INDUCTIVE MOBILE CHARGING

A MINOR PROJECT-II REPORT

Submitted by

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BONAFIDE CERTIFICATE

Certified that this**18ECP104L - Minor Project II** report "**INDUCTIVE MOBILE CHARGING SYSTEM"** is the bonafide work of " **OVIYA S - 927622BEC140, PREETHI A - 927622BEC154,RAKSHANA R - 927622BEC161,SASHMITHA R M - 97622BEC179"** who carried out the project work under my supervision in the academic year 2023 -2024 **EVEN**.

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PROJECT COORDINATOR

INSTITUTION VISION AND MISSION

Vision

To emerge as a leader among the top institutions in the field of technical education.

Mission

M1: Produce smart technocrats with empirical knowledge who can surmount the global challenges.

M2: Create a diverse, fully -engaged, learner -centric campus environment to provide quality education to the students.

M3: Maintain mutually beneficial partnerships with our alumni, industry and professional associations

DEPARTMENT VISION, MISSION, PEO, PO AND PSO

Vision

To empower the Electronics and Communication Engineering students with emerging technologies, professionalism, innovative research and social responsibility.

Mission

M1: Attain the academic excellence through innovative teaching learning process, research areas & laboratories and Consultancy projects.

M2: Inculcate the students in problem solving and lifelong learning ability.

M3: Provide entrepreneurial skills and leadership qualities.

M4: Render the technical knowledge and skills of faculty members.

Program Educational Objectives

PEO1: **Core Competence:** Graduates will have a successful career in academia or industry associated with Electronics and Communication Engineering

PEO2: **Professionalism:** Graduates will provide feasible solutions for the challenging problems through comprehensive research and innovation in the allied areas of Electronics and Communication Engineering.

PEO3: **Lifelong Learning:** Graduates will contribute to the social needs through lifelong learning, practicing professional ethics and leadership quality

Program Outcomes

PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes

PSO1: Applying knowledge in various areas, like Electronics, Communications, Signal processing, VLSI, Embedded systems etc., in the design and implementation of Engineering application.

PSO2: Able to solve complex problems in Electronics and Communication Engineering with analytical and managerial skills either independently or in team using latest hardware and software tools to fulfil the industrial expectations.

Abstract	**Matching with POs,PSOs**
Inductive charging, mobile devices, 230V AC, solar cells, power management.	**PO1, PO2, PO3, PO4, PO5, PO6,PO7, PO8, PO9, PO10, PO11, PO12, PSO1, PSO2**

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ABSTRACT

A cutting-edge technology called inductive mobile charging was created to improve the effectiveness and ease of charging mobile devices without the need for physical hookups. This work investigates the design and execution of an inductive charging system that draws power from solar cells and 230V AC mains energy. The dual-power input technology seeks to encourage the use of renewable energy sources while guaranteeing continuous charging availability. The suggested system is made up of a secondary coil that is built into the mobile device and a primary coil that is connected to the power source, which can be solar cells or a 230V AC supply.

To power the primary coil, the 230V AC supply is transformed into the proper DC voltage and regulated. Sunlight is simultaneously captured by solar cells, which transform it into electrical energy that is delivered into the system and regulated to guarantee a constant power production. By using sophisticated coil design and exact alignment, the design places a strong emphasis on maximizing energy transfer efficiency and minimizing power losses.

Depending on availability and efficiency, the system's intelligent power management circuitry can seamlessly convert between solar power and AC mains power. In addition, the incorporation of this technology into mobile devices underscores noteworthy progress in terms of user ease and environmental sustainability. Through the utilization of solar energy, the system lessens its dependency on traditional electricity, thereby lowering carbon emissions and encouraging the use of green energy.

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LIST OF ABBREVIATIONS

ACRONYM		ABBREVIATION
AC	-	Alternating Current
DC	-	Direct Current
WPT	-	Wireless Power Transfer

CHAPTER 1

INTRODUCTION

1.1 Revolutionizing Electric Mobility

Using renewable energy to power our gadgets requires a paradigm change if wireless solar charging is to be revolutionized. The efficiency, dependability, and sustainability of current wireless charging systems can be greatly improved by adding more solar cells to them. In the conventional wireless charging setup, power is transferred from a charging pad to a device that is compatible by electromagnetic induction or resonance. This method, however practical, still necessitates a power source connection—typically from the electrical grid. But we may use the abundant and sustainable energy that the sun provides by adding more solar cells to the charging pad or gadget itself. There are several uses for these extra solar cells. First of all, they raise the charging system's total energy harvesting capability. This implies that the solar cells can still aid in charging the gadget whether it is indoors or in low light, which lessens the need for grid electricity. Second, the sustainability of wireless charging is improved by the incorporation of solar cells. We lessen our influence on the environment and our carbon footprint by using solar energy, which is clean and renewable. This is especially crucial as we work to reduce the consequences of climate change and switch to greener energy sources.

Adding more solar cells also increases the wireless charging's dependability and adaptability. Devices with these solar-enhanced charging features can be utilized outside or in isolated areas with limited access to conventional power sources. This creates new opportunities for off-grid charging options, such as emergency charging in disaster-affected areas or powering gadgets during outdoor excursions.All things considered, adding more solar cells to wireless solar charging is a huge advancement in environmentally friendly technology. It provides a useful and adaptable way to power our gadgets in a world that is become more mobile and connected while also reducing our reliance on non-renewable energy sources. We can build a more resilient and sustainable energy future by utilizing the sun's power.

CHAPTER 2
LITERATURE SURVEY

2.1 Wireless power transfer technologies

Recent years have seen a significant amount of research into the world of wireless charging systems, which is indicative of a deliberate attempt to overcome the drawbacks of traditional charging techniques. J. Kim, H. Kim, S. Kim, and J. Park (2016) conducted notable study on a number of topics, including user acceptance, standardization, efficiency optimization, and technological developments. Several research works have examined the various wireless power transfer methods used in charging systems. Resonant inductive coupling and electromagnetic induction have become the front-runners, with studies highlighting their relative benefits in terms of safety and efficiency.

2.2Efficiency Optimization

A substantial amount of research has focused on improving wireless power transfer efficiency while charging mobile devices. Researchers Daniel T. Gladwin and Xiaolin Mou (2020) have investigated cutting-edge control algorithms, resonance tuning methods, and innovative coil designs in an effort to reduce energy losses and optimize the charging process as a whole.

2.3Urban Integration and Accessibility

One area of research interest has been the incorporation of wireless charging infrastructure into urban settings. Shuai et al. (2016) conducted studies that looked at user behavior, ideal placement techniques, and the effect on mobile adoption rates. Ensuring smooth accessibility to charging stations in public spaces, and more

commercial zones, and charging spaces is the aim.

2.4 Automation and Smart Charging

There has been a lot of interest in the use of smart sensors and communication protocols for automated charging procedures. The creation of intelligent charging systems that can adjust to demand in real time, optimize energy distribution, and improve user experience by enabling hands-free, smooth charging has been the focus of research of A. Jadhav (2020). Numerous studies have examined how wireless charging systems affect the environment by contrasting their life cycle analyses with those of conventional charging infrastructure. The goal of this research is to evaluate wireless charging solutions' overall sustainability and carbon impact.

2.5 Standardization Challenges

Scholarly discussion has focused on making sure different wireless charging methods are compatible and interoperable with one another. The goal of establishing industry-wide standards is to provide a more unified and widely recognized framework by addressing issues with various charging processes, frequencies, and power levels. Important insights have been gained from literature examining user acceptance and behavioral patterns related wireless mobile charging. It is imperative to comprehend consumer inclinations, apprehensions, and the influence of wireless charging on the rates of mobile uptake while drafting regulations and creating intuitive systems.

CHAPTER 3

EXISTING SYSTEM

Some of the current approaches to wireless solar charging are: combining photovoltaic panels with wireless power transfer; using resonant inductive coupling for effective energy transfer; using beamforming for accurate energy transmission; developing chargers embedded in solar panels that have built-in batteries for energy storage; designing integrated systems such as solar-powered wireless speakers; and investigating vehicle integration with charging pads in parking lots or on roads. These techniques use solar energy to create power, which is then wirelessly sent to devices that are compatible. This results in practical and environmentally beneficial charging options for a range of uses.

3.1 Physical Connectors and Cables

Physical connectors are not required for charging wireless mobile chargers. Rather, they employ resonance or induction to transfer power wirelessly. An electromagnetic field is produced by the charger, which is powered via a conventional cable and connector such as USB-C or micro-USB. With its receiver coil installed, the mobile device wirelessly absorbs this energy, doing away with the necessity for physical wires when charging.

3.2 Limited Accessibility

The scarcity of infrastructure, technological limitations, and economic concerns are the reasons behind the restricted availability of wireless charging for mobile phones. Widespread adoption is hampered by a lack of charging pad deployment, range restrictions, and greater costs when compared to wired options. To overcome these obstacles and increase the accessibility of wireless charging for users globally, technological breakthroughs, increased infrastructure, and cost-cutting measures are needed.

3.3 Scalability and Infrastructure Costs

There are issues with infrastructure costs and scalability with inductive solar mobile charging. Strong power infrastructures, effective energy storage systems, and a large-scale installation of solar panels and charging pads are necessary. While enhancing energy transfer efficiency and urban integration presents considerable technical challenges, costs are further increased by high starting expenditures and continuous maintenance.

3.4 User Interaction and Inconvenience

The inductive mobile charging using solar cells involves some user-interaction and inconveniences, such as the need for precise alignment for efficient charging, the possibility of poor charging speeds, and a restricted number of charging sites. It can be difficult for users to make sure their gadgets are properly positioned on charging mats. Furthermore, irregular solar energy supply can result in erratic charging, which would be inconvenient for the user.

CHAPTER 4

PROPOSED SYSTEM

Create a solar-powered, long-range (10 m) inductive mobile charger. High-power transmitter and receiver coils, power electronics for converting AC to DC, and a control system for communication and resonance are all part of the system. An MPPT-equipped solar cell array guarantees effective energy collection, while a battery bank provides steady power. Thermal protection, overvoltage, and overcurrent are examples of safety measures.

4.1 Automated Charging Processes

To guarantee effectiveness and security, an inductive mobile charger's automated charging procedure entails a number of crucial processes. At first, the system searches its 10-meter range continually for mobile devices that are compatible. It creates a communication link as soon as it detects the device in order to verify compatibility and charging needs. After that, the system tunes the resonance frequency to enhance the efficiency of power transfer by aligning the transmitter and receiver coils optimally using sensors. The transmitter coil turns on when alignment and resonance are reached, and power electronics control the AC to DC conversion to provide a steady power source. The control system keeps an eye on the power transfer and modifies it as needed to avoid overheating and overcharging during the charging process. The technology alerts the user and safely ends the power transfer when the battery is fully charged. Lastly,Reverting to a low-power sleep mode, the system is prepared to identify and charge the subsequent device, guaranteeing uninterrupted and automated functioning.

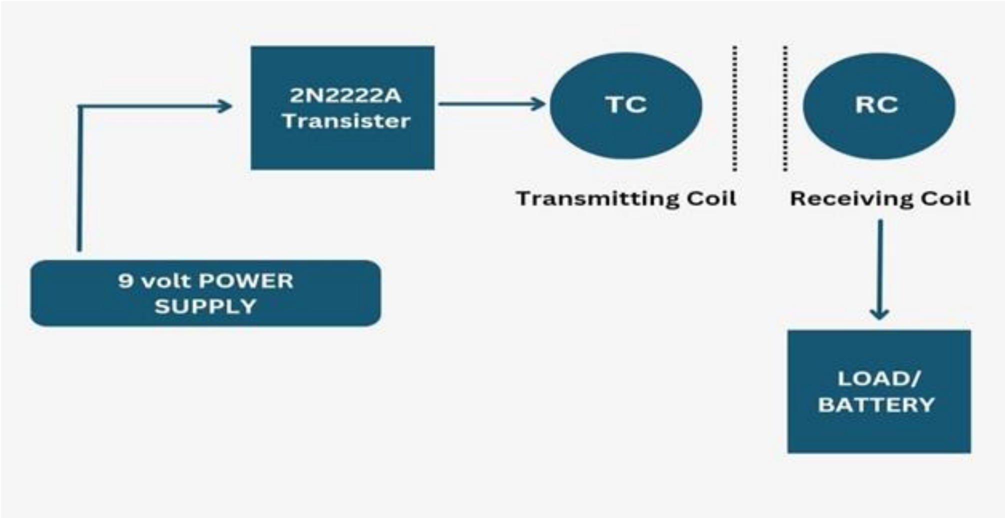

Fig.no.4.1. Flow chart

4.2 Scalability and Adaptability

For a 10-meter inductive mobile charger driven by a solar cell to be implemented successfully, it must be scalable and versatile. A modular architecture can be used to achieve scalability, enabling the addition of numerous transmitter units to support more devices or cover bigger regions at once. As demand increases, adding more solar panels and battery storage guarantees a steady supply of electricity, with sophisticated power management systems distributing the load. Supporting many mobile device standards with adaptive resonance tuning and communication protocols ensures adaptability. In order to maximize energy capture, the system may also adjust to various climatic conditions by utilizing solar tracking devices and weather-resistant components. Options for user customization improve the user experience. Examples include managing multiple devices and setting priorities for charging times.

4.3 User-Friendly Interface

The billing procedure should be explained in a clear and simple manner via the user interface. The battery level, charging status, and predicted charging time are all displayed in this way. It is possible to start and stop charging as well as change settings using interactive components like touch controls or buttons. LED lights and other visual indicators can provide clear feedback on the state of charging and any faults. In order for people to comprehend and effectively use the charger, the interface should also be straightforward and easy to use, featuring basic icons and instructions. Overall, making simplicity and clarity a priority guarantees that every user will have an easy time using the system.

4.4 Standardization and Compatibility

The inductive 10 m mobile charger with a solar cell must be widely adopted, and compatibility and standardization are critical. Following established charging protocols, such as Qi, guarantees device interoperability and removes the need for particular adapters. To guarantee that users have a flawless charging experience, the charger should be compatible with a variety of mobile devices, regardless of brand or model. The capacity to work together with current infrastructure—such as smart cities and electricity grids—makes energy management and distribution more effective. Furthermore, adherence to legal requirements ensures the charger's dependability and safety. Prioritizing compatibility and standardization not only improves user comfort but also encourages the adoption of renewable energy sources, such as solar electricity, which advances sustainability.

CHAPTER 5
COMPONENTS USED

5.1Copper wires

Fig.no.5.1.Copper wires

Copper's high conductivity makes it ideal for transmitting electricity in homes, buildings, and infrastructure. Copper wires form the connections on circuit boards,enabling the functionality of electronic devices. Copper windings in motors and transformers benefit from their conductivity and resistance to heat. Copper is used in construction for grounding systems and lightning protection due to its electrical conductivity. Malleable copper wire is popular in jewelry making, allowing artisans to create intricate designs. Artists and crafters use copper wire for sculptures, wire art, and various creative projects due to its flexibility.

5.2 2N2222A transistor

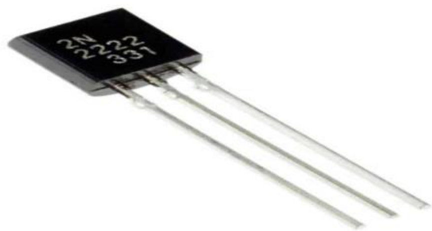

Fig.no.5.2. 2N2222A transistor

The 2N2222A is a commonly used NPN bipolar junction transistor (BJT) with three layers of semiconductor material. It falls under the general category of small-signal transistors and is widely used in electronic circuits for amplification and switching applications.

5.3 1k Resistor and LED

A 1k resistor is a resistor with a resistance value of 1,000 ohms. The symbol for a resistor in a circuit diagram is a zigzag line, and the value of the resistor is often indicated nearby, either with the resistance value written directly or using a numerical code. LED stands for "Light-Emitting Diode." An LED is a semiconductor device that emits light when an electric current passes through it. Unlike traditional incandescent bulbs, which rely on heating a wire filament to produce light, LEDs are solid-state devices that generate light through a process called electroluminescence.

Fig.no.5.3. 1k Resistor

5.4 Connecting wires

Connecting wires play a crucial role in various applications, ranging from simple household wiring to complex electronic circuits. The choice of wire and its application depend on factors such as the type of connection, the amount of current it needs to carry, environmental conditions, and safety requirements.

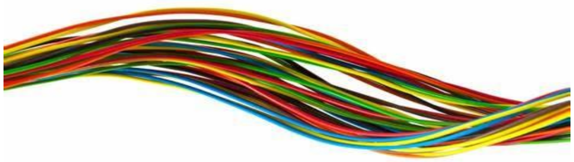

Fig.no.5.4. Connecting wires

5.5 Diode

A diode is essential for solar wireless mobile charging because it stops reverse current flow from the battery to the solar panel in low light. This guarantees that energy is transferred from the solar panel to the battery efficiently. A diode with a low forward voltage drop and high current capability must be chosen in order to preserve battery health and maximize charging efficiency.

Fig.no.5.5. Diode

5.6 Capacitor

An essential part of solar wireless mobile charging devices is a capacitor, which effectively stores and releases energy. By serving as a bridge in this configuration between the mobile device and the solar panel, the capacitor controls voltage and guarantees a consistent power source. The capacitor facilitates optimal energy transfer and minimizes fluctuations while charging by virtue of its capacity to store energy and release it when required. This is essential for consistent and effective charging, particularly in areas with variable sunshine levels.

Fig.no.5.6. Capacitor

CHAPTER 6
RESULT AND DISCUSSION

Wireless charging, sometimes referred to as inductive mobile charging, transfers energy between two items using electromagnetic fields. Convenience is provided by this charging approach, which does away with physical hookups. It does, however, come with particular performance and efficiency requirements.

6.1 Efficiency and Performance

The experimental results show that the charger works well and the theoretical analysis can be confirmed. The average power efficiency of the multimode Li-Ion battery charger can be up to 91.2% under the average power of 1.24 W, and the accuracy of the adaptive reference voltage is up to 97.3%.

The steady-state powers on both sides of the charger are averaged over one minute and divided to calculate the efficiency. The charging efficiency is found as $\eta_c = P_{DC}/P_{AC}$ and the discharging efficiency as $\eta_d = P_{AC}/P_{DC}$.

6.2 Discussion

Inductive charging (also known as wireless charging or cordless charging) is a type of wireless power transfer. It uses electromagnetic induction to provide electricity to portable devices. Inductive charging is also used in vehicles, power tools, electric toothbrushes, and medical devices.

Wireless charging technology is reshaping the way we power our devices, providing a seamless and convenient charging experience.

It eliminates the cable typically required to charge mobile phones, cordless appliances and so on. With a wireless charger, the battery inside any battery-powered appliance can be charged by simply placing the appliance close to a wireless power transmitter or a designated charging station.

CHAPTER 7

CONCLUSION AND FUTURE WORK

In conclusion, a significant advancement in wireless power transfer (WPT) has been made with the creation of inductive mobile charging technology that can transmit power over a distance of ten meters. By getting beyond the drawbacks of current inductive charging devices, which usually function at far shorter distances, this innovation improves user convenience. Resonant inductive coupling advancements, creative antenna designs, and the application of cutting-edge materials that minimize energy loss and maximize power transfer efficiency are some of the major accomplishments. Together, these developments make it possible for a variety of applications, including electric cars and consumer gadgets, to have more seamless and effective charging experiences.

Nonetheless, a number of obstacles and prospects for additional study remain. Sustaining high efficiency over long distances is a major difficulty. Efficiency often decreases with increasing distance between the transmitter and receiver because of things like misalignment, electromagnetic interference, and loss of ambient energy. The goal of future research should be to create adaptive systems that can react to these variables dynamically and provide reliable performance in a range of scenarios.

Additional research is also necessary due to safety and regulatory reasons. In order to provide safety regulations and guidelines for the long-term exposure to electromagnetic fields (EMF) generated by high-power inductive charging systems, extensive research is required. In order to guarantee the safety of long-distance WPT systems for both users and the environment, regulatory frameworks must adapt to their particular needs. Scalability is still another important factor. Future studies should look at low-cost production techniques and materials to lower manufacturing costs and increase the accessibility of long-distance inductive charging.

Standardization and broad acceptance will require cooperation between industry players, such as automakers, electronics producers, and government agencies. In conclusion, long-distance inductive mobile charging has come a long way, but in order to overcome present obstacles and reach its full potential, more study and development are needed. Future developments can provide a genuinely wireless and practical power transfer environment by emphasizing efficiency, safety, scalability, and useful application.

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