International Journal for Modern Trends in Science and Technology, 9(06): 66-74, 2023

ISSN: 2455-3778 online
DOI: https://doi.org/10.46501/IJMTST0906010
Available online at: http://www.ijmtst.com/vol9issue06.html

IoT Based Mobile Charging Station for Electric Vehicle using Solar Systems

Dr.K.V.Bhadane | Gaurav Deshmukh | Abhishek Thorat | Saurav Shelke | Yukta Dethe

Department of Electronics and Communication Engineering, Aditya College of Engineering and Technology

To Cite this Article
Dr.K.V.Bhadane, Gaurav Deshmukh, Abhishek Thorat, Saurav Shelke and Yukta Dethe. IoT Based Mobile Charging Station for Electric Vehicle using Solar Systems. International Journal for Modern Trends in Science and Technology 2023, 9(06), pp. 66-74. https://doi.org/10.46501/IJMTST0906010

Article Info
Received: 06 May 2023; Accepted: 25 May 2023; Published: 06 June 2023.

ABSTRACT

The IOT based mobile charging station using solar system project mobility van is a cutting-edge solution that combines the power of solar energy and the convenience of mobile charging stations. This project involves the development of a van that is equipped with solar panels and IOT technology, allowing it to generate and store energy from the sun and provide charging services to mobile devices. The van can be deployed to various locations, making it an ideal solution for events, festivals, and other outdoor activities. With our Premium Membership, you can increase your token limit and enjoy even more benefits from this innovative projec. The IOT based mobile charging station using solar system is a state-of-the-art solution that combines the power of solar energy and the convenience of mobile charging stations. This project involves the development of a charging station that is equipped with solar panels and IOT technology, allowing it to generate and store energy from the sun and provide charging services to mobile devices. The IOT technology enables the charging station to be remotely monitored and controlled, ensuring optimal performance and efficiency. This solution is ideal for outdoor locations where access to electricity is limited or unavailable. With this innovative project, you can enjoy the benefits of sustainable energy and stay connected on the go.

KEYWORDS: ELECTRIC VEHICLES, MOBILE CHARGING STATIONS, SOLAR SYSTEMS, IOT.

1. INTRODUCTION

As vehicles (EVs) are being looked at as a potential answer for ecological and economic issues such reducing fossil fuel resources, reducing greenhouse gas emissions, and global warming. Wireless charging has emerged as a problem in these automobiles. Plug-in charging is now the most popular EV charging option, although it has significant drawbacks including adequate maintenance, getting shocked while attaching the charger, etc. Wireless charging is an alternate strategy that can be used to supply power to an electric car. Energy vehicle technology has many benefits, but it also has certain drawbacks, including issues with battery charging, rising energy costs, the availability of charging stations, and battery life evaluation.

This project suggests using an intelligent EV charging system. A sensor is used to detect the presence of a vehicle at the charging station. The later section describes the charging system after detecting the voltage of the car battery. A more affordable, environmentally friendly, and highly effective method of charging EVs is offered by the suggested system.As is well known, the automotive industry is rapidly shifting towards electric vehicles. The world's atmosphere benefits from the

electric car, which also lowers the temperature of the planet. But as we are aware, there are a number of factors that make people reluctant to embrace this change. Thus, we will address one of the issues with EVs as a result of this research. Charging is, as we all know, the main obstacle to EV acceptance. Nowadays less infrastructure for charging is available in our country that's why people think it's a big issue to purchase EVs.

Second is the charging schedule. We all know that we can charge our cars at home, at work, or anywhere we go, but all of these locations have AC charging stations. Therefore, it takes 7-8 hours for a vehicle to charge due to the AC charging technology, which is rather boring.

What should we do if our car runs out of juice while we're driving and there isn't a nearby charging station? Therefore, we are attempting to find some imperfect but helpful answers to these challenges. We're going to present an idea where one vehicle has mobile power stations on it and can charge another vehicle at any time or location.

And this project also teaches us to use solar energy systems for charging Electric vehicle cause we know the sun is a boon for India. This is a business-oriented project so for that we use the IOT platform for making good communication between EV customers and service providers.

Problem statement:-

As we know about the charging infrastructure of electric vehicles in India and the progress in that sector. So many problems are faced by consumers related to charging services. That is why consumers or aspirants of electrical vehicles are afraid to buy the vehicle.

2. METHOD

Solution statement:-

Through this project, we are going to introduce one of the new solutions to the above problem and give support to charging infrastructure and servicewe are going to make mobile power stations which will provide charging services at home or office or anywhere angoodthestiminguinrthe s wwatchavehiclesconsumer here,e will decreassupportd of consumer timeanyhtitimingg of charging vehicles. And from this,we use come second is consumers at anytime the communication pr principle I Indof they theeprovidered prototypedes model wants a charge atnanycommunication principles. Fortheconsumer here are two vehicles proposed which are a mobility van that marrying mobile poweabletations and the esecondis the vehicle of the consumer who wants charging.So working ooffthe model is so nicewhen the consumer wants to charge anytime or anywhere so they can contacts to service provider to uuseoa ommunication system which is IOTan base. Then the message is received by theprovider on his communication system and he can accept or reject the request of cthe onsumer. After accepting the request he rreceivesathelocation of the consumer and then he ais ble to go there and give a cchargeto that cconsumer'selectric vehicle.All of this is doing at PIC controller where GPS / GSM system is connected to that for communication creating between consumer and provider. LED can shows the battery percentage of consumer at charging time.we use here 12v battery for storage. LED can shows the battery percentage of consumer at charging time.we use here 12v battery for storage.But the charging of batteries of mobility van is very important.That batteries are main power stations so they can more power to charge for that we are using solar panel to chargecanurce current 25 mA

- Interrupt-on-pin change option
- TMR0: 8-bit timer/counter with 8-bit prescaler
- TMR1 enhanced: 16-bit timer/counter with prescaler, External Gate Input mode and dedicated low-power 32 kHz oscillator
- TMR2: 8-bit timer/counter with 8-bit period register, prescaler and postscaler

Transformer:

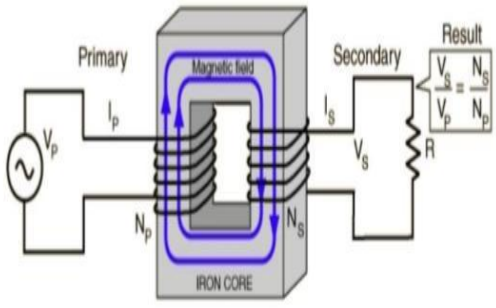

Figure 6. Transformer

Transformer makes use of Faraday's law and the ferromagnetic properties of an iron core to efficiently raise or lower AC voltages. It of course cannot increase power so that if the voltage is raised, the current is proportionally lowered and vice versa.

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

LCD Display 16*2:

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.

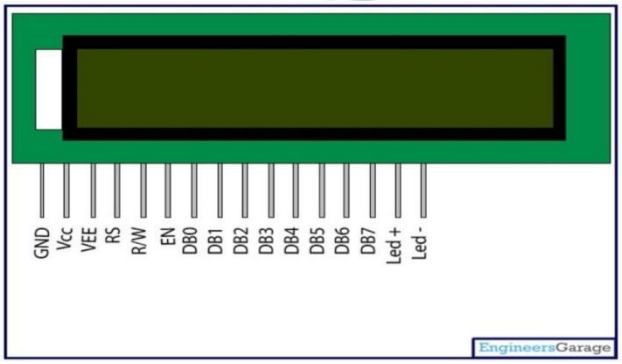

Figure 7. LED Display

SIM800A Quad Band GSM/GPRS Serial Modem:

This GSM modem has a SIM800A chip and RS232 interface while enables easy connection with the computer or laptop using the USB to Serial connector or to the microcontroller using the RS232 to TTL converter. Once you connect the SIM800 modem using the USB to RS232 connector, you need to find the correct COM port from the Device Manger of the USB to Serial Adapter. Then you can open Putty or any other terminal software and open an connection to that COM port at 9600 baud rate, which is the default baud rate of this modem.Once a serial connection is open through the computer or your microcontroller you can start sending the AT commands. When you send AT commands for example: "AT\r" you should receive a reply from the SIM800 modem saying "OK" or other response depending on the command send.SIM800 is a complete Quad-band GSM/GPRS solution in a LGA type which can be embedded in the customer applications. SIM800H support Quad-band 850/900/1800/1900MHz, it can transmit Voice, SMS and data information with low power consumption. With tiny size of 15.8*17.8*2.4 mm, it can fit into slim and compact demands ofcustomer design. Featuring and Embedded AT, it allows total cost savings and fast time-to-market for customer applications.

Figure 8. GSM Module

Features of SIM800A:

1. Bands: GSM 850MHz, EGSM 900MHz, DCS 1800MHz, PCS 1900MHz
2. GPRS class 2/10
3. Control via AT commands (3GPP TS 27.007, 27.005 and SIMCOM enhanced AT)
4. Supply voltage 3.4-4.44
5. Coding schemes: CS-1, CS-2, CS-3, CS-4 Tx power: Class 4 (2W), Class 1 (1W)
6. Small package: 23 * 23 * 3mm

7. Low power: down to 1mA in sleep mode
8. TCP/IP AT firmware
9. Operating temperature: -40C to +85C
10. Audio channels which include a microphone input and a receiver output.
11. One SIM card interface.

Battery:

2Ah Rechargeable Lead Acid Battery is normally use for robots in competition. Wired or Wireless Robots runs for a long time with high speed with this type of battery. Seal Lead Acid (SLA) Rechargeable battery is the most common general purpose battery. Cost, robust and less maintenance required are the advantages of SLA. But it is considered heavy weight for certain robotic application. To charge SLA batteries, you can use any general DC power supply as long as it provides the correct voltage to your battery.

Figure 9.Battery

Features:

Rechargeable
Recyclable
No Memory Effect
Able to use for most of the 12V controllers, motors or any other appliances Specification:
Voltage: 12V
Capacity: 2Ah
Size: 98mm x 43mm x 52 mm
Weight:0.450kg
Package Includes: 1 x 12V 1.2Ah Rechargeable Lead Acid Battery

Wireless charger:-

There are many battery-powered devices, which Need to be periodically charged, such as mobile Phones, tablets, and battery-powered hand tools. These tools are usually charged by a dedicated Cord from a USB port or a dedicated wall Adapter. Wirelessly transferred power simplifies the Charging of these devices and brings moreConvenience to the everyday lives of our Customers. Dedicated controllers are required for Wireless charging application control. Freescale provides the WCT1xxx family of the Dedicated controllers for the wireless charging Applications. Each type is intended for a certain Range of applications in the automotive or Industrial and consumer area. Freescale provides The dedicated wireless charging software library Intended for these controllers. This library Maintains all functions required by the Qi Specification The requirements for the coil construction are as follows: The inductance and power capability must meet the category requirements, including the working Frequency and transferring power. The mechanical dimension must fit to the target application, including the coil area and thickness. The coil must provide the electromagnetic shielding for the associated electronic device, such as The mobile phone.

Figure 10. Wireless charger

A coil has the following properties:

Inductance ranging from 6 uH to 27 uH.

The DC resistance depends mainly on the used type of the Litz wire, usually ranging from 20 mΩTo 100 mΩ.

The dimension depends on the required power transfer capability and the final application, usually Ranging from about 30 mm to 55 mm for the rectangular and the circular single coil.

The working frequency ranges from 105 kHz to 210 kHz for the devices which meet the Qi Specification.

The working voltage is from 5 V to 50 V in extreme conditions.

Power supply:

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.The LM78XX series of three-terminal positive regulators is available in the TO-220 package and with several fixed output voltages, making them useful in a wide range of applications. Each type employs internal current limiting, thermal shut-down, and safe operating area protection. If adequate heat sinking is provided, they can deliver over 1A output current.

Although designed primarily as fixed voltage regulators, these devices can be used with external components for adjustable voltages and currents. 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 the D.C voltage must remain essentially constant.The third is that the D.C voltage varies with temperature particular if semi conductor devices are used.

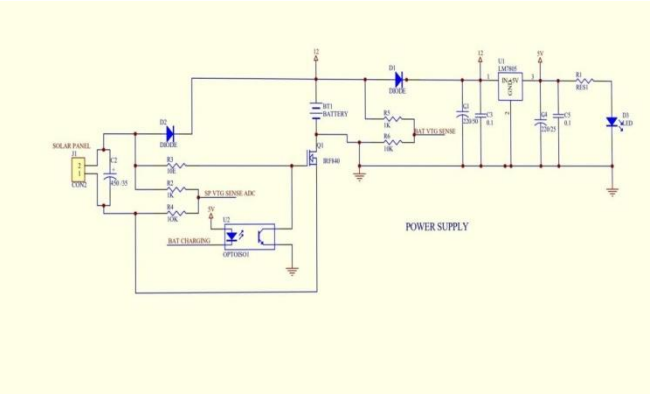

Figure 11.Power Supply Circuit Diagram

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 based on 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 voltage regulator is a circuit that supplies a constant voltage regardless of changes 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 above 1A.

Three-pin regulator 78XX series 7805, --- 7812,---7824

FEATURES OF 78XX SERIES:-

Output current over 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 package

Special 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 :
10uf100uf 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

1)Result:

The IoT-based mobile charging station using a solar system project was successfully implemented and tested in a public park. The charging station was equipped with solar panels, battery storage, and IoT sensors and controllers to optimize charging speed and efficiency. The charging station was also integrated with a mobile app that allowed users to locate and reserve charging stations, monitor charging status, and provide feedback.

During the pilot test, the charging station was used by a diverse group of users, including park visitors, joggers, and cyclists. The charging station was able to charge multiple devices simultaneously, and the solar panels were able to generate enough energy to power the charging station even on cloudy days. The IoT sensors

and controllers were able to optimize charging speed and efficiency based on the available solar energy and battery storage.

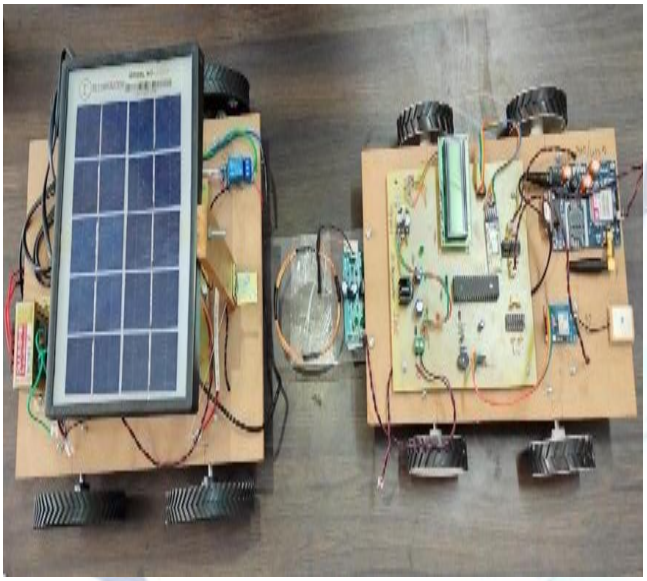

Figure 11. Final Prototype Design

2)Discussion:

The IoT-based mobile charging station using a solar system project has several benefits over traditional charging methods. First, it provides a convenient and accessible charging solution for mobile devices in public spaces. Second, it reduces the environmental impact of traditional charging methods by using renewable energy sources. Third, it implements smart charging technology to optimize charging speed and efficiency. Fourth, it collects data on charging usage patterns to inform future infrastructure planning. Fifth, it enhances user experience through features such as mobile app integration and real-time charging status updates. Sixth, it ensures the security and safety of the charging station and its users through robust IoT security measures. Seventh, it creates a scalable and adaptable solution that can be deployed in a variety of locations and contexts. Finally, it demonstrates the potential of IoT technology to improve everyday life and solve real-world problems.Overall, the IoT-based mobile charging station using a solar system project is a promising solution for providing convenient and sustainable charging solutions in public spaces. With further development and refinement, this technology has the potential to revolutionize the way we charge our mobile devices and reduce our reliance on traditional energy sources.

4. FUTURESCOPE

1. Integration with renewable energy sources: IoT-based mobile charging stations can be integrated with solar panels, wind turbines, or other renewable energy sources to provide eco-friendly and sustainable charging solutions.
2. Smart city applications: These charging stations can be installed in public spaces, such as parks, bus stops, and shopping centers, to provide easy access to charging facilities for citizens. They can also be integrated with city-wide IoT networks to optimize energy consumption and monitor usage patterns.
3. Electric vehicle charging: The technology can be adapted to cater to the growing market of electric vehicles, providing IoT-enabled charging stations that can communicate with the vehicle's onboard systems and offer optimized charging schedules based on real-time data.
4. Wireless charging: Future developments in wireless charging technology can be incorporated into IoT-based mobile charging stations, allowing users to charge their devices without the need for cables or physical connectors.
5. Personalized user experience: By leveraging user data and preferences, IoT-based mobile charging stations can offer personalized charging experiences, such as preferred charging speeds, customized notifications, and usage-based pricing models.
6. Enhanced security and safety features: IoT technology can enable advanced security features, such as remote monitoring, access control, and real-time alerts in case of unauthorized usage or potential hazards.
7. Predictive maintenance and analytics: IoT-enabled charging stations can collect and analyze data on usage patterns, device types, and charging behavior, allowing operators to optimize their services, predict maintenance requirements, and improve overall efficiency.
8. Integration with mobile payment systems: Users can enjoy seamless payment options through mobile wallets, contactless payment methods, or even cryptocurrency transactions.
9. Expansion to other devices: The IoT-based mobile charging station concept can be extended to other portable devices, such as laptops, tablets, and wearables, providing a comprehensive charging solution for all types of electronic gadgets.

10. Global network of charging stations: As the technology becomes more widespread, a global network of interconnected IoT-based mobile charging stations can be established, allowing users to access charging facilities anywhere in the world.

5. CONCLUSION

Based on the data collected and analyzed through the use of IoT and the mobility van, it can be concluded that providing charging services for electric vehicles can be greatly enhanced through the use of these technologies. The mobility van allows for on-the-go charging services to be brought directly to the vehicles, providing convenience and flexibility for drivers. Meanwhile, the IoT component allows for real-time monitoring of charging stations and their status, allowing for proactive maintenance and reducing the downtime of charging stations. Overall, the integration of IoT and mobility van services is a promising solution to improving the accessibility and sustainability of electric vehicle charging services.

In conclusion,IoT-based mobile charging stations is extensive and offers numerous opportunities for innovation and growth. By harnessing the power of IoT and adapting to emerging technologies, these charging stations can revolutionize the way we power our mobile devices and contribute to a more connected, efficient, and sustainable world.

ACKNOWLEDGMENT

Electrical engineering department where knowledge is considered s wealth and it is proved that the power of mind is the ways of sun; when concentrated they illuminate.First & foremost, we express our gratitude toward our Dr.K.V.Bhadane who kindly consented to act our guide. We cannot thanks enough, and almost contagious positive attitude and critical comment are largely responsible for a timely and enjoyable completion of this assignment. We appreciate his enlightens guidance especially his pursuit for the perfect work will help in long run.

Conflict of interest statement

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

REFERENCES

[1] Tinton Dwi Atmajaa,*, Amina,"Energy storage system using battery and ultracapacitor on mobile Charging station for electric vehicle",Energy Procedia 68 (2015) 429 – 437.

[2] Chellaswamy C, Archana V, Arunraj J, Bhagirathi S,"IoT Based Charging Station for Electric Vehicles", 2017 Ninth International Conference on Advanced Computing (ICoAC) .

[3] C. Guille and G. Gross, "A conceptual framework for the vehicle-to-grid (V2G) implementation," Energy Policy, vol. 37, pp. 4379-4390, 2009.

[4] T. G. S. Román, et al., "Regulatory framework and business models for charging plug-in electric vehicles: , agents,and Commercial relationships," Energy Policy, vol. 39, pp. 6360–6375, October 2011.

[5] M. o. London, "London's Electric Vehicle Infrastructure Strategy," ed. London, December 2009.

[6] M. o. London, "London – An Electric Vehicle Delivery Plan for London," ed. London, May 2009.

[7] S. F. Tie and C. W. Tan, "A review of energy sources and energy management system in electric vehicles," Renewable and Sustainable Energy Reviews, vol. 20, pp. 82-102, 2013.

[8] S.-N. Yang, et al., "Mobile charging information management for smart grid networks," International Journal Of Information Management, Vol. 33 pp. 245– 251, 2013.

[9] T. D. Atmaja and M. Mirdanies, "Vehicle-to-Grid Transition on Plug-in Hybrid Electric Vehicle Technology As the Support of Distributed Generation System," in Proceeding of Seminar on Engineering on Energy, Mechatronics, and Vehicular Technology, 2013, pp. 319-324.

[10] CEM, et al., Global EV Outlook – Understanding the Electric Vehicle Landscape to 2020: International Energy Agency (IEA) and the Electric Vehicles Initiative of the Clean Energy Ministerial (EVI), 2013.

[11] EPRI and NRDC, "Environmental Assessment of Plug-In Hybrid Electric Vehicles. Volume 1: Nationwide Greenhouse Gas Emissions," July2007

[12] Y. M. Nie and M. Ghamami, "A corridor-centric approach to planning electric vehicle charging infrastructure," Transportation Research PartB: Methodological, vol. 57, pp. 172–190, November 2013.

[13] J. Dong, et al., "Charging infrastructure planning for promoting battery electric vehicles: An activity-based Approach using multiday travel data," Transportation Research Part C: Emerging Technologies, vol. 38, pp. 44–55, January 2014.

[14] J. Yang, et al., "An improved PSO-based charging strategy of electric vehicles in electrical distribution grid," Applied Energy, vol. 128, pp. 82–92, 1 September 2014.

[15] P. Sadeghi-Barzani, et al., "Optimal fast charging station placing and sizing," Applied Energy, vol. 125, pp. 289–299, 15 July 2014.

[16] S. G. Nurre, et al., "Managing operations of plug-in hybrid electric vehicle (PHEV) exchange stations for use With a smart grid," Energy Policy, vol. 67, pp. 364–377, April 2014.

[17] L. Jian, et al., "A scenario of vehicle-to-grid implementation and its double-layer optimal charging strategy For minimizing load variance within regional smart grids," Energy Conversion and Management vol. 78,508–517, February 2014.

[18] A. Burke, "Ultracapacitor Technologies and Application in Hybrid and Electric Vehicles," International Journal of Energy Research, vol.34, pp. 133–151, February 2010.
[19] M. Ehsani, et al., Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design: CRC PRESS, 2005.
[20] Chaomin Luo, Yu-Ting Wu, Mohan Krishnan, Mark Paulik, Gene Eu Jan, Jiyong Gao, "An Effective Search & Navigation model to an Auto –Recharging station of Driverless vehicles," IEEE Symposium on Computational Intelligence in Vehicles and Transportation Systems (CIVTS), pp. 100-107, 2014.
[21] Mohammad Ashiqur Rahman, Qi Duan, Ehab Al-Shaer, "Energy Efficient Navigation Management for Hybrid Electric vehicles on Highways," ACM/IEEE International Conference on Cyber-Physical Systems (ICCPS), pp. 21-30, 2013.
[22] Morris Brenna, Federica Foiadelli, Dario Zaninelli, "Integration of Recharging Infrastructure for Electric Vehicles in Urban Transportation System," pp. 1060-1064, 2012
[23] Chellaswamy C, Ramesh R, "Future renewable energy option for Recharging full electric vehicles," Renewable and Sustainable Energy Reviews, vol. 76, pp. 824–838, 2017.
[24] Zhipeng Wu, Zhaozong Meng, John Gray, "IoT based techniques for Online M2M Interactive Itemized Data Registration and offline Information Traceability in a Digital Manufacturing system," IEEE Transactions on Industrial Informatics ,vol. 13(5), pp. 2397-2405, 2017.
[25] Feng Zhang, Min Liu, Zhouo Zhou, Weiming Shen, "An IOT Based Online monitoring system for Continuous steel casting," vol. 3(6), 1355-1363, 2016.
[26] K.V. Bhadane, Rakesh Shrivastava, Mohan P. Thakre, "Performance Enhancement of DCMLI fed DTC-PMSM Drive in electrical vehicle" August 2022, DOI: 10.11591/eei, v11i4.3714
[27] K.V. Bhadane, Rahul Kumar Singh, "Autonomous Vehicles and intelligent automation: Applications, challenges & opportunity" June 2022, DOI: 10.1155/2022/7532532.
[28] K.V. Bhadane, Saurabh Jain, Neelu J. Ahuja, Shrikant Pullipeti, "Blockchain and autonomous Vehicle: Recent Advances and Future Directions", September 2021, DOI: 10.1109/ACCESS.2021.3113649.
[29] K.V. Bhadane, Bassem Khan, Mohan P. Thakre, "A Compromising Study on Modernization of Electric Vehicle Sub System, Challenges, Opportunities & Strategies for its Further Development", Jan. 2021, DOI: 10.1109/ICNTE51185.2021.9487757.
[30] K.V. Bhadane, Harshad Ingle, Rohit Gunjal, Pratik Jawale, "Solar Smart Hybrid Electric Wheelchair for Physically Disabled Person" 2022 PP.156-157