IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 2, March 2024

Hybrid Charging Station for Authentic Electric Vehicle

Dr. S. R. Jondhale[1], Londhe Aditi[2], Mali Akanksha[3], Shinde Aparna[4], Varpe Poonam[5]
Department of Electronics & Telecommunication Engineering
Amrutvahini College of Engineering, Sangamner, India

Abstract*:* *The rising popularity of battery-powered electric vehicles (EVs) globally is driven by various factors, including the imperative to mitigate air and noise pollution and reduce reliance on fossil fuels. Understanding battery behavior across different scenarios is crucial for optimizing performance. A battery management system (BMS) plays a pivotal role in this regard, encompassing functions such as battery fuel gauging, implementing optimal charging algorithms, and maintaining cell and thermal equilibrium. Through non-invasive measures like voltage, current, and temperature, the BMS evaluates critical parameters such as battery impedance, capacity, state of charge, health, power decline, and remaining useful life. This review paper synthesizes existing literature on EV charging methodologies, BMS technologies, and state-of-charge estimation techniques.*

Keywords: Electric vehicles, renewable energy, smart charging, battery management, sustainability

I. INTRODUCTION

1.1 Overview

Electric vehicles (EVs) are rapidly emerging as a pivotal solution to address ecological and economic concerns such as global warming, greenhouse gas emissions, and the depletion of fossil fuel resources. As societies worldwide seek cleaner and more sustainable transportation options, the transition to EVs has gained significant momentum. However, the conventional method of charging EVs through plug-in systems presents various drawbacks, including maintenance requirements and safety concerns such as the risk of electric shock during connection.

To overcome these challenges, wireless charging has emerged as a promising alternative for EVs. By eliminating the need for physical connectors, wireless charging offers greater convenience and safety for users. Moreover, it aligns with the overarching goal of reducing pollution and dependence on fossil fuels.

Despite the advancements in EV technology, several challenges persist, including battery charging infrastructure, expanding electric grid capacity, and ensuring the longevity of battery life. Addressing these challenges requires innovative solutions, such as the implementation of smart charging systems.

In this context, the proposed project aims to develop a smart charging system for EVs that integrates renewable energy sources, such as solar and wind power, with conventional energy sources. By harnessing multiple energy forms, the system seeks to enhance reliability, efficiency, and environmental sustainability in charging EVs.

Furthermore, the project introduces an integrated intelligent hybrid power model that optimizes energy flow between generating stations, storage units, charging infrastructure, and the existing grid. This dynamic model incorporates intelligent energy switching based on demand schedules, ensuring efficient utilization of resources while minimizing reliance on fossil fuels.

Additionally, the project introduces innovative features such as GPS-based mobile charging van services for real-time emergency backup and surplus power distribution to remote areas. Through cost optimization using evolutionary algorithms, the project aims to reduce dependence on fossil fuels, contribute to a green circular economy, and pave the way towards a sustainable future.

In summary, the adoption of electric vehicles powered by batteries represents a crucial step towards mitigating environmental impact and reducing reliance on fossil fuels. By integrating renewable and conventional energy sources, implementing smart charging systems, and leveraging innovative technologies, the transition to electric mobility holds immense potential for addressing pressing global challenges such as climate change and energy security.

1.2 Motivation

The motivation behind this project lies in the urgent need for efficient and convenient charging solutions for electric vehicles (EVs). By designing an automatic charging station that eliminates the need for manual intervention, we aim to streamline the charging process, making it faster and more convenient for EV users. Additionally, by integrating renewable energy sources such as solar and wind power, we seek to reduce energy losses and minimize environmental impact. The utilization of sensors and advanced data processing techniques further enhances the efficiency and reliability of the charging system, ensuring optimal performance and safety standards. Ultimately, our project seeks to contribute to the widespread adoption of EVs by providing a seamless and sustainable charging infrastructure.

1.3 Problem Definition and Objectives

The problem at hand is the need for efficient and convenient charging solutions for electric vehicles (EVs). Current charging methods often require manual intervention, leading to inefficiencies, slower charging times, and inconvenience for EV users. Additionally, traditional charging stations may rely solely on grid power, contributing to energy losses and environmental impact. There is a pressing need for an automated charging system that optimizes energy usage, reduces human intervention, and integrates renewable energy sources for sustainability.

- To study the hybrid charging station for authentic electric vehicle.
- To design and implement the electric stations using PIC16F886 controller.
- To provide the equivalent power range, cost and safety of an electric vehicle.
- To make use of wireless module using IOT.

1.4 Project Scope and Limitations

This project aims to investigate the feasibility and functionality of a hybrid charging station tailored for authentic electric vehicles. The scope encompasses the design and implementation of electric stations utilizing the PIC16F886 microcontroller, which will serve as the central control unit for managing charging operations. The project endeavors to deliver charging solutions that offer equivalent power range, cost-effectiveness, and safety standards comparable to traditional electric vehicle charging methods. Additionally, the integration of wireless modules using Internet of Things (IoT) technology will be explored to enable remote monitoring and control of the charging process.

1.5 Limitations As follows:

- Hardware constraints: The scope of this project may be limited by the capabilities and resources of the PIC16F886 controller, which could impose constraints on the complexity and scalability of the charging station design.
- Connectivity issues: The implementation of wireless modules using IoT technology may encounter challenges related to connectivity reliability and network infrastructure, which could affect the real-time monitoring and control functionalities.
- Compatibility concerns: The hybrid charging station may face limitations in terms of compatibility with various electric vehicle models, charging protocols, and communication standards, which could impact its interoperability and adoption across different vehicle platforms.

IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.53

Volume 4, Issue 2, March 2024

II. LITERATURE REVIEW

1. Introduction to Electric Vehicle Charging Infrastructure:

- *Author: Kadlag Sunildatta Somnatha, Mukesh Kumar Gupata*
- This paper provides an overview of various types of chargers and charging methods for electric vehicles. It discusses different topologies and their advantages and disadvantages, along with insights into the construction of battery charging systems and the efficiency of EVs. The role of battery management systems (BMS) is highlighted, emphasizing functions such as data acquisition, state estimation, and safety protection.

2. On-board Unidirectional Single-Phase Electric Vehicle Charger:

- *Author: Xu Xiao, He Molin, Paraskevi Kourtza, Adam Collin, Gareth Harrison, Sasa Djokic, Jan Meyer, Sascha Muller, Friedemann Moller*
- This paper presents typical circuit topologies and control algorithms for an on-board unidirectional single-phase electric vehicle charger. It offers a detailed component-based model, explaining the functionality of each block and its characteristics. The paper also discusses the importance of active Power Factor Control (PFC) and provides comprehensive circuit diagrams and equations.

3. Overview of Electric Vehicle Battery Chargers:

- *Authors: Morris Brenna, Federica Foiadelli, Carola Leone, Michela Longo*
- This paper provides an overview of different EV battery chargers based on power levels, power flow direction, and charging control strategies. It covers inductive and conductive charging methods, along with characteristics of level 1, level 2, and level 3 chargers. The need for vehicle-to-grid power flow is explained, along with a discussion on two-stage on-board charging systems and charging methods for Li-ion batteries.

4. Estimation Techniques for Electric Vehicle Battery State of Charge:

- *Authors: Mingyue Zhang, Xiaobin Fan*
- This review paper examines various methods for estimating the state of charge of electric vehicle batteries. It categorizes estimation techniques into conventional methods based on battery tests, current methods based on control theory, and alternative approaches based on novel concepts. The paper emphasizes the importance of battery management systems (BMS) for vehicle safety, battery life, and cost optimization.

5. Battery Management Systems for Electric Vehicles:

- This paper discusses the basic structure and functionalities of battery management systems (BMS) for electric vehicles. It covers the analysis of charge condition, health, longevity, and maximum capacity of batteries, along with monitoring techniques using voltage, current, and ambient temperature sensors. The critical role of BMS in ensuring battery safety, reliability, and efficiency is underscored, highlighting its significance in extending the vehicle's range and preserving battery life.

III. REQUIREMENT AND ANALYSIS

PIC16F886 Microcontroller:

- The PIC16F886 microcontroller serves as the brain of the system, controlling various functions and interfaces.
- It requires a stable power supply within the voltage range specified in its datasheet (typically 2.0V to 5.5V).
- Proper decoupling capacitors should be connected across the VDD and VSS pins to filter out noise and ensure stable operation.
- Pins dedicated to specific functions such as I/O, ADC, and communication interfaces (SPI, I^2C) need to be configured as per the system requirements.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 2, March 2024

16x2 LCD Display:

- The 16x2 LCD display provides visual feedback and information output to the user.
- It requires a compatible interface with the microcontroller, typically using parallel or serial communication protocols.
- Proper contrast and backlight adjustments should be made for optimal visibility.
- The display module should be securely mounted within the system enclosure for easy viewing.

12V 2Ah Rechargeable Lead Acid Battery:

- The 12V lead acid battery serves as the primary power source for the system.
- It should be connected to the system via appropriate wiring and connectors, ensuring polarity correctness.
- The battery requires a dedicated charging circuit to maintain its charge and prolong its lifespan.
- Safety precautions should be observed during battery handling to prevent short circuits or electrical hazards.

Relay:

- The relay is used for electrically switching high-power loads such as motors or appliances.
- It requires proper interfacing with the microcontroller through suitable driver circuitry.
- The relay coil should be connected to the microcontroller's output pin via a transistor driver to handle the required current.
- Proper isolation and protection circuitry should be implemented to prevent back EMF and ensure safe operation.

Voltage Regulator IC (e.g., 7805):

- The voltage regulator IC regulates the input voltage to a stable output voltage suitable for powering the system.
- It requires input voltage within its specified range (e.g., 7V to 25V for 7805).
- Proper heat sinking and thermal management should be provided to dissipate excess heat generated during voltage regulation.
- Output voltage should be within the tolerance specified by the IC datasheet to ensure reliable operation of connected components.

Transformer:

- The transformer converts AC mains voltage to a lower AC voltage suitable for rectification and regulation.
- It should have the appropriate primary and secondary windings to match the input and output voltage requirements of the system.
- Proper insulation and safety measures should be implemented to comply with electrical safety standards.

Voltage Sensor:

- The voltage sensor is used to monitor and measure the input and output voltages of the system.
- It requires proper calibration and interfacing with the microcontroller to provide accurate voltage readings.
- The sensor should be connected to the appropriate analog input pins of the microcontroller for voltage measurement.
- Adequate filtering and signal conditioning may be required to minimize noise and ensure reliable voltage measurement.

Proteus (Simulation Software):

- Proteus software is used for system simulation and testing before actual hardware implementation.
- It requires a compatible computer system with sufficient processing power and memory to run the simulation smoothly.

- Proper setup and configuration of simulation parameters are necessary to accurately model the hardware components and system behavior.

IV. SYSTEM DESIGN

4.1 System Architecture

The below figure specified the system architecture of our project.

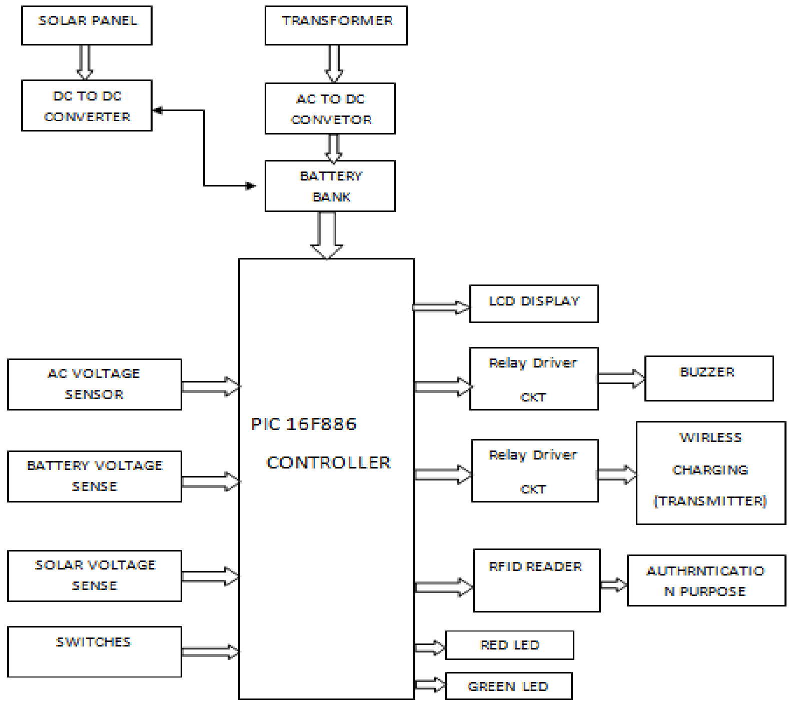

Figure 4.1: Station Unit

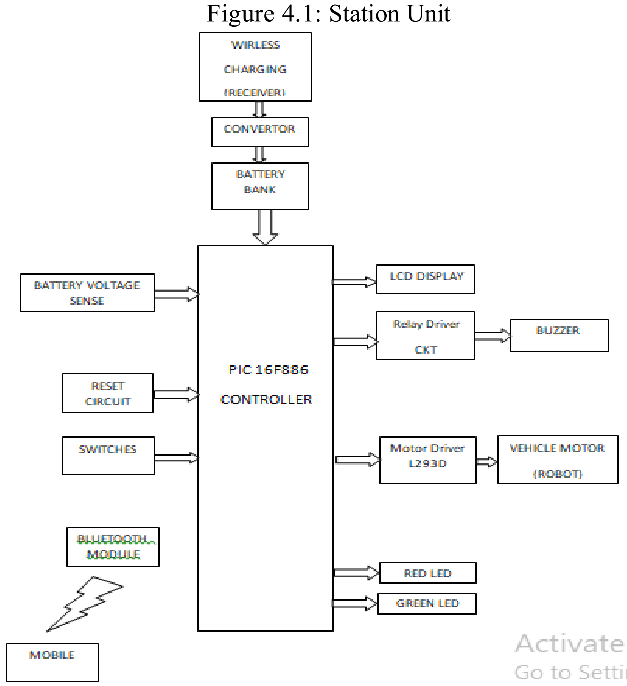

Figure 4.2: Electric Vehicle Unit

4.2 Working of the Proposed System

To design a Hybrid Charging Station for Authentic Electric Vehicles, a comprehensive approach blending convenience, efficiency, and safety is essential. The proposed methodology integrates both wired and wireless charging capabilities to cater to a wide range of electric vehicles.

Firstly, the wired charging system employs a robust infrastructure featuring a high-power charging unit equipped with advanced safety protocols. This unit comprises a PIC16F886 Microcontroller to oversee charging operations, ensuring compatibility with various vehicle models and optimal power delivery. A 16x2 LCD Display interface provides real-time feedback to users, displaying charging status and relevant information. The system utilizes a 12V 2Ah Rechargeable Lead Acid Battery as a backup power source, ensuring uninterrupted operation during power fluctuations.

Secondly, the wireless charging component utilizes electromagnetic induction technology for efficient and hassle-free charging. A relay-based switching mechanism enables seamless transition between wired and wireless charging modes. The voltage regulator IC ensures stable power delivery to the charging coils, optimizing charging efficiency while protecting the vehicle's battery from overvoltage or fluctuations.

Furthermore, the inclusion of a transformer in the charging station enables compatibility with various power grid specifications worldwide, ensuring global applicability. A voltage sensor monitors input and output voltages, providing real-time data to the microcontroller for accurate charging control and safety monitoring.

Simulation and testing of the proposed Hybrid Charging Station are conducted using Proteus software, allowing for thorough validation of the system's functionality and performance under different scenarios. This ensures reliability and safety before the deployment of the charging station in real-world applications.

Overall, the proposed methodology for the Hybrid Charging Station for Authentic Electric Vehicles integrates advanced hardware components with robust control and monitoring systems, ensuring efficient and safe charging experiences for electric vehicle owners while catering to diverse charging requirements.

4.3 Circuit Diagram

The below figure specified the circuit diagram of our project.

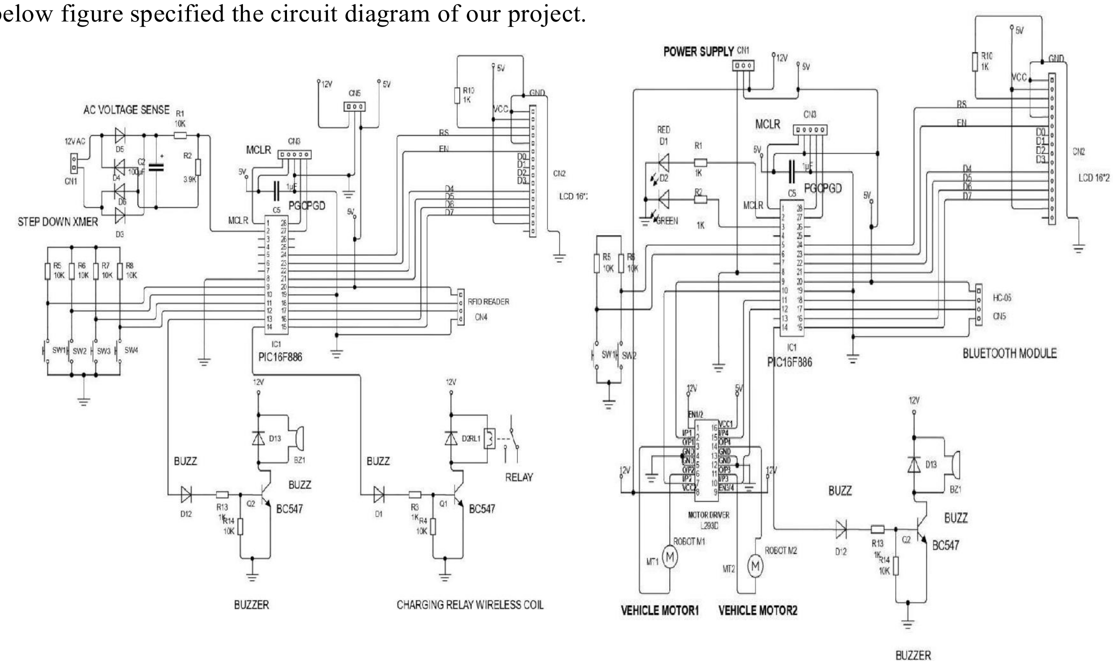

Figure 4.3: Circuit Diagram

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 2, March 2024

4.4 Flowchart

The below figure specified the flowchart of our project.

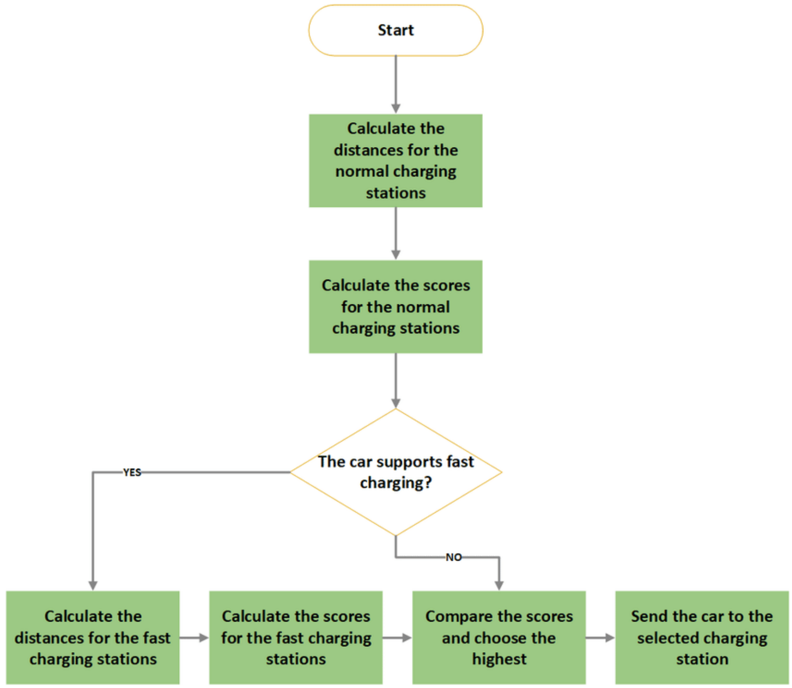

Figure 4.4: Flowchart

4.5 Result

Analyzing the results of a hybrid charging station for authentic electric vehicles involves assessing various factors and their impact on the overall performance and user experience. Here are some key aspects to consider in the result analysis: Charging speed and efficiency: Evaluate the charging speed and efficiency of the hybrid charging station. Measure the average charging time for different charging rates and access the station's ability to deliver the expected power output consistently. Efficient charging ensures that EV owners can quickly recharge their vehicles, enhancing convenience and user satisfaction. Charging infrastructure utilization: Analyze the utilization of the charging infrastructure at different times of the day and days of the week. Determine peak usage periods and identify any bottle necks or under utilized charging points. This information can help optimize the station's layout and capacity planning for future expansion. User feedback and satisfaction: Gather feedback from EV owners who have used the hybrid charging station. Conduct surveys or interviews to gauge their satisfaction levels, overall experience, and any pain points encountered. Addressing user concerns and incorporating their feedback can improve the station's usability and attractiveness to potential EV owners.

Reliability and Maintenance: Assess the reliability of the charging station by monitoring uptime and identifying any maintenance or technical issues encountered during the analysis period. Evaluate the responsiveness and effectiveness of the maintenance and support services provided. High reliability and prompt maintenance support are crucial for ensuring a seamless charging experience. integration with Renewable Energy: Determine the extent to which the charging station utilizes renewable energy sources. Measure the contribution of solar panels, wind turbines, or other renewable energy systems installed at the station. This analysis will highlight the station's sustainability and environmental impact, reinforcing its value proposition.

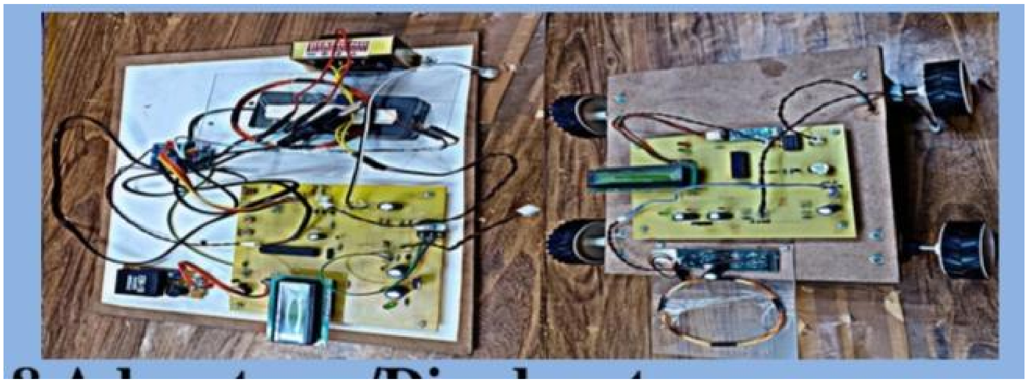

Figure 4.5: Output of Project

V. CONCLUSION

5.1 Conclusion

With some great features and functionalities, we expect to get many electric vehicles on the market in the future. The rising demand for EVs increases the need for charging stations and station locator apps also. So, if you are planning to create such an app to meet users expectations and win the competition, hire an experienced app development company in no time.

5.2 Future Work

The future scope of a project focused on hybrid charging stations for authentic electric vehicles (EVs) holds several promising opportunities. As the EV market continues to grow and technology advances, here are some potential areas for future development and expansion: Enhanced charging infrastructure:

Future projects can focus on expanding the charging infrastructure by adding more charging stations in key locations, such as urban centers, highways, and popular destinations. This would ensure convenient access to charging for EV owners and support the increasing demand for charging services.

BIBLIOGRAPHY

[1]. "Solar and Wind Energy Based Charging Station for Electric Vehicles" by C. Chellaswamy, V. Nagaraju, R. Muthammal. International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering Vol. 7, Issue 1, January 2018.

[2]. "Methodology for the Optimal Design of a Hybrid Charging Station of Electric and FuelCell Vehicles Supplied by Renewable Energies and an Energy Storage System" by Higinio Sánchez-Sáinz, Carlos-Andrés García-Vázquez, Francisco L lorensIborra and Luis M. Fernández-Ramírez. Published: 17 October 2019 DOI:10.3390/su11205743.

[3]. "Renewable energy powered DC charging system for electric vehicle" byPJyothi, P Saketh, ChVignesh and V S Kirthika Devi. Department of Electrical and Electronics Engineering, Amrita School of Engineering, Bengaluru, Amrita VishwaVidyapeetham, India. Doi:10.1088/1742-6596/1706/1/012085.

[4]. "A Review on Hybrid Solar PV and Wind Energy System" by NemaParveen, Varsha Sharma. International Research Journal of Engineering and Technology(IRJET), Volume: 05 Issue: 12 | Dec 2018.

[5]. "A Dynamic Charging Strategy with Hybrid Fast Charging Station for Electric Vehicles" by Onur Elma. DOI: https://doi.org/10.1016/j.energy.2020.117680.

[6]. "EV Charging Station Using Renewable Energy" by HayatoTahara, Naomitsu Urasaki&Toshihisa Funabashi. 2016 IEEE First International Conference on Control, Measurement and Instrumentation (CMI).

[7]. "A Hybrid Wind-Solar-Storage Energy Generation System Configuration and Control" by Dan Shen, AfshinIzadian& Ping Liao. 2014 IEEE Energy Conversion Congress and Exposition (ECCE). DOI: 10.1109/ECCE.2014.6953426.

[8]. "Design of a hybrid solar-wind powered charging station for electric vehicles" by Haiying Li, Hao Liu, AiminJi, Feng Li &YongliJia. 2013 International Conference on Materials for Renewable Energy and Environment. DOI: 10.1109/ICMREE.2013.689383

[9]. Riteshsingh, abhishekgupta, deveshsingh,&akshoyranjanpaul. "Design and assessment of an electric vehicle charging station using hybrid renewable energy" 2022.

[10]. Zheng et al, Wang et al. "An in-depth analysis of electric vehicle charging station infrastructure, policy implications, and future trends" 2013.

[11]. Gadh, Rajit. "Demonstrating Plug-in Electric Vehicles Smart Charging and Storage" 2018.

[12]. Peng Zhang et al."Design of an electric vehicle fast-charging station with integration of renewable energy and storage systems." 2018.

[13]. Wang, S., Tang, Y.J., Shi, J., et al. "Design and advanced control strategies of a hybrid energy storage system for the grid integration of wind power generations" 2015.

[14]. Barone, G., et al. An in-depth analysis of electric vehicle charging station infrastructure, policy implications, and future trends.2019.

[15]. Muhammad ShahidMastoi."An in-depth analysis of electric vehicle charging station infrastructure, policy implications, and future trends".2022. [8]https://embetronicx.com/tutorials/tech_devices/l293d-motor-driverworking/14.08.2023