

Design and Analyze of Lithium Iron Battery for Electric Auto Rickshaw

S. Vijaymurugan¹, M. Sangavi², C. Sowmya³, M. G. Sowmya⁴, M. Vinitha⁵

Associate Professor, Department of ECE, Adhiyamaan College of Engineering, Hosur, Tamilnadu, India ¹

U.G. Student, Department of ECE, Adhiyamaan College of Engineering, Hosur, Tamilnadu, India ²³⁴⁵

ABSTRACT: The worldwide contamination is on rise and every exertion made, being proportional backs the CO₂ emanations and spare the earth. Fuel emanation from vehicles has become the most significant reason for a dangerous atmospheric deviation and subsequently it's imperative to change over the world to a green part. One such effort to reduce global warming is the evolution of Electrical Vehicles (EV). Lithium-iron phosphate batteries are the powerhouse for the advanced electronic innovation during this cutting edge versatile society. Right now the lithium iron phosphate batteries are produced for running the EVs. The objective of this investigation is to design the battery model for e-auto rickshaw and to examination the lithium battery and progress the total information of the battery in three manners.

- 1] Displaying the status of Electric auto rickshaw battery demonstrating the normal estimation of various values such as voltage and current, minimum and maximum voltage and ampere of cell utilizing Raspberry pi.
- 2] Storing the battery esteem intermittently in an external SD card for the future investigate of the battery condition through graphs.
- 3] Observing the condition of the vehicle battery in website through cloud computing.

KEYWORDS: Electric vehicle, LiFePO₄ battery, SD card, Cloud, Raspberry pi display.

I.INTRODUCTION

Electric vehicles for the utilization in the transportation has helped up the vitality effectiveness, so now it requires no immediate fuel for the burning and can completely rely upon power – this is regularly the first significant vitality transporter, which is adding to a decent scope of transportation strategy objectives [4]. These incorporate the incredible measure of vitality to be verified, much better air quality, decreased clamor or less measure of commotion, and furthermore have diminished the ozone harming substance discharges [6].

This work center around a battery examination and information recovered is put away in the SD card module. The worth which is placed in the SD card is equal associated with the cloud source. This source is characterized as getting to the information over the web. The stored data is shown through raspberry-pi. This will likewise prompt the greater interest in The electric vehicles have as of late involved the interest of clients in the ongoing years with the developing business sector.

The fundamental reason is to develop simple to utilize and the showing of the information will progressively adaptable for the customer. The information and data are for all time put away in a SD card and cloud source. By executing this procedure, it very well may be checked by the client from any place to find the time frame if any ill-advised working of the battery.

II.EXISTING METHOD

The strategy of past system follows the procedure of displaying only the present battery status. The correct values of the battery charge are displayed with the help of flip switch. Until the flip switch is pressed the battery values are not updated. It uses a basic Liquid Crystal Display (LCD) display.

A. PROBLEM IDENTIFIED

To see the status of the battery every single time physical activity is done on the gadget. Furthermore, there is no such procedure of putting away the information to identify the problem.

III.PROPOSED WORK

The proposal of this paper is to design and assemble the Lithium iron battery for electric auto rickshaws. There is a amalgamation of serial and parallel relation of cells in the battery. The design of battery consists of seven modules and each module consists of sixty lithium iron cells. Hence totally four hundred and twenty cells have been used in the composition of entire battery for one auto rickshaw. One module consists of two set of series and parallel combination. In each set row contains three cells which are connected in series and column contains ten cells which are connected in parallel. The motive of series link is to increase the voltage of the battery and that of parallel link is to increase the current of the battery. The voltage value of single cell is 3.2V and the ampere value of one cell is 5.5Ah. Hence the total voltage of battery containing seven modules is 67.2V and total current is 110Ah [1]. The number of lithium iron cells to be used and the arrangement of cell in series and parallel combination depend on a distance an auto rickshaw has to travel. The design of four hundred and twenty cells is used to cover a distance of 80 km if the battery is fully charged. Single positive and negative terminal is drawn from the battery.

In this paper 3 methods have been implemented to store and examine the lithium iron battery condition.

- 1] Connection is taken from each and every series and parallel link and is given as the input to BMS (Battery Management System) to manage and monitor the battery state represented by various items such as total voltage, voltages of individual cells, minimum and maximum cell voltage and to indicate the charge level of the battery. Through serial communication BMS is connected to raspberry-pi to display the status of the battery in the display. This part of system is attached to the auto rickshaw to indicate the above mentioned values of the battery.
- 2] An external SD card is attached to the raspberry-pi to store the charge of a battery periodically to check the condition of the battery over some stretch of time. This will be helpful for the future dissects and to locate the time period if any improper functioning of the battery.
- 3] If there should arise an occurrence of any industrial use, the battery values are sent to cloud for examine the condition of the vehicle battery. This is one of the best ways to monitor the battery condition of an e-vehicle even if the owner is far away from it.

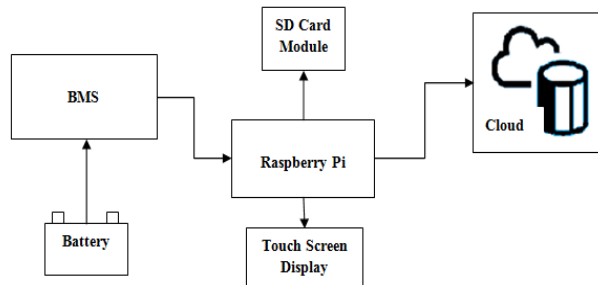


Fig.1 Block diagram of Lithium iron battery analyzer.

Fig 1 shows the block diagram of the proposed work which consist of battery, BMS, raspberry pi, SD card module, display, and the cloud connection.

B. LITHIUM IRON PHOSPHATE CELL

Lithium Iron Phosphate (LiFePO₄) invigorate cells are one of the most strong and most stable cells obtainable along with an incredible life cycle of more than 3000 cycles. These cells can work in high temperature habitat [7]. The diameter of the cell is 32mm and height is 70 mm which is very compact for the current it gives. With a life moment of more than 3000 cycles with good presentation, this is a suit and neglect solution for your battery packs in Electric Vehicles, Solar panels. Inverters, Warehouse Robots and all other high power applications which require longer life cycles uses LiFePO₄ due to its high stability in high stress habitats and its ability to provide continued high performance it was caught up for the trade markets.



Fig.2Lithium iron phosphate cell.

Fig 2 shows the single LiFePO₄ cell with 3.2V and 5.5Ah specification.

The benefits of the LiFePO₄ cells over Li-ion and Lead acid batteries are:

The LiFePO₄ cells offer better contrasted with an ordinary 1C Li-particle 18650 cell. The ordinarily accessible Li-particle cells are appraised for a release rate though the LiFePO₄ 1C cell gives a 6A release rate [8]. There is additionally next to no voltage drop during release which is a lot higher in a lead corrosive battery. The LiFePO₄ is a nontoxic material, non-sullyng material which contains no uncommon earth minerals. This makes it a substantially more condition neighborly decision contrasted with the lead corrosive and Lithium batteries.

Organized by

Department of ECE, Adhiyamaan College of Engineering, Hosur, Tamilnadu, India

Applications of LiFePO₄ battery:

- i. Light electric vehicle, e-bicycle, electric bike, e-rickshaw, electric golf truck, forklift, Remote control autos, vessel airplane, and toys.
- ii. E-instruments like electric drill, Electric saw, grass trimmer, etc.
- iii. Solar and wind power age vitality stockpiling gadgets, sun oriented road lights.
- iv. Small therapeutic gear and convenient hardware.

C. Battery Design For E-Auto Rickshaw:

The structure of the battery is made by the need of the separation to be secured by an electric vehicle. The battery structured right now for an electric auto rickshaw which can travel 80 km if the battery is completely energized. To accomplish this, 7 modules of battery each containing 60 LiFePO₄ cells.

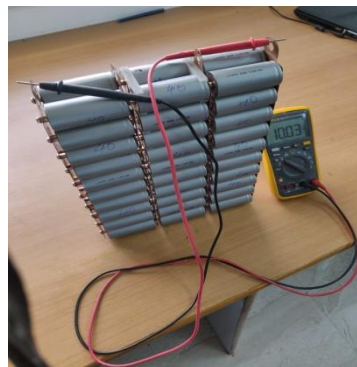


Fig.3 battery arrangement

Fig 3 shows the design of one module of the battery containing two set of series and parallel connection. Three cells are connected in series and ten cells are connected in parallel.

D. BATTERY MANAGEMENT SYSTEM:

Battery Management System is the gadgets that manage restricting the cells of a battery pack together and continually observing the status of every cell. The temperature of each cell, charge-release status, and short assurance is done by BMS. The BMS brings about fertile employment of the battery crate. The BMS is exceptionally reliant on neighborhood climate Conditions and henceforth it's imperative of India to build up their own BMS as opposed to redistributing them [9]. An indigenous BMS will restrict be appropriate for Indian conditions because of the distinctions inside the climate. Right now, BMS assumes the key job to shape the EV reasonable for Indian climate [2].

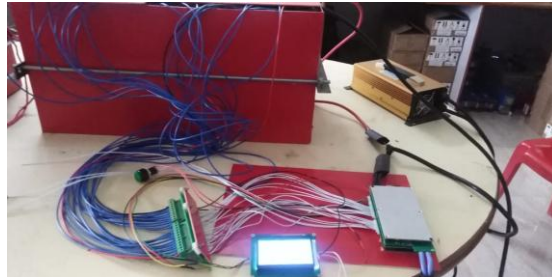


Fig.4 BMS connected with battery

Fig 4 shows the connection of the battery outlets to the BMS through serial connection.

E. RASPBERRY PI 4:

The Raspberry Pi 4 Model B is the most modern Raspberry Pi Personal Computer made, and the Pi structural. The Raspberry Pi 4 is the most recent thing in the Raspberry Pi run, display a braced 64-piece quad centre processor running at 1.5GHz with toiled in metal comfort sink, USB 3 ports, double band 2.4GHz and 5GHz remote LAN, quicker Gigabit Ethernet, and PoE ability by means of a different PoE HAT.

SPECIFICATIONS:

Processor: Quad core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz, Broadcom BCM2711.

RAM: SDRAM 1GB LPDDR4-3200

Bluetooth: BLE, Bluetooth 5.0

Wi-Fi: 5.0 GHz IEEE 802.11ac wireless and 2.4GHz

USB: 2 USB 3.0 ports; 2 USB 2.0 ports

Ethernet: Ethernet in Gigabit

HDMI: 2 × micro-HDMI ports (up to 4kp60 supported)

F. TOUCH SCREEN:

Constancy- The 10.1 inch IPS contact screen LCD screen with high goals of 1280×800 pixels.

Plug And Play - Just interface the control board and the screen by a HDMI link and it can work quickly, unnecessary of driver.

General Fastening Location - Supports Raspberry Pi 4 3B+,3B, 2 Model B, and RPi 1 B+, Latte Panda, and PC.

Multiple Applicable Os- Supports Raspbian, Ubuntu, Ubuntu Mate, Windows, Android, Chrome OS. Also, you can download 3D Stand Installation Manual from the selling page.

Thoughtful Designed - Keeps itself level with 4 copper standoffs of a similar tallness at the back case, additionally for affixing.



Fig 5: Raspberry pi 4 with touch screen.

Fig 5 shows the model of the raspberry pi 4 with touch screen.

G. INTERFACING MICRO SD CARD WITH RASPBERRY PI:

The Arduino Micro SD card Module is a Sequential Peripheral interface (SPI) Communication based gadget. It is good with the TF SD cards utilized in cell phones and can be utilized to give a type of outside stockpiling for small scale controller and chip based ventures, to store diverse sort of information types from pictures to recordings [10]. SD cards by and large are 3.3v rationale level based gadgets, however with the guide of the Micro SD card module; the signs are changed over to 5v by means of a rationale level converter executed on the SD card Module.

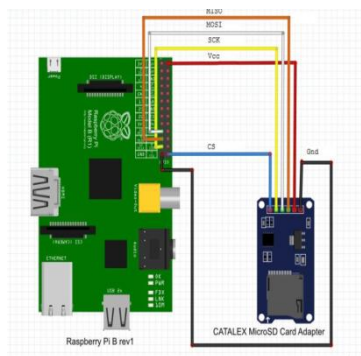


Fig.6SD card module connection

Fig.6 shows the connection of SD card module to the raspberry-pi.

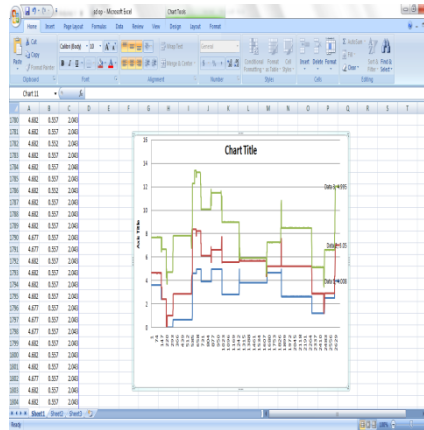


Fig.7 SD card output.

Fig 7 shows the stored values of the battery in an external SD card along with the graph.

H. CLOUD:

Cloud storage is a model of PC information stockpiling in which the advanced information is put away in intelligent pools. Much management is providing the cloud system. In that Amazon Web Services (AWS) plays vital role [11]. Amazon web administration is a stage that offers adaptable, solid, versatile, and simple-to-utilize and practical distributed computing arrangements. By raspberry-pi the data are sending to the cloud which is monitored by Personal Home Page (PHP) and Representational State Transfer (REST) web server.

- Touch screen module can be used easily.
- Accurate battery values can be obtained.
- Fast response.
- The status of the battery charge can be checked from anywhere.
- The values stored in the SD card are used for checking the defect of the battery fault.

IV.RESULT AND DISCUSSION

This paper identifies EVs as an answer for creating countries, which adds to most of worldwide carbon discharges [3]. The route forward is furnishing creating countries with the correct innovation to reasonable energy and utilize low carbon framework. To accomplish maintainable transportation objectives, it is important to offer a less expensive and adorable EV solution. This paper additionally discusses the current EV extends in India and closed that there is an undiscovered EV advertise in the bike, three-wheeler, transport and the open transportation areas. By executing this work, condition of the batteries are observed by different things. For example, all out voltage, voltages of individual cells, least and most extreme cell voltage are shown and stored. This procedure is helpful for the consumers. In future mobile apps can also be created to analyze the details of an electric vehicle which will be more convenient and can also use by any people.



Fig.8 Battery setup in auto rickshaw.

Fig 8 shows the experimental setup of the battery in an auto rickshaw.

V.CONCLUSION

An electric-vehicle battery (EVB) [5] notwithstanding the footing battery claim to fame frameworks utilized for modern vehicles, cells used to express the drive ranging of a battery operated vehicles. These batteries are generally an optional (battery-powered) battery, and are regularly lithium-phosphate iron batteries. Footing batteries, explicitly structured with a high ampere-hour limit, are utilized in forklifts, electric golf trucks, riding floor scrubbers, electric cruisers, electric wagon, vans, and other electric vehicles. This system is supportive for monitoring the various activities gone into cloud services and display process in raspberry-pi. And separately the data have been stockpile in the microchip.

REFERENCES

- [1] HAJI Zakaria, Mounir Hamid, Recent Advancements and Developments for Electric Vehicle Technology,” International Conference of Computer Science and Renewable Energies (ICCSRE) “, 2019.
- [2] Al-Alawi BM, Bradley TH. Review of hybrid, plug-in hybrid, and electric vehicle market modelling studies. *Renewable Sustainable Energy Rev* 2013; 21:190–203.
- [3] Hannan MA. Hybrid electric vehicles and their challenges: *Rev*2014; 29:135–50.
- [4] Tseng HK, Wu JS, Liu X. Affordability of electric vehicles for a sustainable transport system: an economic and environmental analysis. *EnergyPolicy*2013; 61:441–7.
- [5] IEA analysis based on EVI country submissions, complemented by EAFO 2017a, IHS Polk 2016, MarkLines 2017, ACEA 2017a, 2017b and EEA 2017.
- [6] CatenacciM, VerdoliniE, BosettiV, FioreseG. Going electric: expert survey on the future of battery technologies for electric vehicles. *Energy Policy* 2013; 61:403–13.
- [7] <https://www.energysage.com/electric-vehicles/buyers-guide/battery-life-for-top-evs/>
- [8] https://en.wikipedia.org/wiki/Lithium_iron_phosphate_battery
- [9] https://en.wikipedia.org/wiki/Battery_management_system
- [10] Rehan Ahmad Khan, Agastya Gogoi, Rahul Srivastava, Automobile Collision Warning and Identification System using Visible Light and Wi-Fi Communication,” *International Journal of Engineering and Advanced Technology (IJEAT)* ISSN: 2249 – 8958, Volume-8 Issue-5S3” July, 2019
- [11]] Isaac Odun-Ayo An Overview of Data Storage in Cloud Computing,” *International Conference on Next Generation Computing and Information Systems (ICNGCIS)*”, 2017.