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IoT Enabled Domestic EV Charging Station and Management System

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ABSTRACT: In recent years, EVs are gradually replacing traditional IC engine as a means to reduce fossil fuel consumption. Yet range anxiety remains a primary deterrent for potential adopters of EV. Installations of Fast Charging stations in parking spaces, malls, offices, etc. will go a long way in overcoming this range anxiety. In this regard, a prototype model is designed to control, monitor and manage the charging station from a remote location for the benefit of the owner and consumer. The proposed system will estimate the battery parameters like voltage, current, etc. and the retrieved information is shared via the internet to analyze the battery's power consumed, voltage and current in real time. In addition, it ascertains the vehicle's charging cost through integration of IoT operated devices. This model can be successfully implemented on a large scale and cost-effective basis in the real world.

KEYWORDS: Electric Vehicles (EVs); Internet of Things (IoT); Blynk; Fast Charging (FC).

I. INTRODUCTION

In the current scenario, people are facing issues with the increased price of fuel and depletions of fossil fuel, hence Electric vehicles are a lucrative and sustainable alternative to traditional IC engine vehicles. Consequently, the vehicle transport system is rapidly increasing towards a sustainable electric vehicle populace.

Yet people are hesitant to switch to electric vehicles due to the investment and lack of charging stations and their subsequent maintenance. The demand for charging infrastructure, including charging stations in parking structures and garages is more important as the EVs on the road multiply. Also, for long-distance commuters, an available charging station may be a critical requirement to ensure the ability to finish the round trip and make it home. Even when charging is not critical, many EV drivers may plug-in to alleviate range anxiety or to shorten the charge-discharge cycle and decrease battery wear. A scarcity of charging stations may make EVs less convenient and contribute to range anxiety resulting in fewer people embracing the use of electric vehicles.

The aim of this project is to implement cloud-based monitoring and management of the smart charging station for EVs, so as to increase the security-driven IoT enabled direct current (DC) fast/slow chargers. The proposed system estimates the battery parameters like voltage, current, etc. and the retrieved information is shared via the internet to analyze the battery's energy consumed, power consumed, under-voltage, over-voltage, etc. In addition, it ascertains the vehicle's charging cost through the integration of IoT-operated devices. All of the above parameters are displayed on a dedicated user interface via the LCD

Thus the platform provides an optimal way for system to provide an execution framework for the EVs users to provide energy demand solutions to all the entities involved i.e., the owner and the user operating a remote smart charger infrastructure facility.

II. RELATED WORK

A. IoT enabled Charging Station

A charging station comprising of a network embedded system is used by technicians to maintain and support the infrastructure model. Also, the option of battery swapping as a means of fast charging is implemented. The proposed system enables weather-monitoring system, grid optimization using solar energy [1].

B. Implementation

An optimal charging station to ensure minimum charging time, travel time and charging cost is implemented [2]. Ant Colony Optimization (ACO) algorithm is used. Also, MATLAB is used to verify the significance of the proposed solution on a Washington City PEV Network [2].

a. Grid Optimizations:

Power required to charge the PHEVs is managed effectively from grid-connected photovoltaic generations. The energy management system supplies power to the vehicle battery chargers via real time monitoring to secure the maximum utilization of available power charging time and other advantages to the grid such as voltage and load tracking enhancement [5].

b. Multi-port Charger:

Chargers are integrated and provide charging service through shared charging ports to achieve a high utilization rate of chargers. Simulation results show that the equivalent annual costs in MCMP stations are lower than traditional stations [7]. Also, the problem can be divided into two different formalizations of the problem have been presented. In the first one, the power flow to vehicles is constrained to be mono-directional, whereas in the second one power flows from the vehicles are allowed (V2G) [8].

c. Blockchain-based EV charging with dynamic tariff:

In-order to implement a secure and privacy preserving payment method for the consumer, a blockchain-based method is introduced. Different charging stations can send bids for tariffs based on the requested energy. A blockchain is used as a decentralized and immutable storage for transparency and verifiability of the bids [9]

d. Charging Station placement:

Possible queuing of EVs may lead to consumer dissatisfaction. Therefore, appropriate communication via GPS, etc may be implemented reckoning the arrival of EVs. Also, determining the location and sizing of new Ev charging infrastructure is implemented [10].

III. METHODOLOGY

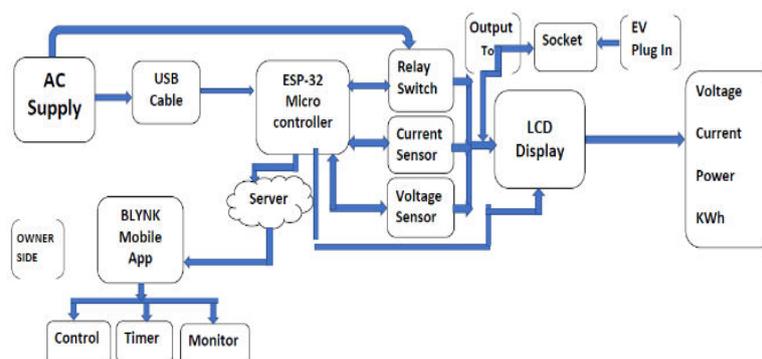


Fig.1. EV Charging and Monitoring (a)Block diagram of EV Charging Station

An IoT based EV charging station is implemented. An ESP32 microcontroller is used to obtain the data from the sensors, wherein a code is created via the Arduino IDE software. The code has 3 libraries: current sensor, voltage sensor and timer option. The microcontroller is connected to a relay, which acts as a switch in order to detect/connect with the supply once the plug is inserted by the user. Also, a thick-wire wound coil is employed, through which the wire from the load is passed, such that the change in magnetic flux helps in accurately measuring the current change. Consequently, the analog pins of voltage and current sensor are given to the microcontroller, which again sends the output data to the Cloud storage. The data is monitored in the BLYNK app over the internet after successfully obtaining and verifying the authentication token. Simultaneously, an LCD is connected to the microcontroller, from where the data from the Blynk App is received and displayed for the benefit of the user.

IV. RESULTS AND OUTCOMES

In this project, the IoT enabled domestic EV charging station is implemented.

A. Observation

1. The charger parameters are successfully connected to the internet over the microcontroller connected with Blynk APP.
2. The charging station successfully controlled by the owner.
3. The energy consumed in terms of power, kWh, voltage and current are monitored.
4. The LCD display for the consumer's satisfaction and information is implemented.
5. The switch is turned off on completion of the timer count.





(c)

Fig. 2.EV Charging and Monitoring (a) Hardware Implementation (b) Vrms and Irms (c) Power and kWh

Figure 2 (a) is an image of the hardware implementation. It is implemented on a acrylic board. (b) is an image showing the Vrms and Irms values on both BLYNK app and LCD display. (c) is an image showing the power consumed and the kWh on both BLYNK app and LCD display.

V. CONCLUSION

This paper outlines a way for monitoring and controlling a universal electric vehicle charging station. Additional features can be added to the proposed project like adding cloud storage to store and track data such as the amount of current, voltage and utilized while charging a specific device. Also, by converting it into a multi socket system, the number of outlets can be expanded.

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