enhancement, Battery swapping methods was introduced, instead of charging for long a while a pre-charged battery can be swapped with an exhausted battery. Even in this case, user may stuck on a road with a exhausted battery and without battery swapping station right next it, lets say while passing a battery swapping station the vehicle’s battery percentage is 60, but in order to reach the next station it requires 50 percent of battery power in this case, the driver cannot be sure about the distance and power required resulting in the driver cannot make it to the next station. The Above-mentioned situation can be debugged with either with an application or a website with an Algorithm which works with the Google Maps API which displays the Battery Swapping Stations, with the fed data about the Battery availability, the amount of power required to reach the destination and recommendation to swap the battery using the data like power left, power required to reach either the destination or the next Battery Swapping Station.

II. PROBLEM ANALYSIS

After considering the research done on the empathy part of the project, we are examining the below three problems faced by the E-vehicles users.

A. UNABLE TO LOCATE THE NEARBY BATTERY SWAPPING STATIONS

As the percentage of the battery drained out, the user may feel helpless to reach the Battery Swapping Stations before the battery is fully drained out. To overcome that we created a website which will guide the user with the information regarding the nearby Battery Swapping Stations.

B. INADEQUATE INFORMATION REGARDING THE BATTERIES AVAILABILITY

As the nearby Battery Swapping Stations were known by the E-Vehicle user, there is no adequate instruction in estimating the availability of the fully charged batteries to pre-book the battery before the battery is fully drained out and before all the batteries were taken out.

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III. SOLUTION FOR THE PROBLEM

Either an Android Application or Web Application with the feature of locating the current location and the battery swapping station location and along with the recommendations for the commercial end user to swap the battery in certain stations based on the destination to reach and the next battery swapping station while on the go for the destination.

IV. APPLICATION SCHEMATIC

The Application mostly relying on Google Maps API works more like food delivery services or Taxi services, for our testing level application the applications is developed in Tomcat Application server. Maven is used for dependency injection, Google Maps API and tomcat socket is injected using Maven considering it is Handy to use in the Application and this will make the Application lite for the testing applications.

A) *Maven*

Apache Maven is a software project management and comprehension tool. Based on the concept of a project object model (POM), Maven can manage a project's build, reporting and documentation from a central piece of information. On the whole, the reason why the maven is used is during the covid it is bit difficult to do the development together in person so we chose to do in GitHub.

Fig

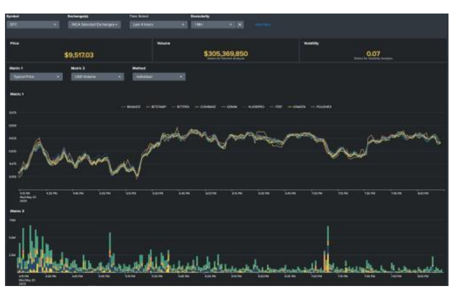
B) Google Maps API

Google APIs are application programming interfaces (APIs) developed by Google which allow communication with Google Services and their integration to other services. Map service one of Google's Service, using maven dependancy the Google Map Service is used in the Appplication.

fig

C) Web-Socket

Socket is a two way communication technique, classically http connections where used but the problem with the http connection is that the either the sender and receiver the connection can only be opened every once the connection is requested, but in the cases like applications with the constant requirement of data to be fed into the system, sockets where used for that. For instance Bitcions or NFT kind of web sites were one of the examples where the dynamic data for each seconds is required to be fed on the page based on the source code, the data will be populated in the page.



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D) Tomcat

Tomcat is a Application server on which the application will be running once it is pushed on to the internet. Apache Tomcat has a local server version using in which the application can be tested locally on the machine in which the application being developed. Tomcat application packet will come with a file name pom.xml it is used for the Maven dependency.

Fig

V. SOFTWARE DESCRIPTION

The Software will be with only one version but with different login modes namely admin login, Battery Swapping Station login and the commercial user's login, based on the login certain options will be hidden and features will be additionally available. The Algorithm used behind the application is FLC(Fuzzy Logic Controller System). There are two logic control systems, Open-loop and closed-loop control systems. In open-loop control systems, the input control action is independent of the physical system output. On the other hand, in a closed-loop control system, the input control action depends on the physical system output. Closed-Hoop control systems are also known as feedback control systems. The output of the physical system under control is adjusted by the help of an error signal. The difference between the atual response (calculated) of the płant and the desired response gives the error signal. For obtaining satisfactory responses and characteristics for the closed-loop control system, an additional system, called as compensator or controller, can be added to the loop. The basic block diagram of the closed-loop control system is shown in Figure. The fuzzy control rules are basically IE-THEN rules.

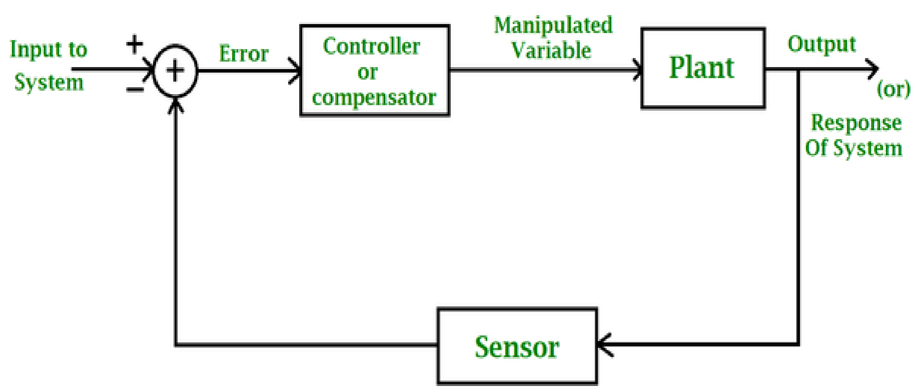


Fig 1: Block Diagram of closed-loop Control System

Designing a controller for a complex physical system involves the following steps:

1. Decomposing the large-scale system into a collection of various subsystems.
2. Varying the plant dynamics slowly and linearizing the nonlinear plane dynamics about a set of operating points.
3. Organizing a set of state variables, control variables, or output features for the system under consideration.
4. Designing simple P, PD, PID controllers for the subsystems. Optimal controllers can also be designed.

VI. Application User Prospective

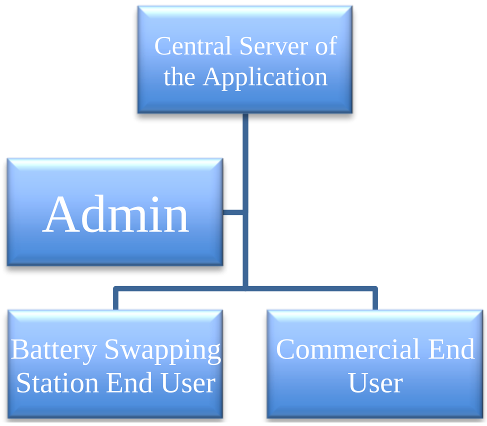
The Application will have three login prospective, unlike other leading application with entirely different Application for each prospective for instance Food delivery applications does have two different application, one for the Delivery person and the other for the commercial users. But in this Application only one application will be developed and pushed and it is for all the roles.

i) *Prospective One:* Admin:
The Admin will posses the feature to get all the data about the Commercial users and station user accounts and to cross check the data for the validation. Also, will have the right to Either to Block or to delete a Account from the user underlying with some legal criteria.

ii) *Prospective Two*: Battery Swapping Stations:
The Account used by the station user will have the features to update or to delete the data such as the station us opened or not, whether the station has Batteries to let the commercial users to swap or not, the number batteries left in the station.

iii) *Prospective Three:* Commercial Users:
The Account owned by the end users will have the features to view the number of battery swapping station surrounding the user on the real time, the number of battery left in the station, recommendation to swap the batteries in certain point based on the destination the user has to reach and using the power left in the Battery.

VII. Block Diagram



The Central Server of the application on which the web App is Running will have Server socket and will listening to all the incoming socket messages based on the incoming messages and the mode of login, the central server will do the process. The admin mode of login will have the access to all the data in all the entire application, the battery swapping station and commercial end user account can be monitored or even be blocked by the admin mode of login. The Central server can also be shut down by the admin login. Battery swapping station login and the commercial End User will have only limited access and the feature in the application.

VIII. Expected Result

On the course of when the application on the Air, the commercial user will find it convenient to drive a long drive on a Electric Vehicle especially people who find it difficult to ride Electric Vehicle because of it's lack of Battery Swapping station. The User will get the recommendations on the path to take and the stations to swap the battery. The rate Electric Vehicle users might slightly improve on the course of years, considering the fact that the some people do avoid to own electric vehicle for its inconvenience.

CONCLUSION

Improving the convenience factor for the commercial end user will lead to increase in the E-Vehicle users on the course of implementing the App will play a role on the same cause. By means of having this on the air, will make it more easier for the Battery Swapping station to advertise their presence to the people who uses the Electric vehicle along with the number of batteries available for the swapping would be a added advantage for the convenience factor of the commercial end user.

FUTURE SCOPES

As electric vehicle manufacturing is becoming popular every day, its market share is also expected to rise greatly. India's GDP is expected to grow by an amazing 25% by 2022. The best part is that, apart from reducing environmental pollution, EVs can lower oil import by about $60 Billion by 2030. Considering these, improvements on convenience factor of the E-Vehicle will aslo help on the course. Financial gain on planiting the Battery Swapping stations will attract more business people to plant the Battery Swapping Stations on the multiple locations ultimately resulting in reducing the inconvenience factor of the E-Vehicle users. Adding some more features like rating the Battery Swapping Stations adding recommendation rating will also help the station user and also the commercial end user

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LVRT Improvement of DFIG Wind Turbine and Fault Mitigation Using PV Supported DVR

[1]S.Sumithra, [2]R.Vijayakumar and [3]M.Poornima,
[1,2,3]Department of Electrical and Electronics Engineering, SNS College of Technology, Coimbatore, TamilNadu, India

Abstract- This paper proposes the Low Voltage Ride Through(LVRT) technique of Doubly Fed Induction Generator(DFIG) wind turbine using PV supported Dynamic Voltage Restorer(DVR). The effective control method used in DVR is digital all pass filter which extracts the positive-sequence component from the unbalanced grid voltage. PI controller is used to derive the positive and negative sequence phase angle of the grid voltage to compensate the unbalanced grid voltage during line fault, while the DGIF wind turbine can operates in its nominal condition without any interruption. The DVR is supplied from the PV which supports the DVR while compensating the voltage fluctuations due to line fault. MATLAB/Simulink simulation shows the effectiveness of the proposed technique.

Keywords *- Low Voltage Ride Through(LVRT), Doubly Fed Induction Generator(DFIG), Dynamic Voltage Restorer(DVR), PI controller, PV system.*

I. INTRODUCTION

The increasing penetration of Wind Energy Conversion System(WECS) into the power system requires a new grid code to the stable and safe operation of the power system. The main element of the new grid code is Low Voltage Ride Through(LVRT) requirement, frequency control, active and reactive power control, voltage regulation, power system protection and power quality. The disconnection of the wind power from the grid affect the power quality on the power system. The wind energy system must stay connected and operate continuously in its nominal operating condition during Low Voltage Ride Through(LVRT).

In Wind Energy Conversion System(WECS) the induction generator and synchronous generator can be used to extract the electrical energy. The change in speed of wind will change the rotating speed of the wind turbine while the rotor speed of the generator will vary. The generator used in WECS should be suit for variable speed of operation for the more efficient output and to maintain the stability. Now-a-days the induction generator, especially Doubly Fed Induction Generator(DFIG) with the integrated power electronics control system. The real and reactive power is separately controllable. The power electronics control system ie. power electronics converters used in rotor side(RSC) and grid side(GSC) are used to achieve the variable speed of operation which is partially rated. DFIG is very sensitive to symmetrical and unsymmetrical voltage dip in grid during symmetrical and unsymmetrical faults in the line due to the direct connection between stator and grid. The voltage dip is the one of the power quality issues.

To improve the power quality under Low Voltage Ride Through proposes the use of a custom power device Dynamic Voltage Restorer(DVR) that is a voltage source converter. The function of DVR is injecting three single phase voltage in series with the incoming grid voltage during LVRT, to compensate the voltage difference between nominal voltage and faulty voltage. The injected voltages are controllable by magnitude and phase. The advantage of this external protection(DVR) is the reduction of complexity in DFIG control system.

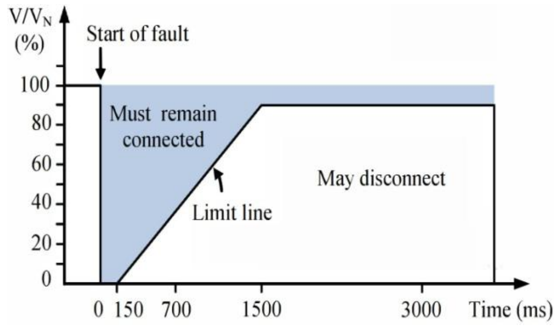

Fig. 1. LVRT requirement of the grid code

The active power capability of the DVR is depends on the capacity of the energy storage element which feed the energy to the voltage source converter of the DVR. It should be capable of compensating the voltage dip from 0.1p.u. to 0.9p.u. of the nominal grid voltage.

In proposed system the DVR is used to compensate the power quality issue such as voltage sag(dip) and voltage swell to improve the Low Voltage Ride Through(LVRT) capability of the DFIG wind turbine system. The PV system has the capability to generate the voltage which is moreover equal to the nominal voltage of the grid so that the PV system is used as the energy supply to the DVR meanwhile it charges the battery.

II. OPERATION OF DFIG

In the DFIG system used in this paper the stator is directly connected with the grid while the rotor is connected through the Rotor Side Converter (RSC), DC-link, Grid Side Converter(GSC) and a transformer. The operation of DFIG comprises the control of RSC and GSC as shown in figure 2.

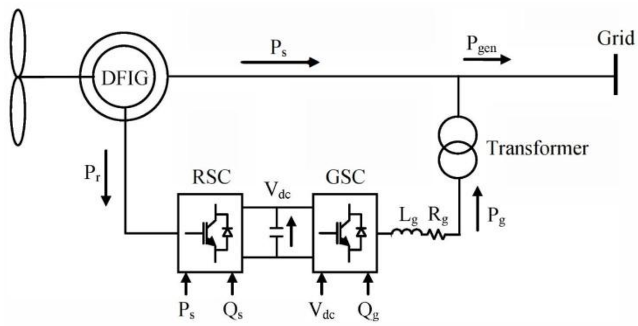

Fig. 2: Schematic diagram of DFIG

A. Rotor Side Converter (RSC) control

The objectives of the rotor side converter are to control the real and reactive power independently. By the stator flux oriented vector control strategy and neglecting stator resistance, the active power and reactive power of the stator can be expressed as,

$$P_s = -\frac{3}{2}\frac{L_m}{L_s}V_{sq}I_{rq} \tag{1}$$

$$Q_s = \frac{3}{2}\frac{V_{sq}}{L_s}(\psi_{sd} - L_m I_{rd}) \tag{2}$$

Where,

P_S - Stator active power
Q_S - Stator reactive power
L_m - Magnetizing inductance
L_S - Stator inductance
V_{sd}, V_{sq} - dq components of stator voltage
I_{rd}, I_{rq} - dq components of rotor current
Ψ_{sd} - d component of stator flux

From (1) and (2) the active power of the stator can be controlled by the q component of rotor current which is orthogonal to the stator flux while the reactive power of the stator can be controlled by the d component of the rotor current which is aligned with the stator flux.

B. Grid Side Converter(GSC) control

The objectives of the Grid Side Converter(GSC) control are to ensure the unity power factor in converter operation and maintain the DC-link voltage in set value irrespective of the direction and magnitude of the rotor power. The current flow through the inductor can be expressed as,

$$\frac{dI_g}{dt} = \frac{V_g - R_g I_g}{L_g} \tag{3}$$

Where,

V_g - Voltage at grid
I_g - Current at grid
R_g - Resistance at grid
L_g - Inductance at grid

The DC-link voltage can be expressed as,

$$C\frac{dV_{dc}}{dt} = I_r - I_g \tag{4}$$

Where,

V_{dc} - DC-link voltage
C - DC-link capacitor
I_r - Rotor current

The cascade vector control strategy is carried out at inner current control loop, along with this strategy reactive power control is combined in the outer DC-link voltage control loop as (3) and (4).

III. DYNAMIC VOLTAGE RESTORER (DVR)

The Dynamic Voltage Restore(DVR) is a custom power device. It consists of three phase Voltage Source Converter(VSC) which is connected in series with the line through series coupling transformer to inject compensating voltage. At the DVR output terminal a low pass filter is connected in parallel with the three phase VSC. The performance of the DVR with the system is depends on the effectiveness of the control technique used in DVR.

The DVR can be enhance the Low Voltage Ride Through(LVRT) of a DFIG wind turbine by compensating the voltage sag in grid voltage. It is connected in series between the stator of the DFIG and grid as shown in figure 3.

The DVR injects voltage of controllable magnitude phase angle and frequency in synchronized and series with the DFIG voltage through the series coupling transformer during the grid voltage sag which avoids the disconnection of the wind turbine from the grid. At the output terminal DVR provides the real power exchange by the DVR input terminal which is supplied from the PV system.

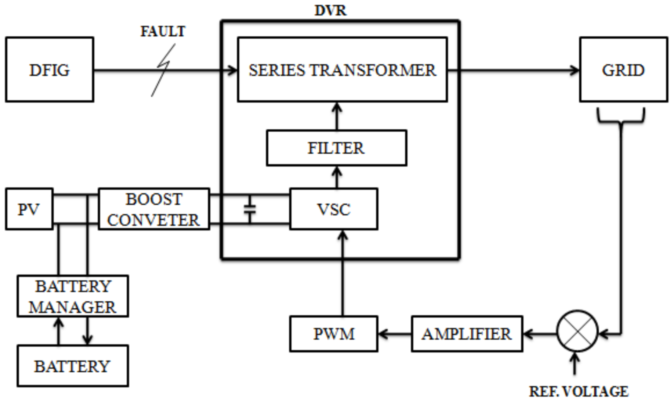

Fig. 3: Block diagram of the proposed system

The control system of the DVR is shown in figure 5. The three phase grid voltage(V_g) is measured and transformed into the dq reference frame voltage such as d component voltage(V_{gd}) and q component voltage(V_{gq}) rotating by the grid voltage θ which is generated by the Phase Lock Loop(PLL). The three phase reference voltage(V_{ref}) is also transformed into dq reference frame as V_{d_ref} and V_{q_ref}. The reference voltage and actual grid voltage are compared by the comparator and the error signal is processed in PI controller. The output of the PI controller controls the switching of DVR inverter in order to inject the compensating voltage properly through the series coupling transformer. DVR operated in a standby mode and injects nothing in normal operating condition. This will reduces the DVR inverter losses.

The DVR system rating is depends on the depth of the grid voltage sag that should be compensated. The required active power of the DVR is written as,

$$P_{DVR} = \left(\frac{V_1 - V_2}{V_1}\right) P_{load} \tag{5}$$

Where,

V_1 - Nominal grid voltage
V_2 - Faulty line voltage

The active power of the DFIG is partially fed into the grid and the DVR system when then DVR compensates the voltage sag. The DC-link energy storage system between the PV system and the inverter is charged by the active power flowing through the DVR. At full voltage sag the rating of the DVR should be same as the wind turbine power. Hence, the DVR is implemented to enhance the Low Voltage Ride Through (LVRT) capability at the voltage sag between 0.1p.u. to 0.9p.u. from the nominal grid voltage and also assists the grid during full voltage sag.

The DVR with PI controller is shown in figure 4. The equation of the PI controller is,

$$u(t) = K_p e(t) + K_i \int e(t)\, d(t) \tag{6}$$

Where

u(t) - Control output in the dq reference to be fed to the PWM generator
Kp - Proportional gain
Ki - Integral gain
e - Error between the reference voltage and injected voltage by the DVR

The PI controller offers the ease of implementation and simplicity.

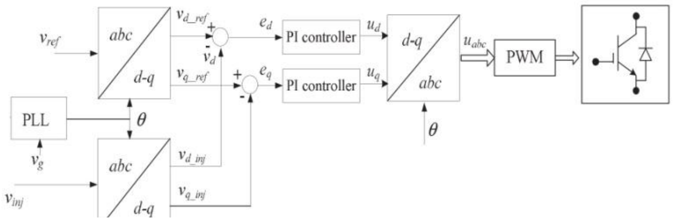

Fig. 4: DVR with PI controller

IV. SIMULATION RESULTS

The simulation of the proposed system is carried out using MATLAB/Simulink to verify the feasibility of the system. It have been performed for the symmetrical grid fault for various time instant. The performance of the DFIG wind turbine is investigated with and without DVR for symmetrical fault at different instant. The simulation results are shown in figure 5 to 8. During fault along with the voltage sag sometimes voltage swell will occur that is also compensated by the DVR.

The nominal voltage of the line is 440V. It is shown in figure 5. The voltage sag occurred at 0.1sec to 0.2secis 36% dip from the nominal voltage as shown in figure 6(a). The DVR injects the compensated voltage to stabilize the line voltage between 0.1sec to 0.2sec as shown in figure 6(b) and the stabilized voltage is shown in figure 6(c). Likewise the voltage sag of 22% from the nominal voltage occurred between 0.1sec to 0.2sec and he DVR injects the voltage to compensate the sag as shown in figure 7(a), (b) respectively. The voltage swell of 15% from the nominal voltage occurred at 0.1sec to 0.2sec during the grid fault and the DVR absorbs the voltage swell and stabilize the grid voltage as shown in figure 8(a), (b), (c) respectively. However, still there is a slight difference between the compensated voltage at the startup transient which is the transient response of the stator active power and DC-link voltage. Consequently, the DFIG operates normally during the grid voltage sag with DVR protection.

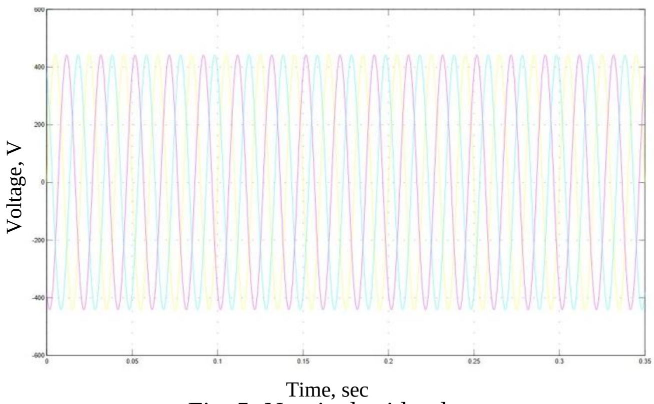

Fig. 5: Nominal grid voltage

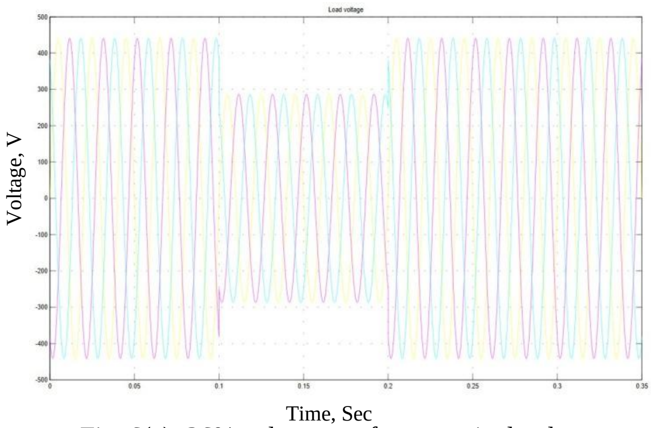

Fig. 6(a): 36% voltage sag from nominal voltage

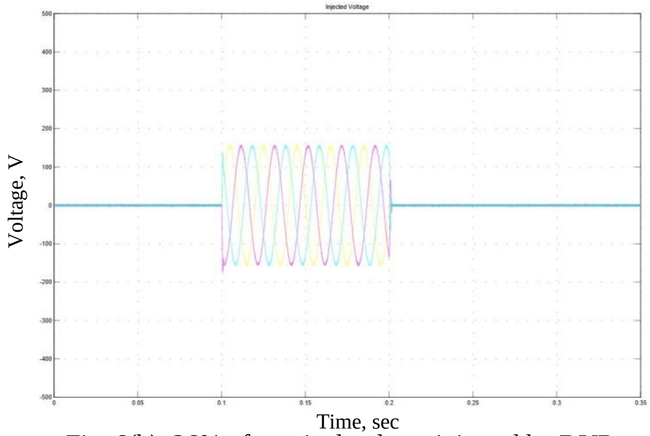

Fig. 6(b). 36% of nominal voltage injected by DVR

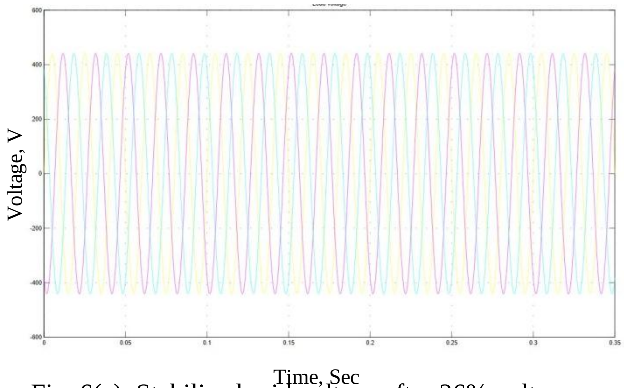

Fig. 6(c). Stabilized grid voltage after 36% voltage sag

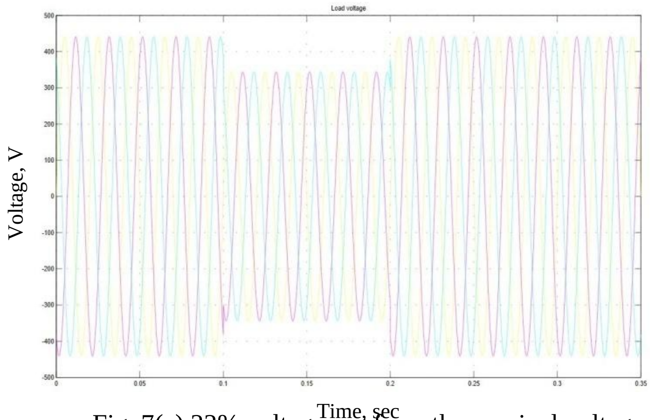

Fig. 7(a) 22% voltage sag from the nominal voltage

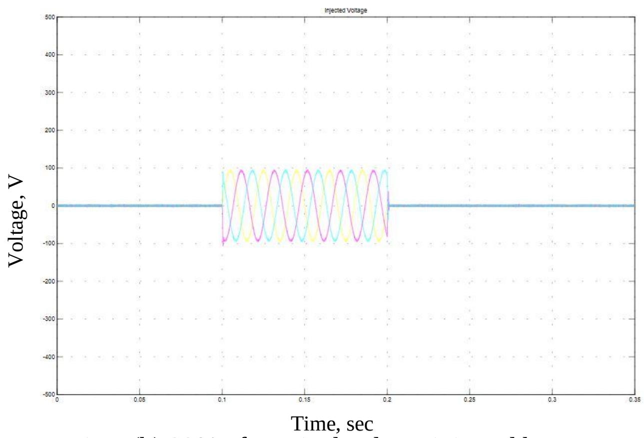

Fig. 7(b) 22% of nominal voltage injected by DVR

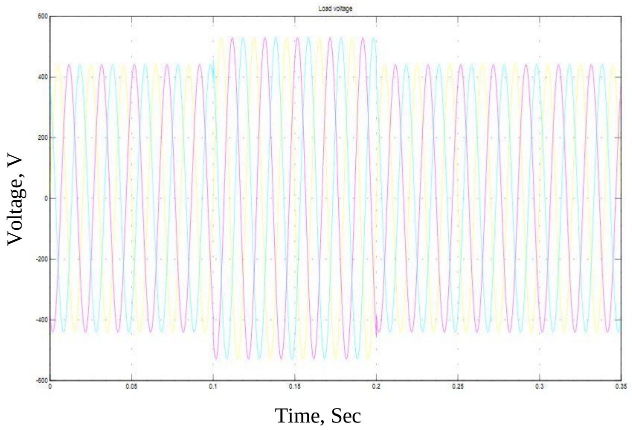

Fig. 8(a). 15% of voltage swell from the nominal voltage

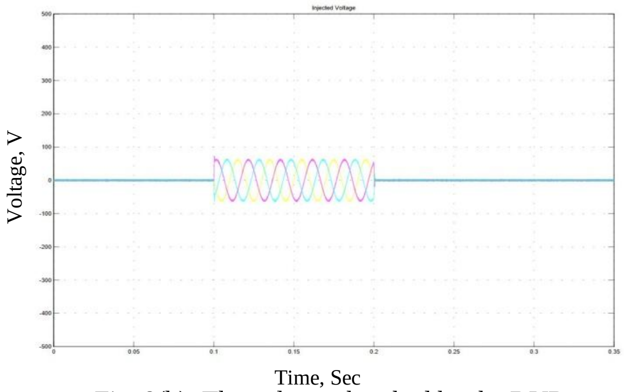

Fig. 8(b): The voltage absorbed by the DVR

CONCLUSION

The LVRT capability enhancement of the DFIG wind turbine is important issue related to the connection and utilization of the Wind Energy Conversion System(WECS) to the grid. It is proposed in this paper by mitigating the grid fault using PV supported DVR. It allows the DVR to utilize the active power of the PV during fault condition and thus improves the system robustness against the grid fault. Hence, the power quality issue can be neglected and the LVRT capability of the DFIG wind turbine is enhanced.

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STARTUP

भारत सरकार
Government of India
सूक्ष्म, लघु एवं मध्यम उद्यम मंत्रालय
Ministry of Micro, Small and Medium Enterprises

MSME
सूक्ष्म , लघु एवं मध्यम उद्यम
MICRO, SMALL & MEDIUM ENTERPRISES

UDYAM
REGISTRATION CERTIFICATE

UDYAM REGISTRATION NUMBER	UDYAM-TN-03-0092553
NAME OF ENTERPRISE	ELECTRITRONICS
TYPE OF ENTERPRISE *	MICRO (Based on FY 2020-21)
MAJOR ACTIVITY	MANUFACTURING
SOCIAL CATEGORY OF ENTREPRENEUR	GENERAL

NAME OF UNIT(S)

S.No.	Name of Unit(s)
1	ElectriTronics

OFFICAL ADDRESS OF ENTERPRISE

Flat/Door/Block No.	365	Name of Premises/ Building	Alakepalayam
Village/Town	Kuppanur	Block	Annur
Road/Street/Lane	Annur	City	Coimabtore
State	TAMIL NADU	District	COIMBATORE , Pin 641653
Mobile	9787175667	Email:	vijisnsct@gmail.com

DATE OF INCORPORATION / REGISTRATION OF ENTERPRISE	01/07/2022
DATE OF COMMENCEMENT OF PRODUCTION/BUSINESS	

NATIONAL INDUSTRY CLASSIFICATION CODE(S)

SNo.	NIC 2 Digit	NIC 4 Digit	NIC 5 Digit	Activity
1	27 - Manufacture of electrical equipment	2750 - Manufacture of domestic appliances	27509 - Manufacture of other domestic appliances n.e.c.	Manufacturing

DATE OF UDYAM REGISTRATION	11/07/2022

* In case of graduation (upward/reverse) of status of an enterprise, the benefit of the Government Schemes will be availed as per the provisions of Notification No. S.O. 2119(E) dated 26.06.2020 issued by the M/o MSME.

Disclaimer: This is computer generated statement, no signature required. Printed from https://udyamregistration.gov.in & Date of printing:- 11/07/2022

For any assistance, you may contact:

1. District Industries Centre: COIMBATORE (TAMIL NADU)

2. MSME-DFO: CHENNAI (TAMIL NADU)

Visit : www.msme.gov.in ; www.dcmsme.gov.in ; www.champions.gov.in

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Government of India
सूक्ष्म, लघु एवं मध्यम उद्यम मंत्रालय
Ministry of Micro, Small and Medium Enterprises

Udyam Registration Number : UDYAM-TN-03-0092553

Type of Enterprise	MICRO	**Major Activity**	Manufacturing
Type of Organisation	Hindu Undivided Family	**Name of Enterprise**	ElectriTronics
Owner Name	SHRI RANGASAMY VIJAYAKUMAR	**PAN**	AINPV8481B
Do you have GSTIN	No	**Mobile No.**	9787175667
Email Id	vijisnsct@gmail.com	**Social Category**	General
Gender	Male	**Specially Abled(DIVYANG)**	No
Date of Incorporation	01/07/2022	**Date of Commencement of Production/Business**	

Bank Details

Bank Name	IFS Code	Bank Account Number
CENTRAL BANK OF INDIA	CBIN0281361	3263955744

Employment Details

Male	Female	Other	Total
1	1	0	2

Investment in Plant and Machinery OR Equipment (in Rs.)

S.No.	Financial Year	Enterprise Type	Written Down Value (WDV)	Exclusion of cost of Pollution Control, Research & Development and Industrial Safety Devices	Net Investment in Plant and Machinery OR Equipment[(A)-(B)]	Total Turnover (A)	Export Turnover (B)	Net Turnover [(A)-(B)]	Is ITR Filled?	ITR Type
1	2020-21	Micro	0.00	0.00	0.00	0.00	0.00	0.00	No	NA

Unit(s) Details

SN	Unit Name	Flat	Building	Village/Town	Block	Road	City	Pin	State	District
1	ElectriTronics	365,	Alakepalayam	Kuppanur	coimbatore	Annur	Coimbatore	641653	TAMIL NADU	COIMBATORE

Official address of Enterprise

Flat/Door/Block No.	365	**Name of Premises/ Building**	Alakepalayam
Village/Town	Kuppanur	**Block**	Annur
Road/Street/Lane	Annur	**City**	Coimabtore
State	TAMIL NADU	**District**	COIMBATORE , **Pin :** 641653
Mobile	9787175667	**Email:**	vijisnsct@gmail.com

National Industry Classification Code(S)

SNo.	Nic 2 Digit	Nic 4 Digit	Nic 5 Digit	Activity
1	27 - Manufacture of electrical equipment	2750 - Manufacture of domestic appliances	27509 - Manufacture of other domestic appliances n.e.c.	Manufacturing

Are you interested to get registered on Government e-Market (GeM) Portal	Yes
Are you interested to get registered on TReDS Portals(one or more)	Yes
District Industries Centre	COIMBATORE (TAMIL NADU)

MSME-DFO	CHENNAI (TAMIL NADU)
Date of Udyam Registration	11/07/2022
Date of Printing	11/07/2022

RESOURCE PERSON

ENTREPRENEURSHIP DEVELOPMENT & INNOVATION INSTITUTE (EDII)
GOVERNMENT OF TAMILNADU, CHENNAI – 32.

BU EDII TN HUB of Bharathiar University, Coimbatore &
CMS COLLEGE OF SCIENCE AND COMMERCE, Coimbatore

Jointly Organizes

"TNSI 2022 Awareness Programme "

RESOURCE PERSON

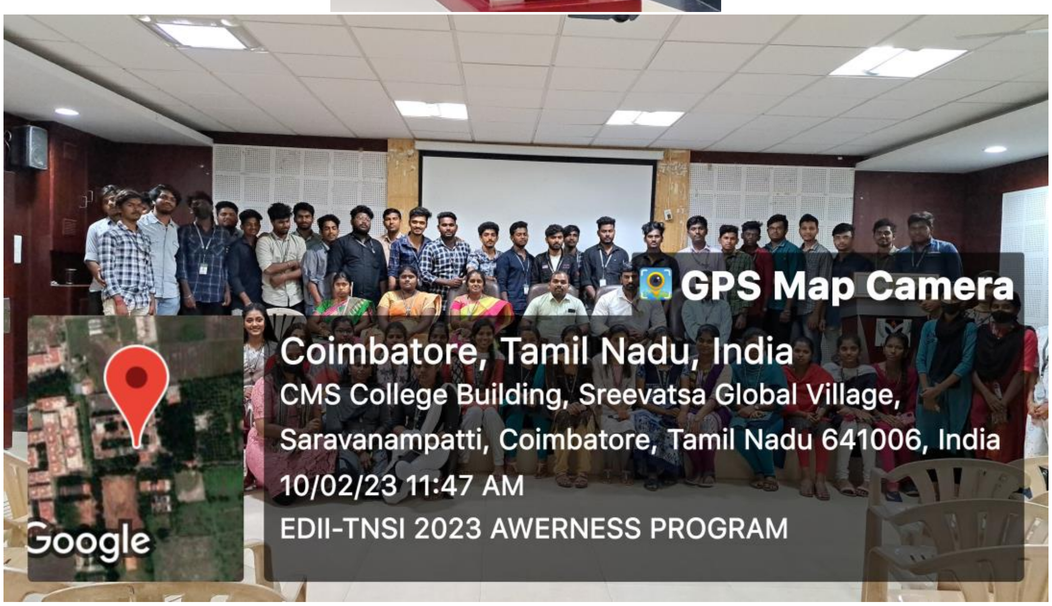
R. VIJAYAKUMAR
Assistant Professor
Department of Electrical and Electronics Engineering
Entrepreneurship Development Cell - Chief Coordinator
SNS College of Technology
Coimbatore.

Date: 10.02.2023 **Time:** 10.00am **Venue:** Athena Hall @ CMSCSC

E-CELL CORDINATOR	HOD	PRINCIPAL
Dr. P. MARI SELVAM	Dr. M. GOMATHEESWARAN	Dr. H. BALAKRISHNAN


2022
DESIGN DEVELOP DELIVER
CMS


CMS
SINCE 1988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Coimbatore, Tamil Nadu, India
CMS College Building, Sreevatsa Global Village,
Saravanampatti, Coimbatore, Tamil Nadu 641006, India
10/02/23 11:47 AM
EDII-TNSI 2023 AWERNESS PROGRAM
Google


KGiSL Institute of Technology
KiTE co-create your genius
KITE - Institution's Innovation Council &
Department of
Science and Humanities
MoE's INNOVATION CELL (GOVERNMENT OF INDIA)
Jointly organize
INSTITUTION'S INNOVATION COUNCIL
Quarter 1 - Self Driven Activity
DESIGN THINKING APPROACH FOR IDEA GENERATION AMONG THE YOUTHS
RESOURCE PERSON
Mr. R Vijayakumar
Assistant professor,
Department of Electrical and Electronics Engineering,
SNS College of Technology, Coimbatore
Event Co-ordinator
Dr. G Sangeetha
Assistant Professor, Department of S&H (Maths),
KGiSL Institute of Technology
22nd NOV
Venue - Sir C V Raman Hall
01:00 PM - 03:00 PM
KiTETechCollege
kgkite.ac.in


28th NOVEMBER 2022
09:00 AM - 10:10 AM
Who you are
Dr. R Menaka
Assistant professor - Chemistry, Department of IT, Dr. NGP
10:30 AM - 12:10 PM
Heads up towards startup eco-system
Ms. Sivaraghavi
Director, Agile Incubation Center, KGiSL
29th NOVEMBER 2022
09:00 AM - 10:10 AM
Career Development Means for Engineers
Mr. Lawrence
Placement Director, KGiSL Edu
10:30 AM - 12:10 PM
Health and Hygiene for Teenagers
Dr. Poorna Chandrika
Family Physician, KG Hospital
12:50 PM - 03:00 PM
Design Thinking
Mr. Vijayakumar
Assistant Professor - EEE, SNS CET
30th NOVEMBER 2022
12:50 PM - 03:00 PM
Evolution of Engineering
Mr. Harish
Founder & Director, MaxxCADD
1st DECEMBER 2022
09:00 AM - 10:10 AM
Role of Engineers in Society
Mr. Prashanth Ganesh
Founder: Athleap Foundation
Co-founder: Praskale & co
10:30 AM - 12:10 PM
Innovative thinking & Decision Making Skills for Contemporary Challenges
Mr. Agathamizh Sri Arunkumar
Founder & Director, Arun IAS Academy
1st DECEMBER 2022
12:50 PM - 03:00 PM
Emotional Intelligence & Character Building
Ms. Anita Rose
Student Counsellor, KGiSL Edu
03:20 PM - 05:00 PM
Innovation
Mr.Navneeth Malingan
Director - Innovation, KGiSL


GPS Map Camera
Coimbatore, Tamil Nadu, India
KGISL INSTITUTE OF TECHNOLOGY Coimbatore, 3XQX+83W, Sahara City, Saravanampatti, Coimbatore, Tamil Nadu 641035, India
Lat 11.07976°
Long 76.995922°
29/11/22 01:29 PM GMT +05:30
Design Thinking Design Thinking Innovation
Google


KGiSL Institute of Technology
Department of Science and Humanities
Dr. Ashok Bakthavathsalam
Founder & Managing Director, KGiSL
21st NOVEMBER 2022
10:30 AM - 12:10 PM
21st NOVEMBER 2022
22nd NOVEMBER 2022
12:50 PM - 03:00 PM
Heads up towards startup eco-system
Mr. Akshay
Director
09:00 AM - 10:10 AM
Career Development Means for Engineers
Mr. Lawrence
Placement Director, KGISL Edu
10:30 AM - 12:10 PM
Health and Hygiene for Teenagers
Dr. Poorna Chandrika
Family Physician, KG Hospital
22st NOVEMBER 2022
23rd NOVEMBER 2022
12:50 PM - 03:00 PM
Design Thinking
Mr. Vijayakumar
Assistant Professor - EEE, SNS CET
09:00 AM - 10:10 AM
Social Responsibility as a Student
Mr. Saravanaprabhu
Art of Living Foundation
10:30 AM - 12:10 PM
Universal Human Values
Mr. Anand Narayanan
Corporate Yoga Trainer


DESIGN


KGiSL Institute of Technology
14th JUNE 2022
02:30 PM - 04:00 PM
KiTE - Institution's Innovation Council
organizes
Quarter 3 IIC Calendar Activity
INSTITUTION'S INNOVATION COUNCIL
WORKSHOP ON
INTELLECTUAL PROPERTY RIGHTS (IPRs) &
IP MANAGEMENT FOR START-UP
RESOURCE PERSON
Mr. R Vijayakumar
Assistant Professor,
Department of Electrical and Electronics Engineering,
Entrepreneurship Department Cell Chief Coordinator,
IPR Coordinator of SNSCT, SNS College of Technology,
Coimbatore.
Sir C V Raman Hall
KiTE TechCollege
kgkite.ac.in


KGiSL
GPS Map Camera
Coimbatore, Tamil Nadu, India
3XMX+XGQ, Saravanampatti,
Coimbatore, Tamil Nadu
641035, India
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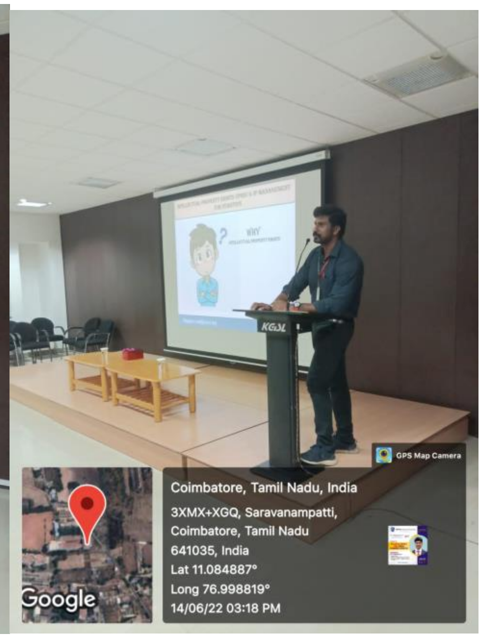
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3XMX+XGQ, Saravanampatti,
Coimbatore, Tamil Nadu
641035, India
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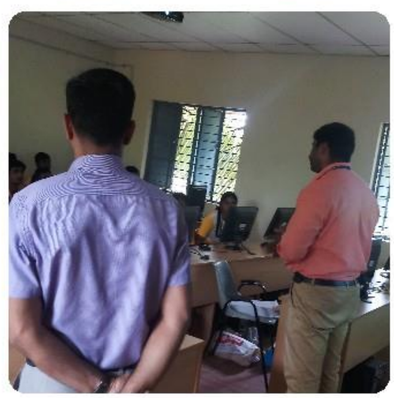
Arduino Projects for School students

Dept. of EEE

28.08.19



Dept. of EEE organized a DT Session for School students

Branding Event

21.10.2019

Govt. Higher Sec School, Tirumarugal

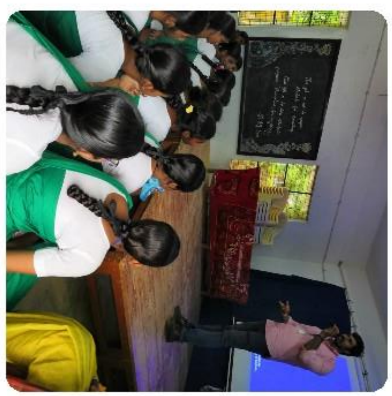
Dept. of EEE organized
a DT Session at

Sri GRM Girls Higher
Secondary School, Tiruvarur

21.10.2019



Dept. of EEE organized a DT session for Sri GKM Higher Sec. School at Tiruvarur on 21.10.2019



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The digital AC Timer is A Cyclic Timer Unit Meant for Cyclic Operation of any type of Air Conditioner. AC Timer can be kept ON from 1 hr. to 24 hrs.

AC Timer latest Micro controller Based Technology. AC Timer very economic model and very compact in industry, it has facility minimum one sec delay time. Heavy duty sturdy relay with heavy 30 Amps connector each capable to take load up to 2 ton window or split AC with auto/ manual facility.

Silent feature of AC Timer:

Latest Low power Micro controller based technology.

Quick Response

Delay Time Facility ,Suitable for window ,splits, package or three phase AC.

RTC Inbuilt

Manual/Auto Mode Operation

Add on Facility:

Remote Control based operation

WiFi based IoT Control

Bluetooth Control System

Maximum 10 Different ACs Controlled with 10 Different timing

Additional Information:

Item Code: SNSCT-ACT-V 1.0

Delivery Time: 2 Days

Warranty: 1 Year from installation

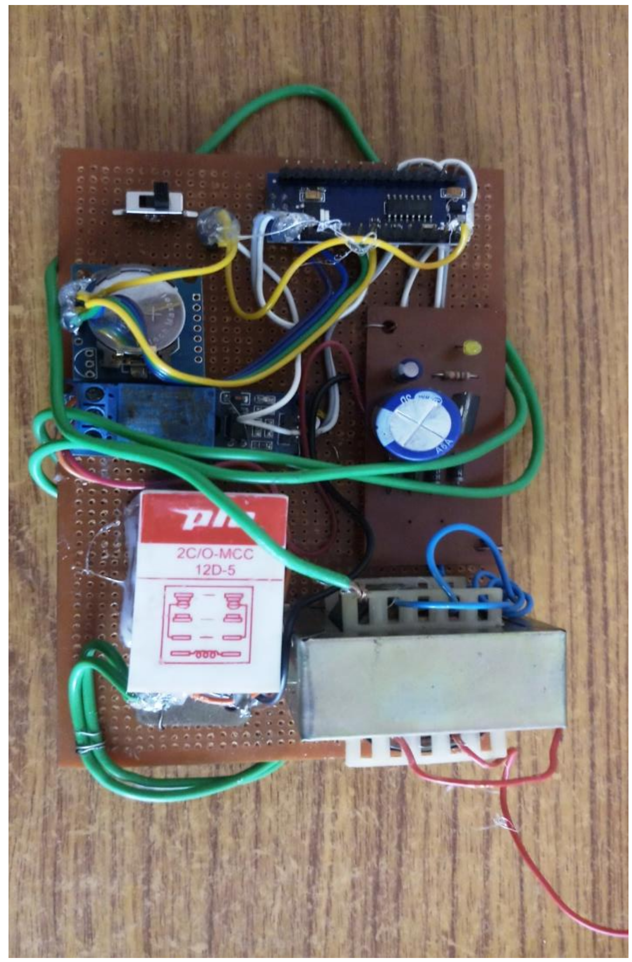
SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)
COIMBATORE-35

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Low Cost Customized Timer for air conditioning system

(SNSCT-AC-V 1.0)



Product Name:

College Time & Power Scheduler

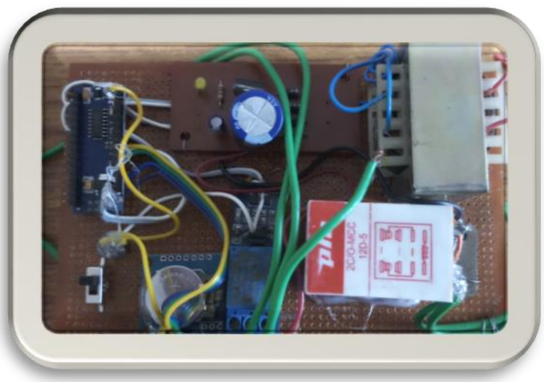
Description:

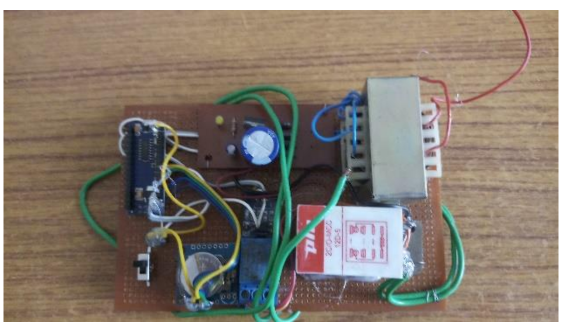
Time Schedule based Air conditioner controller, this device will find week days, week end days and also college working hours, break, lunch time period. The device will allow to operate an Air conditioner system for required time period, in this regards it will save power from unnecessary operation.

Staff In charge:

R.Vijayakumar/AP/EEE/SNSCT

Photos:





Cost:

5,000 Rupees/Unit

Product Name:

Automatic SHAWARMA Lighter

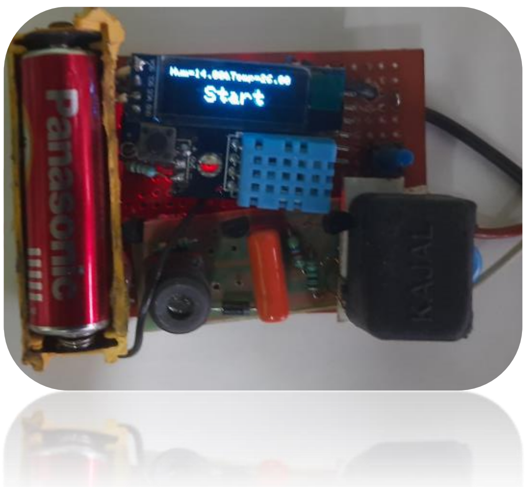
Description:

Chicken shawarma making machines are very popular for non-veg business. The problem for lighting the chicken shawarma machine in every time, this device will help to automatic lighting the chicken shawarma machine and also control the flames.

Staff In charge:

R.Vijayakumar/AP/EEE/SNSCT

Photos:



Cost:

2,000 Rupees/Unit

Product Name:

Mobile Battery Charge Scheduler

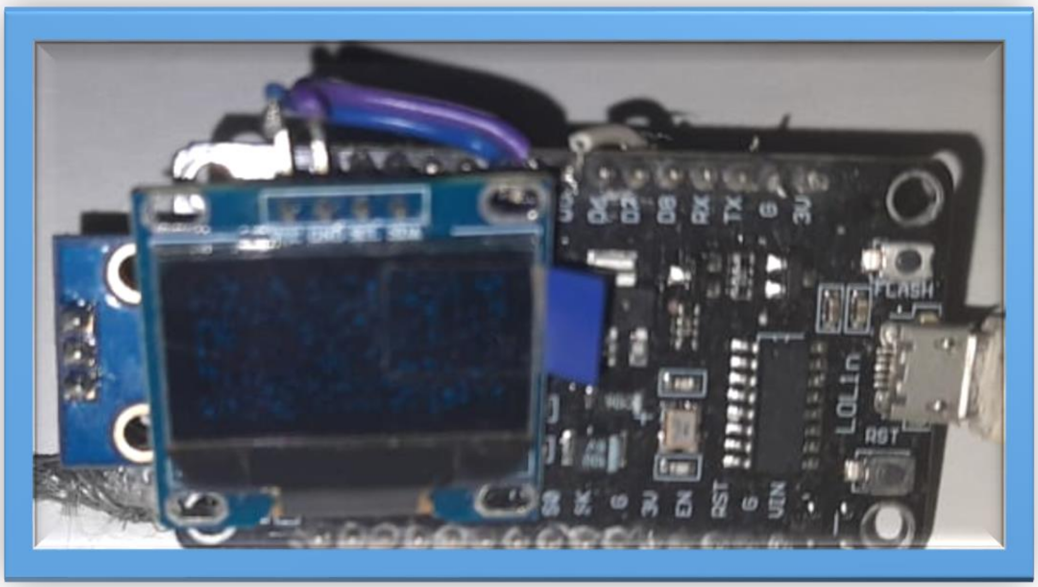
Description:

leaving mobile battery plugged in all night certainly isn't dangerous but it might make battery age slightly faster. “Overcharging” is the term that gets thrown around a lot with this one. This device will help to schedule the charging time and also give remainder alarm with Autocutoff

Staff In charge:

R.Vijayakumar/AP/EEE/SNSCT

Photos:



Cost:

4,000 Rupees/Unit

Product Name:

Astrological Timer-X

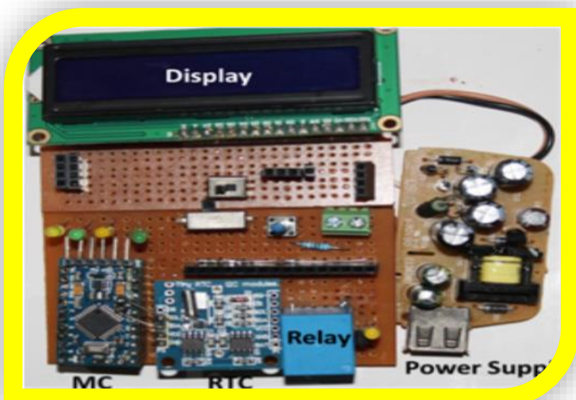
Description:

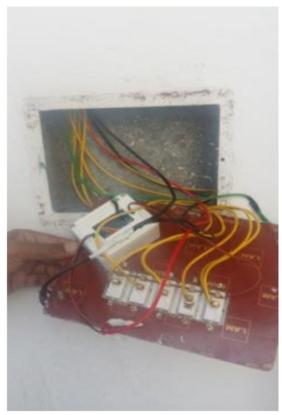
Early switch on by about 45 minutes and later switch off by about 45 minutes can save electricity for 90 minutes = 1.50 hour daily. At present street lights are on for about 12 hours , it can be reduced to very efficient manner with the help of Astrological timer. The sunset and sunrise data stored in cloud for operation. At result more than 12.50% saving can be made

Staff In charge:

R.Vijayakumar/AP/EEE/SNSCT

Photos:





Cost:

6,000 Rupees/Unit

Product Name:

Pre-programmed Water heater Socket

Description:

The water heater device is essential one for hostellers and residential, and also it has high wattage ratings like up to 2500 watts. If forgot to switched off the water heater for 30 minutes, it will consume 1000 watts. We took survey from 100 students, and initiated to do product.

Staff In charge:

R.Vijayakumar/AP/EEE/SNSCT

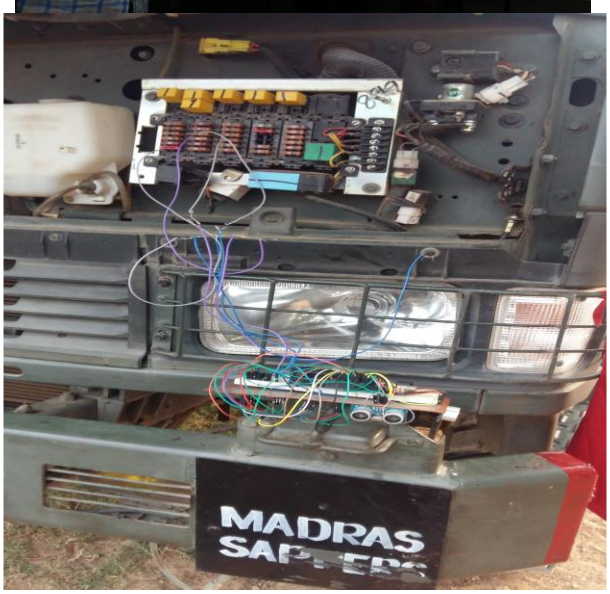
Photos:

Cost:

2,000 Rupees/Unit

PHOTO PLATES


Introduction to Arduino
Microcontrollers


MADRAS

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An AUTONOMOUS Institution
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RAMAPURAM CHENNAI

SRM

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Certificate of Participation

This is to certify that Mr. R.VIJAYAKUMAR of SNS college of technology, CBE has participated in Six days **Online International Faculty Development programme** on **'Research Innovations and Emerging Advances in Electrical Engineering'** organized by Department of Electrical and Electronics Engineering of **Easwari Engineering College** from 14th June - 19th June 2021.

Dr. P. Marish Kumar
Asso. Prof. /EEE
Coordinator

Dr. E. Kaliappan
Professor & Head / EEE
Convener

Dr. R. S. Kumar
Principal
Easwari Engineering College

Made for free with Certify'em

MARKSHEET

Name: **VIJAYAKUMAR R**

DOB: **05-03-1988**

Discipline	Year	Course Name	Marks		Total Marks (100%)	Status	Performance
			Assignment (25%)	Exam (75%)			
EE	2022	Operation and Planning of Power Distribution Systems	21.72	34.5	56	Pass	-
CE	2021	Electronic Waste Management - Issues And Challenges	24.42	30	54	Pass	-
EE	2019	DC Microgrid	22.08	32.25	54	Pass	-
EE	2019	Electric Vehicles - Part 1	23.17	24	47	Pass	-

PROF. ANDREW THANGARAJ
NPTEL COORDINATOR
IIT MADRAS

ID	DEPARTMENT NAME
AE	Aerospace Engineering
AG	Agriculture
CE	Architecture
BT	Biotechnology
CH	Chemical Engineering
CY	Chemistry and Biochemistry
CE	Civil Engineering
CS	Computer Science and Engineering
EE	Electrical Engineering
EC	Electronics & Communication Engineering
ED	Engineering Design
BT	General
HS	Humanities and Social Sciences
MG	Management
MA	Mathematics
ME	Mechanical Engineering
MM	Metallurgy and Material Science
MM	Mining Engineering
GE	Multidisciplinary
OE	Ocean Engineering
PH	Physics
SS	Special Lecture Series
DE	Textile Engineering

Total Mark
>=90
75-89
>=60

Performance
Elite + Gold
Elite + Silver
Elite