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SMART INTEGRATED WIRE/WIRELESS CHARGING SYSTEM FOR ELECTRIC VEHICLES WITH SOLAR AND GRID ENERGY USING IOT

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ABSTRACT

The mission to make majority of the vehicle's electric has been launched by the government. With this the majority of the automobile manufacturers have started launching electric vehicles in the market. Automobile retail outlets have setup the charging stations which will be used to charge the electric vehicles. However, the energy provided for the electric charging stations is through grid. This project deals with the innovative concept of integrated EV Wireless charging system. The proposed system has the capability to switch automatically over solar or grid depending on the energy source available and chose a viable source for the charging of the EVs. To demonstrate the concept the model is developed which can be used to show the process of wireless charging. The SMS Notification is also implemented which will send the SMS with the amount of the charge once the charging is complete. The system also implemented development of IOT based application hosted on cloud which can be used to track the charging status as well as locate and track the charging stations across the city for charging electric vehicles.

Keywords— *Electric vehicle, SMS notification, wireless charging, solar energy and grid energy.*

INTRODUCTION

The government of India has launched "MISSION EV" to make all the vehicles electric as soon as possible. However, the major drawback faced by the Automobile manufacturers and government is the hurdle of battery life and setting up of charging stations. The battery range and the inability to setup charging stations at all the places is a major challenge faced by electric vehicles. Increasing in the number of travelling vehicles has increasing the problems such as air pollution and to the use of petroleum. The human sensibility for the energetic and environmental problem is encouraging the research in alternative solutions for the automotive field, as multiple-fueling, hybridization and electrification. At the same time the systems are modified considering the current problems. For this the solution is the electrically assisted bikes. The electrically assisted bikes are normally powered by rechargeable battery, and their driving performance is influenced by battery capacity, motor power, road types, operation weight, control, and, particularly, by the management of the assisted power.

Improved quality of life and increased mobility lead to greater consumption of energy resources and implied greenhouse gas emissions. This increased power consumption involves more quality and reliability to regulate electricity flows, less mismatching between electricity generation and demand, and more integrated renewable energies. Thus, the concept of smart grid is born in recent years. A smart grid could be easily defined as the electricity delivery system, which transports, converts and distributes the power efficiently (from producers to consumers), integrated with communications and information technology. The main goal of smart grid is to assist in balancing the power generation and the power consumption using sensors, communications and monitoring technologies. Then, the smart grid is seen as a set formed by the interaction of three layers: power transportation and distribution layer, communication and sensors layer and software applications and services layer. Considering tomorrow's electric needs like electric cars, balancing the electricity demand and electricity production in order to increase the grid efficiency while decreasing the number of power outages, is a real huge challenge. In fact, plug-in hybrid electric vehicles (PHEVs) and electric vehicles (EVs) represent an important step in solving environmental problems and are being developed around the world. Many studies are going on to optimize engine and battery efficiency for both operations discharge and recharge. However, it is important to understand the further impact of PHEVs and mostly EVs recharging operation on the electric grid. Depending on when and where the vehicles are plugged in, they could cause strongly constraints on the grid.

LITERATURE SURVEY

1. C. Duan et al. (2018) proposed a solar-powered battery balancing system for EVs, ensuring optimized energy usage and extended battery life.

2. D. Ji et al. (2020) investigated the optimization of solar-assisted EV charging stations in urban areas, proposing solutions to improve location planning and energy utilization.

3. Recent advancements in **IoT-based smart charging systems** have also been studied extensively. **G. Alkawsi et al. (2021)** reviewed the role of renewable energy in EV charging, concluding that integrating solar power with IoT-enabled monitoring significantly improves efficiency and accessibility.

4. Further research by **J. Ebrahimi et al. (2022)** explored multi-source inverters for hybrid energy storage systems, enhancing charging efficiency through bidirectional energy flow.

I. PROBLEM DEFINITION

The rapid adoption of electric vehicles (EVs) has led to significant challenges, primarily due to the limited availability of charging infrastructure and the heavy reliance on grid power. This dependency increases the load on the electrical grid, leading to potential power shortages and higher charging costs. Additionally, the lack of efficient energy utilization results in underuse of renewable energy sources, such as solar power, which could otherwise reduce operational costs and environmental impact. Existing charging systems require manual switching between power sources, making them inefficient and inconvenient. Furthermore, EV users face difficulties in tracking charging status, locating nearby charging stations, and monitoring costs in real-time. To address these issues, this project proposes a smart integrated wired/wireless charging system that automatically switches between solar and grid energy based on availability. The system incorporates wireless charging technology, eliminating the need for physical connectors, and integrates IOT-based monitoring for real-time tracking of charging status, cost, and station locations. By optimizing energy usage and automating key processes, this solution enhances the accessibility, efficiency, and sustainability of EV charging infrastructure.

II. HARDWARE DESIGN

The charging station part:

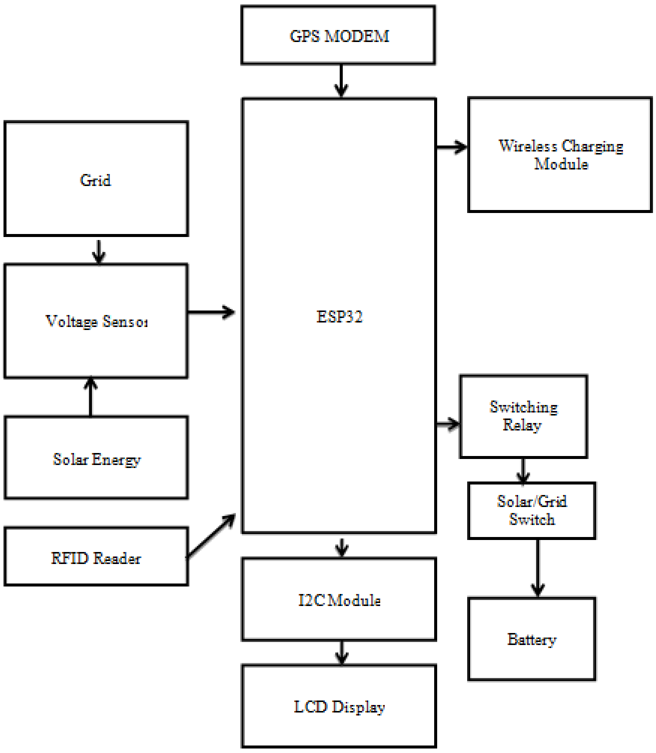


Fig1. Block diagram of charging station

The vehicle part:

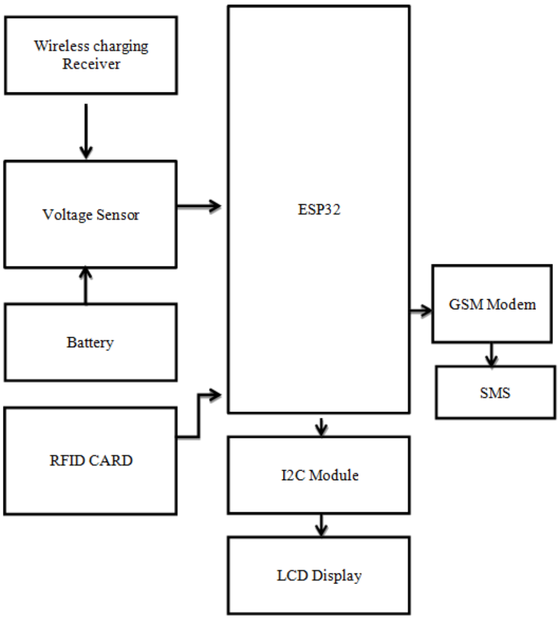


Fig2. Block Diagram of vehicle Part.

The figure below shows the illustrative diagram of the project. As shown in the illustrative diagram the project consists of development Integrated charging system for electricvehicles. The system consists of two charging sources. Solar and grid to boost charging, Ifthe solar energy is available the preference is given to the solar system and if the solar energy or PV energy is not available the charging will be automatically switched to the Grid charging. This was the electricity from the solar can be used for charging of the EVs whenever available. The wireless charging system is implemented which will charge the vehicle wirelessly and send the SMS notification to the user regarding the cost of the chargewhen the charging is complete.

When in operation the controller reads the voltage from the solar panels. If the voltage necessary to charge the battery is available, the EV charging will be switched to the Solarsource using the charging relay. If the requisite power is not available it will be switched to the Grid Charging. The same will be displayed on the LCD display. The output is fed tothe wireless charging system.

The second part is the vehicle. The vehicle consists of an RFID reader and the wireless charge receiver. When the car approaches the charging station the same will be detected using the RFID and then notified to the user using the LCD display present on the vehicle.The wireless charging will start and the voltage will monitor and displayed on the lcd display present in the car. Once the charging is complete the total cost of charging is calculated and the same is sent to the owner using GSM modem. The IOT based application is developed which will be used by the end users to track the charging status, the amount to be paid for charging. The app also helps the users to track different locations of the charging stations available across the city on the map.

1.1. Hardware Material List:

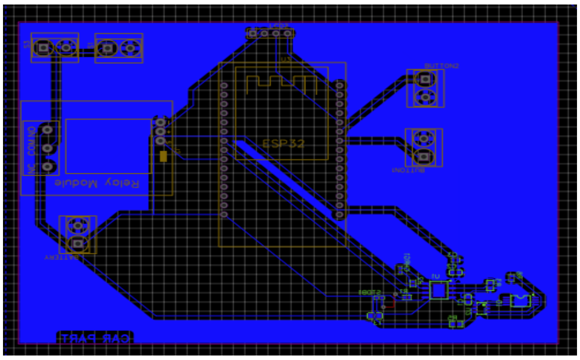
1. Voltage Sensor - Voltage sensor consists of a voltage divider configuration to monitor the battery voltage. We are using two resisters in voltage divider configuration to make a voltage sensor.
2. Battery - We are using piezo buzzer in this project
3. Buzzer- We are using piezo buzzer in this project
4. I2C LCD display
5. Relay Module- Relays are electromechanical switches. They have very high current rating and both AC and DC motors can be controlled through them because motor will be completely isolated from the remaining circuit.
6. RFID module- Radio frequency Identification (RFID) is a wireless identification technology that uses radio waves to identify the presence of RFID tags. RFID based system has two basic elements
   RFID Tag - RFID tag includes microchip with radio antenna mounted on substrate which carries 12Byte unique Identification number.
   RFID Reader - t is used to read unique ID from RFID tags. Whenever RFID tags comes in range, RFID reader reads its unique ID and transmits it serially to the microcontroller or PC.
7. GSM modem - At the heart of the module is a SIM800L GSM cellular chip from Sim Com. The operating voltage of the chip is from 3.4V to 4.4V, which makes it an ideal candidate for direct LiPobattery supply**.**
8. ESP32 Development Board - ESP32 is used for wake word of smart mirror. ESP32 is a series of low-cost, low- power system on a chip microcontrollers with integrated Wi-Fi and dual-mode Bluetooth.
9. GPS Modem - Ublox neo6m GPS modem is used in the project.

1.2. Parts of PCB

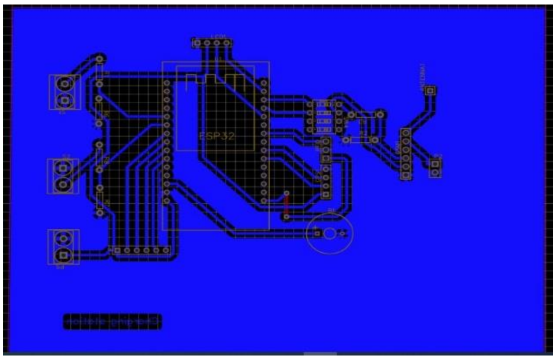
- **Substrate:** The first, and most important, is the substrate, usually made of fiberglass. Fiberglass is used because it provides core strength to the PCB and helps resist breakage. Think of the substrate as the

PCB's "skeleton".

- **Copper Layer:** Depending on the board type, this layer can either be copper foil or a full-on copper coating. Regardless of which approach is used, the point of the copper is still thesame — to carry electrical signals to and from the PCB, much like your nervous system carries signals between your brain and your muscles.
- **Solder Mask:** The third piece of the PCB is the solder mask, which is a layer of polymerthat helps protect the copper so that it doesn't short-circuit from coming into contact withthe environment. In this way, the solder mask acts as the PCB's "skin".



EV Charging Station PCB Layout:



Car part PCB layout:

III. SOFTWARE DESIGN

a. Software used – Arduino IDE - . The software used to program the microcontroller is the Arduino IDE. Arduino is an open-source computer hardware and software company, project and user community that designsand manufactures kits for building digital devices and interactive objects that can sense andcontrol the physical world. The project is based on a family of microcontroller board designs manufactured primarily by Smart Projects in Italy, and also by several other vendors, using various 8-bit Atmel AVR microcontrollers or 32-bit Atmel ARM processors.

b. Easy EDA:

A great web-based EDA (Electronic Design Automation) tool for electronics engineers, educators, students, market and enthusiasts. Easy EDA is free online software for creating circuit schematics, designing PCBs as well as simulating electronics circuits.

c. Algorithms :

Auto Power selection:

Input- Solar and Grid Power
Output- Selection of solar or grid
for chargingStep 1: Read voltage
from solar
Step 2: check threshold voltage
Step3: Compare with the sustainable power
Step4: Select solar if power sufficient to

charge vehicleStep 5: Select grid if solar
power unsufficient
Repeat 1-5

Charging station location finder

Input: GPS signals
Output: Locate charging
station on mapStep 1: Read
GPS
Step 2: Parse NMEA Data
Step 3: Fetch latitude and longitude of
charging stationStep 4: Push data to cloud
Server
Step 5: Update
Location on map
Repeat 1-5

Charging Billing:

Input:
Wired/Wireless
chargingOutput:
Charge amount
Step 1: Read Charge State
Step 2: Read
Battery Percentage
Step 3: Store
current percentage
Step 4: Record
Charging done
Step 5: Calculate
amount
Step 6: Update
amount to APP
using IOT
protocols

IV. Flowchart :

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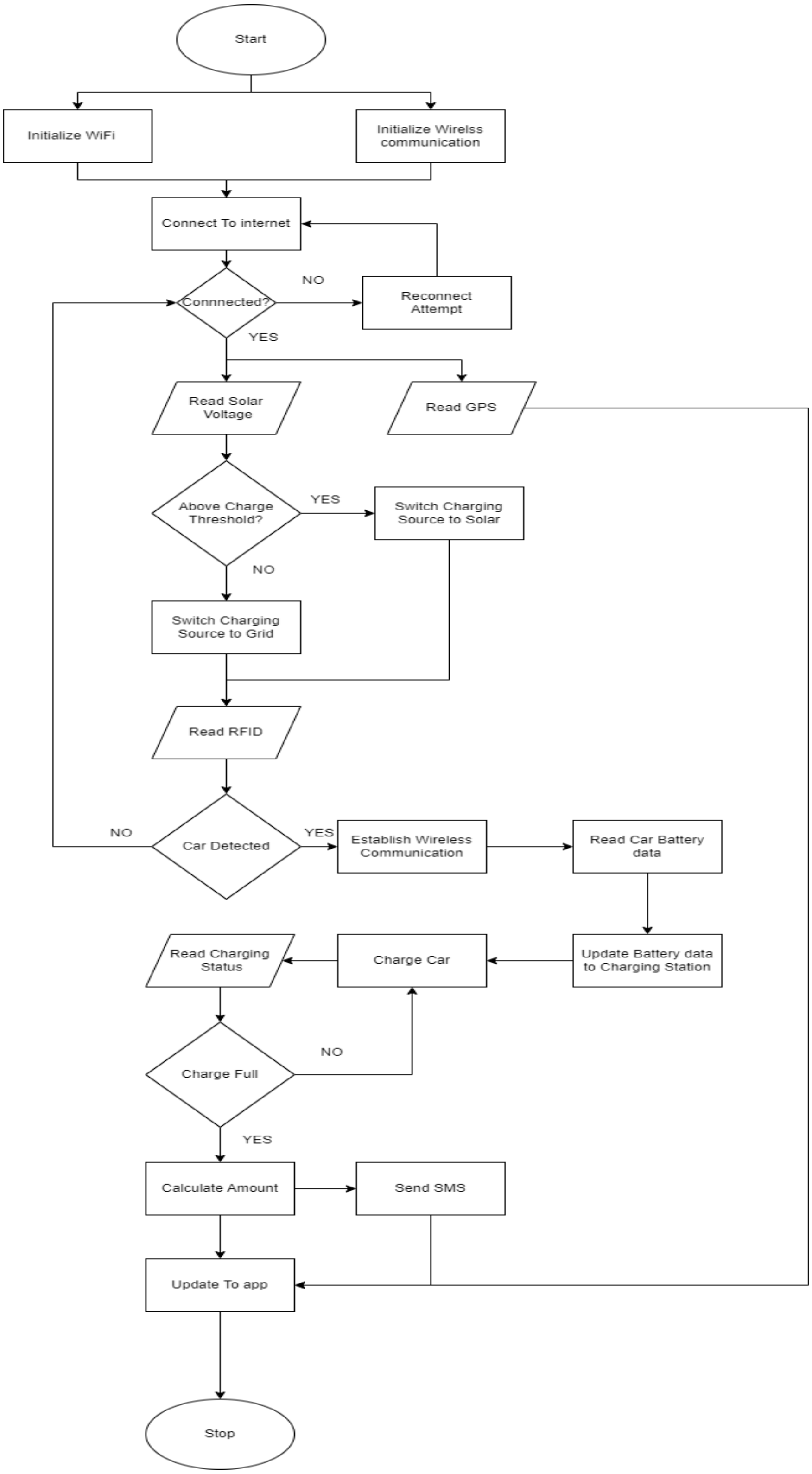

Fig3. Flowchart

V. Implemented Snapshots of the Model:

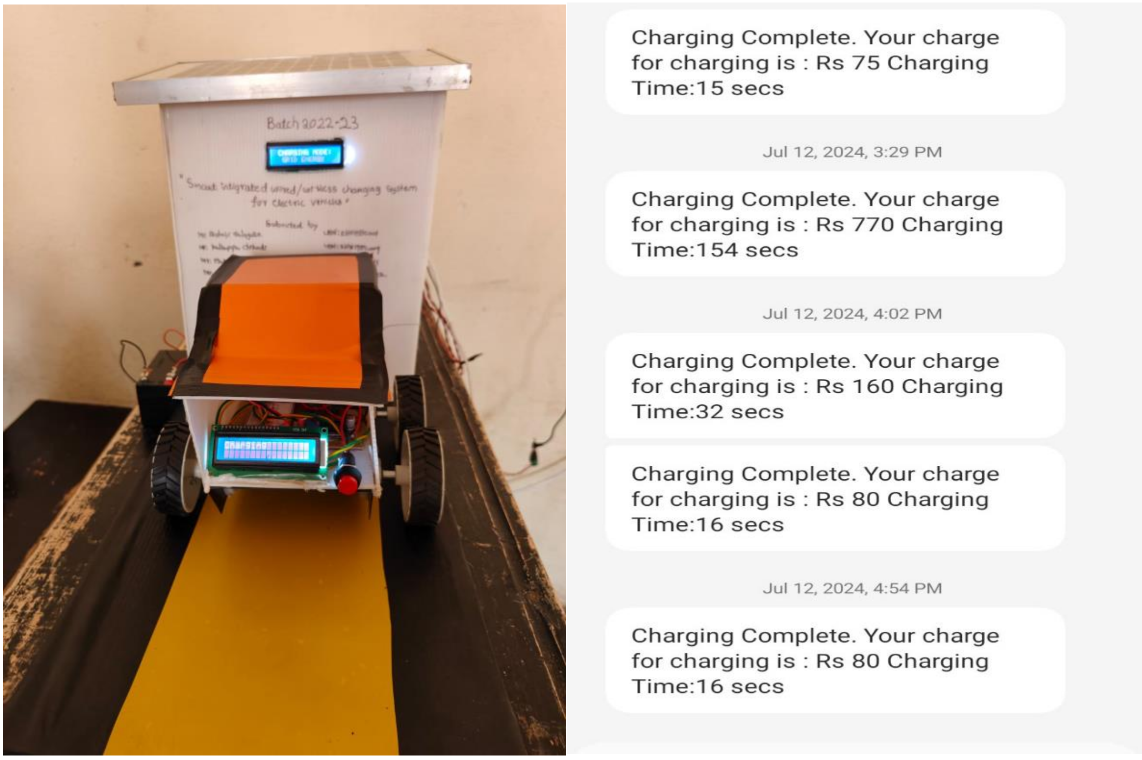

Fig4. Images of Model and Output Obtained.

VI. RESULT

The System was observed for the different Readings and the results were plotted. The tablebelow shows the readings recorded.

Parameter	Dataset	Readings actually Recorded	Efficiency
GPS	50	45	90

From the above table we can conclude that the efficiency of the system to take the readingsis 90 percent. Since the system uses light weight MQTT protocol, the web service hit percentage was almost equal to complete.

The System was monitored for 8 minutes taking 50 sets of readings and the following wasobserved

No of Readings	Time interval	Total time of observation	Readings recorded by server	Readings expected	Efficiency
50	10 seconds	8.3 min	48	50	96%

From the above table we can conclude that the readings are being triggered to server reachat 96 percent. There was loss of 4 readings to 3 readings every 50 readings recorded. However, this loss is due to the network problem. Therefore, the system is expected to work at least 96 percent.

VII. CONCLUSION

The project deals with the concept of smart integrated wireless charging and tracking system for elective vehicles using solar energy and IOT. From the project we can conclude that the proposed project can be useful to automatically switch over to the solar energy for the purpose of the charging. We can further conclude that the developed system can easily be scaled to the actual charging stations. The system will perform wireless charging of the electric vehiclesand notify the owners the charge regarding the same. The proposed project can also help the users of the electric vehicles to track the location of charging stations nearby making it easierto find out the charging stations. The App is developed which will help the users of the electricvehicles to track the status of charging and the charge using IOT.

VIII. ACKNOWLEDGMENT

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