International Journal of Aquatic Science
ISSN: 2008-8019
Vol 12, Issue 03, 2021

Battery Monitoring And Smart Charging Using Iot For Electrical Vehicle Applications

G. Themozhi[1], A. Prabha[2], P. Radhakrishnan[3], K. Manigandan[4]

[1]*Professor, Department of EEE, AMET Deemed University, Chennai, India*
[2]*Assistant Professor, Department of EEE, Kings College of Engineering, Thanjavur, India*
[3]*Professor, Department of Electrical and Electronics Engineering, Tagore Engineering College, Chennai, India*
[4]*Assistant Professor, Department of EEE, AMET Deemed University, Chennai, India*

ABSTRACT
This paper describes the application of Internet-of-things (IoT) in monitoring the performance of electric vehicle battery. It is clear that an electric vehicle totally depends on the source of energy from a battery. However, the amount of energy supplied to the vehicle is decreasing gradually that leads to the performance degradation. This is a major concern for battery manufacture. IoT-based battery monitoring system is consists of two major parts i) monitoring device and ii) user interface. Based on experimental results, the system is capable to detect degraded battery performance and sends notification messages to the user for further action. This method is helpful for transportation systems, and V2G systems. This proposed system will improve the city planning and makes the city life easy. With IoT we can easily manage the whole V2G system which will definitely save time and money.

KEYWORDS: Lithium ions batteries, IoT-Internet of Things, Vehicle to Grid, Electric Vehicle, Vehicle to Home

1. INTRODUCTION

Batteries have become the popular form of electrical energy storage in EVs. The evolution in city transportation has boosted over the last few decades which in turn increased the growth of industries. Since battery is a commonly used device for storage of energy, calculation of Status of Charge plays a vital role in the future [4]. Nowadays, vehicles are essential in the day-to-day life and for industrial use as well. Sufficient effort is being done to withdraw the combustion engines by electric motors [5]. Due to the increase in carbon dioxide (CO2) caused by the industries and transportation, the Kyoto treaty was signed. This treaty was aimed to reduce the level of CO2 and has boosted the findings for new cleaner energy solutions. As a finding, Electrical Vehicles (EVs) appeared as a solution to reduce CO2 emissions. Electric Vehicles are increasing day by day across the globe [6]. When the number of Electric vehicles is increasing, there is a need to implement Electric Vehicles Charging system in parking systems or grid. Automobile major Nissan produced a vehicle-to-grid (V2G) project with Enel, a multinational power company, in the United Kingdom [12] [13].

Previous battery monitoring system only monitor and detect the condition of the battery and alarmed the user via battery indicator inside the vehicle. Due to the advancement of the design of notification system, internet of things (IoT) technology can be used to notify the manufacturer and users regarding the battery status. This can be considered as one of the maintenance support procedure that can be done by the manufacturer. IoT makes smart grid to contribute the information between multiple users and thus amplifies connectivity by the help of infrastructures. Cloud storage is used for the data storage where the data is send through Internet gateway. Fig1 shows the V2G architecture and shows the IoT architecture. This Paper is discussing about the involvement of IoT in V2G and G2V.

PROPOSED ARCHITECTURE

This paper focuses on the state of charge of the battery for electrical vehicle. The user can view the data in the App. Also, the user can locate the nearby charging station locations using the app. Once the user knows about the status of his car battery, he can easily decide whether to proceed with power delivering to the grid or to take power from the grid based on the tariff rates. The tariff rate will be different for delivering power to the grid and taking power from the grid. The grid will have bidirectional converters for transferring power. There are some grids which also uses solar energy as a source. shows the block diagram of the entire system. The important and noticing features of IoT include connectivity, sensors and small device use. New enabling technologies for networking, especially IoT networking, are a kind of networks which are not tied to major providers. IoT creates small and wide networks between its system devices [1]. IoT uses sensors for capturing the input. It uses sensors or controllers as the main working unit. Nowadays more controllers like Arm Mbed, Arduino are gaining more popularity in the IoT field [2,3]. Small devices like phone or tablet are used to view the output or results which minimize the effort to get the data.

EXISTING SYSTEM

In the Existing system work, there is no implementation of IoT platform with application development. This paper focuses on the IoT part of determining the SoC value and sending the data to Adafruit IO. The user can view the data in the App. Also,the user

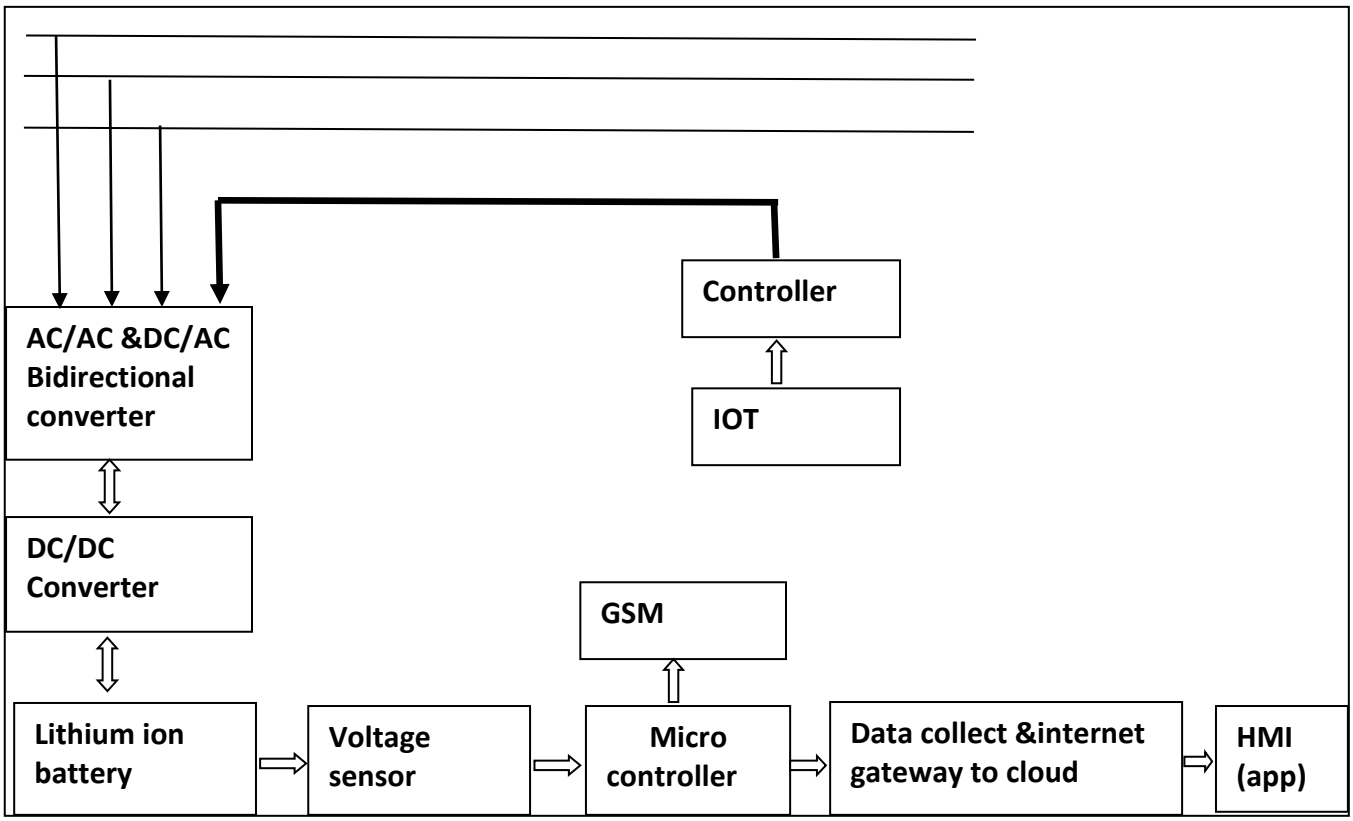

Figure 1: Block diagram of overall proposed design

can locate the nearby charging station locations using the app. Once the user knows about the status of his car battery, he can easily decide whether to proceed with power delivering to the grid or to take power from the grid based on the tariff rates [10][11]. The tariff rate will be different for delivering power to the grid and taking power from the grid. It includes the power and tariff rates for the V2G and G2V power flow and station location also. Google firebase is used as the cloud storage. The user login details are stored here.

VOLTAGE SENSOR MEASUREMENT

In this experiment, the values of five batteries was measured using a multimeter. Then, these values were compared with the values of the same batteries that were connected to the voltage sensor circuit. The purpose is to show the differences and accuracy percentage between both values. The selected batteries were varied in voltage values. The batteries were a mixed of new and used ones. The results of measurement will show these differences.

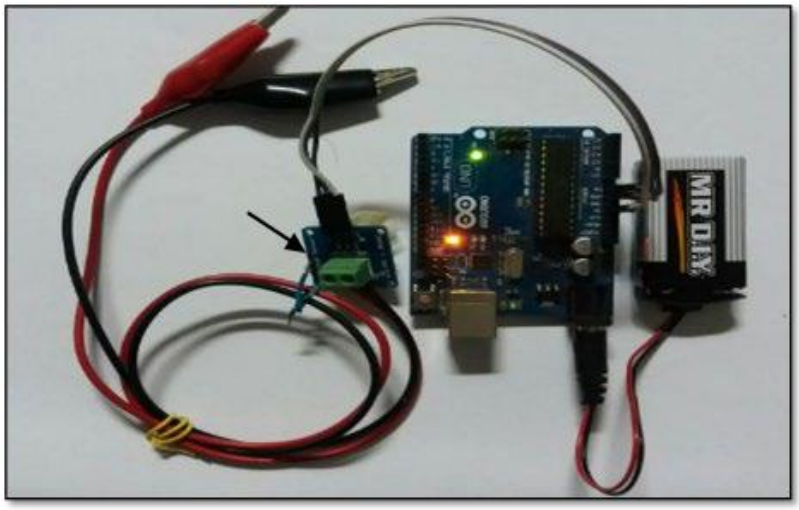

Figure 2: Battery voltage measurement using voltage sensor Circuit.

Battery	Voltage measurement results		Accuracy percentage (%)
	Voltage sensor	Multimeter	
1	3.81	3.79	99.47
2	9.98	9.91	99.29
3	8.70	8.70	98.27
4	1.25	1.23	98.40

The results shows that the accuracy of the voltage measurements taken from voltage sensor are quite similar to the measurement taken using multimeter. The accuracy percentage for all of the measured batteries are above 99%. therefore, it can be concluded that the voltage sensor provides valid measurement values of the batteries.

BATTERY MONITORING SYSTEM

The proposed battery monitoring system in this work is consists of a voltage sensor and SIM808 module. Experiments and analysis to show the characteristics and usefulness of the sensor and module have been presented in the previous subsections. Therefore, in this subsection, the battery monitoring system usefulness is demonstrated. Fig 3 shows the developed hardware circuit of the battery monitoring system [6]. In the figure, the voltage sensor is connected to the SIM808 module. The system has been verified to display voltage values and coordinates simultaneously. The voltage values and coordinates are updated in real time with a one (1) minute delay.

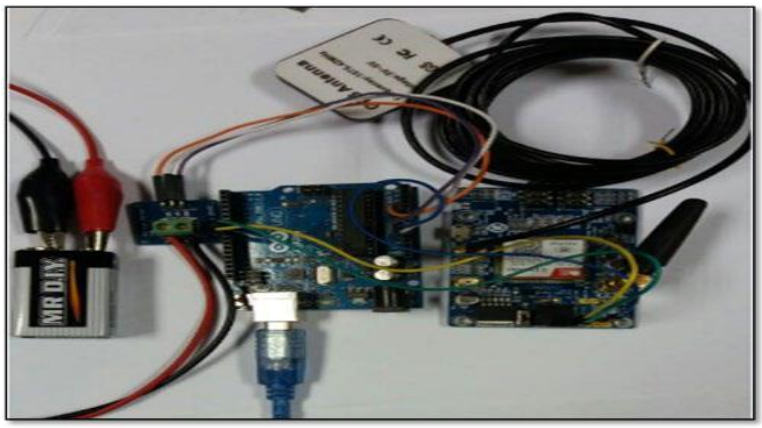

Figure 3: Hardware for the developed battery monitoring system consists of voltage sensor and SIM808 GSM/GPRS/GPS module

The table shows the coordinates of all target locations taken from Google Maps and SIM808 module. From the results, it shows that the accuracy of the coordinates taken from SIM808 module are quite similar to the coordinates derived from Google Maps. The accuracy percentage for all of the measured coordinates are near 100% accurate.

ANDROID APP

Android app for EV owner for tracing the charging location, and details of tariff rates of V2G and G2V are shown in the Android app. The app is built in android studio and the data is stored in firebase cloud. The user can check the location and knows the tariff rates for the power by using the app. User is allowed to register in the cloud using his email and password. Once user login to the system, he can know the nearby location of the charging stations. IoT enabled app for the user to check the battery SoC of his car. One can measure the SoC value using this app.

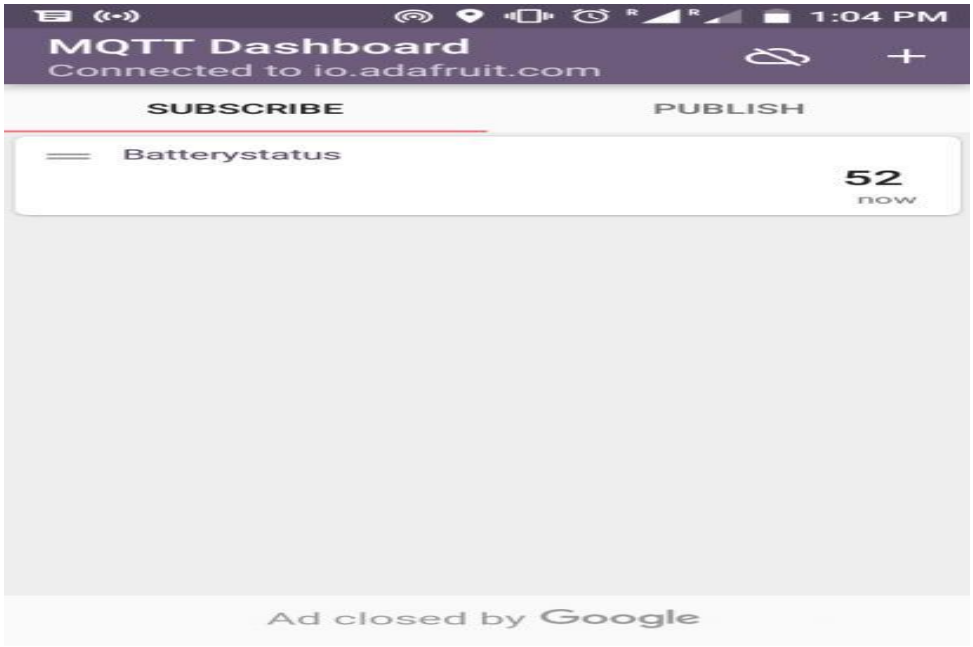

Figure 4: Android app

This paper focuses on the IoT part of determining the SoC value and sending the data to Adafruit IO. The user can view the data in the App. Also,the user can locate the nearby charging station locations using the app. It uses sensors or controllers as the main working unit.Nowadays more controllers like Arm Mbed, Arduino are gaining more popularity in the IoT field. Small devices like phone or tablet are used to view the output or results which minimizes the effort to get the data.

ADVANTAGES OF IOT

The advantages of IoT spread across every area of lifestyle and economy. The major advantages of IoT are as discussed below Customer Engagement - IoT completely transforms to achieve more and more effective and better engagement with audiences to reduce the flaws and blind spots which affects the accuracy of the system [8,9]. Analyses has been carried out to determine degraded batteries by measuring the discharge rates of the battery against time. Basically, EVs utilize lithium-ion batteries in bulk quantity.

Therefore, in this paper an experiment has been conducted to determine battery degradation by using two (2) 3.7V Li -MN batteries, where one (1) battery was in a new condition and another one was a degraded battery. When a 3.7V Li-MN is discharged, there is a low cut-off voltage value that determine the battery is fully discharged. The SoC value for the battery [17].

The data is displayed in the app also. The Adafruit IO is a platform in which the user can easily see his data in the form of graph bar diagram and chart. the comparison of the data collected for various time intervals during a day [14][15]. It is displayed as a graph here. After knowing the status of the car battery. user would be easily able to take a decision whether to deliver power to the grid or to take power from the grid. the SoC status on Android App.

The SoC value for the battery. The data is displayed in the app also. The Adafruit IO is a platform in which the user can easily see his data in the form of graph bar diagram and chart. the comparison of the data collected for various time intervals during a day. It is displayed as a graph here. After knowing the status of the car battery, user would be easily able to take a decision whether to deliver power to the grid or to take power from the grid. the SoC status on Android App.

Figure 7. ARM LPC1768

Once the user has successfully login into the user interface, the battery monitoring interface is displayed. The interface shows a map based on Google Maps application of the location of registered battery monitoring devices marked by red markers. If the battery voltage condition of a device is approaching cut-off discharge state, the red marker will bounce continuously at the location. Clicking the bouncing red marker will show the information of the device such as location (latitude and longitude), battery voltage reading and measured time. This information can be used for the user/admin to inform the users/clients about their battery condition especially during critical battery condition or degraded battery.

2. CONLUSION

In this paper ,it is concluded that, improvement of battery vehicle performance alalyze here. The paper described the design and development of an IoT-based battery monitoring system for electric vehicle to ensure the battery performance degradation can be monitored online. The objective is to proof that the concept of the idea can be realized. The development of the system consists of the development of the hardware for the battery monitoring device and a web-based battery monitoring user interface.. Further modification can be done to improve the system by adding more functions into the system.The car user can easily The system is capable to show information such as location, battery condition and time via internet by incorporating GPS system to detect the coordinate and display it on the Google Maps application check the health of his car battery and he can easily make a decision whether to take power from grid or to sell power to grid. For future work, handling of multiple users could be implemented so as to compare the status of different users.

3. REFERENCES

[1] Sheraz Aslam,Michalis P. Michaelides and Herodotos Herodotou, "Internet of Ships: A Survey on Architectures,Emerging Applications, and Challenges, IEEE INTERNET OF THINGS JOURNAL, VOL. , NO. , MAY 2020

[2] R. Karthickmanoj ⇑, J. Padmapriya, T. Sasilatha, "A novel pixel replacement-based segmentation and double feature extraction techniques for efficient classification of plant leaf diseases, Materials Today: Proceedings, Elseveir(Article in Press)

[3] R. Karthickmanoj ⇑, J. Padmapriya, T. Sasilatha, "Automated machine learning based plant stress detection system", Materials Today: Proceedings, Elseveir(Article in Press)

[4] S.Amirtharaj, D.Lakshmi, V.Madhan kumar, R.Zahira, "Switching Loss reduction and simulation of Quasi Z-Source Inverter System fed BLDC motor", International Journal of Advanced Science and Technology,Vol.29, No.4(2020),pp. 1149-1157.

[5] L. Xiaokang, Z. Qionghua, H. Kui, S. Yuehong, "Battery management system for electric vehicles," J.Huazhong Univ. Of Sci. & Tech. (Nature Science Edition). Vol. 35, No. 8, pp. 83-86, 2007.

[6] S. A. Mathew, R. Prakash, and P. C. John "A smart wireless battery monitoring system for electric vehicles," Int. Conf. Intel. Syst. Des. Appl. ISDA, pp. 189–193, 2012.

[7] W. Menghua and X. Bing, "A Real-time Android-based Monitoring System for the Power Lithium-ion Battery Used on EVs," 2017 10th Int. Conf. on Intelligent Computation Technology and Automation, 245-249, 2017.

[8] Kim, Ho-Sung, Myung-Hyo Ryu, Ju-Won Baek, and Jee-Hoon Jung. "High-efficiency isolated bidirectional ACDC converter for a DC distribution system." IEEE Transactions on Power Electronics 28, no. 4 (2013): 1642-1654.

[9] M. Luo, Y. Xiao, W. M. Sun, and Z. Wang, "Online battery monitoring system based on GPRS for electric vehicles" Proceedings - 2013 5th International Conference on Intelligent Human-Machine Systems and Cybernetics, IHMSC 2013, Vol. 1, 122–125, 2013.

[10] Suresh, Harishankar, Anand Baskaran, K. P. Sudharsan, U. Vignesh, T. Viveknath, P. Sivraj, and K. Vijith. "Efficient charging of battery and production of power from solar energy." In Embedded Systems (ICES), 2014 International Conference on, pp. 231-237. IEEE, 2014.

[11] D. S. Suresh, Sekar R, Mohamed Shafiulla S.,"Battery Monitoring system Based on PLC", International Journal of Science and Research, vol. 3 issue 6. pp. 128-133, 2012.

[12] Cheng, Ka Wai Eric, B. P. Divakar, Hongjie Wu, Kai Ding, and Ho Fai Ho. "Battery-management system (BMS) and SOC development for electrical vehicles." IEEE transactions on vehicular technology 60, no. 1 (2011): 76-88

[13] S. Yonghua, Y. Yuexi, H. Zechun, "Present Status and Development Trend of Batteries for Electric Vehicles," Power System Technology, Vol. 35, No. 4, pp. 1-7, 2011.

[14] C. Piao, Q. Liu, Z. Huang, C. Cho, and X. Shu, "VRLA Battery Management System Based on LIN Bus for Electric Vehicle," Advanced Technology in Teaching, AISC163, pp. 753-763, 2011.

[15] M Rajavelan, C Gnanavel, T Baldwin, Immanuel and P Muthukumar, “Improved Sensitivity of SPR Instrument Using Multiple Reflection Technique” International Journal of Engineering & Technology,vol.7,pp. 1310-1316, 2018.

[16] C Gnanavel, T Baldwin Immanuel, P Muthukumar, Padma Suresh Lekshmi Kanthan , " Investigation on Four Quadrant Operation of BLDC MOTOR Using Spartan-6 FPGA," International Conference on Soft Computing Systems,2018,pp. 752-763,2018.

[17] Veerakumar. P, G. Jegadeeswari, Dr.C.Nayanatara,” IoT Based Integrated Home Security and Electrical Appliances Control System”, Test Engineering and Management, January - February 2020

[18] R Dorothy, S Sasilatha, (2017) “Smart Grid Systems Based Survey on Cyber Security Issues”, Bulletin of Electrical Engineering and Informatics 6 (4), 337-342

[19] M Parameswari, T Sasilatha, (2018)"Cross-layer based error control technique for WSN with modified relay node selection and corruption aware method" Wireless Personal Communications 99 (1), 479-495

[20] A Priya, T Sasilatha (2017) "Wireless network for strategic boundary supervision system" Bulletin of Electrical Engineering and Informatics 6 (4), 367-370