IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Impact Factor: 6.252
Volume 3, Issue 1, January 2023

# Intelligent Battery Swapping System for Electric Vehicles with Charging Stations Locator on IoT and Cloud Platform

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**Abstract:** *Having a sufficient charging infrastructure is crucial to the rapid uptake of electric vehicles (EVs). The availability of such infrastructure would eliminate several barriers related to the short range of EVs. A Battery Swapping Station (BSS) is a practical way to power electric vehicles (EVs) while reducing lengthy wait times at Battery Charging Stations (BCS). In contrast to the BCS, the BSS charges the batteries beforehand and gets them ready for a far faster battery swap. These charging stations may be able to offer special advantages to the power system because they can act as a middleman between EV owners and the grid. This essay explores the benefits of developing the BSS from a number of angles. In light of this, a model for battery charging scheduling from the viewpoint of the station owner is suggested. To demonstrate how the suggested model may assist BSS owners in managing their assets through scheduling battery charging time, an example is given.*

**Keywords:** Cloud, Monitoring, the Internet of Things

## I. INTRODUCTION

Today's research and development organisations are concentrating on creating a battery swap station (bss) architecture with the potential to offer a stable foundation for the successful installation of a sizable fleet of hybrid and electric cars (i.e.Xevs). Similar to existing gasoline refuelling stations, the bss may calibrate its subsystem for the deployment of electric vehicles (EVs) by replacing or swapping out the drained batteries for partially or completely charged ones over the course of a few minutes. The bss strategy, which offers a wider experience of business potential for the individual stakeholders, has emerged as a viable technology to the conventional ev recharge station approach. This work deals with the introduction to bss including infrastructure, techniques, benefits over charging station and key challenges associated with bss. Furthermore, an s34x-smart swapping station for xev's is proposed and finally, the key thrust is research for bss is discussed. To the authors' knowledge, this is the first kind of review work on bss. We are focusing on developing a system that not only plays a role in power electronics but also in embedded system and iot using various approaches. This allows the real-time use of the system to get into public domain.

Today's fast-paced lifestyle necessitates the use of automobiles, but as the number of vehicles has expanded, severe problems with both their management and the environment have emerged. Furthermore, as they are powered by non-renewable resources, it is necessary to create better substitutes for future public transportation that have an effective vehicle management section. Dependence on fossil fuels renders them unsustainable because a large portion of them have been used up and will take a very long time to regenerate, making transportation unsustainable along with them. The idea of changing the entire auto industry, which can be accomplished using the concept of xEVs, is at the core of this research. Due of the aforementioned factors and numerous others, xEVs are unquestionably necessary at this time.

The advancement of xEV technology must go hand in hand with that of vehicle charging technology. The xEVs' supporting framework is their charging infrastructure. Plug-in electric cars (EVs), plug-in hybrid electric vehicles (EVs), and other varieties of xEVs are popular in many different fields. potential including a decrease in reliance on fossil fuels, cost savings, emission-free driving, safe driving, less noise, and cheap maintenance, among others. As a source of joy for the EV industry, the development of xEV technologies is being warmly welcomed. For those stakeholders that need to visualise before they plan to invest in the implementation of electric fleets, there are still certain reservations associated to such fresh ideas, despite such encouraging proof. Due to a lack of charging stations, long charging times, utility grid pressure, and—most importantly—the problem of intrinsic EV range anxiety (EVRA), existing xEV users may experience social difficulties. The conductive xEV charging (flow of power between EV supply equipment (EVSE) and EV battery through conductive link), inductive charging (flow of power between EVSE and EV battery wirelessly through induction principle), and the EV battery swapping system are the notable and promising charging techniques (where the discharged battery is replaced by a fully charged one).

The battery switching system, or third option, is still not available as a commercially viable alternative despite fast progress in the fields of conductive charging and wireless (inductive) charging. Among all potential solutions, switching batteries seems to be the most suitable for the current situation. The switching of the EV battery offers one major advantage over the conductive way of charging via EVSE, namely rapid recharging of the xEVs. The task is simple; the driver just drives to a battery swap station (BSS), parks in a designated spot, and the battery swap is completed automatically. The driver then drives away after paying.

Even faster than recharging an automobile with an internal combustion engine, Tesla has been in the business for more than three years. The entire process takes less than two minutes. Additionally, the range that these services offer is comparable to the proverbial "holy grail" of electric mobility.

## II. METHODOLOGY

### 2.1 Block Diagram

The purpose of this project is to identify charging stations and to replace the battery instead of letting the battery charge for hours. This project is merely a scale illustration of how IOT and cloud platforms are used to perform swapping technologies. The block diagram that follows shows the components utilised in this model.

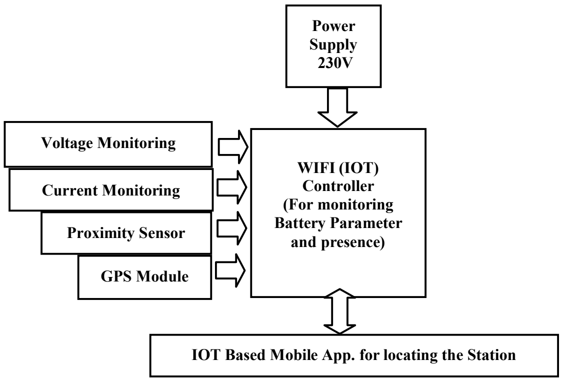


Fig.1: System block diagram

### 2.2 Hardware Prototype

### A. ESP WIFI Controller

A cheap open source IoT platform is Node MCU. Initially, it contained hardware based on the ESP-12 module and firmware that runs on the ESP8266 Wi-Fi SoC from Espress if Systems. Support for the 32-bit ESP32 MCU was later added. The Node MCU serves as the project's brain and heart, constantly monitoring the input from the sensors, acting on the output side, and sending data to the internet. The suggested solution relies heavily on the Raspberry Pi 3. A mouse, keyboard, and pen drive can be connected to its four USB ports. Additionally, an Ethernet cable can be connected to it via an Ethernet compatible connector. We can connect a range of sensors, including ultrasonic, air, temperature, and moisture sensors, to the 40 GPIO pins of the Raspberry Pi 3. The touchscreen display and Pi camera can be mounted in the Raspberry Pi's two special slots.


DOI: 10.48175/IJARSCT-7867

Fig.2:ESP WIFI Controller

**B. Voltage Sensor**

The Voltage Sensor is a straightforward module that can be used with an Arduino (or any other microcontroller with a 5V input tolerance) to measure external voltages that are higher than the microcontroller's maximum allowable value, which is 5V in the case of the Arduino. The voltage sensor module used in this project is shown in the figure below.

In our project, the voltage sensor continuously checks the battery's line voltage and transmits the information to the mobile app. so that the user can monitor the battery's voltage and availability from a remote location.

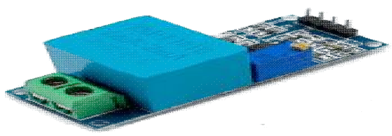

Fig.3: Voltage Sensor

**D. Current Sensor**

The analogue voltage output from this sensor, which runs at 5V, is proportionate to the measured current. The analogue output of this current sensor allows us to read it by measuring the output voltage with a voltmeter or by utilising an Arduino-compatible microcontroller's Analog Read or ADC port.

In our project, the battery current will be continuously monitored by the current sensor, which will also send commands to the mobile app. This displays the battery's available charge.

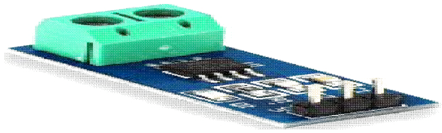

Fig.4:Current Sensor

**E. Proximity Sensor**

A radiation-sensitive optoelectronic component with spectral sensitivity in the infrared wavelength region of 50m is known as an infrared sensor (IR sensor). Motion detectors, which are used in building services to turn on lights or in alarm systems to detect unwanted visitors, increasingly frequently incorporate IR sensors.

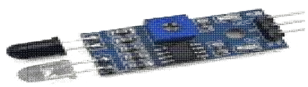

Fig.5: Proximity Sensor

**F. GPS Module**

Small processors and antennas found in GPS modules are used to directly receive data from satellites using specific RF frequencies. From there, it will get data from various sources, including timestamps from all visible satellites. On the mobile app, the Swapping Station can be found using a GPS module.

Fig.6:GPS Module

## III. EXPECTED RESULTS

The model is expected to demonstrate proximity-based battery switching technology and display voltage and current levels on IoT platforms, which are used to find battery swapping charging stations.

## IV. APPLICATIONS

1. Consumer Electronics.
2. Public Transportation.
3. Aviation
4. Electricity Grid.
5. Renewable Energy Storage.
6. Military.
7. Spaceflight.
8. Wearable Technology.

## V. CONCLUSION

Ensure battery performance decline may be tracked online with an IoT-based battery monitoring system for electric vehicles. The goal is to demonstrate the viability of the idea's basic premise. The hardware for the battery monitoring device and a web-based user interface for battery monitoring are being developed as part of the system's development.

The system incorporates a GPS system to detect the coordinate and display it on the Google Maps application, allowing it to display information such as position, battery life, and time via the internet. By including more functionalities, the system can be further modified to be improved.

By creating a smartphone application that can assist users in battery monitoring and serve as a reminder for battery degeneration, the method can be employed in smartphones. Ethernet can be used to improve internet connectivity in order to obtain a better connection than GPRS.

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