RFID Based Wireless Vehicle Charging Using Arduino

Enhancing Mobility with Smart Energy Transfer

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Abstract - The significant increase of electric vehicles (EVs) requires new ways to address range anxiety and the lack of charging infrastructure. Inductive charging road networks, enabled by wireless power transfer technology, can address these challenges. Wireless charging enables transport that is efficient, flexible and reliable, and the driver can simply park in a wireless charging spot and walk away without having to recall using kludged cables or remembering to plug it in. Electric vehicle charging of battery through charger and wires is inconvenient, dangerous, and costly. The internal combustion engine technology vehicles have already been demonstrated to be the perpetrators of air and noise pollution and dangerous green-house gases. These vehicles are now transitioning to electric. This project examines the application of wireless charging technology and its applied capabilities of inductive charging and wireless power transfer technology to charge electric cars without physical cables and plugs. This technology, called Wireless Power Transmission, was originally invented by Nikola Tesla and enables electricity to be transmitted remotely without wired networks to allow vehicles to charge inductively as the vehicle is parked. The technology is currently becoming more efficient and more efficient wireless power transfer which is enabling us to address trends to support electric vehicle charging, and it enables reduction of charging time, enable extended range, and lowered costs for EV technology. Electric vehicle charging technology needs to be supported by proven applied methods that may improve accessibility and adoption by the public.

Keywords: Electric Vehicles (EVs), Wireless Charging, Inductive Coupling

1.INTRODUCTION: We live in a world of technological advancement. New technologies emerge each and every day to make our life simpler. Despite all these, we still rely on the classical and conventional wire system to charge our everyday electronic gadgets. The conventional wire system creates a mess when it comes to charging several electric vehicles simultaneously. It also takes up a lot of electric sockets at the charging port. At this point, a question might arise. What if a single technology can be used to charge these electric vehicles simultaneously without the use of wires and not creating a mess in the process? We gave it a thought and came up with an idea.

The solution to this problem is inductive coupling, a simple and effective way of transferring power wirelessly. Road transportation is the majorly used transportation in the entire world. Usage of the car has drastically increased and the need for petrol and diesel has increased. So recently, Electric vehicles (EVs) are becoming popular, as they decrease reliance on fossil fuels and reduce greenhouse emissions. The problem of the Electric Vehicle is nothing else but the electricity storage technology, which is the major drawback today due to its unsatisfactory energy density, limited lifetime, and high cost. So, our project proposes a novel idea to charge the Electric vehicle wirelessly through the inductive power transfer principle using the transmitting and receiving coil while simultaneously decreasing the battery size and improving the convenience and without the requirement of the cable.

2.LITERATURE SURVEY:

O. Nezamuddin et.al (2020), addresses the inabilities in current stationary charging infrastructure, while proposing V2V in-route wireless charging system and facilitating one electric vehicle to deliver the energy through wireless, at the very time of transit from one destination to another. This system will improve the range and convenience of EVs in reducing dependency on fixed charging stations and facilitating continuous charging while the vehicle is on the move. Discussing the technical challenges that energy transfer efficiency, safety, and coordination of the vehicles pose while also talking about the future of transportation electrification. This is because by presenting this innovative solution, the authors help enhance the feasibility of long-distance EV travel and reduce the main barrier to EV adoption range anxiety.

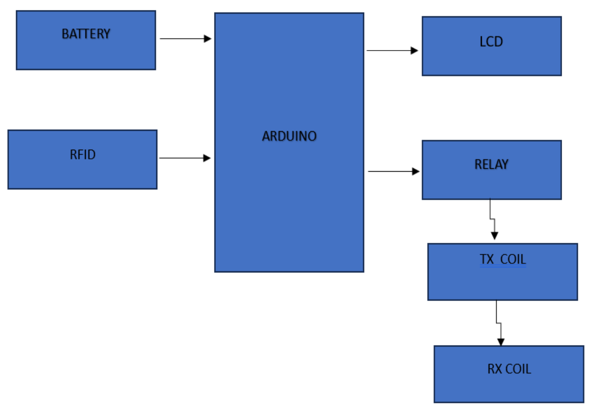
J. K. Nama et.al (2020), proposed an approach of battery charging technology for electric vehicles. The selection of battery charger technology provides a higher platform for electric vehicles (EVs) in the market. Recent trends are towards the inductive power transfer (IPT) based EV battery chargers (EVBCs) as it is a convenient and safe solution over conventional plug-in EVBC. The currently available IPT system utilizes soft switched power electronic converters while maintaining a near sinusoidal current for a limited power transfer range. The proposed concept is verified by using MATLAB/ SIMULINK based simulations for resistive and battery load. An efficiency of 92.5\% is achieved with ZVS fora full dynamic power transfer range of 300 W to 3000 W.

E. A. ElGhanam et.al (2020), provides a comprehensive review of the deployment optimization strategies for dynamic wireless electric vehicle (EV) charging systems. The authors discuss various techniques and methodologies for optimizing the placement and configuration of charging infrastructure to enhance system efficiency, coverage, and cost-effectiveness. Key challenges in dynamic wireless charging, such as power transfer efficiency, vehicle mobility, and infrastructure scalability, are examined. The review also highlights the use of advanced algorithms and optimization models to overcome these challenges. This work can thus be used as a good reference for researchers and engineers engaged in the development and implementation of dynamic wireless charging for EVs.

3.PROPOSED METHODOLOGY: The proposed system commences with the booting of the Arduino microcontroller, which is responsible for managing the functions of the RFID-based wireless charging system. When the system is powered on, the Arduino will boot any necessary peripheral modules such as the RFID reader, relay module, and potentially a display module like an LCD or OLED. This establishes the system to identify RFID tags and to react to incoming tags. When a vehicle approaches the charging station, the RFID reader scans the RFID tag that is mounted or embedded in the vehicle. The Arduino then takes that information and checks the UID (Unique Identifier) of the RFID tag against a previously established list of accepted IDs that is stored in a peripheral module like memory or EEPROM. If the scanned RFID tag matches one of the entries on the accepted list, the Arduino will activate the relay that supplies power to the wireless charging pad. The power pad consists of a transmitter coil that uses inductive coupling to wirelessly transfer power to a receiver coil placed within the vehicle. This method establishes a contactless and seamless charging experience while creating greater durability and ease of convenience. Throughout the charging process, the Arduino can be configured to track the duration of the session using internal timers, and optionally monitor voltage or current if external analog sensors (like current sensors or voltage dividers) are connected. These parameters help in ensuring safe operation, preventing overcharging, and keeping track of energy usage.

At the end of the charging session either due to manual tag removal, timeout, or other stop conditions the Arduino will deactivate the relay, thereby stopping power transmission to the charging pad. This action helps to prevent unnecessary energy consumption and enhances the safety and efficiency of the system.

BLOCK DIAGRAM



BATTERY Use: Power for all parts of the system.

- Provides the voltage needed for the Arduino, RFID module, relay, and LCD. A regulated battery (such as a 12V battery) can be used directly or stepped down if needed.

RFID Purpose: Provides a means of authentication either for the vehicle or the user.

- Reads an RFID tag (such as a card or keychain). If the UID (Unique ID) matches an authorized UID, the Arduino will begin the charging process.

ARDUINO Function: The primary controller which processes all inputs, and controls outputs.

- It is powered by the battery. It will read inputs from the RFID Module. It will activate the relay for wireless charging. It will send status updates to the LCD. It will make logical decisions based on RFID data.

LCD Function: Displays system status or messages.

- Shows messages like "Scan RFID", "Access Granted", "Charging", or "Access Denied".
- Useful for real-time monitoring and user feedback.

RELAY Purpose: Serves as a control switch for the wireless charging circuit.

- Once authentication of the RFID occurs, the Arduino sends a signal to the relay to close the circuit. This activates the TX Coil (transmitter coil) and starts the wireless power transmission.

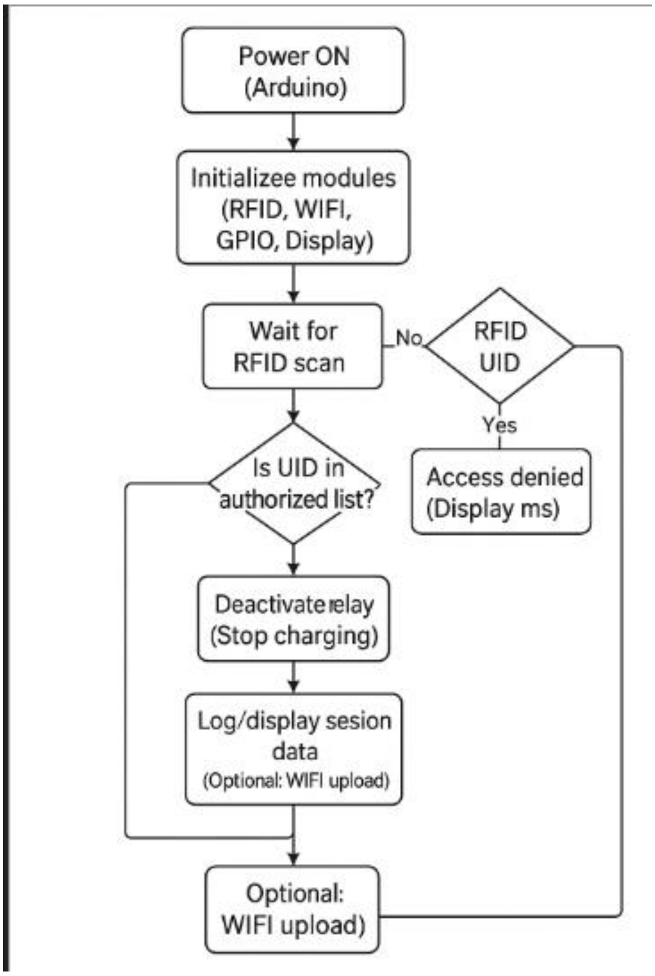
TX COIL (Transmitter Coil) Purpose: Creates the electromagnetic field used for wirelessly transmitting power.

- It is connected to the output of the relay. It converts electrical energy to a magnetic field through inductive coupling.

RX COIL (Receiving Coil) Purpose: Accepts wireless power energy from the TX coil.

- Located on the vehicle side. Changes the magnetic field back to electrical energy to charge the vehicle's battery.

ARCHITECTURE OF THE SYSTEM



RESULT: The wireless vehicle charging system that utilizes RFID technology and an Arduino is developed and tested successfully. The primary objective of this project was to develop a secure and efficient way of wirelessly charging Electric Vehicles, and using RFID as authentication. When the RFID tag is scanned close to the reader, the Arduino validates that tag as authorized or unauthorized. If the RFID tag is authorized, the charging process begins once HDMI is connected. Once validated, the Arduino activates a relay to switch on the transmitting coil (TX coil). The TX coil generates an alternating magnetic field that is captured by the receiving coil (RX coil) in the electric vehicle (EV) once power is sent through it. The RX coil converts the magnetic energy field into electrical energy and charges the battery wirelessly. The system successfully demonstrates inductive power transfer of energy without any firm connections between the system. An LCD display is also built into the project to show the real-time status of the system which can include messages such as "Scan RFID", "Access Granted", or "Access Denied", therefore prompting the interest of the user. A battery powers the system all together and makes it portable and self-sustained.

Conclusion: This paper has explored and evaluated the process of charging electric vehicles (EVs) through wireless power transmission and its unique benefits compared to its wired charging systems. Wireless charging is increasing in popularity because it is much easier for users and is more environmentally friendly. The biggest advantage of wireless charging is that there are no wires and the mechanical connectors are gone; therefore, there are fewer risk factors, such as wear and tear, electrical hazards, and maintenance issues. Wireless charging systems also increase the convenience factor for EV owners. This means there is no longer the need to plug in charging cords, which can significantly reduce the time and inconveniences for the user or owner of the electric vehicle when it is time to charge the vehicle. Wireless charging also decreases range anxiety for electric vehicles since it can utilize dynamic charging when the vehicle is in motion, while increasing system efficiency. Wireless power transmission mainly has three methods by which the process operates: microwave, laser, and mutual coupling. Wireless charging is mainly considered good or has a positive parity value due to mutual coupling, since it orders higher safety, efficiency, and suitability for EVs. In mutual coupling, inductive and capacitive techniques are typically considered for use with contactless power transfer - which will charge electric vehicles and electronics in an efficient and reliable manner.

FUTURE SCOPE: The future of wireless EV charging technology is promising, with some areas ripe for advancement. One promising area is the advancement of dynamic wireless charging systems that can charge EVs while in motion, providing an energy supply without frequent stops. This technology could even change the way public transport systems operate, logistics support systems, and highway infrastructure. Also, power transfer efficiency and charge periods will need to improve to meet a growing demand for fast-charge EVs. Advancements in resonant inductive coupling and magnetic resonance technologies should strengthen power transfer while minimizing energy loss. The synthesis of smart grid technologies and wireless charging technologies will lead to improved energy management systems, allowing for real-time monitoring, balancing loads, and maximizing the use of renewable energy sources. Using RFID-based authentication and payment systems would allow users to streamline their experience with automatic vehicle identification, secure payment transactions, and personalized charging services. In summary, although variations of wireless charging for EVs have changed significantly, ongoing research and technological innovations will improve efficiency, expand applications, and lead to more sustainable and convenient transportation options in the future.

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