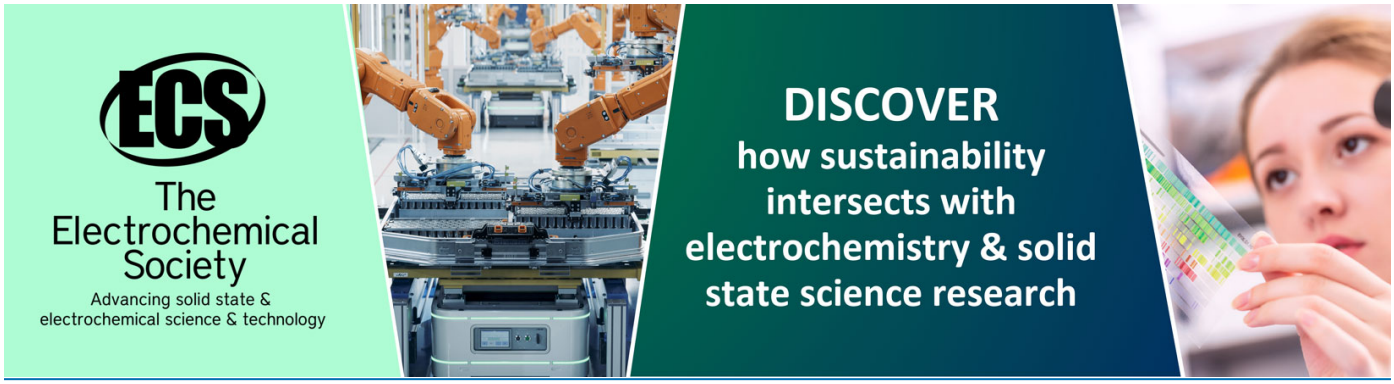
An IoT Based Approach to Monitor and Replace Batteries for Battery Operated Vehicle



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An IoT Based Approach to Monitor and Replace Batteries for Battery Operated Vehicle

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Abstract. In today's world of constant connectivity, instant gratification and customer-driven market, immediate availability of battery supply warehouses and replacement are the vast array of challenges faced by the vehicles such as e-rickshaws. Eelectric vehicles, as a new generation of vehicles, are increasingly favoured by the automotive research field because of their incomparable advantages in energy saving and emission reduction and reduction of human dependence on traditional fossil resources. Especially in the issue of safe operation and supervision of electric vehicles, it has received special attention. Therefore, remote monitoring and management of electric vehicles and remote monitoring of battery replacement stations have become an important part of the safe operation of electric vehicles. In the traditional approach, the recharging pattern of batteries of the e-rickshaw drivers is their own household sockets but the proposed system can immediately provide charged batteries and replace the used batteries by tracking the battery life along with storing the necessary data in the cloud so that it can be accessed from anywhere.

Keywords: e-rickshaw battery replacement, e-rickshaw tracking, battery replacement method

1. Introduction

With the deepening of the global energy crisis and the serious environmental pollution, the world's major auto companies generally recognize that energy conservation and emission reduction are the main directions for future automotive technology development [1]. Among them, electric vehicles, as a new generation of vehicles, are increasingly favoured by the automotive research field because of their incomparable advantages like energy saving, emission reduction, low cost and reduction of human dependence on traditional fossil resources [2–4].

Especially in the issue of safe operation and supervision of electric vehicles, it has received special attention. Therefore, remote monitoring and management of electric vehicles and

remote monitoring of battery replacement stations have become an important part of the safe operation of electric vehicles. After the large-scale popularization of electric vehicles, 70%-80% of electric vehicles will be supplemented with batteries.

Existing techniques does not contain all the parameters simultaneously. The parameters deployed in other possible solutions do not perform different tasks as it does. The recharging pattern of batteries of the e-rickshaw drivers is their own household sockets but the proposed system can immediately provide charged batteries and replace the used batteries by tracking the battery life along with storing the necessary data in the cloud so that it can be accessed from anywhere.

At present, when the domestic electric vehicle is out of power, it is opened to the parking space where the fixed charging pile is installed, and the charging plug is connected to charge the electric vehicle.

However, the number of charging piles is usually less, and most of the cities do not, and the charging piles are charged for too long, which cannot meet the demand for charging a large number of electric vehicles. As a result, the electric vehicles that need to be charged are crowded and queued, occupying a large number of parking lots near the charging piles.

If the electric operated vehicle is unable to drive to the charging pile due to low power, or there is no power available nearby, the electric vehicle will be anchored on the side of the road.

There is therefore a need in the art to provide system and method for management of batteries of a vehicle that seeks to overcome or at least ameliorate one or more of the above-mentioned problems and other limitations of the existing solutions and utilize techniques, which are robust, accurate, fast, efficient, cost effective and simple.

2. Literature Review

Some researchers in the past also proposed e-Rickshaw management solutions but they were entirely different from the solution proposed in this research work. In one such research work, the authors proposed an e-rickshaw management system with GPS and RFID technology. The purpose of the study was to provide safety to passengers by keeping track of passenger data and vehicle location [5].

In another research, E-Rickshaw management system was designed and developed to schedule a ride according to the passenger demands and this initiative was taken to support the concept

of smart cities. This innovation makes use of Apache-Spark, RFID and GPS and the passenger's information was also maintained to incorporate public security [6].

Few of the studies pointed out the key challenges with e-Rickshaws and one of the major challenge among them was unavailability of charging stations [7-11]. As a result, the vehicle may have stuck anywhere and drivers and passengers may have to suffer a lot.

IoT (Internet of Things) enabled e-Rickshaws were also proposed in some of the past studies. In one such study the authors designed and developed an IoT enabled GPS system for real-time tracking of the vehicle. The system was also capable of transmitting vehicle speed and battery power to the user. The innovation did not claim any battery replacement solution in case of emergency [12].

[13] emphasized on the provision of mother power stations in the cities so that the charged batteries can be provided as and when required. The authors did not propose any mechanism where battery status can be monitored in real time to replace them in time.

The literature depicted that the existing E-Rickshaw management systems are only focusing on the public safety and E-Rickshaw booking. Presently, there is no such system that deals with transmitting battery status in real time to the server along with the vehicle location. Such system can help the drivers to track the battery status as well as the location of near by charging station. The batteries can also be replaced if E-Rickshaw gets stuck somewhere.

3. Objective

The aim of this research work is to find out the accurate, fast, efficient and cost effective technique to replace batteries of battery operated vehicles. The second objective is to assist the driver of battery operated vehicle to plan the journey to nearby battery recharge point or battery vendor. The third objective is to provide a mechanism that can indicate battery exhaustion status to the driver/battery vendor in real time.

4. Method

This research work is providing the solution to above said problem by provide a battery management system and method that provides battery status in real time so that a remedial action can be taken in time.

The study was accomplished step by step. All the steps are listed below in a sequential manner.

1. Collection issues with battery operated vehicles.
2. Literature review to identify the existing solutions.
3. Proposing a new solution.
4. Identification of hardware (Sensors etc.).
5. Prototype development.

The issues were collected from the extensive literature review. The related literature was searched on the Google Scholar and Science-Direct online databases. As a result, an advanced battery management system and method was proposed.

This system makes use of GPS sensor, LCD display and a separate hardware unit to track how much energy is left in the battery by monitoring the voltage levels. All the three components would be integrated together with a microcontroller to make a single unit. The proposed solution can be seen in the Fig.1. This figure has been taken from the patented document.

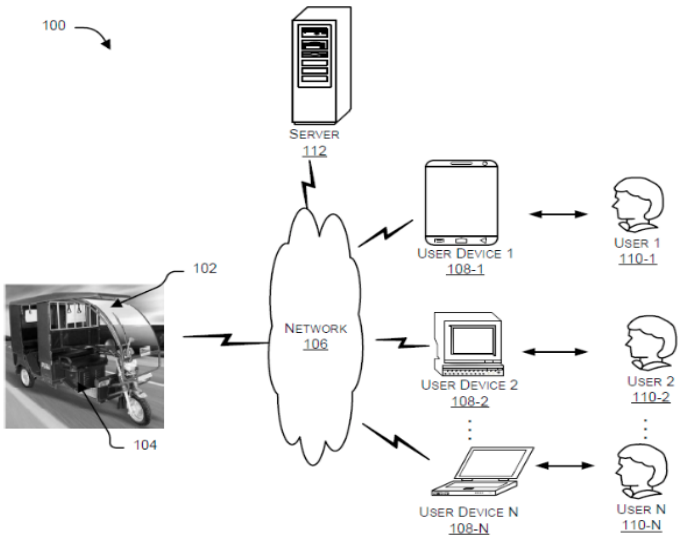

Figure 1. The proposed system (Patent Application No - 201911022755)

NodeMcu microcontroller was proposed in the system as it has the capability to connect with the Internet. The GPS sensor was proposed to monitor the location of e-rickshaw in real-time [14-16]. The real-time GPS locations were transmitted to CLOUD along with the battery status. The system keeps generating alarm along with messages on LCD unit in case the battery status is poor. The system is also capable of suggesting nearby charging station or battery vendor to the e-rickshaw driver after collecting information from the CLOUD server.

5. Discussion and Conclusion

According to an embodiment of the present disclosure a battery management system for a vehicle is disclosed, the system includes; a set of batteries configured with the vehicle to power the vehicle; GPS and battery power consumption sensors operatively coupled with the set of batteries to sense the claimed parameters.

The control unit will transmit the claimed parameters to the CLOUD server in real time. The warning messages will be transmitted whenever the values go below the predetermined threshold value. The overall system also needs continuous Internet connectivity and an Android Application.

The study also proposes that there is need to increase the charging piles/charging-stations as the future of e-Rickshaw is very bright and it is expected that the volume of e-Rickshaw will keep improving in the future due to its benefits [17].

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