International Journal of Disaster Recovery and Business Continuity
Vol.11, No. 1 (2020), pp. 248-256

A SMART SYSTEM TO RECHARGE ELECTRIC VEHICLES IN PARKING AREAS

S. Mohanraj[1], M. Dhana Prakash[2], V. Dhanaraj[3], K. Hariharan[4]
Assistant Professor[1], UG Student[2,3,4]
Department of Electronics and Communication Engineering,
M.Kumarasamy College of Engineering, Karur, Tamilnadu

Abstract

Air pollution has become one of the major threats to the world and is mainly due the vehicular emissions using combustion engines. Hence using electric vehicles have become the alternative solution to the fossil fuels. With the huge development of EVs and their expected growth in the upcoming years, recharging of electric vehicles will give many difficulties. A better charging infrastructure is necessary to meet the increasing requirements. In this project, we introduce a smart system to recharge electric vehicles suitable to be implemented in both public and private parking areas. The main idea of our proposed system is the fact that all the parking places should be needed to be used as a charging point and also to provide facilities to monitor the power consumed by the charging process. Our device allows the users to obtain details such as price of charging, time used for charging process, and the availability of a charging point using a mobile application in real time. Our system is capable of scheduling the charging process by assigning different time periods by the scheduler. It also allows the users to reserve a particular time slot prior to the time of charging.

1. INTRODUCTION

As air pollution is increasing all over the world, the air quality of many cities becoming vulnerable as indicated by many researches. One of the major reasons behind this is the increase in the automobiles. In order to reduce the effects of air pollution it is necessary to adopt policies to reduce the emission of greenhouse gases that affect the atmosphere. This is possible only if we reduce our dependency on fossil fuels. Thus, the solution for this problem is the usage of electric vehicles (EVs). Also, people living in many places are affected by noise pollution and some of the cities in India has the worst noise pollution records. EVs can provide the solution to both the problems.

Since many car manufacturers are developing EVs as the alternative solution the usage of EVs will be increased in the upcoming days. Many companies stopped their development in combustion engine vehicles and increased innovation in the field of EVs. In recent years the adoption of EVs by people has become increased. Many companies are looking for the electrification of the existing vehicles. Many start-ups with their new innovations are blooming in this industry. The government of India has set up many policies to increase the usage of EVs. It has aimed to increase the usage of EVs by 30%. It has also introduced various schemes in the favour of EV users.

As the number of EVs increasing the demand for charging stations become increased. Thus, the development of charging infrastructure will boost the usage of electric vehicles. In developing a charging station, we should consider the challenges such as energy required for the complete charging process, cost for installing charging stations in the parking areas, to make the billing process easy and to give information about the charging status to the user.

ISSN: 2005-4289 IJDRBC

1.1 EV CHARGING STATION

In installation of charging stations in parking areas we should consider several problems such as grid overload and other problems. There are several objectives in deployment of charging stations as follows.

1. To provide satisfactory energy to all the available charging stations.
2. To inform user about the charging process such as the time elapsed in charging process, the cost of charging, and allow the user to book the charging stations.
3. To provide different priority charging base on the number of users as it is necessary to avoid congestion.
4. To measure the electricity consumed by suitable metering system.

2. LITERATURE REVIEW

Guanchen Zhang et al., proposed a charging algorithm that can be used along with the available energy management system for homes by integrating EV hosts by smart meters. The proposed scheme uses an algorithm call as water filling algorithm to measure the charge demand and the details of plugged in electric vehicles [1].

Yue Song et al., proposed an optimal scheduling method for charging station, that reduces the overall charging fee and the electricity value of the node stations at the desired time. The model is converted from the traditional version by using the use of convex rest techniques, through which the globally optimum answer and excessive computational efficiency may be achieved. The method proposed is achieved by using several numerical simulations [2].

Yongmin Zhang et al., proposed a method to decrease the cost required for EV charging. They first observe the user charging behaviour by assigning various charging schemes. They provide various schemes initially to reduce the queues in charging areas. This is necessary to make users to charge their EVs at the normal day time to reduce the grid overload at the peak time. They finally develop a charging strategy which is suitable for all the EV users and enables charging of all the available EVs [3].

Ioannis Zenginis et al., proposed a device that mitigates issues such as high charging times and driver's range tension and provide a way for the extensive adoption of EVs using fast charging stations. In his work, performance of the fast charging stations is calculated with various aspects. The fast charging stations use both the ac and dc charging methods based on the charging needs. The queueing time is initially calculated for a normal fee basis and in order to avoid further more queue a new pricing policy with an extra fee to escape waiting in the queue [4].

Mehmet Sukru Kuran et al., proposed an EV recharging scheduling system which reacts to vehicular mobility and parking patterns. Based on vehicular mobility and parking patterns EVs are categorized as regular and irregular EVs. The proposed system performs better than the fundamental scheduling methods with respect to objectives such as increasing the parking cost and satisfying the customer needs [5].

Bin Wang et al., proposed a system to schedule the charging of EVs. The proposed system contains control center on the provider side and a mobile app on costumer side. The proposed system predicts the scheduling using kernel-based algorithm. The proposed system dynamically controls the charging process as it has no prior information on the number of incoming EVs and schedules their charging at different time slots. The user can control the process of charging by means of a user-friendly mobile application and also acquires all the details of the charging through the application [6].

ISSN: 2005-4289 IJDRBC

Prakhar Srivastava et al., represented a paper to control the energy system with the help of Internet of Things. The proposed scheme involves integrating various sources of renewable sources of energy such as solar power, hydro power, wind energy etc., with the existing grid energy to form a hybrid energy system. The switching between two power sources is done with the help nodeMCU. The nodeMCU module controls the process of connecting with alternate sources of energy based on the requirement. The energy system can be monitored and controlled from anywhere wirelessly [7].

D.Vakula et al., proposed a smart parking device to help the users in parking for high populated developing cities. The proposed system is working on the principle of Internet of Things. In the proposed method, a web page has been developed and provided for the users to know the details of the parking areas such as the total number of parking areas available, number of vacant parking spots, and so on. The device allows users to reserve parking spots. The proposed device uses a nodeMCU to update the real time status of the parking areas [8].

Zhiwei Xu et al., presented a paper on based on a framework to charge the EV at various time intervals. It deals with immediate charging and also at latter period. The proposed method includes three levels of charging such as e.g., provincial stage, a quite large area level, and within the charging station level. The interrelationships between diverse stages in phrases of electricity transaction and facts alternate are sincerely identified. The proposed framework has minimized the cost of charging and also the grid overload [9].

Zhe Wei et al., represented a paper to schedule the charging of EV in the parking area level. In the proposed system initially, the system gets to know the details of all the incoming EVs and confirms that the charging process will be confirmed based on the availability. Next, the admitted EVs are scheduled for their charging process at different time slots with the help of scheduling algorithm. Then adaptive application-oriented set of rules are provided to ensure profit [10].

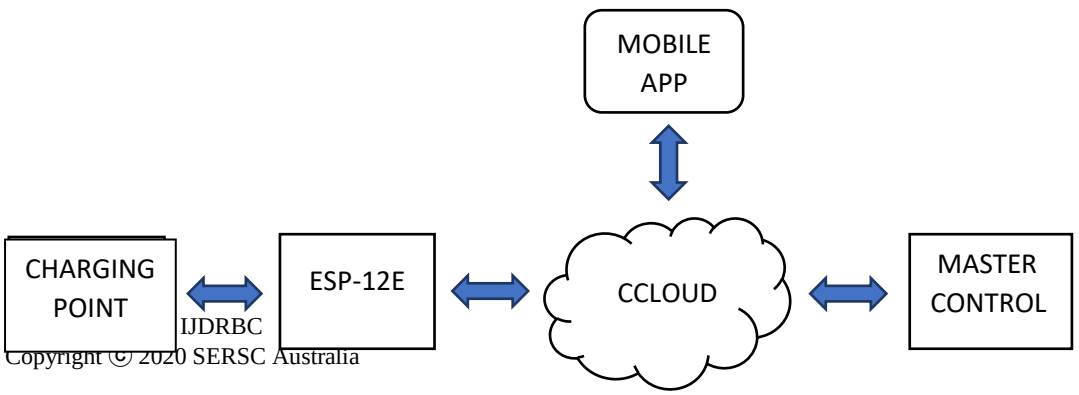
Wanrong Tang et al., presented a paper on EV charging scheduling, where the information about EV are not known prior to the arrival of EV but it can be statistically estimated. To avoid the excessive difficulty in this kind of dynamic programming hassle, a set of rules with the suitable complexity is provided. Analysis suggests that after the steps describing the charging demands is noticed, the complexity of the proposed method is reduced to o (1) [11].

Marc Petit et al., has represented a paper to make the EV charging easier by providing various charging constrains. Here the users are categorized into different groups based on the usage of EVs and their charging habits. The proposed method provides various charging methods based on priority. Thus, the users can charge their vehicles based on their priority and hence reducing the demand [12].

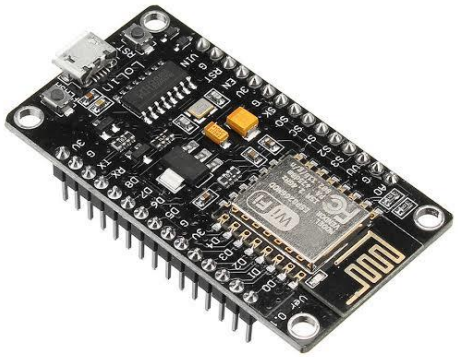
Behnam Khaki et al., represented a framework to manage the EV recharging as a result reducing the load of the grid. The proposed framework, based totally on method known as ADMM. This method helps in increasing the charging infrastructure and also reduces the difficulties in calculations. In this proposed approach, every EV aggregator schedules the EV charging profiles of its stations in a method which keeps all the data of the customers in private [13].

3. PROPOSED SYSTEM

3.1 BLOCK DIAGRAM



3.2 ESP-12E



NodeMCU is not the name of the hardware device it is the bootloader which is used to burn the code to the microcontroller. The hardware module is ESP-12E which belong to the family of ESP8266 devices of Espressif systems. ESP-12E is the latest version (12th version) of the ESP8266 family. The firmware we create can be developed in python language and the bootloader for python language is called as Micro python or Mangoose. The module can also be programmed using Arduino IDE and the bootloader used is called as nodeMCU. The operating voltage of ESP-12E module is 3.3v and has an inbuilt Wi-Fi module to make the module connect to the network. The hardware has an SoC antenna which operates in a frequency range of 2.4Ghz. The ESP-12E module will send and receive data in a mulicast channel.

3.3 SCHEDULER

The scheduler is the application we created to monitor the scheduling of the charging of different EVs. The scheduler has different priority levels and provides different time slots to different EVs based on the priority. The scheduler determines which charging point to be activated. If only one EV is present the scheduler does not do any scheduling and all the available power is provided to the EV. If the are many EVs then the scheduler allots different unmatched time slots to each EV based on priority.

3.4 PROPOSED MECHANISM

First, we consider charging stations in group and each group consists of several charging stations. Anyone of the charging station of the group will be available for charging at a given time. The scheduler supervises this task of scheduling the charging by allotting different time slot. Energy consumption of all the charging station (CS) will be watched continuously which allow us to notice the unplugged EVs and fully charged EVs. We could also allow an EV to receive all the available power for a particular time rather than sharing the available power. This will reduce the number of power meters and also the installed wire cross section. Charging by this method is also good for battery life as it gives time to cool.

ISSN: 2005-4289 IJDRBC

Thus, our proposed method gives all the available power to the particular EVs than sharing equally between the available EVs. We can also schedule the charging process on priority based on several schemes such as turbo mode where the users should pay an extra amount. We also allow the user to reserve a time slot such that they can book the time slot through the mobile application we provide. Thus, saving time and giving confirmation on available charging stations. All the data about charging process will be saved in the cloud and provided to the final user through the mobile application we provide in real time.

4. RESULT

The proposed method has been evaluated in laboratory for testing purpose. Two EVs were considered and different time slots have been provided to both EVs by various aspects such as initial charge of the EV, different fees, etc. The charging process was monitored continuously and the energy consumption with the cost has been provided to the particular customer. The device we created is capable of providing users the information such as the time utilized for charging and an online bill for the energy cost through the mobile application we provided. And when the charging process have been completed the user will receive a notification.

5. CONCLUSION

We have designed an efficient EV power meter to monitor the charging of EVs in parking areas with the desired microcontroller wirelessly. Our system enables the users to obtain information of the recharging process such as cost, time utilized for charging, etc. The usage of Wi-Fi minimizes the wire needed for connection and reduces the complexity of the system and is user friendly. Our system can be easily enlargeable with small alterations in hardware. The proposed system allowed the users to easily interact with the system using the mobile application we provided. The IoT platform is very powerful and also cheaper which enabled us to provide low cost smart EV charger.

REFERENCES

1. Guanchen Zhang, Shaoqing Tim Tan, G. Gary Wang, “Real Time Smart Charging of Electric Vehicles for Demand Charge Reduction at Non-Residential Sites”, IEEE Transactions on Smart Grid, vol. 9, no. 5, September 2018.
2. Yue Song, Yu Zheng, Member, David J. Hill, “Optimal Scheduling for EV Charging Stations in Distribution Networks: A Convexified Model”, IEEE Transactions on Power Systems, vol. 32, no. 2, pp. 1574-1575, March 2017.
3. Yongmin Zhang, Member, Pengcheng You, Lin Cai, “Optimal Charging Scheduling by Pricing for EV Charging Station with Dual Charging Modes”, IEEE Transactions on Intelligent Transportation Systems, vol. 20, no. 9, pp. 3386-3396, September 2019.
4. Ioannis Zenginis, John Vardakas, Nizar Zorba, Christos Verikoukis, “Performance Evaluation of a Multi-Standard Fast Charging Station for Electric Vehicles”, IEEE Transactions on Smart Grid, vol. 9, no. 5, pp. 4480-4489, September 2018.
5. Mehmet Sukru Kuran, Aline Carneiro Viana, Luigi Iannone, Daniel Kofman, Gregory Mermoud, Jean P. Vasseura, “Smart Parking Lot Management System for Scheduling the Recharging of Electric Vehicles”, IEEE Transactions on Smart Grid, February 2015.
6. Dr.S.Palanivel Rajan, “Design of Microstrip Patch Antenna for Wireless Application using High Performance FR4 Substrate”, Advances and Applications in Mathematical Sciences, ISSN No.: 0974-6803, Vol. No.: 18, Issue : 9, pp. 819-837, 2019.

ISSN: 2005-4289 IJDRBC

7. M.Paranthaman, S.Palanivel Rajan, “Design of H Shaped Patch Antenna for Biomedical Devices”, International Journal of Recent Technology and Engineering, ISSN : 2277-3878, Vol. No. 7, Issue:6S4, pp. 540-542, Retrieval No.: F11120476S4/19©BEIESP, 2019.
8. T.Abirami, Dr.S.Palanivel Rajan, “ Detection of poly cystic ovarian syndrome (PCOS) using follicle recognition techniques”, Bioscience Biotechnology Research Communications, ISSN: 0974-6455, Vol. 12, Issue : 01, pp. 1-4, DOI: 10.21786/bbrc/12.1/19, 2019.
9. M.Paranthaman, S.Palanivel Rajan, “Design of Implantable Antenna for Biomedical Applications”, International Journal of Advanced Science and Technology, P-ISSN: 2005-4238, E-ISSN: 2207-6360, Vol. No.: 28, Issue No. 17, pp. 85-90, 2019.
10. T.Abirami, S.Palanivel Rajan, “Cataloguing and Diagnosis of WBC’S in Microscopic Blood SMEAR”, International Journal of Advanced Science and Technology, P-ISSN: 2005-4238, E-ISSN: 2207-6360, Vol. 28, Issue No. 17, pp. 69-76, 2019..
11. M. Anitha, K. Kaarthik, "Analysis of nutrient requirement of crops using its leaf", Journal of Chemical and Pharmaceutical Sciences, Special Issue, pp. 99-103, 2016.
12. Dr.S.Palanivel Rajan, “Enrichment of ECG Quality using Independent Component Analysis for Dynamic Scenario by Eliminating EMG Artifacts”, Advances and Applications in Mathematical Sciences, ISSN No.: 0974-6803, Vol. No.: 18, Issue : 2, pp. 219-237, 2018.
13. K Kaarthik, A Sridevi, C Vivek, "Image processing based intelligent parking system", IEEE International Conference on Electrical, Instrumentation and Communication Engineering, 2017, pp. 1-4.
14. Dr.S.Palanivel Rajan, S.Suganya, “Design of Loop Antenna for the Human Brain Signal Analysis”, Indian Journal of Science and Technology, Online ISSN No.: 0974-5645, Print ISSN No.: 0974-6846, Vol. No.: 11, Issue: 10, pp. 1-6, DOI: 10.17485/ijst/2018/v11i10/120829, 2018.
15. K Kaarthik, C Vivek, "Hybrid Han Carlson Adder Architecture for Reducing Power and Delay", Middle-East Journal of Scientific Research, Vol. 24, Special Issue, pp. 308-313, 2016.
16. M.Paranthaman, Dr.S.Palanivel Rajan, “Design of E and U Shaped Slot for ISM Band Application”, Indian Journal of Science and Technology, Online ISSN No.: 0974-5645, Print ISSN No.: 0974-6846, Vol.: 11, Issue: 18, pp. 1-3, DOI: 10.17485/ijst/2018/v11i18/123042 2018.
17. C.Vivek, S.Palanivel Rajan, “Z-TCAM : An Efficient Memory Architecture Based TCAM”, Asian Journal of Information Technology, ISSN No.: 1682-3915, Vol. No.: 15, Issue : 3, pp. 448-454, DOI: 10.3923/ajit.2016.448.454, 2016.
18. K Kaarthik, C Vivek, “Weed Remover In Agricultural Field Through Image Processing”, International Journal of Pure and Applied Mathematics, Vol. 118, Issue 8, pp. 393-399, 2018.
19. S.Vijayprasath, R.Sukanesh, S.Palanivel Rajan, “Assessment of relationship between heart rate variability and drowsiness of post operative patients in driving conditions”, JoKULL Journal, ISSN No.: 0449-0576, Vol. 63, Issue 11, pp. 107 – 121, 2013.
20. K. Kaarthik, P. Yuvarani , "Implementation of Distributed Operating System for industrial process automation using embedded technology", Journal of Chemical and Pharmaceutical Sciences, Special Issue, pp. 14-17, 2016.
21. S.Palanivel Rajan, R.Sukanesh, S.Vijayprasath, “Design and Development of Mobile Based Smart Tele-Health Care System for Remote Patients”, European Journal of Scientific Research, ISSN No.: 1450-216X/1450-202X, Vol. No. 70, Issue 1, pp. 148-158, 2012.

ISSN: 2005-4289 IJDRBC

22. S.Palanivel Rajan, R.Sukanesh, S.Vijayprasath, “Analysis and Effective Implementation of Mobile Based Tele-Alert System for Enhancing Remote Health-Care Scenario”, HealthMED Journal, ISSN No. : 1840-2291, Vol. No. 6, Issue No. 7, pp. 2370–2377, 2012.
23. K. Kaarthik, S. Pradeep, S. Selvi, "An Efficient Architecture Implemented to Reduce Area in VLSI Adders", Imperial Journal of Interdisciplinary Research, Vol.3, Issue 2, pp. 326-330, 2017
24. Bin Wang, Yubo Wang, Hamidreza Nazaripouya, Charlie Qiu, Chi-Cheng Chu, Rajit Gadh, “Predictive Scheduling Framework for Electric Vehicles with Uncertainties of User Behaviors”, IEEE Internet Of Things Journal, vol. 4, pp. 52-63, October 2016.
25. Srivastava, P, Bajaj, M, Rana, A. S, “IoT Based Controlling of Hybrid Energy System Using Esp8266”, 2018 IEEMA Engineer Infinite Conference (Etechnxt).
26. D.Vakula, Yeshwanth Krishna Kolli, “Low Cost Smart Parking System For Smart Cities”, International Conference On Intelligent Sustainable Systems (ICISS 2017).
27. Zhiwei Xu, Wencong Su, Zechun Hu, Yonghua Song, Fellow, Hongcai Zhang, “Hierarchical Framework for Coordinated Charging of Plug-In Electric Vehicles in China”, IEEE Transactions on Smart Grid, vol. 7, no. 1, pp. 428-438, January 2016.
28. Zhe Wei, Yue Li, Yongmin Zhang, Lin Cai, “Intelligent Parking Garage EV Charging Scheduling Considering Battery Charging Characteristic”, IEEE Transactions on Industrial Electronics, vol. 65, no. 3, pp. 2806-2816, March 2018.
29. K Kaarthik, C Vivek, “Variable Latency Approach in VLSI Adder Implemented to Reduce Area and Power”, Indian Journal of Science and Technology, Vol. 11, Issue 18, pp.1-7, 2018.
30. K. Kaarthik, S. Pradeep, S. Selvi, "An Efficient Architecture Implemented to Reduce Area in VLSI Adders", Imperial Journal of Interdisciplinary Research (IJIR), Vol.3, Issue 2, pp. 326-330, 2017
31. S.Palanivel Rajan, et.al., “Intelligent Wireless Mobile Patient Monitoring System”, IEEE Digital Library Xplore, ISBN No. 978-1-4244-7769-2, INSPEC Accession Number: 11745297, IEEE Catalog Number: CFP1044K-ART, pp. 540-543, 2010.
32. S.Palanivel Rajan, et.al., “Cellular Phone based Biomedical System for Health Care”, IEEE Digital Library Xplore, ISBN No. 978-1-4244-7769-2, INSPEC Accession Number: 11745436, IEEE Catalog Number: CFP1044K-ART, pp.550-553, 2010.
33. S.Palanivel Rajan, et.al., “Performance Evaluation of Mobile Phone Radiation Minimization through Characteristic Impedance Measurement for Health-Care Applications”, IEEE Digital Library Xplore, ISBN : 978-1-4673-2047-4, IEEE Catalog Number: CFP1221T-CDR, 2012.
34. S.Palanivel Rajan, et.al., “Experimental Explorations on EOG Signal Processing for Real Time Applications in LabVIEW”, IEEE Digital Library Xplore, ISBN : 978-1-4673-2047-4, IEEE Catalog Number: CFP1221T-CDR, 2012.
35. K Kaarthik, C Vivek, "Hybrid Han Carlson Adder Architecture for Reducing Power and Delay", Middle-East Journal of Scientific Research, Vol. 24, Special Issue, pp. 308-313,2016.
36. Dr.S.Palanivel Rajan, Dr.C.Vivek, “Performance Analysis of Human Brain Stroke Detection System Using Ultra Wide Band Pentagon Antenna”, Sylwan Journal, ISSN No.: 0039-7660, Vol. No.: 164, Issue : 1, pp. 333–339, 2020.
37. Dr.S.Palanivel Rajan, Dr.C.Vivek, “Analysis and Design of Microstrip Patch Antenna for Radar Communication”, Journal of Electrical Engineering & Technology, Online ISSN No.: 2093-7423, Print ISSN No.: 1975-0102, Vol. No.: 14, Issue : 2, DOI: 10.1007/s42835-018-00072-y, pp. 923–929, 2019.
38. Dr.S.Palanivel Rajan, M.Paranthaman, “Characterization of Compact and Efficient Patch Antenna with single inset feeding technique for Wireless Applications”, Journal of Applied Research and Technology, ISSN: 1665–6423, Vol. 17, Issue 4, pp. 297-301, 2019.

ISSN: 2005-4289 IJDRBC

39. Wanrong Tang, Ying Jun Zhang, "A Model Predictive Control Approach for Low-Complexity Electric Vehicle Charging Scheduling: Optimality and Scalability", IEEE Transactions on Power Systems, vol. 32, no. 2, pp.1050-1063, March 2017.
40. Marc Petit, Martin Hennebelev, "EV Smart Charging in Collective Residential Buildings: The Bienvenu Project", 2019 IEEE Milan Powertech.
41. Behnam Khaki, Chicheng Chu, Rajit Gadh, "A Hierarchical Admm Based Framework for EV Charging Scheduling", 2018 IEEE/Pes Transmission and Distribution Conference and Exposition (T&D).

ISSN: 2005-4289 IJDRBC