AN EFFICIENT BATTERY CHARGING FOR EV

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Abstract: This project, An Efficient Battery Charging for EV is one of several projects that make use of the Internet of Things (IoT). Thanks to the IoT, energy-efficient gadgets can be created, reducing both energy usage and human work. We hope to develop an efficient charging system as part of this project that maximizes battery life by reducing battery stress and automatically managing its behavior using the webserver and the battery being charged. The IoT platform includes a Wi-Fi microchip module, and the webserver is stored on the module. Because the webserver is platform agnostic, meaning it can run on any computer or device, including smartphones. These devices exchange data with the webserver. This project helps to automatic device monitoring and alerting on smartphones, lowering the amount of energy and time needed to maintain those devices. The battery might be charged when the appliance is connected, and charged only when necessary, and the system could monitor other appliances. The battery's life could be prolonged by limiting fast charging by switching between parallel and series connections.

Keywords – An Efficient Battery Charging for EV, Internet of Things, Web server, Smartphones

I. INTRODUCTION

The project's main objective is to help preserve the battery's life, reduce battery stress and reduce wastage of energy. The device provides two charging modes to alternate between adaptive and standard charging to keep battery life from deteriorating, and needless fast charging is prevented by establishing a restriction for when fast charging stops. It could charge your phone steadily overnight to help sustain long-term battery life. Adaptive charging employs the settings on your alarm clock to fully charge your battery just before you wake up. The above-mentioned factors are implemented in the proposed system.

The cost and capacity of batteries are important considerations in determining whether electric vehicles will be extensively used. However, due to battery stress, overcharging and quick aging of the battery, the electric vehicle has not yet proven to be an acceptable answer for the automobile consumer. Our initiative aims to improve battery efficiency and battery life. Various ways have been used to improve battery efficiency, and as a result, a battery management system has been implemented for user reference. Currently, greater attention is being paid to the design and development of efficient chargers for electric vehicles. The scientists research and work on the subject of green transportation for the twenty-first century is underway.

With the overcharging and usage of fast charging all the time, the batteries tend to age quicker which results in draining of the battery at a faster pace and battery swelling. The closer it gets to 100%, the more damaging it is to the battery. The same is true for battery levels close to 0%. To reduce stress on the battery, it should be charged right before use to extend its life. The device that can monitor and control power consumption will greatly aid in reducing energy waste. This feature steadily charges your battery over the course of several hours rather than working as quickly as possible to get to 100%. Because the device will not be in use for an extended period of time, there is little concern that the user will be dissatisfied with how long it takes to fully charge. By dynamically controlling charges, adaptive charging helps to preserve battery health over time. Simply connect your battery in the evening, set an alarm, and let Adaptive Charging do its job. Several modules, including the Wi-Fi microchip, when connected with the charging circuit, the Particle Photon and other node MCUbased modules turn the charger into an IoT device, but the Wi-Fi microchip is the cheapest and uses the least amount of power.

This project is concerned with topics such as IoT and mobile applications. IoT is used in this case to communicate between the application and real-world hardware via the cloud. The server of this Blynk Cloud is Blynk Server is an Open-Source Java server built on Nitty that manages message routing between the Blynk mobile application and different microcontroller boards and SBCs. A mobile application is used to receive the data from the server and view the received patient's health condition from anywhere. The other major area of this project is Automation where the battery will be charged parallelly and then autonomously switched to series. It will automatically stop charging when the battery is maxed out.

A device that can monitor and control power usage will greatly assist in reducing energy waste. This system would only be able to turn on and off when the device was plugged in., as well as charge only when appropriate, and it could be broadened to monitor other appliances. When linked to the charging circuit, NodeMCU (ESP8266) change the charger into an IoT-based gadget.

II. LITERATURE SURVEY

Mauricio Restrepo *et al*. (2018), offer a proposal for a single-phase bidirectional EV charger that can operate in all four quadrants of the P-Q plane Real-world responses from a bidirectional charger prototype for varying P-Q demands are utilized to assess the steady-state and step responses of the proposed model. The model might be used in time-domain simulations that need several EV charging models, such as research into EV integration in low-voltage (LV) distribution networks. A real-world case study is offered to demonstrate and assess the suggested efficient charger and model, as well as to investigate vehicle-to-grid (V2G) supply for active and reactive power in a low-voltage residential distribution network. These findings emphasize the advantages of the charger type recommended for development.

Niangjun Chen *et al.* (2021), claims that despite the uncertainty surrounding EV arrivals, adaptive charging has the potential to charge electric cars (EVs) on a large scale and at a reasonable cost. Adaptive EV charging is characterized as a feasibility challenge in which all EV energy demands are satisfied ahead of schedule while charging rate and total charging power limits are met. In the absence of future arrivals and requests, we present a smoothed least-laxity first (sLLF) online method for establishing current billing rates. We examine and statistically describe the performance of the sLLF algorithm. According to numerical testing using real-world data, it has a greater rate of feasible EV charging than numerous other existing EV charging methods. To assess the algorithm's survival, the resource augmentation framework is applied. The results of the evaluation reveal that the sLLF method achieves.

III. METHODOLOGY

The project's primary goal is to extend battery life and reduce energy waste. The charging takes place in two different connections to the battery. If the battery charge is less than 40%, the connection of the battery is in parallel which results in fast charging. If the battery charge is more than 40%, the connection of the battery is switched to series with the help of a relay module which results in steady-paced charging to prolong the battery life. This project consists of an alarm system so, when the battery reaches 80% it stops charging and then starts to charge an hour before the alarm time to reduce the battery stress. The battery will be fully charged on or before the alarm goes off. After reaching 100%, the charging stops autonomously. Live battery percentage can be seen via the Blynk app and alarm time is also set using it. The Flowchart of An Efficient Battery Charging for EV is shown in Fig. 1.

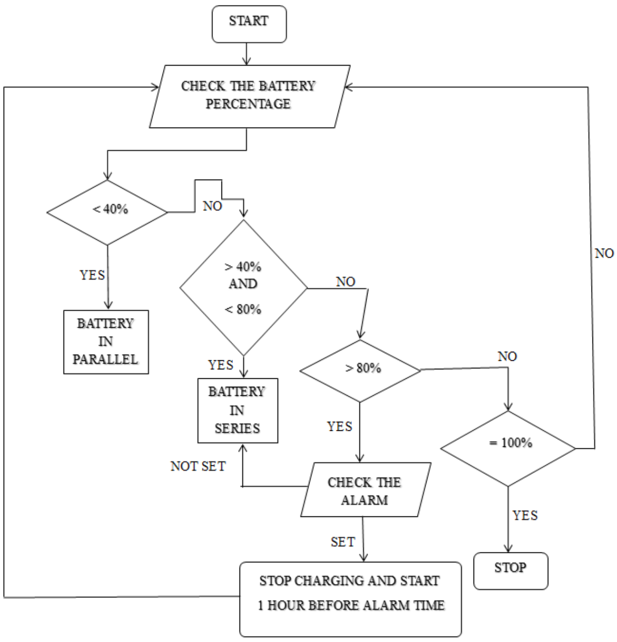

Fig.1: Flowchart of an Efficient Battery Charging for EV

A. Technical Background

This Project deals with fields like IoT, Mobile applications. IoT is used in this context to communicate between the application and the real-world hardware via the cloud. The server is kept in this Blynk Cloud. Blynk Software is an Open Nitty-based Java server that manages interactions between the Blynk application and different microcontroller boards and SBCs. A mobile application is used to receive the data from the server and view the received patient's health condition from anywhere. The other major area of this project is Automation where the battery will be charged parallelly and then autonomously switched to series. It will automatically stop charging when the battery is maxed out.

B. Proposed Solution

This project was designed to create an efficient charging system that decreases battery stress, hence extending battery life, and it also leverages the webserver and the charged battery to control its behavior autonomously.

The problems with existing methods are:

• In the existing system, the device doesn't reduce the battery's stress and the necessary things to prolong the battery life.

• IoT is not implemented in the current existing system. Because of this, we can't access it using mobile devices.

• It doesn't switch between the serial and parallel connection of the battery.

• Alarm can't be set in the existing device.

• The existing system doesn't charge autonomously.

C. Hardware Components

1. NodeMCU (ESP8266)
2. SMPS (Switched-Mode Power Supply)
3. Relay module
4. OLED Display
5. Serial – Parallel Interface adapter module
6. Control switch
7. Battery
8. Connecting cables
9. Potentiometer

IV. IMPLEMENTATION

With the overcharging and usage of fast charging all the time, the batteries tend to age quicker which results in draining of the battery at a faster pace and battery swelling. The closer it is to 100%, the more harmful it is to the battery. The same goes for battery levels closer to 0%. To reduce stress on the battery, it should be charged right before use to extend its life. The device that can monitor and control power consumption will greatly aid in reducing energy waste. This feature steadily charges your battery over the course of several hours rather than working as quickly as possible to get to 100%. Because the device will not be used for an extended period of time, users are unlikely to be dissatisfied with how long it takes to fully charge. By dynamically controlling charges, adaptive trying to charge helps preserve battery health and longevity. Simply plug in your battery in the evening, set an alarm, and let the Adaptive Charging do its thing. When connected with the charging circuit, the Wi-Fi microchip, Particle Photon, and other Arduino-based modules convert the charger into an IoT device, but the Wi-Fi microchip is the most cost-effective and uses the least amount of power.

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D. Working principle

An efficient battery charger is a switch-mode power supply (sometimes referred to as a high-frequency charger) that can communicate with a battery pack to manage and monitor the charging process. An efficient charger can detect the condition of a battery and adjust its charging settings appropriately, whereas "dumb" chargers provide a steady voltage, sometimes through a predetermined resistance. The charger has a computer chip that electronically communicates with the battery about its charging status. The battery connection (Series and Parallel) varies depending on the battery's health. To determine the ideal charging time, an intelligent charger analyses the battery's charge time.

E. Series-Parallel Connection

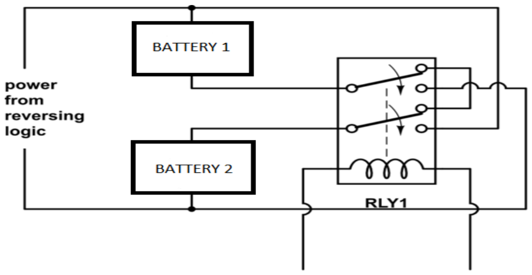

Fig.2: Series and parallel Connector

An interesting way to boost the power applied to a battery is by using two ways. When they are connected in parallel, more current is provided, but the voltage is lower. When they are placed in series, more voltage is applied, but the current is lower. This switching process can be accomplished. The series parallel connecter connections are shown in Fig. 2.

F. Block Diagram

The block diagram consists of the charging port to the buck-boost converter connected with a serial-parallel converter to the battery. The controller will monitor the battery percentage and switch the connections through the relays, which connect to the loads. The block diagram of An Efficient Battery Charging for EV. The block diagram of An Efficient Battery Charging for EV is shown in Fig. 3.

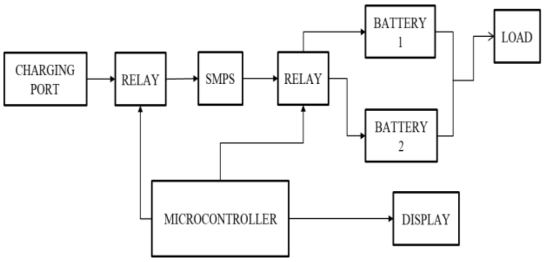

Fig.3: Proposed Block diagram

G. Circuit Diagram

The circuit diagram consists of the buck-boost converter that will increase or decrease power connected with a serial-parallel converter to the battery. The NodeMCU monitors the battery percentage and switches the converter based on the alarm time sets. The circuit diagram of is shown in Fig. 4.

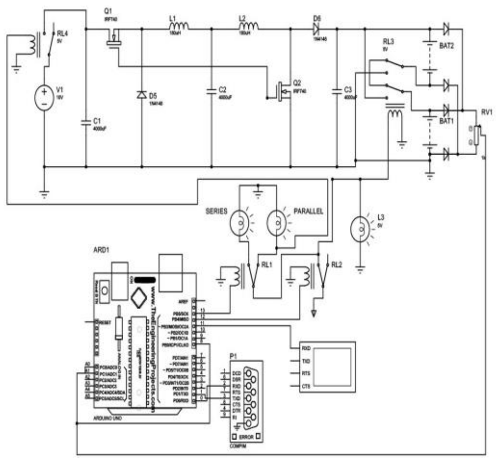

Fig.4: Circuit diagram for An Efficient Battery Charging for EV

V. SIMULATION

A. Simulation Diagram

The circuit diagram of An Efficient Battery Charging for EV is shown in Fig. 5.

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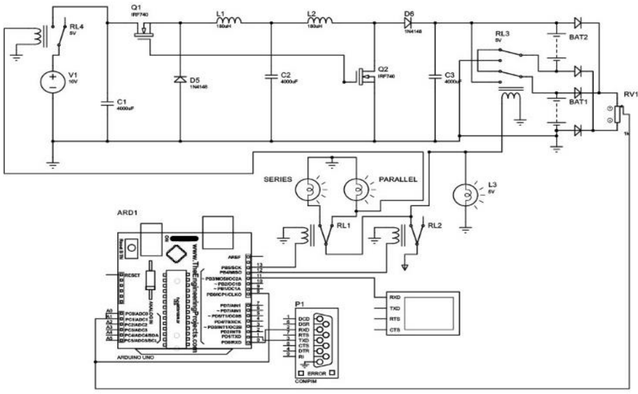

Fig.5: Simulation diagram

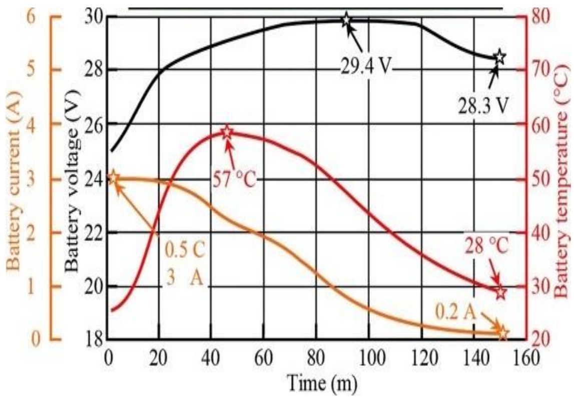

Fig.7: Proposed Efficient Battery Charging Method

B. Simulation Output

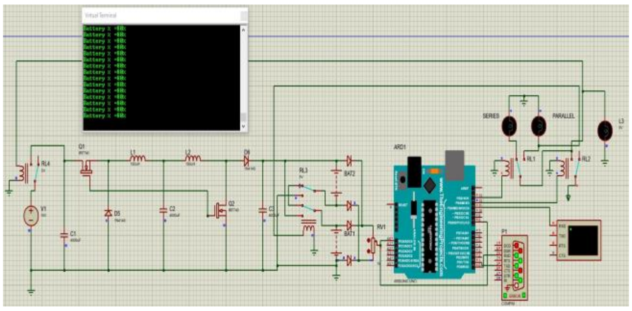

Fig.6: Simulation results

The simulated output where the battery's charge is above 40% is shown in Fig. 6.

Due to this condition, the connection of the two batteries is switched to series with the help of a Relay Module. This switching of connection results in steady-paced charging which helps in prolonging the battery's life.

The project consists of an Alarm Setting System in which the battery, after reaching 80% stops charging and then starts to charge again an hour before the alarm time to reduce the battery stress. The battery will be fully charged before the alarm goes off.

VI. RESULTS AND OBSERVATIONS

The circuit is designed using Proteus software with the help of Blynk in order to improve the battery efficiency, and life and reduce its stress. The output of proposed adaptive battery charger is shown in Fig. 7.

IoT - Internet of Things

VSPE - Virtual Serial Port Emulator

IDE - Integrated Development Environment

MQTT - Message Queuing Telemetry Transport

COM - Communication

TCP - Transmission Control Protocol

OLED - Organic Light-Emitting Diode

TWI - Two-Wire Interface

LED - Light Emitting Diode

DC - Direct current

USB - Universal Serial Bus

PWM - Pulse width modulation

VII. CONCLUSION

The proposed system is an Efficient Battery Charging for EV that is simple to use, efficient in reducing energy waste, and capable of automating battery charging. As the battery will be fully charged right before the alarm time it minimizes battery stress and this system can also switch between fast charging and steady paced charging using a relay module to prolong the battery life. This system was successfully implemented in simulation and the required results were obtained.