E-VAHAN CHARGING STATION

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Abstract: In a technological world where both pollution and population increase every day, electric vehicles play a key role in saving energy and reducing carbon dioxide emissions and harmful greenhouse gasses in transportation. Rapid changes are occurring in the electrical industry. Rising energy prices, mass electrification of everyday life, and global warming are the main factors determining the speed with which such changes occur. In response to the growing demand for sustainable transportation solutions and the urgent need to reduce carbon dioxide emissions, the concept of the E-Vahan Charging Station emerged as a pioneering initiative. This innovative project seeks to harness the abundant renewable energy resources of solar and wind power to revolutionize the way electric vehicles (EVs) are charged. As the world transitions towards a greener future, this charging station represents a crucial step in promoting clean and Eco-conscious mobility.

Index Terms: Electrification, Harness, Pioneering, Initiative, Crucial, Eco-conscious, E-Vahan Charging Station, etc.

I. INTRODUCTION

The construction of the E-Vahan Charging Station is a key step toward environmentally friendly development of transportation infrastructure development. These charging infrastructures use the power of renewable energy resources to provide clean and efficient charging solutions for electric vehicles (EVs).

The innovation of this project named "E-VAHAN CHARGING STATION" has been inspired by the **Fame II Scheme,** a scheme launched by the Government of India to accelerate the development of Electric Vehicles. The first phase of Faster Adoption and Manufacturing of Electric Vehicles (FAME) was launched in April 2015, and Phase II was launched in April 2019. It aimed to increase the purchase of electric vehicles by making them more affordable through financial support being offered under this subsidy scheme by the government. The E-Vahan Charging Station with solar and wind power sources envisions a future where electric vehicle charging is synonymous with sustainability, affordability, and innovation.

We can integrate solar panels and wind turbines into the charging infrastructure design, these charging stations switch to operating on renewable energy resources, reducing their dependence on traditional grid electricity and minimizing environmental impacts. Solar panels convert solar energy into electricity and wind turbines convert wind energy into kinetic energy which generates electricity to charge the EVs. This method reduces carbon dioxide emissions and pollution produced through fossil fuel-powered vehicles and boosts the adoption of electric vehicles. Furthermore, solar and wind-empowered E-Vahan Charging Stations are adaptable as they can be installed in various locations, including urban centers, highways, and remote areas. Today due to climate change and daily rising oil prices, energy efficiency is the first priority in countries where transportation is highly dependent on fossil fuels, leading to the demand for an E-Vahan Charging Station in the country.

Overall, these charging stations are a sustainable and forward-looking solution to meet the growing demand for electrical vehicle charging infrastructure while promoting the transition to a cleaner and greener transportation system using renewable energy.

II. EXISTING HARDWARE

Existing hardware on the E-Vahan Charging Station typically includes different components designed to facilitate the charging process for electric vehicles. Here are some common hardware elements found in E-Vahan Charging Stations:

1. **Charging Units -** The component that delivers electrical power to the battery of an electric vehicle during recharging. The grid point produces AC but the battery of the electric car needs DC. So, in E Vahan both AC and DC Charging units are used. AC Charger for slow and DC Charger for fast charging.
2. **Connectors and Cables -** Connectors and cables are utilized to establish a physical connection between the electric vehicle and the charging station.

3. **User-friendly interface -** The display and user interface are essential for EV drivers, providing them with information such as the status of charging, on/off option, payment option, and launch and start of the charger.
4. **Communication and Network -** The charging station's communication and networking enable monitoring, automation, payment, on/off and software updates to be performed by an external system.
5. **Safety -** Security measures are present in E-Vahan Charging Stations to ensure the safety of both passengers and wiring.

These methods have several limitations. For safety measures, outdated electrical wiring and power supplies can cause failure in connectivity or short circuits. The problem of failure or short circuits can be solved by introducing a main switch on the IoT cloud interface to cut off the power connection during any failure. By utilizing hardware components that are both reliable and efficient, electric vehicle charging infrastructure can be built, which contributes to the development of green transportation systems.

III. WORKING METHODOLOGY

The project is divided into two sub-parts-

- The proposed E-Vahan Charging Station consists of an ESP8266, Arduino UNO, RFID reader, RFID Card, Relay modules, Solar panel, Battery, Voltage Regulator, Temperature sensor, LCD Screen, and Keypad. The system is designed to monitor all stations in real time and can control the battery charging by using a relay module. Those who want to charge their E-Vehicle, have been provided an RFID Card which can be recharged and can be used for charging as per requirement. ESP8266 acts as a controller to control the overcharging system and can monitor any disturbance occurs in the station.

The Station operates as follows:

1. **Scanning RFID card:** The RFID reader is used to read the RFID card for charging the vehicle and charges a particular amount of money which will be less than as usual Electricity amount charged by the Government.
2. **Card Recharging Unit:** The recharging unit is controlled by Arduino UNO, which helps in recharging the RFID card by using a KEY pad and displays it on an LCD screen.
3. **Battery Charging system:** Solar panels are used for charging the station's battery (Energy storage element) for further charging the vehicle and overall voltage is regulated by a voltage regulator (LM2596).

- The second part is the controlling and monitoring system of the station through various components and sensors. These are different components and the sensor is used as a temperature sensor and relay module which gives the overall temperature near the main battery for getting information about short circuits or any other hindrance. The proposed station has several advantages over normal charging units which cost money as per the Government Units system, but this station uses Renewable Energy Resources [Solar energy] for Energy production which costs a minimal amount for vehicle charging. It is highly efficient and has an IoT-based system that helps control the station through the Internet.

IV. BLOCK DIAGRAM

[Part-1] Controlling and Monitoring of Station (Figure-1)

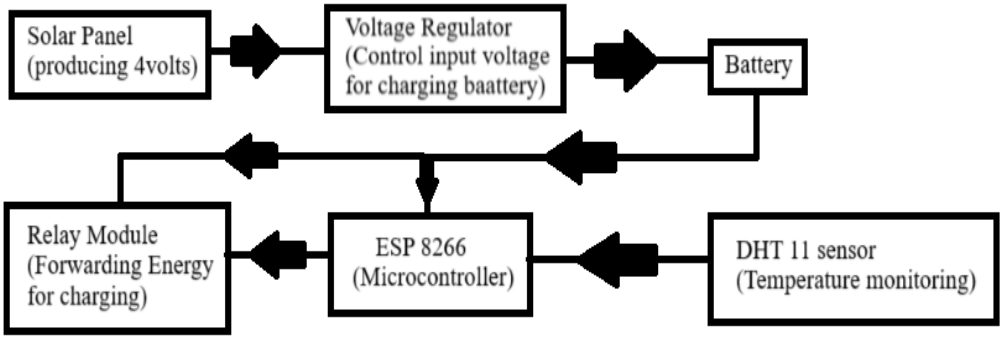


Figure 1. Controlling and Monitoring of Station

[Part-2] Charging Vehicles and Recharging RFID cards (Figure-2)

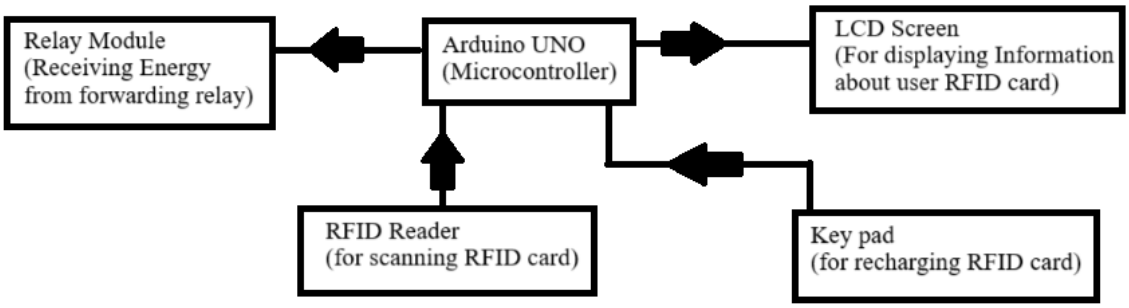


Figure 2. Charging Vehicles and Recharging RFID cards

V. HARDWARE DETAILS

1. ESP-8266

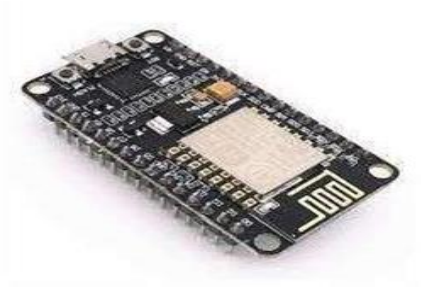


Figure 3. ESP 8266

ESP8266 is a Wi-Fi microchip, low cost, small in size, and adaptable with Embedded devices. It is a widely used IOT-based application. The Wi-Fi module allows the ESP8266 to connect to a wireless and communicate with other devices, making it an ideal platform for IOT-based systems that require internet connectivity. E-Vahan charging station in ESP8266 communicates with the IOT cloud and stations around any type of problem created like a short circuit we easily solve this problem with the help of the IOT cloud in our laptops or smartphones. Its ability to connect to Wi-Fi networks and communicate with other devices also makes it an ideal platform for developing IOT-based systems that require internet connectivity.

2. Solar Panel

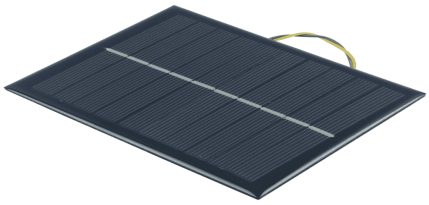


Figure 4. Solar Panel

Solar Panel is a group of Photovoltaic cells placed in a framework for the installation. Solar Panel renewable energy in the form of sunlight converts it into electricity and then stores the electricity in a specified battery, which can then be used to provide electrical loads. These panels are typically made of silicon cells that convert sunlight into usable energy. The solar panels are installed on the roof or nearby to absorb sunlight. Then the electricity produced is used to charge electric vehicles, reducing reliance on the grid and lowering carbon emissions. It is pollution-free, cost-effective, and renewable energy that generates and cuts down on pollution.

3.Arduino UNO ATmega328P

Figure 5. Arduino UNO

It is a microcontroller and E Vahan charging station using Arduino Uno is like a small brain controlling all the important stuff. Arduino Uno was used in our project to monitor some other components like the Relay module, RFID Reader, Servo motor, LCD, and Keypad. The Arduino Uno manages the power to make sure everything is safe while your Electric vehicle charges. It is an E-Vahan charging station that manages charging, monitors safety, communicates with users, and regulates the charging process.

4. RFID Reader and Card

Figure 5. RFID Reader and Card

It is a plastic card that stands for Radio Frequency identification. RFID card used in E Vahan charging station for payment system and security purposes. Does not need to swipe or insert them like traditional cards, it works through radio waves. RFID card is only provided to the Authenticate users if he is registered in E Vahan station then use the RFID card and scan the card the E-Vahan Station main gate is open through the servo motor. The user easily goes to the station and when the user scans the RFID card, at the same time the payment is also deducted according to the Electric vehicle charging.

5. Relay Module

Figure 6. Relay Module

It is an Electrical switch that is operated by an electromagnet and activated by a separate low-power signal from a microcontroller. We use a relay module in our E Vahan charging station for two main reasons. Firstly, when the electric vehicle finishes charging the station automatically turns off and secondly, if there's a short circuit near the E Vahan charging station, we can manually turn off the E Vahan charging station. Relay can also be controlled with its very low voltages of 5v connected to a battery provided by Arduino Uno and ESP8266 pins.

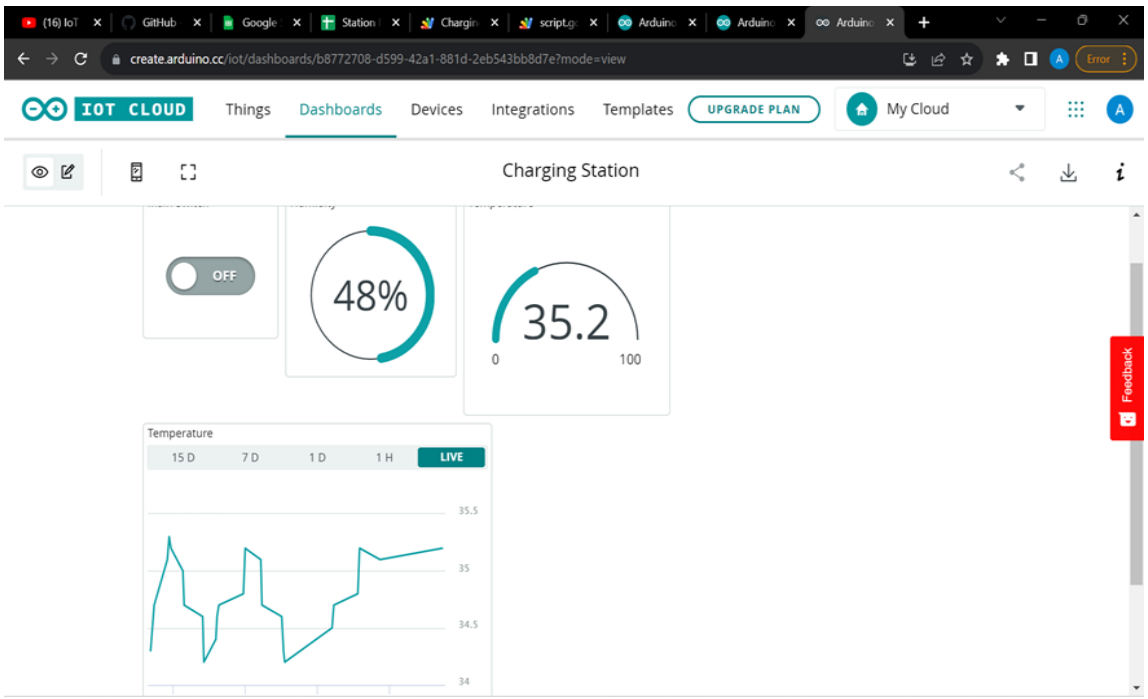
6. LCD Screen

Figure 7. LCD Screen

It is a flat-panel display that uses the light-modulating properties of Liquid crystal combined with polarizers. In E Vahan charging stations, we have incorporated an LCD for several reasons. Firstly, it allows you to easily see the payment made via RFID cards. If the balance on an RFID card runs out users can also see this displayed on the LCD screen. This features transparency and convenience for users, allowing them to monitor their transactions and remaining balance effortlessly.

VI. HARDWARE RESULT

1. The charging station energy conversion efficiency of this system is 95% which surpasses the industry standards.
2. Researchers might conduct experiments to assess the charging speed of E-Vahan charging stations using charging technologies, such as Level 1, Level 2, etc.
3. Researchers might conduct experiments to evaluate user experience and satisfaction with E Vahan charging stations.



IoT Cloud Interface

VII. ADVANTAGES

E Vahan charging stations are critical components of the infrastructure needed for the widespread deployment of electric vehicles (EVs). This section explores the numerous benefits of E Vahan charging stations, emphasizing their importance in accelerating the transition to sustainable mobility.

Facilitating EV Adoption

E Vahan charging stations address one of the most common impediments to EV ownership: range anxiety. These stations provide simple and accessible charging choices, allowing EV owners to charge their vehicles in a variety of locations, including at home, work, and on the road. This accessibility increases the viability and desirability of EV ownership, promoting the uptake of electric vehicles.

Fostering Technological Innovation

E Vahan charging stations are at the forefront of technological advancement in the transportation industry. With the growing demand for electric vehicles and charging infrastructure, there is a concerted drive to develop better charging solutions. These include fast chargers, wireless charging, and vehicle-to-grid (V2G) technologies, which improve the efficiency of charging infrastructure while paving the way for new business models and services in the electric mobility ecosystem.

VIII. CONCLUSION

Despite the obvious benefits of E VAHAN charging stations, several difficulties and potential for improvement exist. These include addressing issues about charging infrastructure accessibility, compatibility, and dependability, as well as developing technology breakthroughs to improve charging speed and efficiency. Furthermore, regulatory assistance and incentives are required to speed up the implementation of E VAHAN charging stations and encourage wider adoption of electric cars.
E VAHAN charging stations are a vital component of the transition to a sustainable and ecologically friendly transportation system. These charging stations have a significant impact on the future of mobility since they address range anxiety, promote sustainability, and stimulate economic growth. Continuous investment, innovation, and collaboration are required to overcome hurdles and exploit the promise of E VAHAN charging.

The E VAHAN charging station infrastructure is a critical component in the global shift to sustainable mobility. Throughout this study, we investigated the several benefits and implications of these charging stations. One of the biggest barriers to the broad adoption of electric vehicles is range anxiety. By strategically putting charging stations in strategic locations, E VAHAN ensures that electric vehicle users have access to dependable and convenient charging facilities, eliminating concerns about running out of power on their trips.

Furthermore, the expansion of E VAHAN charging stations contributes significantly to sustainability and climate change mitigation. Electric vehicles driven by sustainable energy sources greatly reduce greenhouse gas emissions and air pollutants, minimizing the environmental effect associated with typical fossil fuel-powered automobiles.

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