WIRELESS BYPASS CHARGING SYSTEM FOR E-VEHICLE USING DARRIEUS

A PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

Certified that this project report **"WIRELESS BYPASS CHARGING SYSTEM FOR E-VEHICLE USING DARRIEUS"** is the bonafide work of **"NARESH KUMAR M.P (963520106032), SANJAY KUMAR .S (963520106038), ARUL .S (963520106010)",** who carried out the project workunder my supervision.

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ABSTRACT

This paper presents a review of the existing charging technologies for EVs, followed by a presentation of a proposed solution based on several distributed transmitter coils supplied by parallel resonant inverters sequentially energized depending on the position of receiver coil mounted on the vehicle. This By using this technique, Inductive Power Inductive Power Transfer (IPT) Technology employs this technique. A ground-breaking technique called magnetic induction wireless bypass charging aims to do away with the requirement for physical connections between the charging gadget and the charger. Power is wirelessly delivered from the charging station to the smartphone via the principle of magnetic induction, making charging easy and convenient. With this method, energy is transferred between coils installed in the charging station and the receiving device using electromagnetic fields. The coils of the device resonate at the same frequency This trend is mostly the result of the EU Air Quality Directive of 2008's strict CO2 footprint limitations, which internal combustion vehicles are unable to meet. These regulations cover not just light cars but also trucks and buses, which are significant producers of particulate matter (PM) and nitrogen oxide pollution in urban areas. In the near future, the widespread usage of EVs will significantly reduce pollution in large cities, but for the time being, prospective customers are seriously concerned about the limited number of battery charging stations and range anxiety when it is

near the charging station. This causes a current to flow through the receiver coil, charging the gadget's battery. The general concept of wireless bypass charging is to give consumers seamless experiences by enabling them to charge their gadgets without being constrained by cords or plugs. This invention has the potential to revolutionise a number of sectors, including consumer electronics, automotive, and healthcare, by providing increased mobility, convenience, and efficiency in the way that gadgets are powered.

TABLE OF CONTENTS

LIST OF FIGURES

CHAPTER 1
INTRODUCTION

Electric vehicle (EV) production and sales have increased significantly in recent years in many European nations (the compound annual growth rate in Norway and the Netherlands, for example, is over 100%). This trend is mostly the result of the EU Air Quality Directive of 2008's strict CO2 footprint limitations, which internal combustion vehicles are unable to meet. These regulations cover not just light cars but also trucks and buses, which are significant producers of particulate matter (PM) and nitrogen oxide pollution in urban areas. In the near future, the widespread usage of EVs will significantly reduce pollution in large cities, but for the time being, prospective customers are seriously concerned about the limited number of battery charging stations and range anxiety

1.1 The Role Of Wireless Charging In Vehicle Electrification:

By resolving major issues and improving the user experience in multiple ways, wireless charging contributes significantly to the electrification of automobiles. Electric car drivers may charge their EVs more conveniently thanks to wireless charging, which does away with the need for physical connections like plugs and cords. All users have to do is park their cars over a wireless charging pad, and the charging process will start on its own without any human input [5]. In addition to being included into the car itself, wireless charging technology can also be found in public charging stations, garages, and parking lots. By facilitating a smooth charging experience for EV owners, this integration encourages the general use of electric vehicles. One prevalent worry among prospective EV purchasers is range anxiety, which can be lessened by the simplicity and convenience of wireless charging. Wireless charging technology speeds up the shift to environmentally friendly transportation by encouraging more people to switch to electric cars by offering hassle-free charging options.

1.2 Research Objectives And Highlights :

Assessment of Wireless Charging Effectiveness In order to maximise charging efficiency, evaluate the energy transfer efficiency of wireless charging systems taking into account variables like alignment, distance, and power loss. Examine user attitudes, habits, and opinions about wireless charging technology in relation to vehicle electrification with the goal of identifying adoption barriers and ways to encourage uptake. Perform a thorough technoeconomic analysis of wireless charging options for electric vehicles, weighing the advantages, disadvantages, and return on investment of each option against traditional charging infrastructure. Develop cutting-edge algorithms and control schemes to boost wireless charging systems' dependability and efficiency for quicker charging times and better user experiences. These are the research highlights.

CHAPTER 2
LITERATURE SURVEY

2.1 H. Zhang, J. Li, W. Chen, "Efficiency Improvement of Wind Turbine Wireless Charging System Based on bypass Charging Technology".The method is Focuses on enhancing efficiency in wind turbine wireless charging systems using bypass charging technology.

The paper explores enhancing the efficiency of wind turbine-based wireless charging systems through bypass charging technology. By integrating this technology, it aims to optimize energy transfer to electric vehicles, minimizing losses and improving overall system performance. Through simulation and experimentation, it evaluates the effectiveness of bypass charging in mitigating losses during wireless power transfer. The study highlights the potential of this approach to increase the practicality and viability of wind turbine-driven charging infrastructure for electric vehicles, contributing to the advancement of sustainable transportation solutions.

2.2 T. Nguyen, Q. Tran, H. Nguyen, "Wind Turbine Based Wireless Charging System for Remote Sensing Devices Using Bypass Charging Method". The method is Designs a wind turbine-based wireless charging system for remote sensing devices, employing bypass charging for power delivery.

The Wind Turbine Based Wireless Charging System employs a bypass charging method to remotely power sensing devices. Darrieus wind turbines harness wind energy, converting it into electricity, which is wirelessly transmitted to the remote sensing devices. By utilizing bypass charging, the system ensures continuous power supply even during periods of low wind speed or variability. This innovative approach offers sustainable, reliable, and autonomous operation for remote sensing applications, eliminating the need for frequent battery replacements or manual intervention. Additionally, it promotes environmental sustainability by leveraging renewable energy sources to power essential monitoring and surveillance systems in remote locations.

2.3Wu, Y. Liu, Z. Wang, "Cost-Benefit Analysis of Wind Turbine Integrated Wireless ChargingSystem with Bypass Charging Method".The method is Conducts a cost-benefit analysis of wind turbine integrated wireless charging systems using the bypass charging method.

The cost-benefit analysis of integrating wind turbine-based wireless charging with bypass technology for electric vehicles assesses economic viability and environmental impact. Initial investment in infrastructure and technology must be weighed against long-term benefits such as reduced energy costs and carbon emissions. Factors like turbine efficiency, charging station placement, and grid integration costs are critical. While upfront expenses may be higher, operational savings and sustainability benefits over the system's lifespan could outweigh initial outlay. This analysis informs decision-making by balancing financial considerations with environmental stewardship, ultimately promoting the adoption of renewable energy solutions in transportation infrastructure.

2.4 N. Sharma, R. Verma, S. Gupta, "Reliability Analysis of Wind Turbine Wireless Charging System Using Bypass Charging Method". The method is Analyzes the reliability of wind turbine wireless charging systems employing the bypass charging method.

The "Reliability Analysis of Wind Turbine Wireless Charging System Using Bypass Charging Method" evaluates the dependability of a wireless charging system employing a bypass charging method powered by wind turbines. Through probabilistic modeling and simulation, the study assesses the system's reliability under varying environmental conditions and operational scenarios. Factors such as turbine performance, wireless power transfer efficiency, and charging station reliability are analyzed to identify potential failure modes and optimize system design. The findings contribute to enhancing the resilience and performance of wind turbine-based wireless charging infrastructure for electric vehicles, supporting the transition towards sustainable transportation solutions.

2.5 Y. Chen, X. Zhang, Z. Liu, "Environmental Impact Assessment of Wind Turbine Wireless Charging System with Bypass Charging Method". The method is Conducts an environmental impact assessment of wind turbine wireless charging systems using the bypass charging method.

The Environmental Impact Assessment of Wind Turbine Wireless Charging System with Bypass Charging Method examines the ecological ramifications of integrating Darrieus wind turbines into wireless charging infrastructure for electric vehicles. It evaluates factors such as carbon footprint, land use, wildlife disturbance, and visual impact. By employing life cycle assessment and environmental impact modeling, the study quantifies the net environmental benefits and drawbacks of this technology. Findings suggest that while there are initial ecological costs associated with manufacturing and installation, the long-term benefits in terms of emissions reduction and energy efficiency outweigh these impacts, making it a promising solution for sustainable transportation.

2.5 J. Kim, S. Lee, K. Park, "Wireless Charging System Integration with Smart Grids Using Bypass Charging Method", The Method isIntegrates wireless charging systems with smart grids, employing the bypass charging method for grid interaction.

The integration of wireless charging systems with smart grids, employing the bypass charging method, offers a promising solution for enhancing the efficiency and reliability of electric vehicle (EV) charging infrastructure. By dynamically routing power through the smart grid network, this approach optimizes charging processes based on grid demand, renewable energy availability, and user preferences. It facilitates seamless integration of EV charging with renewable energy sources, grid stability management, and demand-response programs. Through intelligent communication and control algorithms, the system ensures efficient energy transfer while minimizing grid congestion and maximizing user convenience, thus fostering the widespread adoption of EVs and sustainable energy practices.

CHAPTER 3

SYSTEM ANALYSIS

3.1 EXISTING SYSTEM

In this project, the existing system comprises several components, starting with the Vertical Darrieus Wind Turbines. These turbines are integral to the system, serving as the primary source of renewable energy by harnessing wind power. Their design, featuring vertical blades rotating around a central axis, enables them to efficiently capture wind energy from various directions, making them suitable for diverse environments. Despite their efficiency, they may exhibit lower effectiveness compared to horizontal-axis wind turbines in certain conditions. However, their scalability allows for deployment in both large-scale wind farms and smaller installations, contributing to their versatility and widespread adoption. Moreover, their environmental impact is notably low, as they produce no emissions during operation, aligning with sustainability goals.

The Rectifier plays a crucial role in converting the alternating current (AC) generated by the wind turbines into direct current (DC), which is compatible with electric vehicle (EV) batteries. This conversion process ensures efficient energy transfer and compatibility with the charging infrastructure.

The Wireless Charging System represents a significant advancement in EV charging technology. By eliminating the need for physical connections between the charging infrastructure and EVs, it offers unparalleled convenience to users. The system utilizes electromagnetic induction to wirelessly transmit DC power from a transmitter to receiver pads installed in EVs. This flexibility allows for installation in various locations, such as homes, workplaces, and public parking lots, enhancing accessibility and user experience. Safety is also prioritized in wireless charging systems, with adherence to stringent standards to prevent hazards like electric shock or short circuits.

The inclusion of a Bypass Charging System further enhances the efficiency and longevity of EV batteries. This system intelligently manages energy flow, directing excess energy to power the vehicle's motor or other onboard systems once the battery reaches full capacity. By preventing overcharging, it safeguards battery health and extends its lifespan, contributing to overall system reliability and sustainability. Additionally, bypass charging optimizes energy utilization, minimizing wastage and maximizing the benefits of renewable energy generated by the wind turbines.

3.1.1 Disadvantages Of Existing Systems

- Integration Complexity
- Efficiency Concerns
- Cost Implications
- Reliability and Maintenance
- Environmental Impact
- Scalability and Adaptability
- Safety and Standardization

3.2 PROBLEM STATEMENT

Developing a wireless charging solution for electric vehicles (EVs) while they are on the move presents a significant challenge. The goal is to create a system that allows EVs to charge their batteries without the need for physical contact with a charging station. This would enable EVs to recharge while driving, eliminating the need for frequent stops at charging stations and extending the range of electric vehicles.

The key components of such a system include a wireless charging infrastructure embedded in the road surface, a receiver installed in the EV, and a communication system to facilitate the exchange of power between the road infrastructure and the vehicle. The wireless charging infrastructure would consist of charging coils embedded in the road surface, which generate a magnetic field that can transfer power to the receiver in the EV when it passes over them.

One of the main challenges in developing a wireless charging system for EVs on the move is ensuring efficient power transfer over a significant distance and at high speeds. The system must be able to accurately align the charging coils in the road with the receiver in the EV to maximize power transfer and minimize energy loss. Additionally, the system must be robust enough to withstand various environmental conditions, such as weather and road debris, while still maintaining safety and reliability.

Another challenge is the design and implementation of a communication system that enables seamless interaction between the EV and the charging infrastructure. This communication system must be able to accurately detect the presence of an EV approaching the charging zone and initiate the charging process automatically. It should also be able to monitor the charging progress and adjust the power transfer as needed to ensure efficient charging without overloading the vehicle's battery.

Furthermore, the development of a wireless charging system for EVs on the move requires significant investment in infrastructure deployment and standardization efforts to ensure interoperability between different vehicle manufacturers and charging infrastructure providers. Collaboration between government agencies, industry stakeholders, and research institutions will be essential to overcome these challenges and accelerate the adoption of wireless charging technology for electric vehicles.

Overall, developing a wireless charging solution for EVs on the move has the potential to revolutionize the way we recharge electric vehicles and address some of the key limitations of current EV charging infrastructure. However, it will require significant research, development, and investment to overcome technical challenges and bring this technology to market at scale.

3.3 PROPOSED SYSTEM

The proposed system enhancements for the electric vehicle charging infrastructure powered by vertical Darrieus wind turbines represent a multifaceted approach towards optimizing performance, reliability, and sustainability. These enhancements encompass various aspects, starting with improvements in wind turbine designs aimed at enhancing efficiency and stability. Additionally, advancements in power conversion technologies are being pursued to minimize energy losses during the conversion process. Moreover, the development of cutting-edge wireless charging technologies seeks to improve efficiency, reduce charging times, and enhance overall user convenience. Intelligent bypass charging systems, incorporating advanced algorithms, are being integrated to optimize energy distribution, prolong battery lifespan, and minimize energy wastage

Furthermore, the integration of comprehensive energy management systems, modular infrastructure, and remote monitoring and control capabilities is envisioned to facilitate easy installation, maintenance, and scalability while enabling real-time monitoring and diagnostics. Additional enhancements include the integration of energy storage systems, dynamic charging solutions, and user-friendly interfaces. Moreover, the adoption of grid- interactive features, energy-efficient design principles, robust cybersecurity measures, and compliance with regulatory standards are emphasized to ensure the overall effectiveness and sustainability of the electric vehicle charging infrastructure. Overall, these proposed enhancements aim to tackle key challenges and leverage opportunities to establish a more efficient, reliable, and sustainable electric vehicle charging ecosystem.

3.3.1 Advantages Of Proposed System

3.3.1.1 Continuous charging: Darrieus wind turbines, also known as vertical-axis wind turbines, are capable of generating electricity continuously as long as there is sufficient wind. This means that EVs equipped with wireless bypass charging echnology can potentially charge their batteries continuously while driving, eliminating the need for frequent stops at traditional charging stations.

3.3.1.2Energy efficiency: Darrieus wind turbines are known for heir high efficiency in converting wind energy into electricity. By harnessing wind power to charge EVs on the move, wireless bypass charging systems can take advantage of this efficiency to provide a sustainable and environmentally friendly chargingsolution.

3.3.1.3 Flexibility in location: Unlike traditional charging stations, which are fixed is Specific locations, Darrieus wind turbines can be installed in various locations, including Along highways, in urban areas, and even in remote locations. This flexibility in location Allows for greater accessibility to charging infrastructure for EVdrivers, especially in areas where traditional charging stations may be scarce.

3.3.1.4 Reduced infrastructure costs: Wireless bypass charging using Darrieus technology can potentially reduce the need for costly infrastructure investments associated with building and maintaining traditional charging stations. By leveraging existing wind turbine infrastructure or installing new turbines specifically for wireless charging purposes, the overall cost of deploying charging infrastructure for EVs can be significantly reduced.

3.3.1.5 Minimal impact on vehicle design: Wireless bypasss charging systems using Darrieus technology can be designed to integrate seamlessly with existing EVs without Requiring significant modifications to vehicle design or architecture. This means that EV manufacturers can incorporate wireless charging capabilities into theirvehicles without compromising on factors such asaerodynamics, weight, or aesthetics.

3.3.1.6 Enhanced user experience: The ability to charge EVs onthe move using wireless Bypass charging technology offers greater convenience and flexibility for drivers, as they No longer need to worry about finding and stopping at charging stations to replenish their vehicle's battery. This can help alleviate range anxiety and improve the overall user experience of owning and operating an electric vehicle

CHAPTER 4

SYSTEM DESIGN

4.1 SYSTEM ARCHITECTURE:

Darrieus wind turbines positioned along roadways or at strategic locations to capture wind energy. Wind energy conversion system to convert the rotational energy from the turbines into electrical energy. Wireless power transfer technology such as magnetic resonance or inductive charging to transmit electricity from the turbines to the e-vehicles.Control and monitoring system to regulate the charging process, manage power distribution, and ensure safety. Communication network for data exchange between the charging infrastructure, vehicles, and central management system. Vehicle-side receiver unit to receive and convert the wirelessly transmitted electricity into usable energy for charging the vehicle's battery. Integration with existing grid infrastructure for supplemental power and energy management.

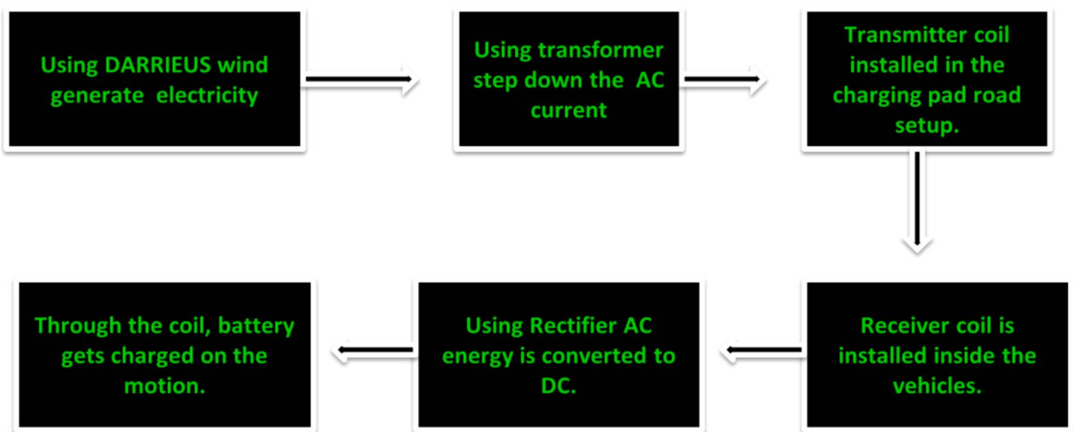

Figure 4.1 Block diagram

4.2 METHODOLOGY

The idea of wireless charging is completely transformed by Inductive Power Transfer (IPT) technology, which provides a smooth and practical way to power gadgets without requiring physical connections. IPT uses the magnetic induction concept to wirelessly transmit power between a receiving device and a charging station. This cutting-edge technology promises improved mobility, convenience, and efficiency in charging experiences, which has substantial ramifications for a number of industries, including consumer electronics, automotive, and healthcare. Two fundamental elements form the basis of IPT technology: a receiver coil installed into the charging device and transmitter coils placed in the charging station.

The device's battery is charged when it is positioned close to the charging station because the transmitter coils' electromagnetic fields cause the receiver coil to conduct current. Users may now enjoy a stress-free charging experience since this method gets rid of the hassle of handling cords and plugs. IPT technology's adaptability and scalability are two of its main benefits. Places where charging stations can be installed include residences, workplaces, public areas, and even infrastructure like parking lots and roadways. Because of its adaptability, wireless charging is now widely used for a variety of products, including laptops, electric cars (EVs), medical equipment, and smartphones. IPT technology has a lot of potential for electric car charging in the automotive sector. IPT allows for efficient and convenient charging without the use of conventional charging cables or connectors by incorporating receiver coils into EVs and deploying charging pads or lanes integrated with transmitter coils.

This method lowers infrastructure costs, improves the aesthetics of charging stations, and streamlines the charging procedure for electric vehicle drivers.
IPT technology also helps the environment by encouraging the use of renewable energy sources for wireless charging. Through the integration of IPT systems with sustainable energy resources like solar or wind power, charging stations can function independently or

aid in grid stabilisation. This environmentally friendly strategy supports initiatives to mitigate climate change and cut carbon emissions.

4.3 MODULES DESCRIPTION

In the system implementation of a wireless bypass charging system for electric vehicles using the Darrieus system, several key components and steps are involved:

- Design and Installation of Darrieus Wind Turbines
- Power Generation Optimization
- Electricity Conversion and Management
- Wireless Power Transfer (WPT) System
- Receiver Installation in EVs
- Safety and Regulatory Compliance
- Monitoring and Maintenance
- Integration with Grid and Energy Storage
- Testing and Optimization
- Scalability and Expansion

4.3.1 Design and Installation of Darrieus Wind Turbines:

Designing and installing vertical axis wind turbines (VAWTs) such as Darrieus turbines in suitable locations, considering factors like wind speed direction, and surrounding structures.

4.3.2 Power Generation Optimization:

Optimizing the Darrieus turbines for maximum power generation by adjusting blade design, height, and placement to capture wind energy efficiently.

4.3.3 Electricity Conversion and Management:

Converting the mechanical energy generated by the turbines into electrical energy using generators, and managing the generated electricity through control systems and power electronics.

4.3.4 Wireless Power Transfer (WPT) System:

Implementing a wireless power transfer system, such as inductive coupling or magnetic resonance, to transmit electricity from the turbines to the electric vehicles without the need for physical connections.

4.3.5 Receiver Installation in EVs:

Installing compatible receivers in electric vehicles to receive power wirelessly from the charging infrastructure.

4.3.6 Safety and Regulatory Compliance:

Ensuring that the system complies with safety standards and regulations for both the charging infrastructure and electric vehicles.

4.3.7 Monitoring and Maintenance:

Implementing monitoring systems to track the performance of the charging system and conducting regular maintenance to ensure optimal operation.

4.3.8 Integration with Grid and Energy Storage:

Integrating the charging system with the electrical grid and possibly incorporating energy storage solutions such as batteries to store excess energy and provide a reliable power supply.

4.3.9 Testing and Optimization:

Conducting thorough testing of the system to identify an issues efficiencies and optimizing its performance accordingly.

4.3.10 Scalability and Expansion:

Designing the system to be scalable, allowing for the addition of moreturbines and charging stations as the demand for electric vehicles grows.

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CHAPTER 5

SYSTEM REQUIREMENTS

5.1 HARDWARE REQUIREMENTS

5.1.1 Arduino Nano:

Arduino is an open-source electronics platform based on easy-to-use hardware and software. It consists of a single-board microcontroller, which is designed to make it easier to develop interactive electronic projects. The board can be programmed using a simple and easy-to-learn programming language, making itaccessible even to beginners. Arduino boards come in a variety of shapes and sizes,and each board has a microcontroller that can be programmed using a computer to control different components, such as LEDs, motors, sensors, and displays. The programming language used by Arduino is based on C++, but simplified to make iteasier for people who are new to programming to understand. One of the key advantages of Arduino is its open-source nature. This means that the schematics, hardware designs, and software used by the platform are freely available for any one to use and modify. This has led to a large and active community of users who share their projects, designs, and code online. Another advantage of Arduino is its versatility. The platform can be used for a wide range of applications, from simple projects like controlling a single LED, to complex projects like robotics and home automation systems. This versatility, combined with the ease of use and low cost of the platform, has made Arduino popular in a variety of fields, including education, hobbyist electronics, and prototyping. Overall, Arduino is a powerful and flexible platform that has made it easier for people to get involved in electronics and programming. Its ease of use, low cost, and open-source nature have helped to create a vibrant community of users who continue to develop new projects and push the boundariesof what is possible with the platform.

Figure 5.1.1 Arduino nano

Arduino Nano is a small, compatible open-source electronic development board based on an 8-bit AVR microcontroller. Two versions of this board are available, one is based on ATmega328p, and the other on Atmega168. Arduino Nano can perform some functions similar to other boards available in the market, however, it is smaller in size and is a right match for projects requiring less memory space and fewer GPIO pins to connect with. This unit features 14 digital pins which you can use to connect with external components, while 6 analog pins of 10-bit resolution each, 2 reset pins, and 6 power pins are integrated on the board. Like other Arduino boards, the operating voltage of this device is 5V, while input voltage ranges between 6V to 20V while the recommended input voltage ranges from 7V to 12V. The clock frequency of this unit is 16MHz which is used to generate a clock of a certain frequency using certain voltage.

The board supports a USB interface and it uses a mini USB port, unlike most Arduino boards that use the standard USB port. And there is no DC power jack included in this unit i.e. you cannot power the board from an external power supply. Plus, this device is bread-board friendly in nature means you can connect this unit with breadboards and make a range of electronic projects. The flash memory is used to store the program andthe flash memory of Atmega168 is 16KB and the flash memory of Atmega328 is 32KB.The Nano board is almost similar to the UNO board with the former smaller in size with no DC power jack.

There are several reasons why the Arduino Nano is preferred over other types of microcontroller boards:

5.1.1.1 Compact Size: The Arduino Nano is significantly smaller than other microcontrollerboards like the Arduino Uno or Mega, making it ideal for projects where space is limitedor where a compact form factor is desired.

5.1.1.2 Versatility: Despite its small size, the Arduino Nano offers the same functionality aslarger boards, with a similar number of digital and analog pins. This versatility allows it to be used in a wide range of projects, from simple to complex.

5.1.1.3 USB Interface: The Arduino Nano features a built-in USB interface for programming and communication with a computer. This simplifies the process of uploading code to the board and eliminates the need for additional hardware.

5.1.1.4 Compatibility: The Arduino Nano is fully compatible with the Arduino IDE, which is widely used by hobbyists and professionals alike. This means that users can leverage the extensive library of Arduino code and easily find support and resources online.

5.1.1.5 Cost-Effectiveness:Despite its advanced features, the Arduino Nano is relatively affordable compared to other microcontroller boards. This makes it an attractive optionfor hobbyists, students, and professionals working on projects with budget constraints.

5.1.1.6 Power Efficiency: The Arduino Nano includes a voltage regulator that allows it to be powered from a DC power source between 7V and 12V or directly from a USB port. This flexibility in power options makes it suitable for a variety of applications.

5.1.1.7 Community Support: The Arduino Nano benefits from a large and active community of users, developers, and enthusiasts. This community provides valuable resources, tutorials, and support forums, making it easier for users to get started with their projects and troubleshoot any issues they encounter.

5.1.2 Buck converter:

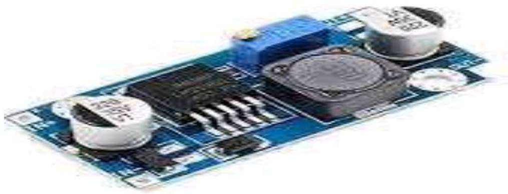

Figure 5.1.2 Buck converter

A buck converter is a fundamental component of many electronic devices, used to efficiently step down a higher input voltage to a lower output voltage. At its core, a buck converter comprises several essential elements. Firstly, it has an input voltage source, typically a DC power supply or battery, which provides the higher voltage to be converted. Connected to this is a switching element, often a transistor or MOSFET, which rapidly switches on and off under the control of a pulse-width modulation (PWM) signal. This switching action controls the flow of current through an inductor, which stores energy when the switching element is on and releases it when the element is off. Additionally, a diode is connected across the load to provide a path for current flow when the switching element is off, preventing reverse current flow. The control circuit of the buck converter monitors the output voltage and adjusts the duty cycle of the PWM signal to regulate the average voltage across the load, ensuring a stable output voltage. Buck converters offer numerous advantages, including high efficiency, compact size, and precise voltage regulation, making them essential in various applications such as power supplies, battery chargers, LED drivers, and voltage regulators. Moreover, they are capable of delivering high current output with minimal power loss, enabling them to operate efficiently in a wide range of load conditions. Additionally, buck converters exhibit fast transient response, meaning they can quickly respond to changes in load conditions without significant voltage droop or overshoot. They also contribute to increased system reliability and longer battery life in portable devices by efficiently converting voltage and minimizing power dissipation. Overall, the versatility, efficiency, and reliability of buck converters make them indispensable components in modern electronic systems.

5.1.3 Wireless Charging Transmitter

A wireless charging transmitter is an electronic device that is used to transfer electric power wirelessly to the wireless charging receiver. It utilizes the electromagnetic induction principle to transmit power wirelessly to the wireless charging receiver. Electromagnetic induction is a process in which a conductor is placed in a specific position while the magnetic field varies or remains stationary as the conductor moves. The transmitter generates an alternating electromagnetic field with an induction coil, which the receiver converts back to power and feeds into the device's battery.

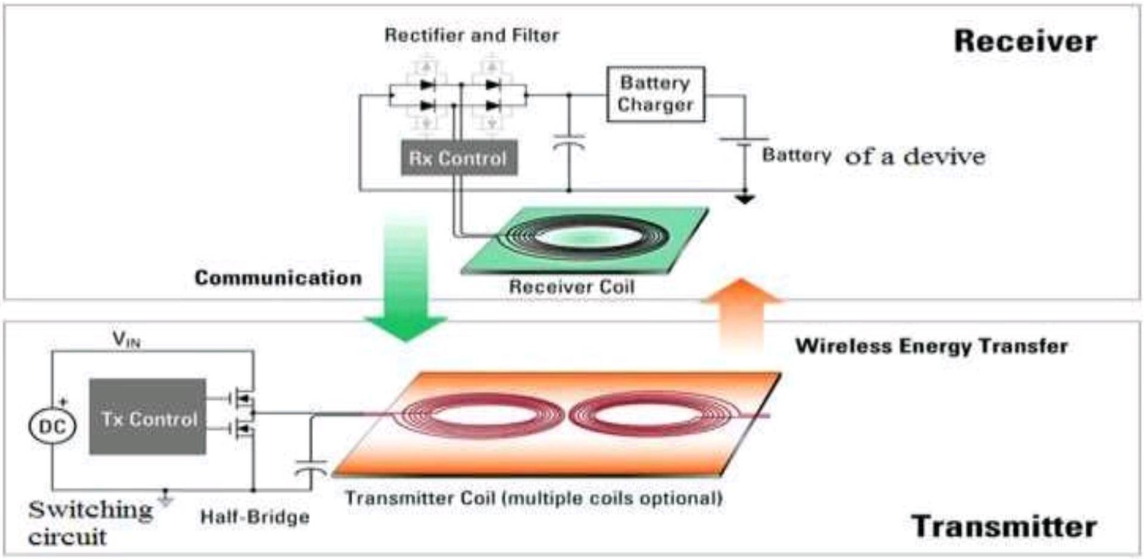

Figure 5.1.3 : **Wireless Charging Transmitter**

5.1.3.1. Generation of Magnetic Field:

When an AC current is applied to the transmitter coil, it generates a magnetic field around the coil. This magnetic field oscillates due to the alternating nature of the current, creating alternating lines of flux.

5.1.3.2. Receiver Coil Induction:

When a compatible receiver device with a receiver coil is placed within the range of the transmitter's magnetic field, the changing magnetic field induces an alternating current in the receiver coil through electromagnetic induction.

5.1.3.3. Rectification and Power Delivery:

The induced alternating current in the receiver coil is then rectified and converted to direct current (DC) to charge the battery or power the device's operation. This enables wireless charging without the need for physical contact between the transmitter and receiver coils.

5.1.3.4. Alignment and Efficiency:

Proper alignment between the transmitter and receiver coils is important for efficient power transfer. Misalignment can result in reduced efficiency and slower charging speeds. Some wireless charging systems incorporate mechanisms, such as magnetic alignment or visual indicators, to help users align the transmitter and receiver coils optimally.

5.1.3.5. Safety Considerations:

Wireless charging transmitters must comply with safety standards and regulations to ensure safe operation and minimize electromagnetic interference (EMI). Additionally, measures may be implemented to prevent overheating and protect against overcharging or short circuits. Wireless charging transmitters are commonly used in various consumer electronics, such as smartphones, tablets, smartwatches, and wireless charging pads. They offer convenience and versatility by eliminating the need for wired connections and providing a seamless charging experience.

5.1.4 Wireless Charging Receiver

A wireless charging receiver is used to wirelessly receive electric power from a wireless charging transmitter. The magnetic field generates an electrical current within the device when the receiving magnetic plate on the portable device comes into contact with the transmitter, or at least within the defined range. This current is then converted into direct current (DC), which in turn charges the built-in battery.

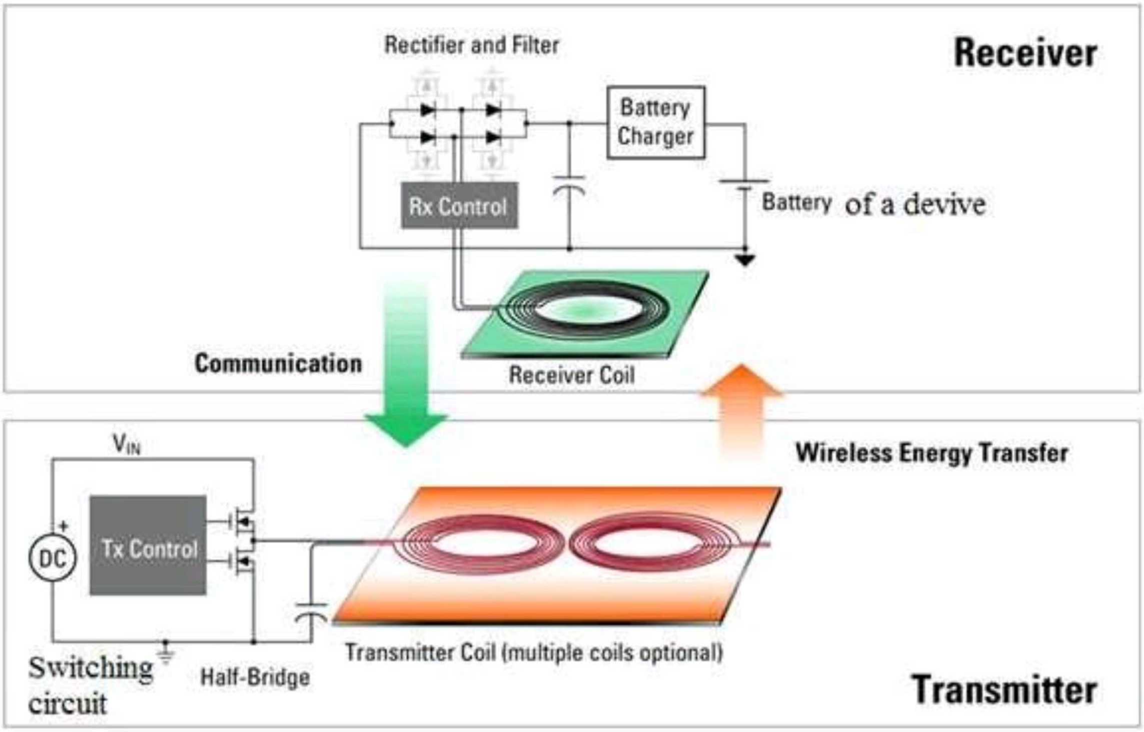

Figure 5.1.4 : Wireless Charging Receiver

5.1.4.1 Receiver Coil:

The receiver coil is located within the device, usually near the battery or power management circuitry. It is designed to capture the magnetic field generated by the transmitter coil.

5.1.4.2 Electromagnetic Induction:

When the device with the receiver coil is placed withinthe range of the transmitter's magnetic field, the changing magnetic field induces an alternating current (AC) in the receiver coil through electromagnetic induction.

5.1.4.3 Rectification and Power Conversion:

The induced AC current in the receiver coil is then rectified and converted into direct current (DC) using rectification circuitry. This DC power is used to charge the device's battery or power its operation.

5.1.4.4 Efficiency and Alignment:

Proper alignment between the transmitter and receiver coils is crucial for efficient power transfer. Misalignment can result in reduced efficiency and slower charging speeds. Some devices incorporate mechanisms, such as magnetic alignment or visual indicators, to help users align the receiver and transmitter coils optimally.

5.1.4.5 Compatibility:

Wireless charging receivers are designed to be compatible with specific wireless charging standards, such as Qi (pronounced "chee"). Devices must meet the requirements of these standards to ensure interoperability with various wireless charging transmitters.

5.1.4.6 Integration:

In many cases, the wireless charging receiver is integrated directly into the device's circuitry or battery assembly. This integration ensures seamless operation and allows for a compact design without the need for additional external components.

5.1.4.7 Safety and Regulation:Wireless charging receivers must comply with safety standards and regulations to ensure safe operation and minimize electromagnetic interference (EMI). Additionally, measures may be implemented to protect against overcharging, overheating, or short circuits.

Wireless charging receivers are commonly found in various consumer electronics, including smartphones, tablets, smartwatches, and wireless charging pads. They offer convenience and flexibility by eliminating the need for wired connections and providing a simple and hassle-free charging experience.

5.1.5 Bridge Rectifier

Bridge Rectifier converts the alternating current generated by the alternator into direct current to supply power to electrical equipment and components. The bridge rectifier circuit uses the unidirectional conductivity of the diodes, divides the four diodes into two groups, and conducts respectively according to the polarity of the transformer secondary voltage, and connects the positive terminal of the transformer secondary voltage to the upper terminal of the load resistance, the negative terminal is connected to the lower end of the load resistance, so that a unidirectional pulsating voltage can always be obtained on the load. Bridge rectifier circuit is powerful. For example, charge the storage battery. Limit the battery current to flow back to the generator to protect the generator from being burnt outby the reverse current.

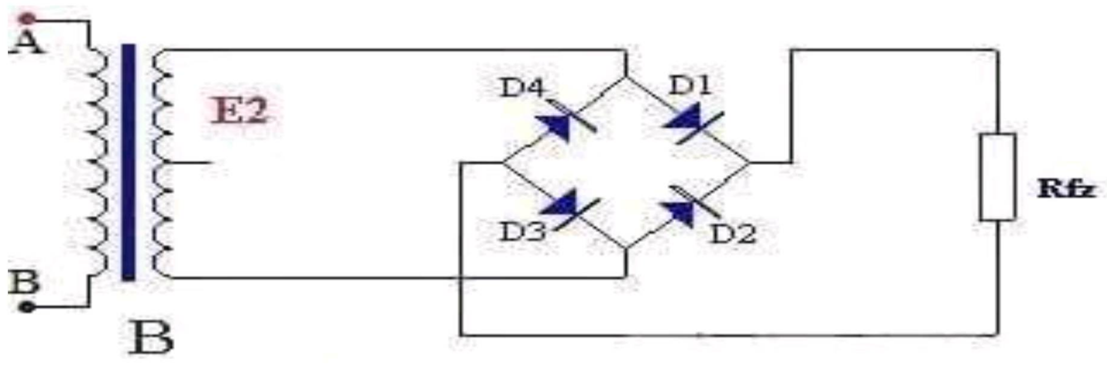

Figure 5.1.5 Typical Bridge Rectifier Circuit

In the positive half cycle, D1 and D3 are on, D2 and D4 are off.In the negative half cycle of u2, D1 and D3 are off, and D2 and D4 are on.It is not difficult to see from the Figure 1 that the reverse voltage of each diode in this bridge circuit is equal to the maximum value of the secondary voltage of the transformer, which is half smaller than the full-wave rectifier circuit. So bridge rectifier is an improvement on diode half-wave rectifier. A capacitor is an electronic component that stores electrical energy in an electric field. It consists of two conductive plates separated by an insulating material called a dielectric. When a voltage is applied across the plates, opposite charges accumulate on each plate, creating an electric field between them. This electric field stores energy in the capacitor, which can be released when needed.

5.1.5.1 Structure: A capacitor typically consists of two metal plates, usually made of aluminum or tantalum, separated by a thin insulating layer known as the dielectric. The dielectric material can be made of various substances, such as ceramic, polyester, or electrolytic solution.

5.1.5.2 Charge Storage: When a voltage is applied across the plates, electrons accumulate onone plate, creating a negative charge, while an equal number of electrons are removed from the other plate, creating a positive charge. This process continues until the voltage across the capacitor reaches its maximum value, determined by the capacitance of the capacitor.

5.1.5.3 Capacitance: The capacitance of a capacitor, measured in farads (F), determines its ability to store charge at a given voltage. Capacitance depends on factors such as the areaof the plates, the distance between them, and the properties of the dielectric material.

5.1.5.4 Energy Storage: The energy stored in a capacitor is proportional to the square of the voltage across it and the capacitance. Mathematically, the energy (E) stored in a capacitor is given by the formula: $E = 0.5 * C * V^2$, where C is the capacitance in farads and V is the voltage across the capacitor.

5.1.5.5 Applications: Capacitors are used in a wide range of electronic circuits and devices for various purposes, including energy storage, filtering, decoupling, timing, and signal coupling. They are commonly found in power supplies, amplifiers, filters, oscillators, and memory circuits.

5.1.5.6 Charging and Discharging: Capacitors can charge and discharge rapidly, dependingon the circuit configuration and the applied voltage. When a capacitor is connected to a voltage source, it charges up until it reaches the source voltage. When the voltage sourceis removed or changed, the capacitor discharges, releasing the stored energy.

Overall, capacitors are essential components in electronic circuits, providing energy storage, filtering, and coupling functions critical for the operation of various electronic devices and systems.

5.1.6 Voltage sensor:

A voltage sensor is a device that measures voltage. Voltage sensors can measure the voltage in various ways, from measuring high voltages to detecting low current levels. These devices are essential for many applications, including industrial controls and power systems.

A voltage sensor is a device that measures the voltage of an electrical circuit. Voltage sensors are used in many applications, including monitoring and controlling equipment and machinery. Different types of voltage sensors work in various ways; here is an example:

5.1.6.1 Electromagnetic. This type uses an electromagnetic field to detect changes in voltage. The sensor's exposure to an electric current generates a magnetic field. It induces currents in nearby conductors, such as wires or circuit boards, sensitive enough to detect these changes. This type of sensor is often used with microcontrollers since they can easily measure changes in electromagnetic fields around them with the help of built-in analog-to-digital converters (ADCs).

Voltage sensors are used in various industries, including the automotive, manufacturing, maintenance, and medical fields. In the maintenance industry, voltage sensors are used to monitor the voltage of assets andequipment. For example, if the sensor is wireless, it can be placed anywhere on an asset. The data can be relayed back to a CMMS (for example), where a maintenance manager can make adjustments based on their preventive maintenance plan. Below aresome examples of voltage sensors in maintenance:

- **Power failure detection:** the process of detecting a power failure so that the system can safely switch to an alternate power source.
- **Load sensing:** a method of measuring the load on a motor and adjusting its speed accordingly.
- **Safety switching:** refers to a device that shuts off power in case of an overload or fault condition to prevent equipment damage.
- **Motor overload control:** a technique for preventing motor damage due to overloading by using thermal sensors, pressure sensors, current sensors, or other methods to detect the condition of the motor and avoid damage.
- **Temperature control:** refers to controlling temperature by regulating airflow or adding insulation around machinery components.
- **Fault detection:** refers to identifying faults within machinery components using sensors, alarms, or other devices to perform maintenance before severe damage.

5.1.7 OLED Display

An OLED (Organic Light-Emitting Diode) screen is a type of display technology commonly used in Arduino projects and other electronic devices. It consists of a thin film of organic compounds that emit light when an electric current is applied. OLED screens offer several advantages over traditional LCD (Liquid Crystal Display) screens, including better contrast, faster response times,and wider viewing angles.

5.1.7.1. Organic Layers: An OLED screen is made up of multiple organic layers, including an emissive layer, a conductive layer, and a substrate. These organic layers are sandwiched between two electrodes, typically made of transparent conductive materials such as indium tin oxide (ITO).

5.1.7.2. Electroluminescence: When a voltage is applied across the electrodes, an electric current flows through the organic layers, causing electrons to move from the cathode (negative electrode) to the anode (positive electrode). As electrons pass through the organic layers, they recombine with positively charged "holes," releasing energy in the form of light.

5.1.7.3. Pixel Control: OLED screens are composed of individual pixels, each of which contains red, green, and blue subpixels that emit light of different colors. By controlling the voltage applied to each pixel, the intensity of light emitted by the subpixels can be adjusted, allowing for precise color control and brightness modulation.

5.1.7.4. Thin and Flexible: OLED screens are typically thinner and more flexible than LCD screens, making them suitable for curved and flexible displays. This flexibility allows for innovative designs and applications in areas such as wearable devices, automotive displays, and foldable smartphones.

5.1.7.5. Arduino Compatibility: Many Arduino-compatible OLED screens are available, featuring standard communication interfaces such as I2C (Inter- Integrated Circuit) or SPI (Serial Peripheral Interface) for easy integration with Arduino microcontrollers. Libraries and code examples are often provided to simplify programming and control of OLED displays in Arduino projects.

Overall, OLED screens offer high-quality, high-performance display solutions for Arduino projects and a wide range of other electronic devices, providing vibrant colors, excellent image quality, and versatility in design and application.

5.2 SOFTWARE REQUIREMENTS

5.2.1 Arduino IDE:

Arduino IDE (Integrated Development Environment) is an open-source software application that is used for writing and uploading code to Arduino boards.It is a user-friendly interface that simplifies the process of programming and creating projects with the Arduino platform. The IDE provides a text editor, a compiler, a debugger, and a serial monitor, among other features. It is a versatile software tool that allows users to write and upload code for various Arduino boards and modules .The Arduino IDE is available for free download on the Arduino website and can be used ondifferent operating systems, such as Windows, Mac, and Linux. It supports the most commonly used programming language for Arduino boards, which is a simplified version of C++. The text editor of the IDE is the main interface for writing code. It provides syntax highlighting, code auto-completion, and indentation, making the process of writing code easier and less prone to errors. The IDE also has a built-in library manager, which allows users to search and install additional libraries that are needed for a particular project. Once the code is written, it can be compiled and uploaded to the Arduino board. The IDE has a built-in compiler that converts the code into machine- readable instructions that can be understood by the Arduino board. The uploading process is also simple, and it involves connecting the Arduino board to the computer via a USB cable and selecting the appropriate board and port settings in the IDE. The IDE also includes a serial monitor, which allows users to communicate with the Arduino board and receive data from it.

This feature is particularly useful for debugging and testing purposes, as it enables users to see the output of their code in real-time. Another advantage of the Arduino IDE is its large and active community. The community is made up of developers, enthusiasts, and hobbyists who are passionate about Arduino and its applications. They contribute to the development of the IDE by creating libraries, tutorials, and examples that can be used by other users.

CHAPTER 6

RESULT AND DISCUSSION

The charging control system in an EV coordinates various components to facilitate wireless bypass charging. It integrates with the vehicle's onboard systems, the charging infrastructure, and renewable energy sources like wind turbines to enable seamless and sustainable charging . The control system utilizes communication protocols to establish a connection between the EV and the charging station. It enables data exchange for monitoring charging parameters, ensuring compatibility, and coordinating charging activities. Efficient charging requires precise alignment between the transmitter coil in the charging station and the receiver coil in the EV.

The control system employs algorithms to optimize coil alignment, maximizing energy transfer efficiency and minimizing charging time. Managing power flow during wireless charging is critical for safety and efficiency. The control system regulates the power output from the charging infrastructure, adjusting it based on the battery's state of charge, charging rate limits, and grid conditions. The control system interfaces with the EV's Battery Management System (BMS) to monitor battery health, temperature, and charging status. It ensures that charging parameters remain within safe limits, preventing overcharging, overheating, or damage to the battery. The control system implements charging scheduling algorithms to prioritize charging based on user preferences, energy tariffs, and grid conditions.

It optimizes charging times to minimize electricity costs, reduce peak demand, and support grid stability. An intuitive user interface provides EV owners with real-time charging status updates, scheduling options, and energy consumption data. It enables remote monitoring and control, allowing users to manage charging sessions conveniently through mobile apps or vehicle dashboards.

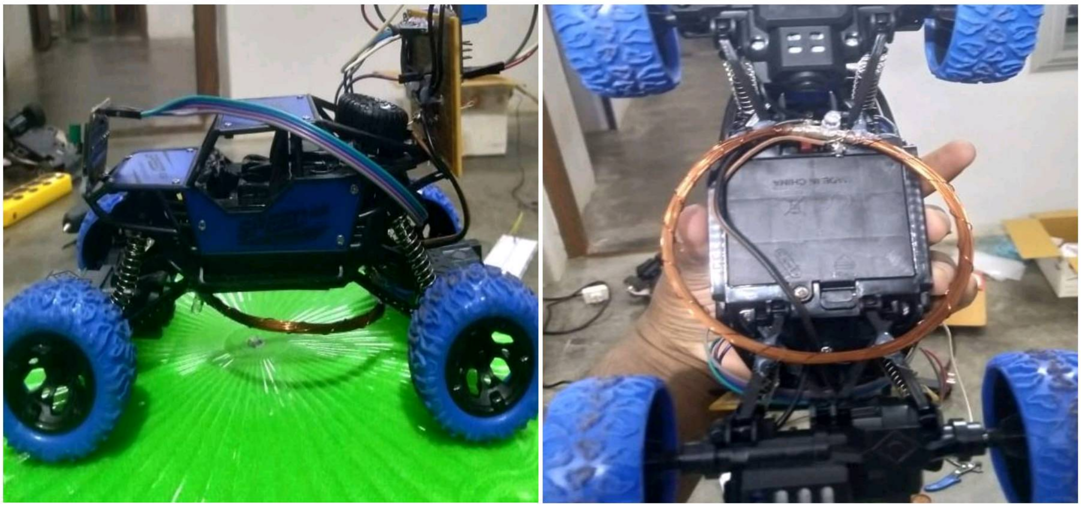

Figure 6.1: Receiver setup

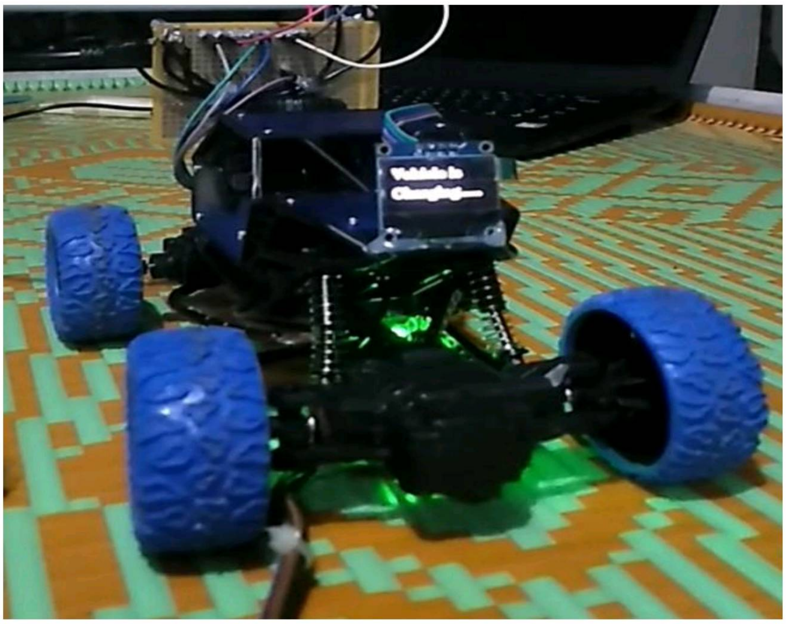

Figure 6.2: Final output of project

CHAPTER 7

APPENDIX

```
 #include <Wire.h>
#include <U8g2lib.h>
 // Initialize the OLED display object
U8G2_SSD1306_128X64_NONAME_F_SW_I2C u8g2(U8G2_R0, /* clock=/ A5, /
 data=/ A4, / reset=*/ U8X8_PIN_NONE);
 // Define the analog pin to which the voltage sensor is connected
const int voltageSensorPin = A0;
 void setup()
  {
 // Initialize the OLED display
u8g2.begin();
  }
        void loop()
      {
 // Read the voltage from the sensor
 int sensorValue = analogRead(voltageSensorPin);
 // Convert the sensor value to voltage (assuming 5V reference)
float voltage = sensorValue * (5.0 / 1023.0);


 // Print the voltage value to the OLED display
u8g2.clearBuffer(); // Clear the display buffer
u8g2.setFont(u8g2_font_ncenB14_tr); // Choose a font
```

```
 //u8g2.setCursor(0, 20); // Set cursor position
u8g2.drawStr(0, 20, "Vehicle is");
 //u8g2.print("                    "); // Print label

 if (sensorValue < 50)
 {
 u8g2.drawStr(0, 50, "Discharged."); // Print voltage value with 2 decimal places
 //u8g2.print("V"); // Print unit
 u8g2.sendBuffer(); // Send the buffer to the display
 }
 else
 {
     u8g2.drawStr(0, 50, "Charging... "); // Print voltage value with 2 decimal places
 //u8g2.print(""); // Print unit
 u8g2.sendBuffer(); // Send the buffer to the display
 }

 delay(1000); // Delay for readability, adjust as needed
 }
```

CHAPTER 8

CONCLUSION AND FUTURE ENHANCEMENT

8.1 CONCLUSION:

Wireless bypass charging using Darrieus wind turbines presents a promising avenue for advancing wireless power transfer technology. This innovative approach combines the principles of magnetic induction with the renewable energy generation capabilities of Darrieus wind turbines, offering a sustainable solution for wireless charging applications. In this conclusion, we will explore the key advantages, challenges, and future prospects of this technology. One of the primary advantages of wireless bypass charging using Darrieus turbines is its ability to harness clean, renewable energy sources for powering devices wirelessly. Darrieus wind turbines, with their vertical axis design, are particularly suitable for urban environments where space is limited, making them ideal candidates for integrating wireless charging infrastructure into existing infrastructure seamlessly. By utilizing wind energy, this technology contributes to reducing reliance on fossil fuels and mitigating environmental impacts associated with conventional charging methods. Furthermore, the integration of Darrieus wind turbines into wireless power transfer systems enhances energy efficiency and sustainability. These turbines can generate electricity even in low wind conditions, ensuring a consistent power supply for charging applications. Additionally, their modular design allows for scalability, enabling the deployment of charging stations in various locations to meet the growing demand for wireless charging services.

The studies demonstrate the feasibility and viability of utilizing Darrieus wind turbines for wireless power transfer applications. Researchers have successfully designed, implemented, and optimized systems that integrate Darrieus turbines into wireless charging networks. Efforts have been made to enhance the efficiency of wirelesspower transfer systems by optimizing the design and operation of Darrieus turbines.

Various parameters such as blade geometry, rotational speed, and system configuration have been investigated to maximize power transfer efficiency.

8.2 FUTURE ENHANCEMENT:

8.2.1. Scaling up: Implement the system on a larger scale, integrating multiple wind turbinesand charging multiple electric vehicles simultaneously.

8.2.2. Improving efficiency: Optimize the system's efficiency by exploring advance materials, designs, and technologies for the wind turbines, rectifiers, and wireless charging components.

8.2.3. Grid integration: Connect the system to the grid, enabling excess energy to be fed back into the grid and stabilizing the power supply.

8.2.4. Vehicle-to-Grid (V2G) technology: Implement V2G technology, allowing electric
vehicles to act as energy storage devices and supply energy back to the grid when not in use.

8.2.5. Smart charging infrastructure: Develop intelligent charging infrastructure that optimizes charging times, reduces peak demand, and ensures efficient energy distribution.

8.2.6. Electric vehicle adoption: Promote widespread adoption of electric vehicles, reducinggreenhouse gas emissions and dependence on fossil fuels.

8.2.7. Renewable energy integration: Explore integration with other renewable energy sources, such as solar power, to create a hybrid energy system.

8.2.8. Advanced materials and designs: Research new materials and designs for wind turbines, wireless charging components, and energy storage systems to enhance efficiency and reduce costs.

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