IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 6, June 2023

DOI: 10.17148/IJARCCE.2023.12649

BATTERY MANAGEMENT SYSTEM ON ELECTRIC VEHICLE WITH HYBRID CHARGING

Sharvari S. Datir[1], Prof. Nitin N. Mandaogade[2]

Student, G H Raisoni University, Amravati M.H. India[1]

Professor, G H Raisoni University, Amravati M.H. India[2]

Abstract: -Renewable energy generation and electric vehicles (EVs) have recently received increased attention in the smart grid. This paper describes a grid-connected solar-wind hybrid system for supplying Battery's electrical load demand. Battery monitoring systems for E-vehicles are a new development in the automotive and electrical industries. There are currently no large-scale monitoring systems for batteries in India. It has not progressed from a small-scale personal project to a large-scale application. Aside from that, there are existing methodologies that rent the batteries to the user as such and rely entirely on the user's timely payment in person. A battery supervision scheme is an automatic system that protects a rechargeable battery, for example, by preventing it from functioning outside of its safe operational area, monitoring its state, planning inferior statistics, commenting on that data, monitoring its situation, confirming it, and/or supplementing it. The BMS will also order the battery to be recharged by redirecting the improved energy back into the battery pack. It is only used for battery charging and discharging at rummage sales. With our proposed system, the EV battery is charged by both renewable and non-renewable sources, such as a solar PV plate. The battery management system can be linked to the monitoring structure, which can manage, monitor, and log data to an online database. This system monitors battery parameters such as voltage, current, temperature, power, and charge state. These parameters are then transmitted and stored in a database over the internet, which is then displayed to the user via an Android app. When a large enough dataset is available in the database, intelligent machine learning algorithms can be used to predict the life cycle of the battery and make recommendations to the user about the time and duration of each charge cycle, the battery's health, and other factors. When used in battery rental companies, the battery can only be charged if the user pays the rent on time.

Index Terms—Charging station, electric vehicle (EV), solar photovoltaic (SPV) panels,

I. INTRODUCTION

The accessibility of restricted petroleum product saves, climatic impacts, and ozone depleting substance discharges has constrained the concentration toward sustainable power age in the previous years. As per the Service of New and Sustainable power, in India, environmentally friendly power age represents ap- generally 20% of the absolute power age. The significant commitments are from sun based and wind power instead of hydro, warm, sea, and biomass energies [1]. Sunlight based and wind power become conspicuous advances to supply electrical burden in remote and off-lattice areas attributable to the new progressions in power electronic capacity gadgets and the falling costs of the parts. Reference [2] expressed that sunlight-based energy and wind energy are openly available in nature and are more favorable than different hotspots for power age. Notwithstanding, the blend of sun powered and wind energy builds the complexities because of their unusual and variable nature, which presents specific specialized, ecological, and financial difficulties [3]. A half breed sustainable power framework can be planned utilizing numerical models of various parts and enhancement procedures [4], [5].

An application stage called a "battery management framework" can watch out for a battery's presentation and gauge what amount of time it will require to charge and release the battery under current burden conditions. It is used for ongoing battery execution checking. The strategy by which information from batteries can be gotten to will have an immediate bearing on the battery the executives framework's quality. The battery the executives framework monitors the present status of the batteries' charging and releasing cycles and gives verifiable execution information. Breaking down the condition of batteries is straightforward when verifiable information is utilized.

Independent directed vehicles (AGV) have arisen because of always expanding mechanical progressions in the car business. Each boundary in AGV checking fundamentally affects the vehicle's development, way arranging, and travel

DOI: 10.17148/IJARCCE.2023.12649

distance comparable to the battery's present status. It is feasible to foresee the battery's life expectancy and how much time before it tends to be securely depleted by observing its condition. The battery checking structure should be trustworthy and flexible with the objective that the functionalities can be extended whenever required. This sort of framework has not yet been executed in India, regardless of the way that there are a couple of them in different nations. The Trap of Things (IoT) depicts the association of genuine articles — "things" — that are introduced with sensors, programming, and various headways to connect and exchanging data with various devices and systems over the web. These apparatuses can be fundamental family things or complex modern instruments. Specialists guess that the quantity of associated IoT gadgets will arrive at 10 billion by 2020 and 22 billion by 2025, up from the ongoing 7 billion. Prophet has accomplices in the gadget business.

Point: A battery checking framework for E-vehicles is a creating field in the car and electrical businesses. There is no current framework in India for checking batteries.
1.To decrease the misuse of uninhibitedly accessible energy.
2. To decrease the quantity of stacking zones.
3.Ensuring that power arrives at each rustic corner conceivable.

II. LITERATURE REVIEW

The electric vehicle (EV) industry has grown rapidly in recent years [1, 2]. Due to their high energy and power density, long life cycle, and low rate of self-discharge, lithium ion (Li-ion) batteries have emerged as one of the most popular battery technologies for EVs [[3], [4], and [5]] despite the fact that numerous commercial batteries are utilized as energy storage systems. However, the current charging strategies of EVs have severely restricted the widespread use of Li-ion batteries [6, 7]. As a new paradigm toward a smarter battery management system (BMS), research on the provision of an optimal charging method for Li-ion batteries has emerged to address this issue [8, 9]. Li-particle battery frameworks in EVs comprise of hundreds to thousands of cells in series or equal. The state of health (SOH) of each cell in an EV's Li-ion battery system is closely linked to the development of an optimal charging method [10, 11], which presents significant challenges [13, 14], and [15].

Li-ion batteries can be easily charged using either constant-current (CC) or constant-voltage (CV) charging, both of which are inefficient and unable to meet the growing demand for modern electric vehicle (EV) industries [16, 17]. Improved charging methods for Li-ion batteries have been developed in a variety of ways, including accelerated charging, improved charging performance, and extended service life [18, 19]. From a variety of perspectives, these improved methods can be divided into charging waveform improvement, battery model coupling, and the most recent alternating current (AC) charging. In practice, these methods have resulted in a significant improvement in performance.

Improving charging profiles by transforming either the voltage waveform or the current waveform is the first category of improved charging methods. There are a number of alternatives to the standard constant current-constant voltage (CC-CV) method, such as multi-stage CC using the integer linear programming (ILP) algorithm [20] and multi-stage CC-CV based on the evolution of the internal resistance of the battery [21]. In addition, either pulse current or pulse voltage is used in the development of pulse charging to achieve ion diffusion and neutralization during the pulse's rest period. It has been demonstrated that pulse charging can significantly shorten the amount of time required to charge lead-acid batteries and extend their service life [22,23]. This provides some guidelines for the development of more advanced charging methods for Li-ion batteries. Waveform-based charging strategies have been generally investigated to charge Li-particle batteries these days [[24], [25], [26]].

The second class of the improved charging strategies is to apply battery models, for example, identical circuit models (ECM) and electrochemical models (EM) to streamline charging exhibitions [27,28]. In Ref. [29], an ECM-based charging strategy employing a universal voltage protocol (UVP) and model parameters derived from experimental data is capable of increasing charging efficiency and extending battery life cycles. Charging strategies based on EM have also been proposed in order to study the internal characteristics of a Li-ion battery during the charging process [30, 31]. Exploratory outcomes show that the EM based charging strategies are prepared to do extraordinarily shortening charging time while meeting the necessities of wellbeing related conditions.

When it comes to battery systems that require a lot of power and high performance from charging equipment, none of the aforementioned charging methods produce satisfactory results [32,33]. The answer is to use AC charging, which brings us to the third category of improved charging methods [34, 35, 36]. This method of charging has gradually gained widespread attention. Recent research focuses on determining the optimal charging frequency for lithium ion batteries,

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 6, June 2023

DOI: 10.17148/IJARCCE.2023.12649

which is nonlinearly affected by temperature, state of charge (SOC), and SOH. In Ref. [37], a dynamic online tracking algorithm for determining the optimal charging frequency in any circumstance is developed.

A summary of a diverse range of improved approaches to charging Li-ion batteries based on constant current or voltage waveform, battery model, and AC waveform is shown in Figure to identify the advantages and commonalities of those three categories. 1. This lays the groundwork for further development of a smarter BMS for EVs by assisting in the discovery of the evolution of optimized charging methods.

III. PROPOSED WORK

The principal objective of this proposed work is to Force of the framework can be screen utilizing the current and voltage esteem detected by the arduino. The screen of the sun-oriented energy framework shows the power and energy use. This framework assists with carrying out in brilliant matrix for effective use.

To carry out a battery the board framework (BMS) for an electric vehicle (EV) with mixture charging utilizing an ESP32 microcontroller, the accompanying strategy can be followed:

1. Identify the necessities: Decide the prerequisites for the BMS, for example, the quantity of cells in the battery pack, the greatest and least cell voltages, the charging and releasing current cutoff points, and the correspondence convention with the charging station.
2. Select the equipment parts: Select the equipment parts, for example, the ESP32 microcontroller, voltage and current sensors, and transfers for controlling the charging and releasing.
3. Develop the product: Foster the product for the BMS, which incorporates perusing the voltage and current qualities from the sensors, computing the condition of charge (SoC) and condition of wellbeing (SoH) of the battery pack, controlling the charging and releasing current, and speaking with the charging station utilizing the predetermined convention.
4. Implement wellbeing highlights: Execute security elements, for example, overvoltage assurance, undervoltage insurance, overcurrent assurance, and short out assurance to guarantee the protected activity of the EV and its inhabitants.
5. Test and approve: Test the BMS on a model EV with half and half charging to approve its usefulness and execution. Utilize a blend of lab testing and on-street testing to confirm the exactness of the sensor readings, the control of charging and releasing flows, and the correspondence with the charging station.

Generally, carrying out a BMS for an EV with half and half charging utilizing an ESP32 microcontroller requires an exhaustive comprehension of the necessities, equipment parts, programming improvement, security highlights, and testing and approval processes. It is vital to guarantee that the BMS is dependable, effective, and protected, as it assumes a basic part in the activity of the EV.

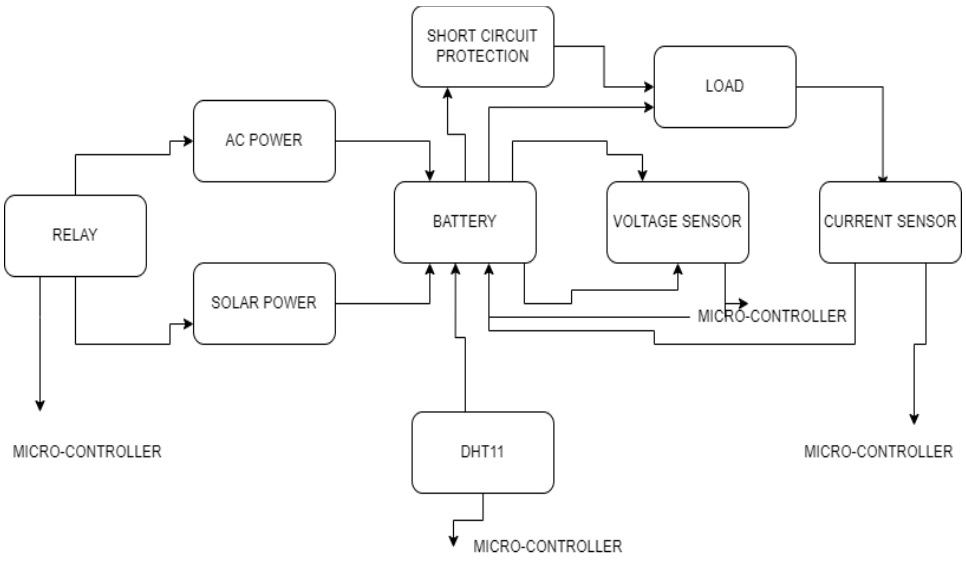

Figure.1 Block diagram of proposed system

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 6, June 2023

DOI: 10.17148/IJARCCE.2023.12649

In the above block diagram, we can see that we are using the ESP32 as a microcontroller. The power supply should step down the voltage and maintain a constant 5V voltage. The DHT11 temperature sensor is connected as an input device to the ESP32, as are the voltage and current sensors. To display all of the data on a mobile phone, we are using an Arduino IOT application.

IV. BACKGROUND OF EV TECHNOLOGIES

2.1. Advancement of EV By and large, EV is alluded to as an electrically determined vehicle that involves at least one electric engines for its impetus. It might incorporate an electric vehicle, train, truck/transport and cruisers/bikes. In this paper, nonetheless, the meaning of EV is restricted to the half breed electric vehicle (HEV), the module mixture electric vehicle (PHEV) and absolutely the battery electric vehicle (BEV). Table I [19] depicts the varieties of the EV applicable to this paper. An astounding truth that isn't known to many is that the EV was fabricated and driven significantly sooner than the gas powered motors (ICE) vehicles [14]. The main EV was dispatched in 1828 and encountered the pinnacle improvement in late nineteenth 100 years. Notwithstanding, toward the start of 20th hundred years, the headway in ICE has added to an emotional downfall on the development of the EV. The ICE has a much predominant driving reach, more limited refueling time and huge organization of topping off framework contrasted and the EV [20,21]. In spite of these constraints, the new resurgence of EV is fuelled by worries on the effect of the ICE to the a dangerous atmospheric devation. The EV likewise offers a few different benefits, for example, no vibration, smell, commotions and simplicity of stuff changes generally to fuel vehicle. With the mechanical progression in battery innovation, power hardware, converters, control and microelectronics, the EV is supposed to make serious advances to the engine business.

2.2. Battery The electrical energy is the life saver of EV as well as a vital part of each and every part of life [22,23]. Thus, the battery is a fundamental gadget in EV to store the electrical energy and use it for foothold reason particularly. As a result of its straightforwardness, security and somewhat high energy thickness, battery-powered battery is the most widely recognized energy capacity for the EV impetus framework. In spite of the presentation of other stockpiling components, for example, the ultra-capacitor, flywheel and hydrogen power module, they couldn't match the expense adequacy of batteries. In any case, a battery has a few significant downsides: (1) restricted energy limit; (2) long charging time; and (3) limited charging cycles. These variables bring about restricted driving reach and costly substitutions. The presentation of a battery is described by its particular energy, effectiveness, support, cost and effect on climate [24]. Battery innovation keeps on progressing with more modest sizes, while fit for putting away more energy [25,26]. The development of the battery innovation starts with the lead corrosive, advancing to nickel-based and presently to lithium battery [27]. Present day EV is done involving lead corrosive for impetus because of its high weight, low unambiguous energy, hazard of compound spillage and unfortunate temperature attributes. In any case, it is still generally utilized in customary ICE vehicle for the start, sound/video and lighting framework. Then again, the nickel-based battery offers higher explicit energy contrasted and the lead corrosive battery. Furthermore, it is greater climate well disposed, has longer life cycle, great temperature qualities and level release profile and displays irrelevant erosion. Regardless of these benefits, nickel based battery experiences memory impact, ‡ making it unsatisfactory for successive charge/release application, for example, EVs [28]. Right now, lithium battery is the ideal decision due to its higher energy effectiveness, power thickness, minimization and lighter weight [29,30]. In addition, it gives quick charging ability, wide working temperature range, no memory impact, long life cycle and low self release rate. Lithium-based battery incorporates a wide variety of compound substances; for moment, the Lithium Ferro Phosphate LiFePO4 gives a simplicity as far as dealing with due to its predominant warm strength in completely energized condition and okay of blast when the battery is coincidentally cheated or shortcircuited. Lithium-titanate is the most recent sort; it gives a more extensive working temperature range, quicker to re-energize and acknowledges higher re-energize rate (>10C) [31]

5V Single-Channel Relay Module

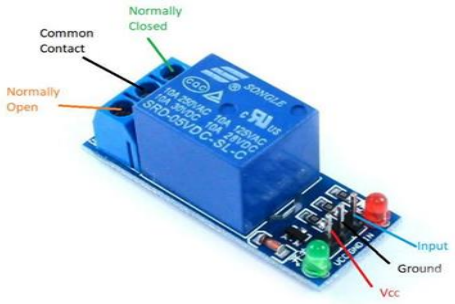

Figure.2 5V Single-Channel Relay Module

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 6, June 2023

DOI: 10.17148/IJARCCE.2023.12649

A relay is an electromechanical device that opens or closes the contacts of a switch using an electric current. The single-channel relay module is more than just a relay; it includes components that facilitate switching and connection as well as indicators that show whether the module is powered and whether the relay is active or not.

Lithium Ion Battery

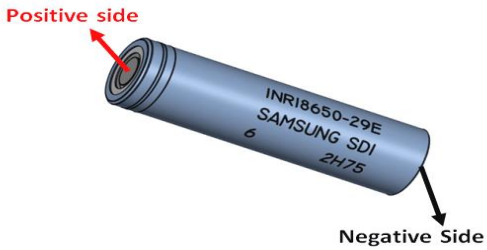

Figure.3 Lithium Ion Battery

The 18650 Cell is a Li-particle type battery which has found its application in many fields, for example, Compact hardware like light lights, Electric Vehicles/Vehicles like Tesla and substantially more. The principal justification behind this battery finding lasting success is its properties contrasted with its rivals. These properties incorporate current conveying ability, voltage, cycle life, capacity life, security, and working temperature and considerably more. Underneath table shows the examination between famous batteries for key boundaries.

Battery management system(BMS)

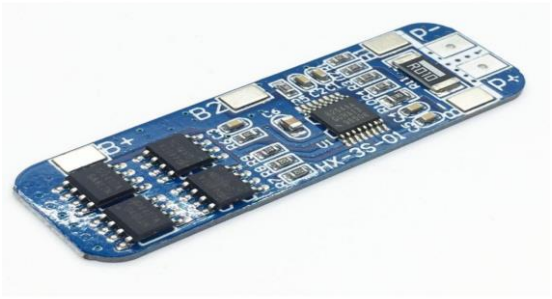

Figure.4 Battery management system(BMS)

I. Higher than 3A current release item, the release pace of battery release is above 3C.
II. Multiplier estimation equation: 1C battery, 2000 limit is equivalent to 2AH * 1 = 2A most extreme working current.
III. 3C proportion battery, 2000 limit is equivalent to 2AH * 3 = 6A greatest working current.
IV. When the battery in series 3, if it's not too much trouble, guarantee that the voltage of every battery is something very similar, in the event that not the equivalent, kindly fill in that frame of mind of batteries and afterward use When the release is tried, the battery in which the voltage drop is the quickest is the contrast between the battery and the battery.
V. After the line is associated with the need to charge (charge voltage 12.6V) actuation, there will be yield.
VI. 3A current over the release items, the battery release rate to 3C or more.Formula: 1C proportion of the battery, the 2000 limit is equivalent to the greatest working current 2AH*1=2A.3C proportion of the battery, the 2000 limit is equivalent to the most extreme working current 2AH*3=6A.in the utilization of the battery will be the battery power isn't relevant, this present circumstance should not be utilized from now onward, indefinitely quite a while, the battery will before long be harmed. Depiction understanding.

SOFTWARE REQUIREMENT:

The Web of Things has made the way for various incredible activities for producers. Having the option to construct distant sensors and gadgets is both engaging and helpful.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 6, June 2023

DOI: 10.17148/IJARCCE.2023.12649

Permitting IoT gadgets from various producers to communicate with your own manifestations can truly open up various helpful applications, some that you might not have recently thought about building.

There are numerous ways of building IoT gadgets, some of them more complicated than others. Numerous experimenters utilize cloud stages like Blynk, or "roll their own" answers with conventions like MQTT and improvement applications like IBM Hub Red.

Today we will take a gander at one more approach to assembling IoT applications utilizing microcontrollers and the Arduino IoT Cloud.

Arduino IoT Cloud

The Arduino IoT Cloud was, in numerous ways, like the current Blynk item. It permitted you to make IoT applications for Arduino microcontrollers and associate them to a cloud administration, to control them or to communicate them with existing IoT gadgets.

The underlying execution of the cloud was a piece restricted in the quantity of Arduino sheets it upheld. It had both a free and paid level, and utilized the current Arduino online sketch proofreader.

Toward the finish of 2020 Arduino made various upgrades to the IoT Cloud, and changed its record structure. The complementary plan remained, and was improved with the capacity to utilize chosen outsider sheets. Different highlights like Programming interface and information maintenance were saved for the paid levels, of which there are presently three.

The Arduino IoT Cloud permits you to use your current Arduino mastery and make your own IoT gadgets.

To utilize the cloud, you'll initially have to figure out some of its remarkable phrasing

ESP32/ESP8266

The Arduino IoT Cloud upholds an extensive variety of outsider sheets in view of the ESP32 and ESP8266 microcontrollers with help for Wi-Fi. To set them up, essentially pick the outsider choice in the gadget arrangement.

V. RESULT

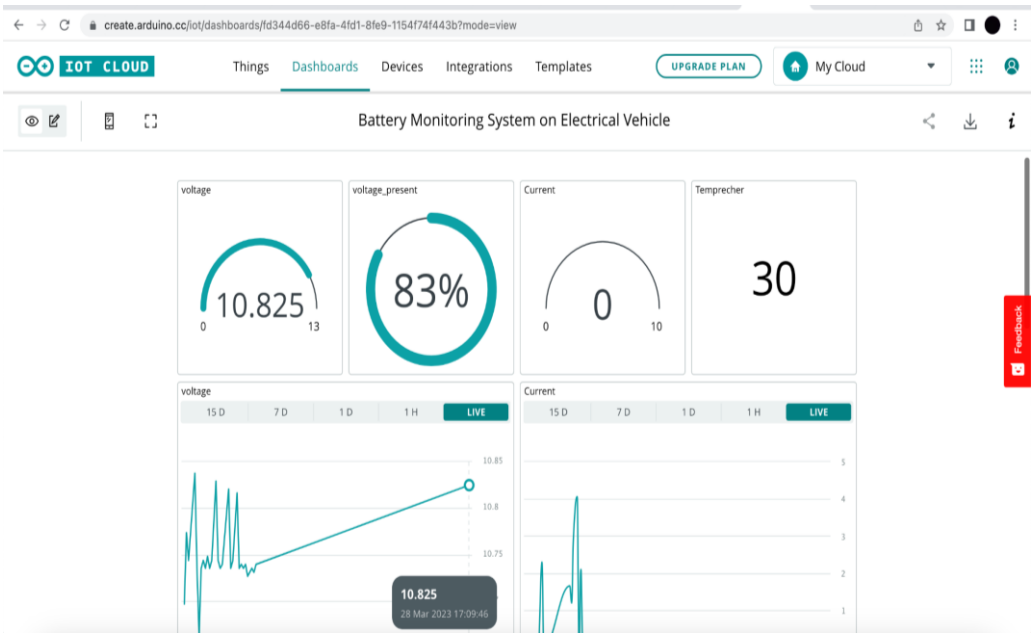

Figure.5 battery monitoring system in electric vehicle

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 6, June 2023

DOI: 10.17148/IJARCCE.2023.12649

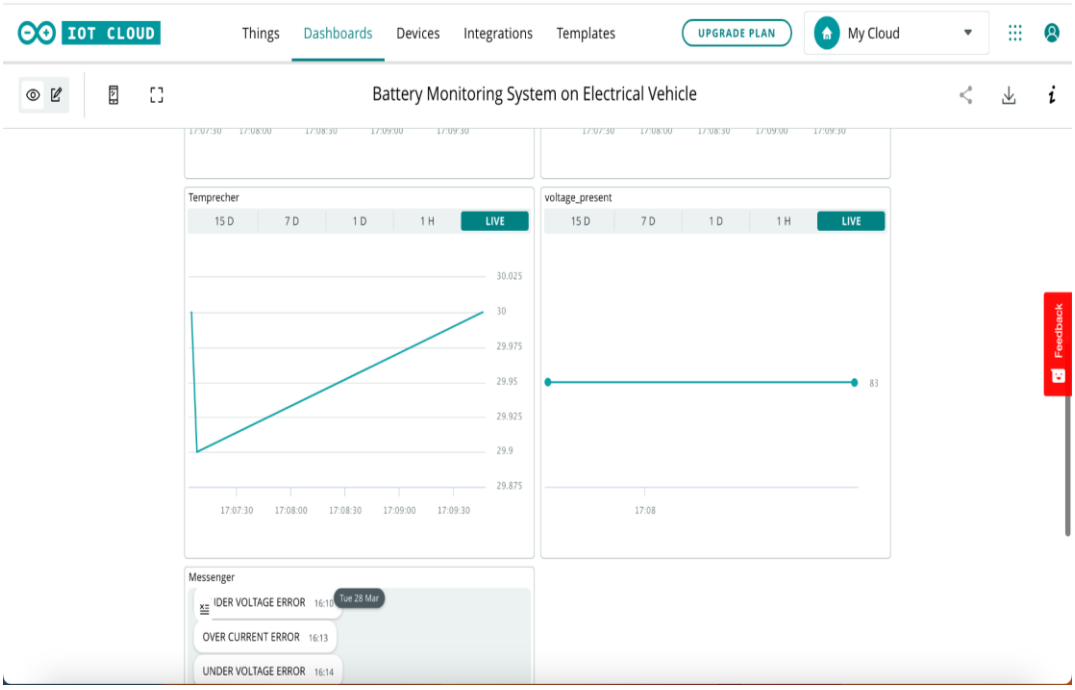

Figure.6 battery monitoring system in electric vehicle

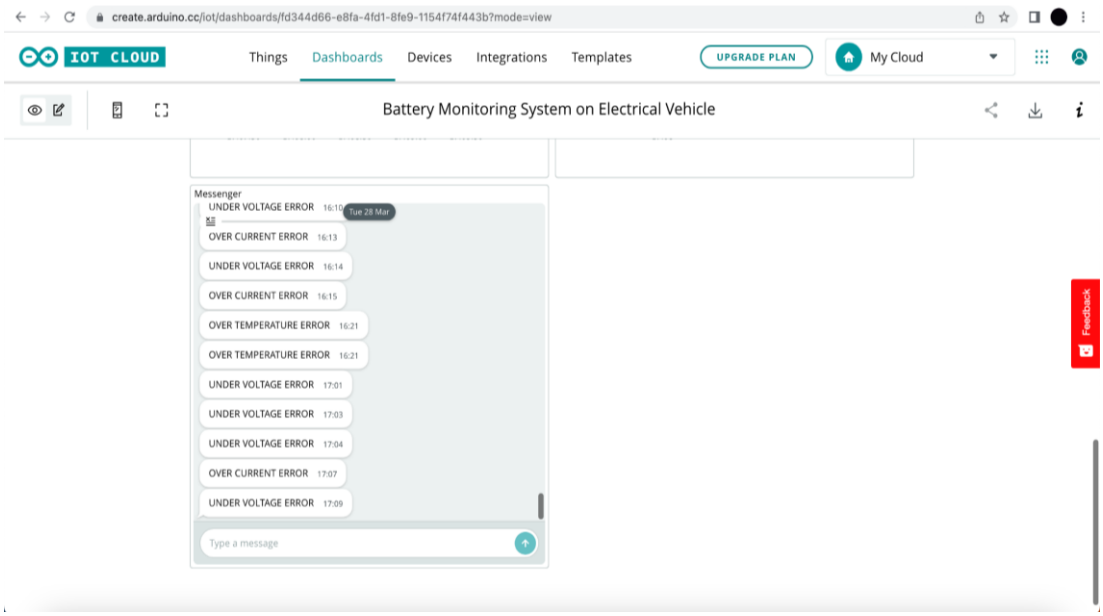

Figure.7 battery monitoring system in electric vehicle

VI. CONCLUSION

Battery The executives of Electric Vehicle From this undertaking we have reached the resolution that the voltage flow temperature and battery level of Lithium-Particle battery have been charted and the worth has been shown in the worth presentation. Assuming that the voltage of the lithium-particle battery becomes under voltage 9 over voltage 13 and the temperature surpasses 36 and the flow surpasses 4 amps then our electric vehicle will consequently switch off and the hand-off vehicle's lithium-particle battery ought to be secluded. We can likewise do programmed charging as we call it half and half charging in this, we can do accusing of sunlight based charger and such line and programmed lithium-particle battery will begin charging when it is released and at day time when there is daylight then it will charge from sunlight based charger If not will charge from AC Line.

DOI: 10.17148/IJARCCE.2023.12649

REFERENCES

[1] Galus MD, Andersson G. Demand management of grid connected plug-in hybrid electric vehicles (PHEV). Energy 2030 Conference. ENERGY 2008. IEEE, 2008
[2] Kelman C. Supporting increasing renewable energy penetration in Australia – the potential contribution of electric vehicles, 2010 20th Australasian Universities Power Engineering Conference (AUPEC). 2010.
[3] . Lindgren J, Niemi R, Lund PD. Effectiveness of smart charging of electric vehicles under power limitations. International Journal of Energy Research 2014; 38(3):404–414.
[4] De Schepper E, Van Passel S, Lizin S. Economic benefits of combining clean energy technologies: the case of solar photovoltaics and battery electric vehicles. International Journal of Energy Research 2015; 39(8):1109–1119.
[5] Ben Salah C, Ouali M. Energy management of a hybrid photovoltaic system. International Journal of Energy Research 2012; 36(1):130–138.
[6] Barker, P.P. and Bing JM. Advances in solar photovoltaic technology: an applications perspective. Power Engineering Society General Meeting, 2005. IEEE. 2005.
[7] Goldin E et al. Solar powered charge stations for electric vehicles. Environmental Progress & Sustainable Energy 2014; 33(4):1298–1308.
[8] Kadar P, Varga A. Photovoltaic EV charge station. Applied Machine Intelligence and Informatics (SAMI). 2013 IEEE 11th International Symposium on. 2013.
[9] Branker K, Pathak MJM, Pearce JM. A review of solar photovoltaic levelized cost of electricity. Renewable and Sustainable Energy Reviews 2011; 15(9):4470–4482.
[10] Van Roy J et al. Apartment building electricity system impact of operational electric vehicle charging strategies. IEEE Transactions on Sustainable Energy 2013; PP(99):1–1.
[11] Locment F, Sechilariu M, Forgez C. Electric vehicle charging system with PV grid-connected configuration. Vehicle Power and Propulsion Conference (VPPC). 2010 IEEE. 2010.
[12] Gamboa G, et al. Control strategy of a multi-port, grid connected, direct-DC PV charging station for plug-in electric vehicles. Energy Conversion Congress and Exposition (ECCE). 2010 IEEE. 2010.
[13] Tulpule PJ et al. Economic and environmental impacts of a PV powered workplace parking garage charging station. Applied Energy 2013; 108(0): 323–332.
[14] Alonso Abella M, ChenloAbella MAF, and Chenlo F. Photovoltaic charging station for electrical vehicles. Proceedings of 3rd World Conference on Photovoltaic Energy Conversion, 2003.
[15] Chiang SJ, Hsin-Jang S, Ming-Chieh C. Modeling and control of PV charger system with SEPIC converter. IEEE Transactions on Industrial Electronics 2009; 56(11):4344–4353.
[16] Dharmakeerthi CH, Mithulananthan N, Saha TK. Modeling and planning of EV fast charging station in power grid. Power and Energy Society General Meeting, 2012 IEEE. 2012.
[17] Haghbin S et al. Grid-connected integrated battery chargers in vehicle applications: review and New solution. IEEE Transactions on Industrial Electronics 2013; 60(2):459–473.
[18] Letendre S. Solar electricity as a fuel for light vehicles. Proceedings of the 2009 American Solar Energy Society Annual Conference, Boulder, CO, 2009.
[19] Hybrid and plug-in electric vehicles. California's Alternative and Renewable Fuel and Vehicle Technology Program, 2014.
[20] Li, S. and Zhang C. Study on battery management system and lithium-ion battery. International Conference on Computer and Automation Engineering (ICCAE '09), 2009.
[21] Chan CC. An overview of electric vehicle technology. Proceedings of the IEEE 1993; 81(9):1202–1213.
[22] Bhatti AR et al. A comparison of output waveforms of different alternating current sources and uninterruptible power supplies of various brands. Life Science Journal 2012; 9(4):637–642.
[23] Bhatti AG et al. Energy crisis in Pakistan, adaptation and mitigation measures. Journal of Faculty of Engineering & Technology 2012; 19(1):67–82.
[24] Whittingham MS. History, evolution, and future status of energy storage. Proceedings of the IEEE 2012; 100(Special Centennial Issue):1518–1534.
[25] Ma T, Mohammed O. Optimal charging of plug-in electric vehicles for a car park infrastructure. IEEE Transactions on Industry Applications 2014; PP(99):1–1.
[26] Bergveld HJ, Kruijt WS, Notten PHL. Battery Management Systems: Design by modeling. Philips Research 2002; 1 ISBN: 978-90-481-6108-9 (Print) 978-94-017-0843-2 (Online).
[27] Guerrero, C.P.A., et al. Hybrid/electric vehicle battery manufacturing: the state-of-the-art. 2010 IEEE Conference on Automation Science and Engineering (CASE), 2010.
[28] Ni L. Energy storage and management for a small series plug-in hybrid electric vehicle. PhD. dissertation, 2010.