Comparative Analysis of Various Techniques of IOT in Electric Vehicle

Rakshitha Ravi, Usha Surendra and N Shreya

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RAKSHITHA RAVI[1]
PhD Scholar,1982502
Department of Electrical and Electronics
CHRIST (DEEMED TO BE) UNIVERSITY
Bangalore,India
rakshitha.r@res.christuniversity.in

Dr USHA SURENDRA[2]
Professor
Department of Electrical and Electronics
CHRIST (DEEMED TO BE) UNIVERSITY
Bangalore,India
ushachrist81@gmail.com

SHREYA N[3]
UG STUDENT,
Department of ECE
RVITM
Bangalore,India
rakshitha.r@res.christuniversity.in

Abstract— Electric Vehicles are increasing day by day across the globe [3]. Electric vehicles, also known as EVs, are steadily gaining in popularity. Research has shown that electric cars are better for the environment. Electrical Vehicles (EVs) appeared as a solution to reduce CO2 emissions. They emit less greenhouse gases and air pollutants over their life than a petrol or diesel car. Energy storage systems, usually batteries, are essential for hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs), and all-electric vehicles (EVs). Batteries for electric vehicles are characterized by their relatively high power-to-weight ratio, specific energy and energy density; smaller, lighter batteries are desirable because they reduce the weight of the vehicle and therefore improve its performance. Most plug-in hybrids and all-electric vehicles use lithium-ion batteries. In the report, BNEF outlines that electric vehicles (EVs) will hit 10% of global passenger vehicle sales in 2025, with that number rising to 28% in 2030 and 58% in 2040. According to the study, EVs currently make up 3% of global car sales. Through their entire lifetime, electric cars are better for the climate. In the manufacturing process, electric vehicles will produce more global warming emissions than the average gasoline vehicle, because lithium-ion batteries require a lot of materials and energy to build. The Internet of Things (IoT) technology has immense potential for application in improvement and development of Smart Grid. Dynamic electrical energy storage system viz., Electric Vehicles (EVs) are relatively standard due to their excellent electrical properties and flexibility but the possibility of damage to their batteries is there in case of overcharging or deep discharging and their mass penetration profoundly impacts the grid. To circumvent the possibility of damage, EVs' batteries need a precise state of charge estimation to increase their lifespan and to protect the equipment they power. Based on ease of implementation and less overall complexity, in this paper a comparison between 3 techniques namely Node-Red, MQTT and Arduino method is analyzed with the help of real-time Battery Monitoring System (BMS) using coulomb counting method for SoC estimation. The electric vehicles are going to be the future transport but the main disadvantage of the electric vehicles are lack of charging stations and the long charging time. When an electric vehicles battery is charged using AC Supply by using AC to DC Converter there are many losses due to conversion and in form of heat and it reduces the charging station efficiency and increases the charging time.To overcome these problems, The charging station should have a separate battery pack from which the electric vehicles are to be charged by using DC to DC rapid charging technology, Thus the efficiency of the charging station is increased with reduced charging time. Every electric vehicles power consumption details and the cost for charging of each vehicle gets updates to the charging stations website periodically. The efficiency of the charging station and charging speed can be increased by installing charging ports or wireless charging pads in the parking of hotel, parks, theatre, malls and in traffic signals.

Keywords: Internet of Things, Battery Monitoring System, MQTT, SOC estimation, Arduino

I. Introduction:

Electric vehicle companies are enabling modern technologies like Artificial Intelligence and IoT to improve efficiency. Nowadays, vehicles are essential in the day to day life and for industrial use as well. Sufficient effort is being done to withdraw the combustion engines by electric motors [2].A system with IoT will definitely streamline the performance of EV charging and looks the impacts. IoT will improve the city planning and makes the city life easy. Automotive/transportation sector is undergoing a phenomenal course of rapid, change. This transformation is enabled by similar factors that are driving advancements in the Internet of Things including increased computing resources and ubiquitous connectivity. They're easier on the environment. EV's don't even have an exhaust system, meaning they have zero emissions. And since gas-powered vehicles are large contributors to greenhouse-gas buildup in the earth's atmosphere, making the switch to an electric car can help contribute to cleaner air and a healthier planet. Electric vehicles (EVs) burn no gasoline and have no tailpipe emissions, but producing the electricity used to charge them does generate global warming emissions. In regions with the "cleanest" electricity grids, EVs produce lower global warming emissions than even the most fuel-efficient hybrids. As more countries are moving towards pollution free traffic, EVs are gaining more popularity across the globe. As the number of EVs increases, EV charging infrastructure will be also a basic need. If the user is having the car battery fully charged, he can deliver some power to the grid and can earn some money. SoC is measured using the ARM Mbed controller and transmitted to cloud. The application will also display the battery status (SoC) of the user when he comes to the grid. Batteries have become the popular form of electrical energy storage in EVs. The evolution in city transportation has boosted over the last few decades which in turn increased the growth of societies and industry. Since battery is a commonly used device for storage of energy, calculation of Status of Charge plays a vital role in the future [1]. Due to the increase in carbon dioxide (CO_2) caused by the industries and transportation, the Kyoto treaty was signed. This treaty was aimed to reduce the level of CO_2 and has boosted the findings for new cleaner energy solutions.

Benefits of Electric Vehicles:

There are a number of great benefits to electric vehicles (EVs) over conventional petrol/diesel cars.

- Cheaper to run. Owners of an EV have the advantage of much lower running costs.
- Cheaper to maintain. ...
- Other savings. ...
- Better for the environment.
- Health benefits. ...
- Safety improvements. ...
- Our energy security.

Advantages:

1.Better for the Environment

There are a ton of people who choose to purchase an electric vehicle solely because these vehicles are better for the environment than the alternatives. These cars do not contain an exhaust system at all, which means they aren't creating emissions like other cars. Vehicles that are powered by gas are major contributors to the buildup of greenhouse gases, which stay in the earth's atmosphere. As such, having an electric car helps keep air cleaner and the planet healthier.

Electricity is Less Expensive than Gas

When you break everything down, the average American pays about 15 cents a mile to drive a gas-powered vehicle. This might seem negligible but that changes when you look at the cost to drive an electric car. Rather than 15 cents a mile, many electric cars run on five cents a mile due to the fact that electricity is largely less expensive than gasoline. Most people will also be charging their cars in the garage, which means installing a few solar panels can cut that price even further while offering savings on powering your entire home.

Less Maintenance at a Lower Cost

With a gasoline-powered car, there's a ton of maintenance. It starts with oil changes and only goes on from there. Electric cars don't have oil and don't require that maintenance task or others associated with a gas engine. Anything related to the combustion engine in a traditional car isn't needed with an electric car. In addition, the brakes on electric vehicles tend to last longer. That only adds to the cost savings of choosing an electric car rather than one that uses gasoline. It all starts to add up when you begin to think about it.

Electric Cars Tend to Be Quiet

Everyone who lives in an area with a busy street can attest to how loud cars can be during rush hour. Even smaller engines can make a racket. Electric vehicles, on the other hand, are nearly silent in nature. In fact, these cars can be so quiet that some United States legislators have suggested that these cars have noise-making devices installed to ensure that pedestrians know that a car is near them.

Fig1: Importance of Electric vehicle

II. Description of IOT:

A system with IoT will definitely streamline the performance of EV charging and looks the impacts. IoT will improve the city planning and makes the city life easy. Internet of Things (IoT) signifies the network-based interconnection of daily usage entities. It is termed as a self-organizing wireless linkage of devices aimed at the interconnection of everyday objects. It links with the wireless network through the interface by the electronic identifiers, sensors, two-dimensional codes on things. The IoT technology helps achieve the communication between man and machine or machine to machine. Three key features of IoT are: considerable, intelligent and internet connective [1]. There are four features in IoT: gathering of data, bilateral communication, handling and response control. IoT integrated Smart Grid results in improvement of energy productivity, reduced ecological influence, enhanced security, reduced vulnerability to external interference and increased consistency of electric supply [3]. Increased deployment of energy storage devices in the distribution grid will help expedite this process and improve system performance [4]. Bulk energy storage has been used for decades in the utility grid and now the integration of renewables is creating a need for more distributed storage. With increasing adoption of non-conventional energy sources and rise in popularity of plugin hybrid electric vehicles (PHEVs) and all electric vehicles (EVs), the need is for a far more vigorous electric infrastructure. Figure 3 shows the key areas where energy storage systems can be applied.

Applications of IOT

The online delivery market in India is seeing rapid growth with technological advancement and the growing use of the Internet. Many companies operating in the segment are using AI and IoT-enabled electric scooters for smart delivery services. The electric vehicle (EV) industry is also growing rapidly to combat pollution, and has now entered the online delivery space. These AI and IoT-enabled scooters aim to ensure efficiency and safety of the goods as well as the driver, and is also transforming the whole delivery sector.

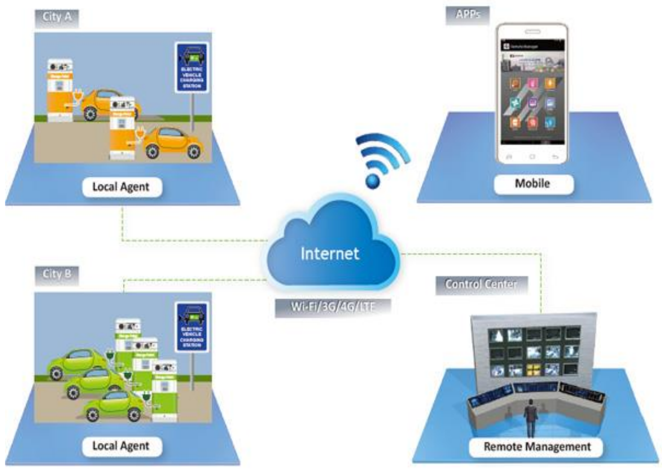


Fig2: Importance of IOT

1.Delivery operations in traffic and pollution

Urban logistics and delivery services are one of the main issues troubling every big and small city in the country. From grocery to food items, the delivery market has grown rapidly, along with the growth of technology and the Internet. According to data by MDS Trans modal Limited, these delivery services represent between 8 and 18 percent of urban traffic flows. Hence, online delivery services will reduce the capacity of the roads by 30 percent in the coming years due to the increase in the number of online delivery companies and the rise in demand by the consumers. The movement of these vehicles in rush hours, which are already congested by private transport, have a high impact on congestion and urban environmental quality. They are also responsible for about 20 percent of CO_2 emissions in urban areas.

2.The role of IOT in EVs

A new segment that has joined the delivery services segment is electric vehicles. The electric vehicle industry, which is growing rapidly to combat pollution, is seen as a catalyst to reduce CO_2 emissions, and more intelligent mode of transportation systems. The Government of India is also pushing for a shift towards electric vehicles. The government has claimed that India will move to 100 percent electric cars by 2030, and has the vision of making the country electrically mobile.

The Government of India has also encouraged mainstream electric mobility by dedicating Rs 10,000 crore to boost EV usage under Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) II scheme, and a five percent reduction of GST on electric vehicles.

3.AI and IoT in delivery services

As the technology is growing, many industries are adopting to these changes. Many electric vehicle companies are enabling modern technologies like Artificial Intelligence (AI) and Internet of Things (IoT) in their vehicles. It also enables easy access to any location in urban areas, and the reliability is also very high with e-vehicles. This is the reason delivery giants are now opting for e-scooters instead of petrol or diesel vehicles. However, some of the problems related to the use of electric vehicles is the lack of adequate infrastructure, such as charging stations; limited autonomy, especially in hilly areas; and some technical malfunctions of engines and batteries. But now, AI and IoT technologies have come up with a solution for all these problems.

4.AI and IoT in electric scooters

Today, AI and IoT have transformed the entire delivery services, especially with electric vehicles (EVs). Now, electric scooters used by delivery executives are AI and IoT enabled, which helps monitor the driver's behavior for safe and timely delivery of goods. Companies have also started using Telematics devices for tracking and monitoring vehicle movement. These technologies will not only monitor the movement of vehicles, but also ensure the safety of drivers in case of any road accidents. Using AI and IoT will help contact the driver and a consumer easily in case of an emergency. These scooters can be controlled by a mobile application and GPS, which is installed in the vehicles, and an accelerometer can tell the company every single movement of a scooter during the delivery of the goods. Apart from using AI and IoT, e-scooters, which are equipped with cellular, GPS, and accelerometer technology, use machine learning to interpret the habits of their riders and either notify dangerous habits of the drivers or alter their machines to produce safer conditions.

Attaching an accelerometer to the scooter, which is AI and IoT enabled, has also made it possible for the company to monitor the driver. Electric vehicles also come with features like navigation assist, ride statistics, remote diagnostics, voice-enabled app, anti-theft alarm and lock, speedometer call alerts, and ride behaviour-based artificial intelligence suggestions, which can be used in case of an emergency. AI and IoT have helped electric scooters to connect to the driver's smartphone and store all vehicle-related data on the cloud. The next level of tech revolution can be seen in the electric vehicle sector. There is 24×7 connectivity to a cloud server, which allows a user to monitor the performance of the vehicle even when the driver is not around. Data analytic algorithms employed by the server analyses the data and notifies the user about possible service needs.

5.IoT in battery charging technology

Modern technologies like AI and IoT have also improved the battery charging technology of electric vehicles, and reduced the time it takes to stop at a gas station. Hence, electric vehicle companies are using artificial intelligence to monitor the state of the battery as it is charging. This improvement in the battery technology has not only made delivery services faster, but also safe for the consumers as well as delivery companies-cars don't emit climate damaging greenhouse gases or health-harming nitrogen oxide. They're quiet and easy to operate. Electric vehicles seem to have a lot of advantages over cars that run on gasoline or diesel. ... If e-cars are running on electricity produced by burning dirty fossil fuels, climate benefits are limited. EVs generate considerably lower emissions over their lifetime than vehicles running on fossil fuels, irrespective of the source that generates the electricity. ... This makes EV's much eco-friendlier compared to the conventional gasoline-powered vehicles crowding the market today. While electric cars have zero tailpipe (or tank-to-wheel) emissions, there are upstream emissions from manufacturing the battery and from electricity generation. But analyses of full life cycle CO_2 consistently show that on average battery electric vehicles emit less CO_2 over their lifetime than diesel cars.

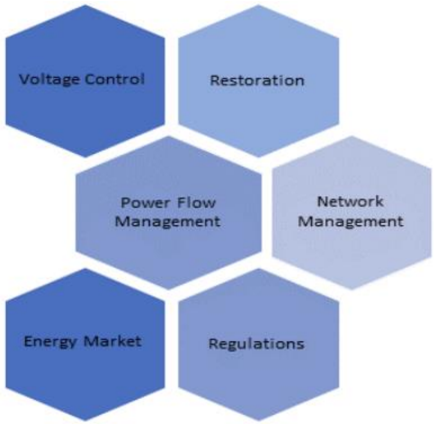


Fig.3: Areas of application of energy storage in smart grid

Innovations in battery technology have been the key motivation for distributed storage systems. With the increasing penetration of electric mobility, the battery prices are declining which will be of assistance in grid applications. To prolong the life of battery-based energy storage system and ensure their reliability, a proper battery monitoring system needs to be integrated along with.

Battery Monitoring System

Battery Monitoring System (BMS) is a smart system whose function is to monitor the vigor of a battery pack. BMS computes the battery's capacity, depreciation of battery while the charging/discharging and correct productivity of the battery and provides this information in real time to users. This mitigates the sense of incorrect safety of periodic battery assessment as it is vigilant to emerging issues before hand the occurrence of a possible malfunction. As every cell is observed separately, so any damage can be checked and appropriate warnings against the values pre-set by consumers and protective measures can be employed, safeguarding the other cells against cumulative damage thereby extending battery life. BMS logs history data of all measured parameters for further analysis and future reference. BMS is unable to sense movable connections present in the battery, leakage of cell material, corrosion of connections leading to the development of high resistance and subsequently fire danger. It is also unable to visually monitor developing swelling, potential leakage, cracks in the outer geometry of battery pack etc.

SoC Estimation

Proper battery use demands the knowledge of its State of Charge (SoC). The development of suitable control strategy necessitates the accurate estimation of battery's remaining capacity i.e., SoC [6]. Being a vital parameter depicting battery performance, precise estimation prolongs the battery lifecycle, avoids deep discharges and helps designing practical control methods to keep battery operating in the optimum region. However, a battery being a chemical energy storage source, and this chemical energy isn't directly accessible which makes the estimation of the SoC of a battery challenging [7]. By estimating the present capacity of the battery, it can be safely charged/discharged at levels appropriate for battery lifecycle enhancement. The energy capacity of a battery depends upon its charging current, discharging current, oldness, operating temperature, cut-off voltage, and usage profile. Numerous techniques have been suggested for the batteries SoC estimation [3-4]. These techniques can be classified into three types: electrochemical-based, electrical based and adaptive ones. The electrochemical techniques although highly accurate are considered difficult to implement in software or hardware as they require access to the chemical composition of battery. Adaptive techniques [7] involve a battery equivalent model and a solution algorithm e.g., neural network [10], Kalman filter [11] and fuzzy logic algorithm. The efficiency of the equivalent model determines the accurateness of these techniques. But, electrical techniques demand only measurable parameters e.g., terminal voltage, charge/discharge current and internal resistance. Due to ease of implementation and low complexity, coulomb counting technique which is based on the integration of current over time is one of the most commonly used electrical technique for SoC estimation [10,11]. In general, battery's SoC is termed as the proportion of its current capacity ($Q(t)$) to the nominal capacity (Qn). The battery manufacturer specifies the nominal capacity which shows the utmost quantity of charge that can be stored in the battery. The SoC can be defined as follows:

$$SoC(t) = \frac{Q(t)}{Q_n} \quad (1)$$

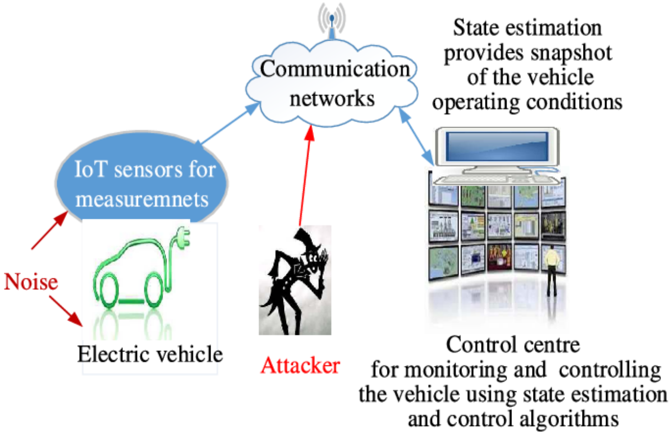


Fig 4: Importance of IOT in Electric Vehicle

Coulomb Counting Method:

With assumption that initial SoC (at time to) is in knowledge, SoC at any instant is usually estimated by integration of the battery current over time, as shown in equation (2)

$$SoC(t) = SoC(t_o) + \frac{\int_{t_o}^{t_o+\Delta} I_{bat}.d\Delta}{Q_n} \times 100\% \quad (2)$$

SoC: State of Charge,

Ibat: value of battery current,

Qn : nominal capacity

The accurateness of Coulomb counting technique depends upon various parameters viz., operating temperature, battery usage history, discharge current, and cycle life [14]. The coulomb counting technique consists of using the equation (2) by enumerating the charge supplied by the battery by sensing its input and output current [10]. Though, few inefficiencies are there in this technique- the initial SoC value is not correctly known, presence of self-discharge phenomena can change the real SoC value after a prolong storage time and battery degradation due to aging should be taken into consideration.

III. Methodology:

Case a) Node-Red The estimation algorithm was implemented in the Node-Red environment. Node-Red is a graphical means for connecting various hardware appliances, Application Programming Interfaces (APIs) and real-time facilities together– to equip the Internet of Things. Using a browser-based flow editor, Node-RED offers an extensive range of nodes to simply connect the flows which can be executed to the runtime with minimal effort. The light-weight runtime is built on Node.js, taking maximum benefit of its event-driven, non-blocking model [15].

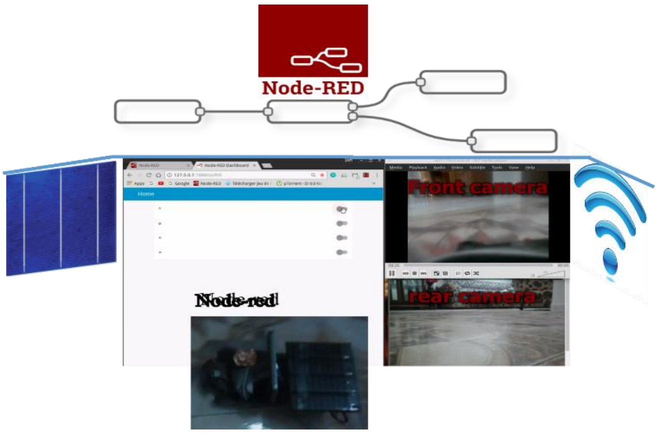


Fig 5: Importance of Node-Red in Electric Vehicle

Case b) MQTT (Message Queuing Telemetry Transport) is a messaging-based communication protocol that affords the lightweight network with an easy means to deliver data. The protocol is used for machine-to-machine (M2M) communication and plays an imperative part in the IoT. It uses a publish/subscribe communication model. MQTT is a useful selection for wireless systems which undergo fluctuating levels of latency because of bandwidth restrictions or fickle connections. In publish/subscribe model, communication is straight from client to an endpoint. But the publisher (client sending message) and subscriber (client getting message) have no knowledge about the presence of each another. There exist a third element, known as broker, who is familiar with both the existing parties i.e., publisher and subscriber. The broker categorizes every received message and delivers them suitably. As MQTT delinks the publisher and subscriber, only the information about hostname/IP and port of the broker is sufficient in order to communicate with messages. Delivery success is effortlessly conveyed upon the successful communication of the message.

Figure 6 shows a typical BMS framework incorporating the measurement of key battery parameters e.g., current, voltage, temperature etc., and performing necessary calculations/estimations to extract useful information about energy storage system i.e., State of Health (SoH), State of Charge (SoC), operating temperature range. Based on these calculated parameters, controlling actions are taken to maintain the battery's lifecycle and safety against potential hazards. Therefore, the prime objective of monitoring is to gauge various variables, log events, generate warnings, record usage profile and represent this information locally and remotely to the user.

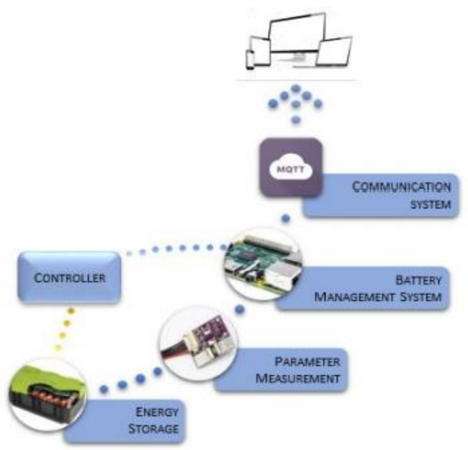


Figure 6 BMS hardware prototype at the block level.

The battery packs electrical parameters are measured using hall effect current/voltage sensors and after amplification, are communicated with the processor Raspberry Pi 3 B interfaced through an 8-bit ADC. Likewise, the external temperature is measured using sensor DHT 11 and conversed with the processor. The coulomb counting algorithm is implemented in the Node-RED environment and estimated SoC is communicated via MQTT protocol. Users can view the value of SoC and operating temperature. The lifecycle of the battery pack can be augmented overall by the feasible formulation of battery charging, discharging, and sleep practices e.g., in the occurrence of SoC topping 10%, the discharge should be allowed and in the occurrence that it trips down below 10%, the discharge need to be stopped. When the SoC touches 95%, then the battery charging must be stopped. Cyclic full charge/discharge enhances the longevity of the battery pack. The operation should be ensured below the specified temperature to avert the risk of explosion of the battery.

MQTT dashboard is the app used to check the SoC.

1) Methodology: Data collection State of Charge (SoC) of a battery shows the remaining battery capacity and this value is expressed in percentage value (ranging from 0 to 100) [9] [10].
case1: If SoC = 100, battery is fully charged.
case2: If SoC = 0, battery is empty. SoC = Initial SoC − (current flowing (1) through battery/Nominal capacity of battery) The magnitude of current is constantly positive for the discharging process and it will be negative for charging process.

2) SOC calculation: Coulomb counting method which means counting the charge flowing into (or) out of the battery. This method is also known as Book-Keeping systems [11]. This method yields an approximate SoC estimation when all the charge applied to the battery is recovered at any time.

1. A 12V, 7Ah Li-ion battery is taken for testing.
2.15V DC RPS is used as the power source.
3. Current is limited by a rheostat (51 ohms) and given to current transducer (LEM 25NP) and is connected to battery.
4. Voltage and current across output of CT is measured.

3) Calculation:
1. The Analog voltage is given to pin20 of Mbed lpc1768 controller.
2. The code is written to calculate the SoC of the battery and compiled and burn to the Mbed LPC1768.
3.The calculated data is send to esp8266 wifi module by serial communication.
4.The data is send to Adafruit IO by esp8266 WiFi module and the data can be viewed in the app.

Results and Discussion of MQTT:

The working of SoC estimation technique and real time of communication of battery parameters were tested during the charging mode of the LiPo batteries. Figure 4 represents the effective capacity estimated by the coulomb counting method. These values are communicated with user using MQTT protocol.

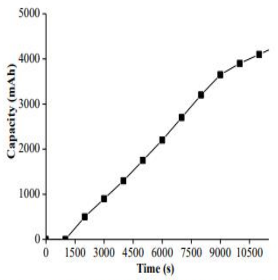


Fig. 4: Estimated capacity of battery packs

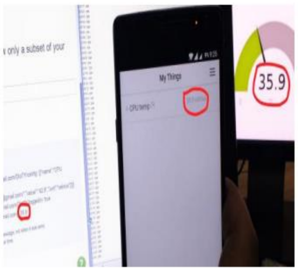


Fig. 5: Battery pack temperature across different platforms

The battery external temperature measured is communicated in real time. Figure 5 shows the temperature displayed on the PC and smartphone App labeled as CPU temp using DIoTY broker.

Ardinuo:

Nowadays Electric Vehicle (EV) technology has grabbed great passion from the people. EVs, as a backup to the conventional combustion engine vehicles, are widely recognized as a quick fix solution to enhance energy efficiency and cut down carbon emissions. EVs commonly have a great energy demand with a high charging rate, hence their accelerated growth under the approach of a smarter grid can place a considerable amount of stress on the existing power grid without effective scheduling mechanisms. In [1] , inexhaustible energy generation appliances were supplied in the energy station. In [2] & [9], there are chain of charging stations supplied with an energy storage appliance and propose a system that allots power to them from the grid, as well as routes customers. In [3], the work empower the vehicle to compute a routing policy that reduces their expected time of journey. [4] describes the fee scheduling problem in EVs at the microgrid scale. In [5] To reduce the computational demand during long control horizon, a nested optimization method is used to breakdown the joint OPF and EV charging problems. In [6] the paper explains the problem of charging a set of electric vehicles from photovoltaic power and rectified by "Maximum Variable Resource Allocation Problem" (MVRAP). In [7] & [8] an energy management algorithm that organize the optimal charging and discharging times of an electric vehicle battery has been introduced. In [10], they introduced charging rate compression (CRC) algorithm which decreases the problem-solving complexity in EVs.

Implementation

Electric vehicles are going to be the future transport. In order to increase the efficiency of the charging station and to reduce the charging time we made the charging station by utilizing the renewable and non-renewable energy to increase it's efficiency and with fast charging technology through wired or wireless modes to reduce the charging time. The charging station should have a separate battery pack from which the electric vehicles are to be charged by using DC to DC rapid charging technology through wired connection or wirelessly. Using IOT all the details i.e power consumption, cost are updated in the charging station and thus the efficiency of the charging station is increased with reduced charging time. It's performance can be increased by installing charging ports or wireless charging pads in the parking of hotel, parks, theatre, malls and in traffic signals with renewable energy sources. We know that EV charging involves renewable energy generated from solar panels utilized by all manufactures today for industrial and domestic purpose. The estimation of energy generated can be predicted even though it is not as accurate and it is time-varying and limited. By considering the charging requirements for a particular vehicle and the expected power generated from the solar generation a local energy storage unit can be introduced. In order to automatically control the storage unit in vehicles, charging station provides sufficient flexibility. So that it can increase the stations introducing energy storage. Like our ordinary electricity bill, it can charge for the storage utilized per unit energy whether it is charged or discharged and by this, charging station can be benefited by making extra cost. Whenever energy state of the storage chargers changes, they exclude the installation cost of the storage and charge for the appropriate capacity of the storage to fulfill this task as an energy buffer. To make the entire vehicle as automated, power storage is in control by the charging station which decides when to charge or discharge the storage unit. Accurate value will be maintained by proper usage of storage unit, with the help of various monitoring sensors.

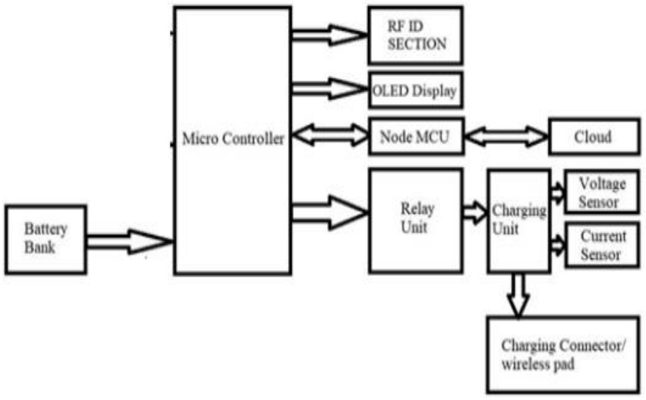


Figure 1. Block Diagram Of Charging System In An Electric Vehicle

Figure shows the block diagram of an electric vehicle charging system. The main part or the heart of the system is the microcontroller which controls the functions of the devices connected according to the requirement. Using the Ardino uno processor the proposed system is implemented with programming written in Embedded C. The figure 2 shows the different sensors used in the system. The three sources of input are solar panel [11], grid supply and battery bank. Mostly solar cells available in different voltages and current ratings and when it absorbs sunlight it generates electricity. Current sensor is used to measure the amount of current in a wire and generates a signal which is directly proportional to the current. The output signal is used to display the measured current using ammeter, or can be utilized for further analysis. Another important sensor is the Voltage Sensor which is mainly used to converts voltage measured into a physical signal and it is directly proportional to the voltage. Connection V is a physical signal port that outputs the measurement result. The specialty is, it will measure the presence of a voltage without making metal contact. It is made of resistive voltage divider and that integrated resistors, embedded in a casted resin, which has very low inductance. The whole arrangement is in the shape of zigzag, together with the resin permittivity which acts as a capacitance. Radio Frequency Identification system [12-14] has two main parts, a tag attached to an object which is to be identified, and a Transceiver called as Reader. The Reader consists of a RF module and an antenna which produces high frequency electromagnetic field. Figure 3 shows the front view of Auduido uno, OLED and node MCU. The Arduino Uno microcontroller board developed based on Microchip ATmega328P, which has analog and digital input/output pins which can be connected to various extension boards and circuits.

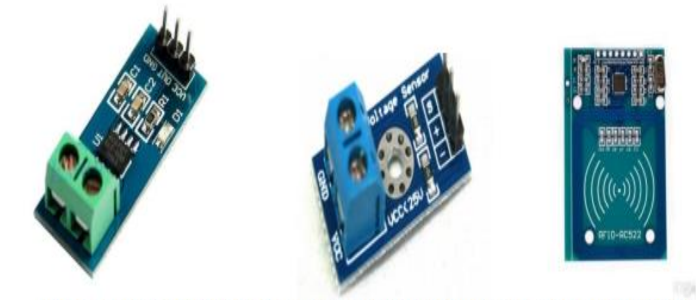
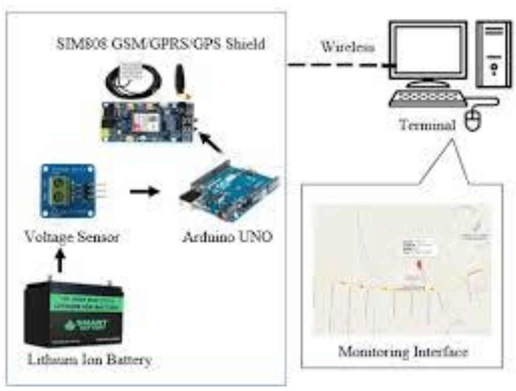


Figure 2. Front Panel Of Current Sensor, Voltage Sensor and RF ID Module

Figure 3. Front Panel Of Arduino Uno, OLED Display and Node MCU

Organic Light Emitting Display is a LED in which the emissive electroluminescent layer is a film of organic compound that emits light in response to an electric current.In between two electrodes organic layer is present and at least one of the electrodes is transparent. Node MCU, an IOT platform includes firmware which runs on the ESP8266 Wi-Fi SOC and hardware depending on the ESP-12 module. The IOT module can be controlled from local Wi-Fi network or from the internet source. The ESP-01 module consists of GPIO pins which is programmed to turn ON/OFF. the LED or a relay through the internet. This can also be programmed by using an Arduino/USBto-TTL converter through the serial pins. Any operating systems can be used to write code and upload to the board such as Windows, Mac OS, and Linux. Here in this paper the coding is written in java , which is more suitable with any Arduino board.



Results and Discussion

To reduce the charging time of the vehicle and to avoid stopping of vehicles on the road due to dead batteries all the roads must be installed with wireless charging technology so that the vehicle gets charged while travelling. Charging and discharging of a battery simultaneously decreases the efficiency and the lifetime of the batteries, so they must have two batteries as pre-installed. Such that, while one battery is discharging the other will be charged through wireless charging technology while travelling. It reduces the charging time also. Wireless Battery Charger mainly works on the principle of mutual inductance. Power is transferred from transmitter to the receiver wirelessly based on the principle of inductive coupling.

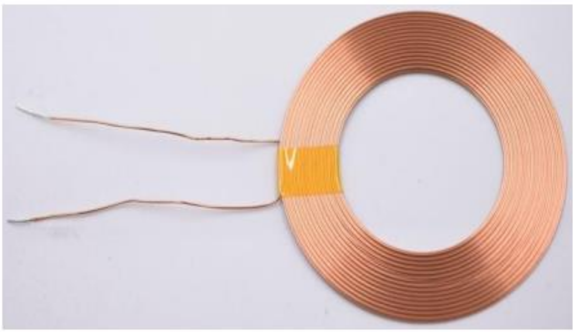
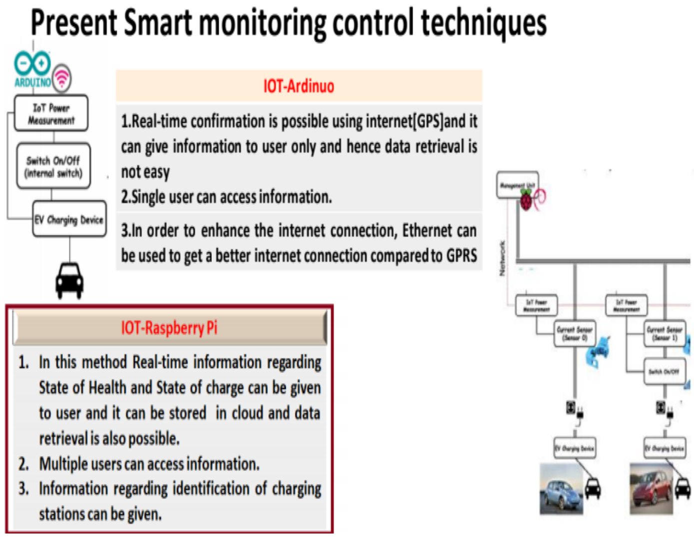


Figure 4. Coil Used For Wireless Charging

By considering this, we have designed an electric vehicle charging station and it is controlled through IOT. The efficiency of the charging station was increased by utilizing the power from non-renewable resources and by DC to DC rapid charging method the charging time was also increased by wireless charging method in the vehicle parking areas and in traffic signal. The user get details about the charging time, charging voltage and the cost for charging in the charging station as well as the owner of the vehicle can also check these details in the electric vehicle charging webpage.



Conclusion

In this paper we have proposed an electric vehicle charging station using IOT. In addition to the vehicles charged, it has to be updated automatically using IOT. Optimal solution will be attained when a charging station decides which arriving EVs to admit and schedule according to its charge capacity. For this, the uncertainty factor i.e the effect of solar energy prediction has to be determined. In order to avoid the charging time, the parking area itself can be utilized as charging station. Without making any contact with the vehicle, the charging can be done using mutual inductance of the coil which is the major advantage of this proposed system.

V. Conclusion and future scope:

Internet of Things (IoT) refers to the networked interconnection of everyday objects. IoT has a major role in the rapid development of smart grid. The implementation of Smart Grid devices in the utility grid will influence vast modification in grid management and usage of electric power in upcoming years. The integration of distributed generation necessitates the deployment of energy storage system. Due to better electrical characteristics, the dynamic energy storage system i.e., Electric Vehicles (EVs) is a good prospect although the probability of damage to battery pack in case of overcharging or deep discharging situations is there and uncontrolled charging can severely impact the grid functioning. To mitigate the danger of damage, an accurate real-time capacity determination of a battery pack is desired to increase their lifespan and to protect the equipment they power. A less complex and easy to implement algorithm i.e., coulomb counting technique is implemented in this paper and the estimated SoC along with measured parameters are made available in real time to the user on a remote basis in form of messaging communication. Further an optimization model for maximizing the trade revenue for aggregator of EVs is presented aimed at facilitating smart charging to reduce the impact of increased penetration of EVs on grid.Internet of Things(IoT) based smartgrid has been developed to monitor status of batteries in smartgrid systems. The IoT which is developed here uses a cloud platform and Android Apps for communication purposes. The car user can easily check the health of his car battery and he can easily decide whether to take power from grid or to sell power to grid. The data stored in the Adafruit IO lasts for 30 days. For future work, handling of multiple users could be implemented so as to compare the status of different users.

V. References:

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