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IoT Based Mobile Charging Station For Electric Vehicle Using Solar System

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ABSTRACT

The technology is an electrical vehicle, and it has been developed to decarbonize the nature or air, which is polluted by the conventional road transport system.The world of EVs (Electrical Vehicles) has numerous obstacles, including those related to performance, battery management, charging infrastructure, etc. The author of this study discussed the infrastructure for charging of electric vehicles. There are two types of charging stations: a fixed charging station (FCS) and a mobile charging station (MCS).But the EV consumer wants service at anytime or anywhere, for this MCS is useful. According to this viewpoint, MCS requires developing technologies like IOT for communication.The MCS is constantly working on the roads, and India has 8 to 10 hours of sunlight per day. So, either a grid system or a solar system can be used to charge the MCS. Specially with solar power, we are able to install the system on the MCS vehicle's roof.This paper discusses the various MCS and EV charging methods, including the use of an IOT server for MCS.

KEYWORDS: ELECTRIC VEHICLE , MOBILE CHARGING STATIONS,SOLARSYSTEM,IOT

1. INTRODUCTION

As we know the world automobile sector transform towards the electric vehicle with fast adoption. The electric vehicle is boon for world's atmosphere and it's help to decrease global temperature. As we know about the traditional transport system of world is running on the fuel like petrol, disel,etc.In this system the emission of pollution is too much and hardly effect on the health of nature and human being.Thats why the technology like Electrical vehicle is come to save worlds life from pollution.Due to EV's the pollution of world is come down or will come down cause EV is purely non-emission polution system. But the challenges in this technology are too much which is performance of Ev charging at one time, Battery management like capacity, weight,etc and charging infrastructure which is not so developed.The charging infrastructure growth is so slow according to growth of EV sector due to this consumers faces some problem.

So author want to contribute in charging system by giving idea about charging provider system.In traditional system the refill the fuel of vehicle is easy and in short time duration.The petrol or diesel is refills the vehicle within 2-3 minutes. But the Ev charging timing depends on type of supply or type of charger. Averagly it takes lot of time to fully charged than traditional vehicle. The fix charging station at one supply system there is two charger available and there is big land area is acquired by the station.So fix charging station is not a very reliable service system due to it each vehicle take averagly 30-45 minutes. Consumer not ready to spend too many time for charging of vehicle. The charging service which at anytime or anywhere save the time and money cause the discharge vehicle is tow by one other vehicle. Now the challenge about wireless charging which is most attractive point in charging system.The limitations of wire length , safety of wire when high rated voltage power is transferred from it for charging or in rainy season short circuit of wired. Due to above problem the wireless charging is beneficial and it's give good performance.

The renewable energy sources like solar system is very effective for charging system,the sun is boon for world energy sources. Solar system is very easy and less costly way to gain energy and can be use for various task. So we can use solar for Ev charging infrastructure and make more reliable. This system can easy to installed at any place and gives good output in form of energy. The sun is available in India for 7-8 hours in a day it's a sufficient time to charge a batteries of large capacity.

The new technologies are present in world of science which makes things simple and reliable. They makes system simple to use and online. Same as the IoT technology is so effective technology on making connectivity between the two systems which is work on server client based system.From this technology good communication will develop between clients and charging system.

2. METHOD

2.1 Charging mode

There are two main methods to describe an electric vehicle charging station: slow charging point and fast charging point [5,6].However, according to several theories, charging stations can be divided into four categories depending on their electrical properties, charging times, and charging activity methods[7].

There are on-board method and off-board technique of charging, respectively. While off-board approach uses external charger to charge the vehicle's ESS, on-board metcharge is conducting charging activities inside the vehicle. Depending on where it is, charging may take place in a home area (level 1,2), a public area (level 3), or a common location like a highway (level 4). Typically, charging level 1 requires either 120/240VAC single phase with a charging period of 6–8 hours or 400VAC three phase with a charging time of 2–3 hours, both at 16 A.32 A uses 400VAC three phase with a 1-2 hour charging time or 240VAC single phase with a 3-4 hour charging time. Level 2 charging would require 400VAC, 63 A, three phases, and a 20–30 minute charging period. The fastest charging level, level 3, would take less than 20 minutes and require 50-700VDC, 100-125 A direct current. Table 1 contains a thorough explanation[7].These requirements would be a key factor in constructing the MCS with the appropriate energy storage for the appropriate charging mode. The electrical characteristic and potential given charging service are impacted by the energy storage option used.

Wireless charging mode:-

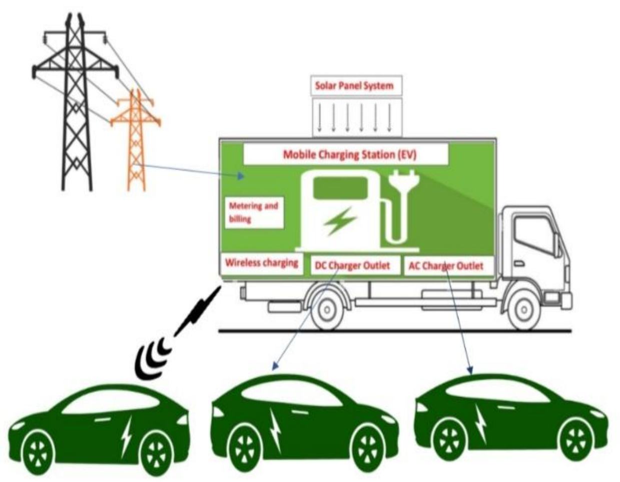
In order to charge wirelessly, transmitter and receiver are necessary. The transmitter side absorbs high freq. Alternating current from a 220Volt ,50Hz Alternating current . The receiver coil is cut by the alternating magnetic field produced by the high frequency AC, which subsequently produces an output of AC power in the receiver coil. However, for wireless charging to work, the resonance frequency must be kept constant between the transmitter and receiver. On both sides, compensation networks are put into place to protect the resonant frequencies. At the end ,the Alternating current power at the receiver side was converted to Direct Current and provided to the battery by the Battery Management System.[1]

2.2 Mobile charging station infrastructure

A charging station is described as an electric car charging infrastructure made up of one or more charging poles (CPs) connected to the distribution grid[4]. Transformers, generators, or energy storage devices will be installed in the grid connection to guarantee dependable service for the charged EV. Owner of the installed parking lot is responsible for the investment, operation, and maintenance of the EV charging infrastructure, while ISO/RTO will be in charge of energy supply.

Charging stations (FCS) and mobile charging stations (MCS) are the two categories of charging stations that can be differentiated based on their mobility. FCS will be housed in a permanent structure that could be a modest or large building that has numerous CPs. Direct access to the power grid or a nearby energy source, such as a wind turbine or photovoltaic (PV) cell, provided the energy. MCS will take the form of an electric or hybrid car fitted with several CPs that can cover a variety of distances. A limited amount of energy storage may be built into the MCS itself or it may be connected to the power grid via the FCS inlet or with renewable energy sources like solar [8].To connect to the power grid and charge its energy storage, MCS can be installed in the authorised FCS, which has additional parking space. [1]

Off-grid charging mode and on-grid charging mode are the two different charging modes in which MCS can be deployed. MCS was connected to the electricity grid and able to charge adjacent EVs when it was stationed in a specific FCS. Because it uses its connection to the power grid to charge the neighbouring EV in this state, MCS was in on-grid charging mode. Because this MCS uses its energy storage without being linked to the grid, it will activate off-grid charging mode when the EV was deployed to be charged outside FCS. Demonstrates the on-grid and off-grid charging illustration.[1]



2.3 Need of IOT

The cloud-based charging station's status is automatically updated by the IoT-CS(IoT-Charging station) The EVs may access data from the cloud to determine which station is best for charging given the amount of charge still in the car. The outcome of the simulation demonstrates that the IoT-CS may simply fit in EV.By the some categories we can understand the need of IOT in EV for charging system. IoT is for locating the stations and communication with them.[2]

Category 1: In this instance, there is no communication between the electric car and the charging station. The purpose of these EV charging stations is the same as the purpose of the existing petrol charging stations. The location of the charging station is not made known to the EV user in any way.

Category 2: The user can get location-specific information from these kinds of charging stations. The only exception is that the EVs can only be connected to the charging stations if they are present inside the zonal region that surrounds the charging stations, which is a zone of some unit distance.But in this category consumer only knows about fixed charging station.[2]

Category 3: In this group, electric vehicles can be connected to charging stations regardless of their location or any other variables. To make this possible, we use IOT-based communication, which gives EV customers direct access to the clouds, the ability to learn their location from the cloud, and the ability to link to a variety of charging stations.And by using GSM system we can exchange the message also with the station to knows about status.

2.4 Power Supply with Solar System

Required regulated power supply for op-amp is +/- 12V dual and +12V required for relay Driver section. Detail description of power supply with design is given in separate chapter. Step Down transformer, Rectifier, filter, regulator, additional filter and indicator are the main block of Power supply.Numerous fixed voltages for output and the TO-220 Package make the three-terminal positive voltage regulators of the LM78XX series helpful in a number of applications. Inner current minimising thermal close-down, and safe operation area protection are utilised by all kinds.They are capable of supplying more than 1A of output current if sufficient heat sinking is offered.

Almost all electronic circuits require a DC source for power supply unit may be defined as a piece of equipment, which converts the alternating waveforms from the power lines (A C supply) into an essentially direct voltage A rectifier with filter gives out unregulated supply An unregulated power supply consists of a transformer, a rectifier, and filter circuit .There are three reasons why such a simple system Is not good enough for same. The first is its poor regulation i.e. the output voltage is for from constant as the load varies.The second is that the D.C output voltage varies with the A.C input directly in many locations the line voltage for nominal value 230 v may vary as wide a range as 150 v to 270 v and yet it is necessary that the D.C voltage remains essentially constant.The third is that the D.C voltage varies with temperature particular if semi conductor devices are used.

For any regulated power supply unregulated input voltage should be

Vin=1.5 X Vout. --------------------(1)

For output 12V input should be 18V.

1) Transformer

Required o/p voltage will depend upon the Vm rating of transformer

Selected step down transformer of rms voltage rating 0-12V/500ma. Vin=1.414 x Vrms

Vin=1.414 x 12

Vin=17 Volts.--------------------(2)

Eqn(2) satisfies eqn(1) Vdc=2xVm/3.14

Vdc=2x17/3.14

Vdc=10.82V

2) Diode 1N4007

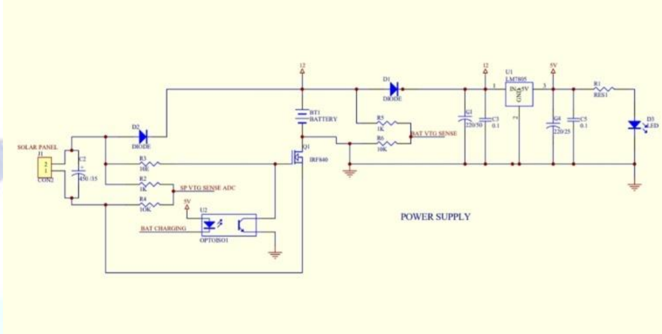
Rectifier diode PIV rating should be greater than Vm rating of transformer and current

Capacity should be up to required current.

PIV=2xVm

=2x1.414xVrms

=34 Volt.



Pdmax = Avergae current x On state drop

Assume average current to be 500ma from diode.

Hence Pdmax =500ma x 0.7 V

Pdmax = 350 mw

Specification of Selected diode: 1N4007

PIV=700V

Iavr=1Amp

Power dissipation =Pdmax=400mWatt

3) Filter Capacitor:

Filter Capacitor design on the basis of ripple. To have a minimum ripple C should have maximum value because ripple is inversely proportional to capacitor value. The voltage rating of capacitor should be greater than Vm rating of transformer. Assumption of ripple will be from 5% to 10%. Assume allowed ripple is 10%. Hence o/p voltage may have extreme change from 13.2V to 10.8V means capacitor can charge up to 13.2V (V1) and discharge to 10.8V (V2).

V2=10.8V= √2 x (12-0.7V).Sinwt.

0.7 V considered as on state drop across diode.

Capacitor will discharge up to 10.8 after 90 deg as from the waveform of fullwave rectification.

Hence, Sinə =10.8 / √2 x (12-0.7V)

Sinə =10.8/15.97

Sinə =0.67

Sine inverse of this factor will give us angle 42 deg. 90 deg.=5 msec

Hence total time = 5+2.4=7.4msec

Cap=ΔQ/ ΔV

ΔQ=I x t

=500 ma x 7.4 msec

= 3.7 ma x msec=3700 microCap= 3.7mili/2.4 V =1.54 mf =1540 uf/25V

Hence selected capacitor may be higher than this capacity. 2200uf/25V

4)Three pin voltage regulator.

A circuit known as a voltage regulator maintains a steady voltage regardless of variations in load current.The 78XX series consists of three terminal positive voltage regulators with seven voltage options. These ICs are designed as fixed voltage regulators with adequate heat sinking can deliver output currents in excess of 1A.
Three-pin regulator 78XX series 7805, --- 7812,---7824
FEATURES OF 78XX SERIES:-
Output current in excess of 1A.
Internal thermal over load protection.No external component requires.Output transistor safe area protection.Internal short circuit current limit.Available in plastic to 202 packageSpecial circuitry allows start up even it output is pulled to negative voltage (and supplies).

ABSOLUTE MAXIMUM RATINGS OF 78XX SERIES

1. Max. Input Voltage – 37V.
2. Operating temp. Range – 0(C-100(C
3. Maximum junction temp. - +1240C
4. Storage temp. Range – 650C to +1500C
5. Lead temp. (Soldering 10- second) - +2300C

Additional Filter capacitor :
10uf-100uf additional filter capacitor will improve the load regulation characteristics. It is connected at the output. LED for indication:- At the output of power supply led in series with 1.5k for 12V is connected to indicate the on state of power supply.

I forward led= 2V I forward led=10ma.

V=Is x Rs + V forward led

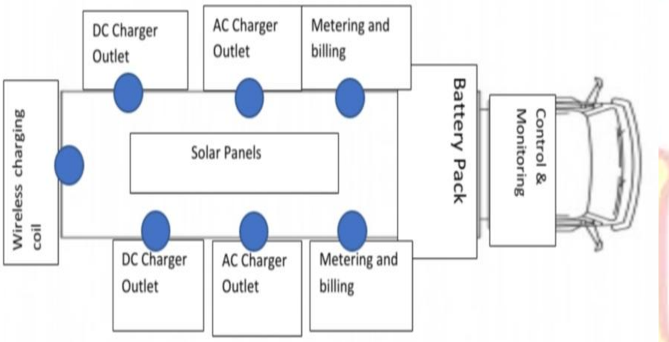
12V= 10 ma x Rs + 2 V

Rs= 12 V-2 V/ (10ma)Rs= 1KFor 12V Rs is up to 1K to 1.5Kohm.

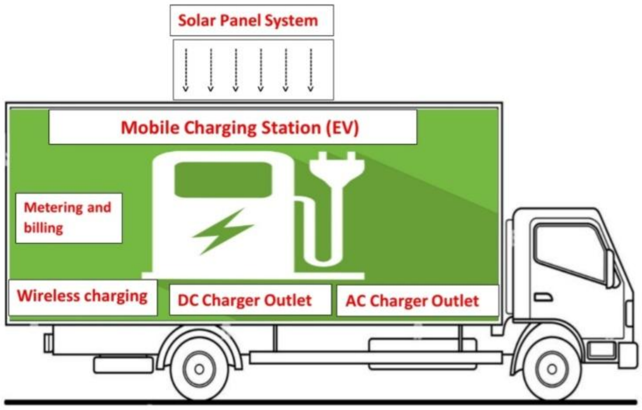
3. RESULTS AND DISCUSSION

In order to enable energy storages to support all four charging levels, an energy storage system (ESS) was created. Because of this, there are three types of charger outlets: AC charger outletsa, DC charger outlets wireless charger outlet. Rapid or extremely rapid charging (level 4) is supported by DC/DC converters in DC charger outlets. On the other hand, a DC/AC inverter-equipped AC charger outlet will carry out sluggish charging (level 1, 2, or 3).Battery output is a DC signal that is easily converted for quick or ultrafast charging. To offer delayed charging, the battery itself can be fed to the DC/AC inverter. To keep track of the energy situation and notify the operator when a charge is required, battery monitoring will be implemented. Primarily at day time MCS is connected with solar system and continue charge the battery system. Solar system is under working 8-10 hour per day. When MCS was connected to the electrical grid via its AC charger inlet, energy storages could be charged. An AC charger inlet was included so that it may be connected to the electrical grid. The utilisation of this integrated energy storage would be optimised by further development of the battery management system (BMS). BMS controls the AC charger and performs a monitoring function in addition to determining whether the energy storage needs to be charged.

The final ESS element Is a metering and billing system that computes and shows the customer the ongoing charged process.The MCS unit should have the shape of an electric car that can transport a battery. The best kind of vehicle would be a medium-duty or heavy-duty truck. Medium load trucks should weight between 6 and 12 tonnes, whereas light duty trucks should weight between 2 and 6 tonnes. The back compartment of the vehicle will house the ESS together with a battery pack, a DC/DC converter, a DC/AC inverter, and an AC charger. Figure 3 shows the installation of the ESS on the MCS. Figure 3 depicts the top view of the MCS truck, while Figure 4 depicts the side view of the MCS truck. There



are various interfaces on the side of the truck to make the charging service easier. To maximise the charging coverage area, an AC charger outlet and a DC charger outlet will be positioned in the centre of the side panel and wireless charger outlet is at back end of truck.Depending on the situation, these charger outlets will be added to one or more charging poles. The somewhat backward at this side panel was where the charger inlet was. This side panel also has a metering and billing display so the consumer can simply keep track of how much is being charged. The length time, charging mode, price per unit of electricity, and real-time claimed pricing should all be displayed by the metering and billing system.To simplify the charging method on both sides of MCS, the side panels on the right and left will be identical in content and purpose.The dashboard was used by the ESS in addition to the back compartment and side panel for monitoring and controlling the entire ESS. The operator would need to be able to control and monitor the state of the energy storage, charging, and invoicing systems through the provision of a friendly user interface, which would require further development. The dashboard module needs internet connection to deliver real-time data to and from MCS central. The data is required to find the MCS or decide the MCS's next duty.[1]



Selling electricity back to the grid was the idea behind vehicle-to-grid (V2G) connectivity [3, 9]. When there is low demand at night, the PHEV would be charged at home, and when there is high demand during the day, the power would be discharged back onto the grid. To operate the bulk power system with the ESP, the idea of selling back the electricity to the grid would require complete cooperation from the ISO/RTO. In order for the PHEV outside the FSC to sell the power back on the grid by requesting the MCS, the dispatch of an MCS unit with a battery and ultracapacitor would assist the transition to this V2G connectivity idea.[9]

4. FUTURE SCOPE

The third- biggest EV market in the entire globe is in India. The competitive market, which grew by 23% in 2022, is anticipated to fundamentally alter the Indian vehicle industry by 2023. To achieve net-zero carbon emissions by 2070, the finance minister allotted Rs 35,000 crore in the government budget for the fiscal year 2023–2024.In 2025, 20 percent of all new vehicles sales globally are projected to be electric; by 2030, the number is expected to rise to 40%. By the year 2040, electric vehicles shall make up more than half of vehicles sold worldwide.

You might not be aware of this, but India is considering moving to electric vehicles by 2030 in order to reduce carbon dioxide emissions by one gigatonne. Less air pollution will be produced as a result of this accomplishment, protecting the health of our current and future generations.Not just India, but the entire globe is fighting climate change and global warming. By purchasing electric vehicles (EVs), car customers may contribute to save planet Earth, our only known home. Vehicle consumers will ultimately profit from the millions of vehicles with zero tailpipe emissions made possible.The inability to drive electric cars over long distances was originally one of the primary barriers that foresaw a bleak future for them in India. This is not to say that a car operating on fossil fuels could not travel very far.

On the opposite conjunction, it was challenging to charge an EV due to the lacking of charging hubs and stations spread over the whole nation. All of this is rapidly shifting now that the Indian government released tenders for private firms to build for a long time transient, and mobile EV charging stations. All EVs are supplied with a fast charger as well, making it simple for setting up at home. So, after a few hours, you may charge your car while it is parked in your driveway.With these developments, EVs can now travel between cities and are no longer just for city driving. It is genuine to presume that soon many people wishing to buy a car will choose for an EV instead of purchasing a second vehicle, supporting the concept that electric vehicles have a promising future in India.

According to the market and the advantages it offers to various parts of the world, the EV has a promising future.Strong EV charging infrastructure is required for this.For the many EV applications, new technologies like AI, ML, IOT, etc., should be implemented or used. The most attractive thing is using renewable energy sources to charge EVs because it will be beneficial and extremely effective for both the economy and the environment.

5. CONCLUSION

To provide EVs with on-grid or off-grid charging, a mobile charging station is required The energy store installed on the back compartment serves as the MCS power source when it is in the off-grid charging mode.His MCS had an AC charger so that when it was linked to the power grid, it could recharge the energy storage.And with solar it continues charge the battery at day . A battery monitoring system is also a feature of MCS. Observe how the energy storage is being used.

A truck-style vehicle should have ESS installed and make use of the dashboard, side panel, and back compartment. The battery pack, the DC/DC converter, the DC/AC inverter, with the AC Charger placed in the back compartment. The solar system is placed at roof of the truck. The back compartment should be used to mount the battery pack, DC/DC converter, DC/AC inverter, AC charger and wireless charger coil. The centre of the side panel will be placed with an AC charger outlet, a DC charger outlet, an AC charger inlet, and a metering and billing display. The dashboard's general user interface will display the entire control and monitoring the system which connect with IOT server. The addition of a battery and solar to the MCS unit should enable the development of a smarter transport system that supports emerging electricity delivery technologies like the smart grid and the V2G concept.

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Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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