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OPTIMUM CHARGING METHOD FOR E-VEHICLES

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Abstract: The concept of a smart charging regulator, a novel technology designed to enhance battery efficiency and extend lifespan through intelligent control mechanism. Traditional charging techniques frequently fail to adapt to changing conditions, resulting in overcharging / undercharging or exposure to unfavourable working situations, all of which can harm battery health. The smart charging regulator is a potential improvement in battery management technology, providing a holistic approach to optimizing efficiency and lifespan. Uncoordinated charging of Electric Vehicles (EVs) can cause voltage fluctuations, power outages, and incremental overloads, all of which are taxing and damaging to the distribution networks. In this paper, a new method to minimize the cost of charging electric vehicles based on the Day-Ahead Electricity Price (DAEP) is proposed on taking battery degradation cost, taking into account the EVs' maximum power charger, state of charge (SOC) limits. The full charging of the EVs' batteries at the end of the charging period, and the distribution feeder subscribed power is analysed. Additionally, the EVs' initial SOC uncertainties are evaluated using their daily mileage. Lastly, a single-phase Low Voltage (LV) distribution network with an EV penetration rate of 50% and 100% has been installed in a residential area to demonstrate the effectiveness of the suggested strategy. In this paper, the linear programming approach is used to address the optimization problem. The findings demonstrate that, in comparison to uncoordinated EV charging, the suggested strategy can lower EV charging costs by 50% and 38% for 100% and 50% of EV penetration rate, respectively.

Keywords: battery efficiency, lifespan, volage fluctuations, cost of charging, linear approach.

I. INTRODUCTION

EV hazards include solid flammable materials (e.g. seat foam and plastic interior decoration). Flammable gases emitted from the battery, coolant, brake fluid, windscreen washer fluid, gearbox fluid and liquid fuels stored in hybrid EV's. The Figure 1.1 Gives the information about the battery's safety cross voltage and temperature.

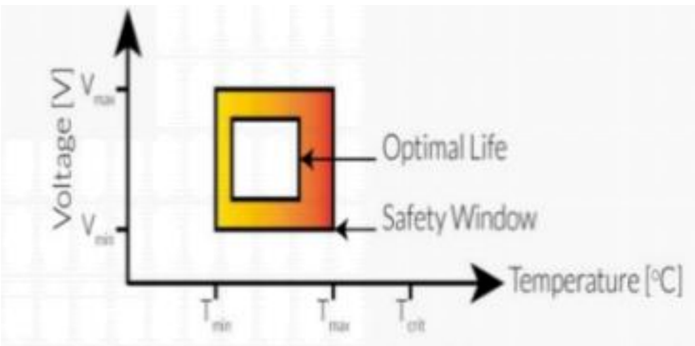

Fig.1.1 the plot of temperature and voltage

To design a circuit for optimum and safety charging of EV battery by using optimum charge controlling method [1]. According to the Organization for Economic Cooperation and Development the transportation industry is responsible for a significant portion of global carbon dioxide emissions and oil consumption [2][4]. Since electrification of the transportation sector could lower air pollution [8], greenhouse gas emissions, and reliance on oil [2][6]. It also encourages the integration of renewable energy sources into the transportation sector, making it an appealing alternative towards sustainable mobility [3]. However, the power grid may be overworked and harmed by the widespread unregulated charging of electric vehicles (EVs) [5]. The effect of EV charging on the distribution grid has been the subject of numerous research. According to reports in uncoordinated EV charging may result in voltage reductions, higher losses, transformer degradation and feeder thermal limit violations [7]. As a result, the transformers with lower power may be more impacted.

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OBJECTIVES

To decrease the accident and prevent them from occurring.

- Optimal damage, to improve the life of the battery.
- Automatic cutoff, when it reaches its maximum level.

The above objectives will be fulfilled with optimum charge-controlled method.

II. PROBLEM IDENTIFICATION

1. Charging electric vehicles parked in unventilated areas where heat cannot be dissipated.
2. Charging electric vehicles at dawn increases the risk of fire.
3. The most common cause of fire is an electrical breakdown during charging.

The figure 2 represents the EV accident scene diagram, under the various conditions.

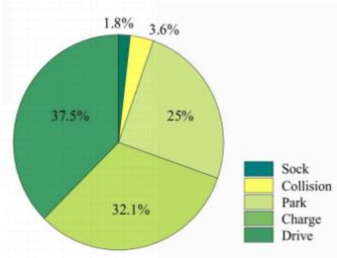

Fig.2 The EV accident scene diagram.

PROBLEM FACED BY BATTERY CHARGING VEHICLES

Network data analysis shows that there will be much more vehicle fire accidents in 2021 than in 2020 as shown in the figure 3. Among the possible causes and characteristics are:

The base of the vehicle expands. The number of electric cars is fast increasing as people choose to drive electric cars to and from work and to transport students to and from school as traffic congestion becomes more severe as a result of sociological, scientific and technical breakthroughs.

Electric car batteries are not properly tested or maintained. energy vehicles might catch fire when charging due to differences in energy storage capacity and charging times caused by different battery manufacturers and materials.

The industry has yet to establish a comprehensive system for tracking, identifying and recalling battery issues.

Fig.3 Vehicle fire accidents in 2021

III. FUNCTIONAL BLOCK DIAGRAM

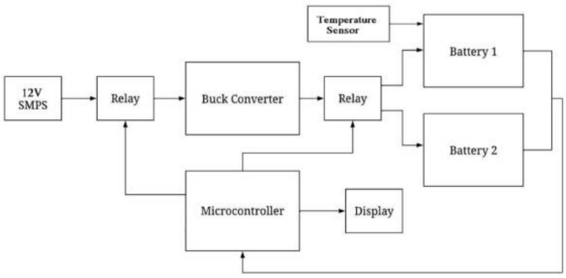

Fig.3.1 Basic functional block

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The above figure 4 is divided into 3 sections for operations, with various components like relay, buck converter, microcontroller, battery, temperature sensor and 12V SMPS. And the below table 3.1 explains the working principal of the block diagram.

Table 3.1

INPUT	PROCESS	OUTPUT
Giving 12v from the main supply	Controlling	Increasing the lifespan
	Maintaining	Improves the efficiency of the battery

IV. PROPOSED METHODOLOGY

Developing a proposed approach for the optimal charging method for EV entails a number of phases and considerations. Here's a generalized outline along with a diagram illustrating the process. Collect data on EV usage patterns, charging infrastructure, grid capacity and user preferences. Examine current charging techniques and their limitations.
Stakeholder Analysis: Identify key stakeholders, including EV owners, charging station operators, utility companies and policymakers. Understand their needs, issues and goals for EV charging.
Technological Assessment: Examine current EV charging technologies (such as level 1, level 2 and DC rapid charging) and their compatibility with various car models. Investigate new technologies including vehicle-to-grid (V2G) and smart charging options. Collect data on e-vehicle usage patterns, charging infrastructure, grid capacity and user preferences.
Optimise charging strategies using algorithms that include power pricing, grid load, renewable energy availability and user schedules. Consider using dynamic pricing methods to encourage off-peak charges and load balancing. User Interface Design: Create intuitive interfaces for e-vehicle owners to schedule, monitor and manage charging sessions.
Incorporate real-time information about charging station availability, energy pricing and expected charging timeframes. Ensure interoperability and standardisation of charging equipment to provide a consistent user experience. Consider integrating renewable energy sources, such as solar and wind, into the charging infrastructure. Implement energy storage technology to reduce intermittency and improve renewable energy utilisation.
Monitoring & Evaluation: Establish performance criteria to evaluate the charging method's efficiency, cost savings and environmental impact.

V. CIRCUIT DIAGRAM

The circuit's input is a 12V supply, which is coupled to a single relay that controls the battery's automatic cutoff mechanism. It contains three more relays for regulating reasons after that. Our processor, a Node MCU, splits the signal and sends it in accordance with the specifications. They supply the relays with four inputs (D5, D6, D7 and D8) and the display with four additional inputs (D1, D2, 3V3 and GND). The figure 5.1 shows overall circuit diagram for proposed system.

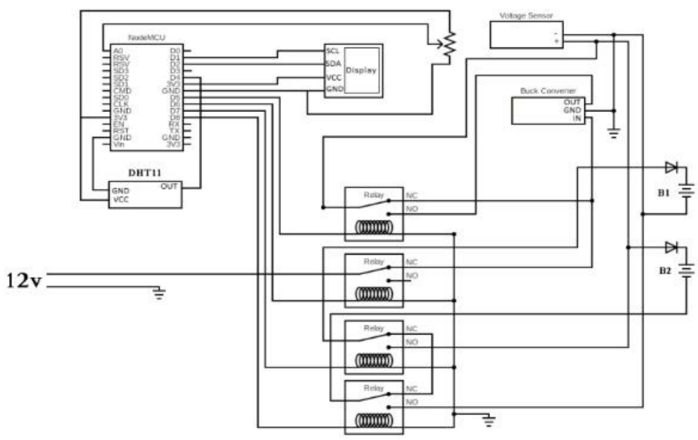

Fig.5.1 The circuit diagram for the proposed system.

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VI. FLOW CHART

The ideal charging technique for electric vehicles is completed by this link in the diagram figure 6.1.

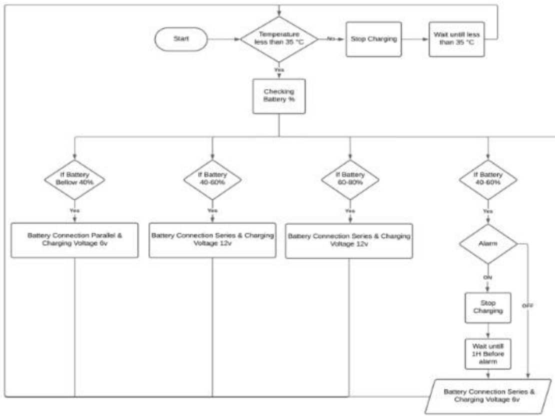

Fig.6.1 The flow chart for the proposed system.

VII. SIMULATION DIAGRAM

The simulation diagram of proposed system is given in the figure 7.1. The circuit's input in this simulation picture is a 12V supply (v1). A BUCK converter has been attached to the supply's end. Proceeding, it has been connected to a group of batteries whose output is attached to a potentiometer. The potentiometer's output is connected to the Arduino Board, which houses a node MCU.

Two switches, a timing circuit (sw1) and an alarm, are attached to the board's opposite end (sw2). To view the voltage level based on the potentiometer triggering, the other end is attached to an OLED display. Additionally, it has two external relays linked to it (rl1, rl2). That is related to the connections for light glowing in series (l1) and parallel (l2).

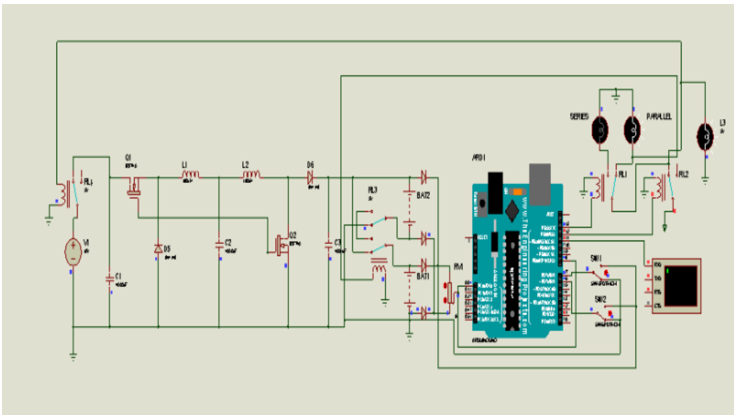

Fig.7.1 The simulation diagram for the proposed system.

DIFFERENT MODES OF OPERATION

They are being operated at three different modes or levels. Namely,

1) CHARGING LEVEL AT 40%
2) CHARGING LEVEL AT 80%
3) CHARGING LEVEL AT 100%

VIII. RESULT

MODE 1

The circuit's initial half in this simulation circuit is identical to the previously described standard functioning principle. Additionally, the potentiometer is gradually adjusted from 0% to 40%.

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The supply voltage, which is 12 V, doesn't alter even after the potentiometer is adjusted to 40% level as shown in figure 8.1.

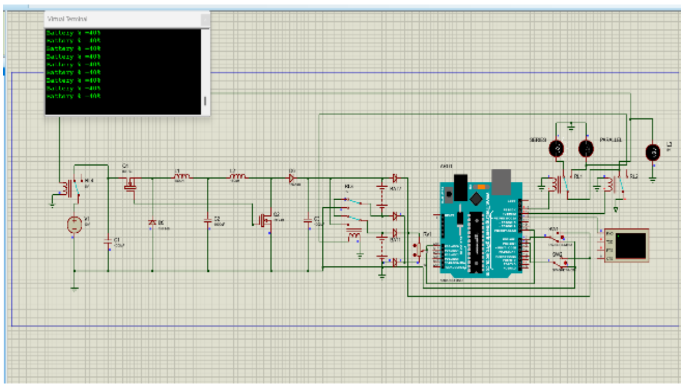

Fig.8.1 The simulation diagram for the system under MODE 1.

MODE 2

The circuit's initial half in this simulation circuit is identical to the previously described standard functioning principle. Additionally, the potentiometer is gradually adjusted from 40% to 80%.

The supply voltage, which is 12 V as mentioned previously, changes when the potentiometer is adjusted to an 80% level Stepping down the voltage to 6V also results in an increase in current 80% level as shown in figure 8.2.

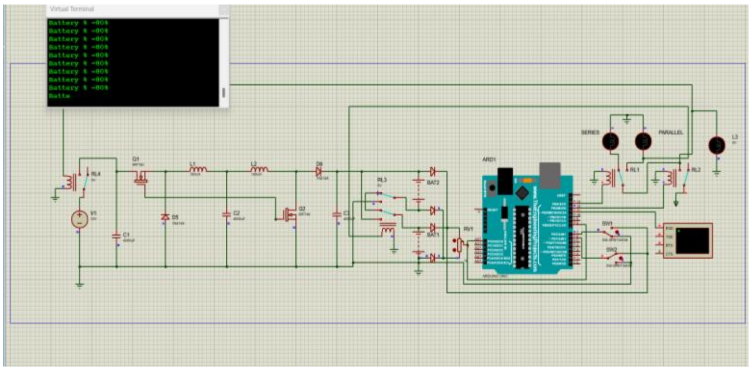

Fig.8.2 The simulation diagram for the system under MODE 2.

MODE 3

The circuit's initial half in this simulation circuit is identical to the previously described standard functioning principle. Additionally, the potentiometer is gradually adjusted from 80% to 100%.

The supply voltage, which is 12V as was previously mentioned, changes when the potentiometer is adjusted to 100%. Stepping down the voltage to 6V also results in an increase in current 80% level as shown in figure 8.3.

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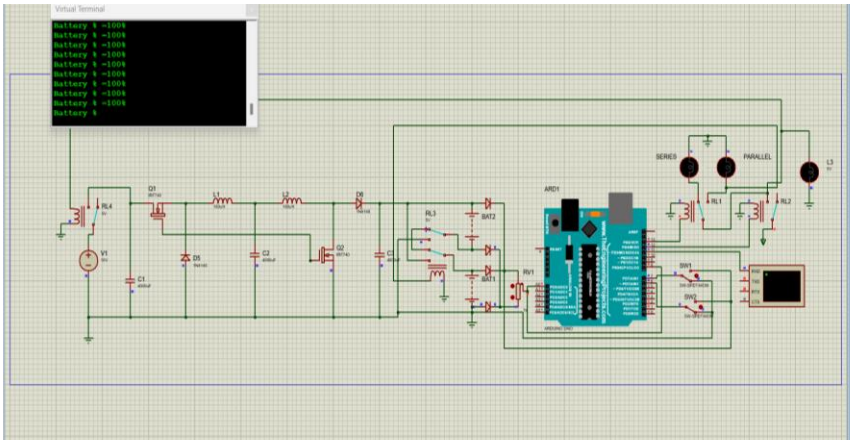

Fig.8.3 The simulation diagram for the system under MODE 3.

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IX. CONCLUSION

In this paper, a charging-side deep learning approach for fault warning and state monitoring of electric vehicle charging operations is proposed. The method's objective is to guarantee the security of charging electric vehicles, encourage the amalgamation of diverse data sources with automobile safety technologies and expedite the execution of the country's big data plan. The suggested approach may efficiently track different physical amount data related to EV charging, provide EV charging fault alerts and stop false alarms brought on by inaccurate charging data.

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