DESIGN & FABRICATION OF A SOLAR-BASED POWER CHARGER

A Thesis
by

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SONARGAON UNIVERSITY (SU)

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NOTATION

RTU-Remote Terminal Unit
LAN- Local Area Network
IEDs -Intelligent Electronic Devices
SPI Pins-Serial Peripheral Interface
SCK-Serial Clock
TTL-Transistor Transistor Logic
GPS-Global Positioning System
PCB-Printed Circuit Board
THD-Total Harmonic Distortion
GSM-Global System for Mobile Communications
RTU-Remote Terminal Unit
AC – Alternating Current
DC – Direct Current
PV – Photovoltaic
SP – Solar Panel
SCC – Solar Charge Controller
PWM – Pulse Width Modulation
MPPT – Maximum Power Point Tracking
USB – Universal Serial Bus
QC – Wireless Charger
LED – Light Emitting Diode

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ABSTRACT

The increasing use of portable electronic devices has created a growing demand for reliable, portable, and environmentally friendly power sources. Conventional charging methods depend heavily on grid electricity, which is often unavailable in remote areas and contributes to environmental pollution. This project presents the design and implementation of a solar-based wireless power charger that utilizes renewable solar energy to charge electronic devices through both wired (USB) and wireless methods. The proposed system consists of a solar panel, solar charge controller, 12V battery, DC–DC converters, USB output, and a wireless charging module. Solar energy is converted into electrical energy using a photovoltaic panel and regulated by the charge controller to safely charge the battery. The stored energy is then supplied to USB and wireless charging units, ensuring continuous power availability even during low sunlight conditions. Wireless charging is achieved using electromagnetic induction, providing convenient and contactless charging. The system was tested under different operating conditions, and the results demonstrate reliable performance for low-power devices. Although wireless charging introduces some efficiency losses, the overall system proves to be portable, eco-friendly, and suitable for off-grid and emergency applications. This project highlights the feasibility of integrating solar energy with wireless charging technology as a sustainable alternative to conventional charging methods.

CHAPTER 1

INTRODUCTION

1.1 Introduction

The increasing global demand for portable electronic devices such as smartphones, tablets, and wearable systems has led to a corresponding rise in energy consumption. Conventional charging methods rely heavily on grid-supplied electricity, which is primarily generated from fossil fuels. This dependence contributes to environmental degradation, greenhouse gas emissions, and energy insecurity, particularly in remote and off-grid regions. As a result, the development of sustainable and renewable energy-based charging solutions has become an important area of research.

Solar energy is one of the most abundant, clean, and renewable energy sources available. Photovoltaic (PV) technology enables the direct conversion of sunlight into electrical energy without producing harmful emissions. Due to recent advancements in solar panel efficiency and power electronics, solar-powered charging systems have become increasingly viable for small-scale and portable applications. However, the intermittent and variable nature of solar irradiance presents challenges in delivering stable and reliable power to electronic devices.

A solar-based power charger addresses these challenges by integrating energy storage and power conditioning circuits. By employing a charge controller, energy harvested from the solar panel can be efficiently regulated and stored in a rechargeable battery. The stored energy is then processed through DC-DC converters to provide a constant and safe output voltage suitable for charging electronic devices. Advanced techniques such as Maximum Power Point Tracking (MPPT) further enhance system efficiency by ensuring optimal utilization of the solar panel under varying environmental conditions.

This project focuses on the design and analysis of a portable solar-based power charger capable of delivering regulated DC output for mobile and low-power electronic devices. The proposed system aims to improve energy efficiency, portability, and reliability while maintaining a cost-effective and environmentally friendly design. The study also evaluates system performance in terms of efficiency, charging time, and practical usability, demonstrating the feasibility of solar energy as an alternative power source for everyday charging applications.

1.2 Problem Identification

The increasing dependence on portable electronic devices has created a need for reliable charging solutions, especially in areas with limited or unreliable grid electricity. Although solar energy offers a clean and renewable alternative, conventional solar chargers suffer from unstable output, low efficiency, and long charging times due to variations in sunlight and poor power management. The lack of proper energy storage and voltage regulation further reduces reliability and safety. Therefore, there is a need to design an efficient and portable solar-based power charger that can provide stable, safe, and reliable power under varying environmental conditions.

1.3 Objectives

The project's objectives are to

i. To provide portable and renewable energy using solar power.
ii. To charge electronic devices without cables through wireless charging.
iii. To ensure power availability in emergency or outdoor situations.
iv. To reduce dependence on grid electricity and promote green energy.
v. To support eco-friendly and sustainable charging solutions.
vi. To offer convenient and user-friendly mobile charging anywhere.
vii. To store solar energy efficiently for later use.

1.4 Necessity of Solar Energy

The growing use of portable electronic devices has increased the demand for continuous and reliable power sources. In many remote and rural areas, access to grid electricity is limited or unreliable, making conventional charging methods impractical. A solar-based power charger provides an independent, renewable, and eco-friendly solution by utilizing abundant solar energy. It reduces dependence on fossil fuels, lowers carbon emissions, and ensures device availability during power outages and emergencies. Therefore, solar-based power chargers are essential for sustainable, off-grid, and portable power applications.

1.5 Advantages of Solar Power

i. Uses renewable and eco-friendly solar energy.
ii. Works without grid electricity.
iii. Useful during power cuts and emergencies.
iv. Portable and cost-effective
v. Reduces carbon emissions

1.6 Disadvantages of Solar Power

i. Depends on sunlight availability and weather conditions.
ii. Slow charging compared to conventional chargers.
iii. Low efficiency in cloudy or indoor conditions.
iv. Higher initial cost for solar panels and components.
v. Limited power output for high-power devices.

1.7 Chapter Summary

This chapter introduces the need for a solar-based power charger due to the increasing use of portable electronic devices and the limitations of grid electricity. It highlights solar energy as a clean and renewable solution and discusses the problems of conventional charging methods. The objectives, necessity, advantages, and disadvantages of solar power are outlined, establishing the importance of developing an efficient, portable, and eco-friendly solar-based charging system.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The growing dependence on portable electronic devices and the increasing demand for sustainable energy solutions have accelerated research into solar-based power chargers. Solar energy, being renewable, clean, and widely available, offers a practical alternative to conventional grid-based charging systems. Solar-based power chargers, including wired and wireless configurations, aim to provide portable, efficient, and environmentally friendly charging solutions for mobile devices, power banks, and even electric vehicles. This literature review examines existing research on the design, fabrication, and performance of solar-based power chargers, with particular emphasis on wireless charging, power management, system efficiency, and practical implementation.

2.2 Fundamentals of Solar Power

A solar-based power charger works on the principle of photovoltaic energy conversion, where solar panels convert sunlight into electrical energy. This electrical energy is regulated using a charge controller and stored in a rechargeable battery. A DC–DC converter is then used to provide a stable output voltage suitable for charging electronic devices. The system ensures efficient energy utilization, safe battery operation, and reliable power delivery under varying sunlight conditions.

2.3 Solar Energy Harvesting and Power Management Systems

Efficient solar energy harvesting and power regulation form the foundation of solar-based charging systems. Shariff et al. (2019) investigated a solar-powered electric vehicle charging station, focusing on photovoltaic integration, battery storage, and power conditioning to ensure stable output. Similarly, Dev et al. (2024) designed a solar-based off-grid charging station emphasizing decentralized energy systems for sustainable power access.

Soltani et al. (2023) extended this concept by introducing a portable solar-based poly-generation system, which demonstrated improved performance through optimized system design and fabrication. Kolawole and Ayodele (2024) further emphasized the role of smart electronics in improving the efficiency and reliability of solar-powered systems, highlighting advanced power management techniques applicable to small-scale solar chargers.

2.4 Wireless Power Transfer in Solar-Based Charging Systems

Wireless charging has emerged as a significant advancement in solar-powered chargers due to improved user convenience and reduced cable dependency. Shufian et al. (2019) presented one of the earlier implementations of a solar-powered wireless battery charger, demonstrating the feasibility of combining photovoltaic systems with inductive charging. Tran et al. (2021) developed a solar-powered charging station with wireless charging capability for mobile devices, emphasizing inductive power transfer efficiency. Jain et al. (2023) and Tiwari et al. (2025) expanded wireless charging research into electric vehicle applications, addressing system modeling, power transfer efficiency, and scalability.

2.5. Smart Charging, Control, and Battery Management

Smart charging techniques play a crucial role in enhancing system safety, efficiency, and battery lifespan. Sunanda et al. (2020) introduced smart instant charging methods for power banks, focusing on reducing charging time and optimizing energy utilization. Santhakumar et al. (2024) proposed a solar-based wireless charging system with integrated battery level management, ensuring protection against overcharging and deep discharge. Kolawole and Ayodele (2024) also highlighted the importance of intelligent electronics and control strategies in maintaining system reliability and performance.

2.6 Large-Scale and Infrastructure-Level Charging Applications

Beyond portable devices, several studies explored solar-based charging infrastructure for higher power applications. Shariff et al. (2019) and Dev et al. (2024) focused on solar-powered charging stations, highlighting system reliability, energy storage, and grid independence.

Jain et al. (2023) and Tiwari et al. (2025) extended infrastructure-level research to wireless electric vehicle charging systems, demonstrating the scalability of solar-powered wireless charging technologies.

2.7 Energy Efficiency and System Optimization

Energy efficiency remains a critical concern across all solar-powered charging systems. Esho et al. (2024), although focused on satellite communication systems, provided valuable insights into energy-efficient design principles and power optimization strategies applicable to solar-powered electronics.

Soltani et al. (2023) and Kok et al. (2024) also emphasized performance assessment and efficiency improvement through optimized system design and component selection.

2.8 Design and Fabrication of Solar Charging Stations

Beyond small-scale chargers, several researchers have investigated solar-based charging stations, offering valuable design methodologies. Shariff et al. (2019) developed a solar-powered electric vehicle (EV) charging station, addressing system architecture, power electronics, and energy storage. Jain et al. (2023) and Tiwari et al. (2025) extended this work to wireless EV charging, demonstrating the scalability of solar charging concepts from portable devices to high-power applications.

Dev et al. (2024) presented the design and implementation of an off-grid solar-based charging station, highlighting the importance of system sizing, load estimation, and battery backup. Although EV and station-level systems operate at higher power levels, their design frameworks inform the fabrication of smaller solar-based power chargers, particularly in component selection and system integration.

2.9 Practical Implementations and Prototyping Support

Practical demonstrations, such as those shown in the referenced YouTube resources, complement the academic literature by illustrating real-world fabrication techniques, component integration, and troubleshooting methods. These resources typically demonstrate the use of solar panels, charge controllers, DC–DC converters, lithium-ion batteries, and wireless charging modules. Such implementations bridge the gap between theoretical design and hands-on fabrication, reinforcing concepts discussed in the reviewed studies.

2.10 Summary and Research Gap

In summary, existing research demonstrates that solar-based power chargers are a promising solution for sustainable and portable energy needs. Prior studies have explored various design approaches, including wired and wireless charging, smart power management, and scalable charging architectures. The insights from these works provide a strong foundation for the design and fabrication of a solar-based power charger, particularly in selecting components, implementing control strategies, and evaluating performance. This project builds upon existing research by integrating efficient solar energy harvesting with practical charging solutions suitable for modern portable electronic devices. There remains a research gap in developing a compact, cost-effective, and highly efficient solar-based wireless power charger with integrated smart control and battery management, which this project aims to address.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter covers the hardware implementation, which is the main focus of our project. The project would not be feasible without appropriate implementation. Thus, we outline our hardware implementation and discuss the project's success in this chapter.

Several devices with predetermined nominal values are required to complete the project. You won't receive the intended outcomes if the device ratings don't match. As a result, we have discussed the various gadgets we used for the project and their specifications.

3.2 Methodology

The methodology of the proposed solar-based wireless power charger involves a systematic design and evaluation process. Initially, system requirements such as wireless charging power, battery capacity, and solar panel rating are defined. A suitable system architecture is then designed in which solar energy is harvested using a photovoltaic panel and regulated through an MPPT-based charge controller to efficiently charge a lithium-ion battery. The stored energy is supplied to a DC–DC converter to provide a stable voltage required for the wireless charging transmitter. A Qi-compatible wireless power transfer module is used to deliver power to the load without physical connectors. The complete system is implemented as a prototype and tested under different sunlight and operating conditions. Key parameters such as charging time, efficiency, output stability, and temperature are measured and analyzed to evaluate system performance and feasibility.

3.3 Flow Chart of The Project

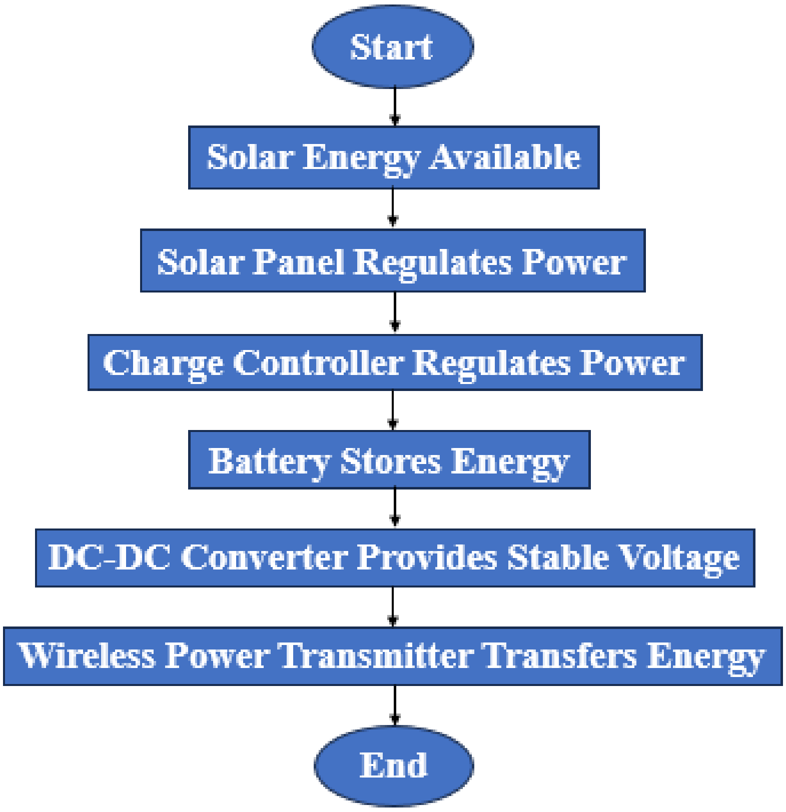

Fig 3.1 Flow Chart of the project

The flow of operation of the solar-based wireless power charger begins with the solar panel converting sunlight into electrical energy. This generated power is regulated by the solar charge controller to ensure safe and efficient charging of the 12V battery. The battery stores the electrical energy and acts as a backup power source when sunlight is unavailable. When sufficient battery power is available, energy is supplied to the USB output for wired charging and to the wireless charger for contactless charging of devices. All components are interconnected through wires and clips, and the system continues operating until the charging process is completed or the power source is depleted.

3.4 Block Diagram of the Project

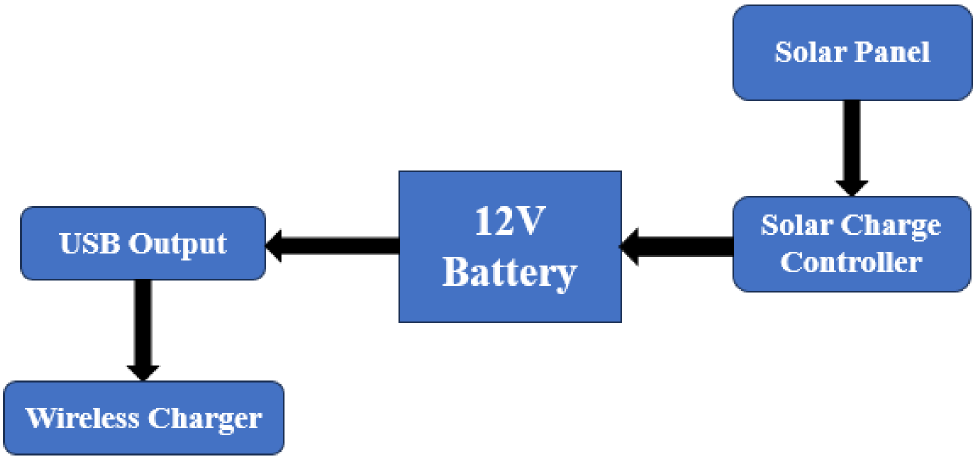

Fig 3.2 Block diagram of the project

Here is a brief overview of our project. The block diagram of the proposed solar-based wireless power charger consists of a solar panel as the primary energy source, which converts solar energy into electrical energy. This electrical power is fed to a solar charge controller that regulates the voltage and current to safely charge a 12V battery. The battery stores the generated energy and supplies power to both wired and wireless charging units. A USB output is provided for conventional wired charging, while a wireless charger enables contactless power transfer to compatible devices. All electrical components are interconnected using wires and clips to ensure proper connectivity. The entire system is housed inside a protective box, while a supporting frame is used to mount and secure the solar panel and enclosure, ensuring structural stability and ease of use.

3.5 Circuit Diagram of our project

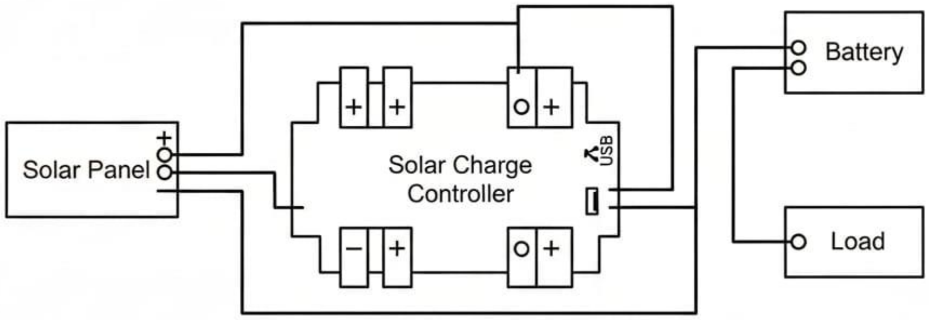

Fig 3.3 Circuit diagram of the project

The circuit diagram of the solar-based wireless power charger consists of a solar panel connected to a solar charge controller, which regulates the generated electrical energy and safely charges a 12V battery. The battery acts as an energy storage unit and supplies power to the load through a fuse and a main switch for protection and control. From the battery, the 12V DC supply is stepped down to 5V using DC–DC buck converters. One buck converter provides a regulated 5V output to the USB port for wired charging, while the other supplies power to the wireless charging module for contactless charging. All components are interconnected using wires and clips, and the complete circuit is enclosed in a protective box, with a frame used to support the solar panel and housing structure.

3.5 Design of Hardware

Fig 3.4 Final hardware setup of the project

3.7 CAD Design of the Project

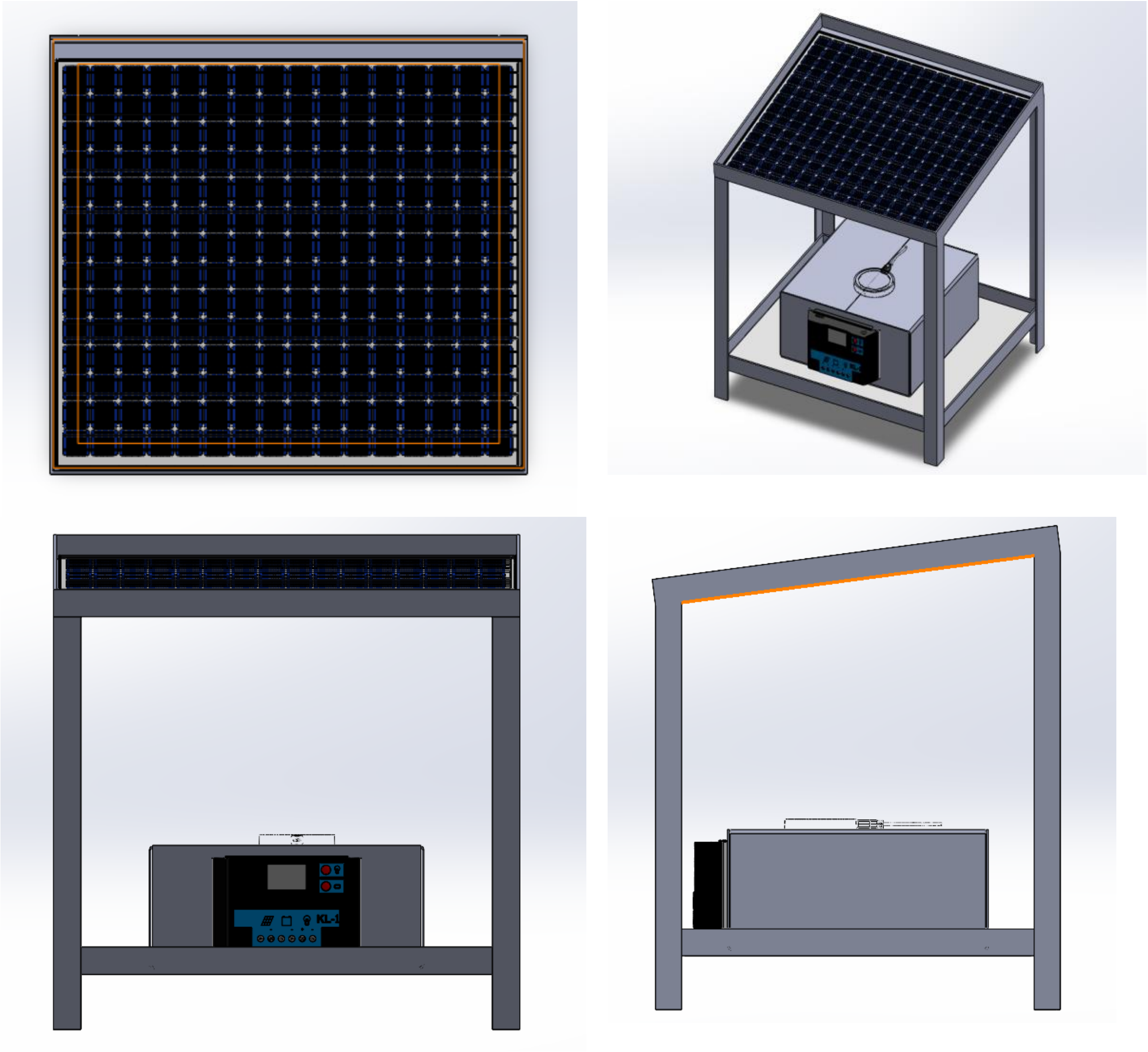

Fig 3.5 CAD Design of the project

CHAPTER 4

HARDWARE SETUP

4.1 Introduction

It is challenging to be fully informed on the project's hardware and software. The electronic parts have been positioned as optimally as feasible. The most crucial part of our project is the solar controller. We see this section as the core of the extension, as it includes all of the computer program's information. This project also made use of a Solar panel and Wireless charging.

Hardware elements:
The project used many hardware and software components, which are described below:

- Solar Panel
- Solar Charge Controller
- USB
- Wireless Charger
- Battery 12V
- Box
- Frame
- Wire
- Clip

4.2 Solar Panel

The solar panel is the primary energy source in the solar-based wireless power charger. It operates on the photovoltaic principle, converting sunlight directly into electrical energy. When exposed to sunlight, the solar panel generates DC voltage, which varies with light intensity and environmental conditions. This generated power is supplied to the solar charge controller, where it is regulated before charging the battery. The use of a solar panel enables the system to function independently of grid electricity, making it suitable for portable, off-grid, and environmentally sustainable power applications.

Fig 4.1 Solar Panel

4.2.1 Pins

- Positive (+) terminal
- Negative (–) terminal

4.2.2 Power

- Electrical energy generated by the solar panel.
- Power output depends on sunlight intensity.
- Regulated by the solar charge controller.
- Stored in the battery for later use.
- Converted to required voltage using DC–DC converters.
- Efficient power management improves overall system performance.

4.2.3 Specifications

- Solar Panel: 18–20 V, 15–25 W
- Charge Controller: Solar charge controller (PWM / MPPT)
- Battery: 12 V rechargeable battery
- USB Output: 5 V DC
- Wireless Charger Output: 5 W (Qi compatible)
- Charging Method: Wired (USB) and Wireless
- Power Source: Solar energy
- Enclosure: Protective box
- Mounting: Supporting frame
- Connections: Wires and clips

4.3 Solar Charger Controller

Fig 4.2 Solar Charger Controller

The solar charge controller is a vital component of the solar-based wireless power charger, responsible for regulating the voltage and current produced by the solar panel before it reaches the battery. It ensures safe and efficient charging by preventing overcharging, deep discharging, and reverse current flow from the battery to the solar panel during low-light or nighttime conditions. By maintaining proper charging parameters, the solar charge controller enhances battery life, improves system reliability, and provides a stable power supply to the connected loads such as the USB output and wireless charging module.

4.3.1 Operating Condition

- Requires adequate sunlight for effective operation
- Output power varies with weather conditions
- Solar panel should be properly oriented toward the sun
- Operates within rated voltage and current limits
- Battery must remain within safe charging range
- Suitable for outdoor and off-grid use
- Wireless charging requires proper alignment of device

4.3.2 Pins

- PV +: Positive terminal of the solar panel
- PV – : Negative terminal of the solar panel
- BAT + : Positive terminal of the battery
- BAT – : Negative terminal of the battery
- LOAD + : Positive terminal of the load (USB / wireless charger)
- LOAD – : Negative terminal of the load

4.3.3 Working System

The working system of the solar-based wireless power charger begins with the solar panel converting sunlight into electrical energy. This generated DC power is regulated by the solar charge controller to ensure safe and efficient charging of the 12V battery. The battery stores the energy and provides a continuous power supply even when sunlight is unavailable. When a device is connected, the stored energy is supplied through DC–DC converters to provide the required voltage for both USB and wireless charging. The wireless charger transfers power to compatible devices through electromagnetic induction, while the USB port allows wired charging. The entire system operates in a controlled and reliable manner, providing sustainable and portable power.

4.4 Wireless Charger

JST Wire is used to establish a connection between the devices. ESP-8266 module, Rain sensor, and Ultrasonic sensor connection were done using this wire.

Fig 4.3 Wireless Charger

4.4.1 Working Principle

The wireless charger works on the principle of electromagnetic induction. When electrical power is supplied to the transmitter coil, it produces a high-frequency alternating magnetic field. When a compatible device is placed on the charging pad, the receiver coil inside the device couples with this magnetic field and an electric current is induced in it. This induced current is then converted into DC power to charge the device battery. Proper alignment between the transmitter and receiver coils ensures efficient power transfer and safe charging.

4.5 12V Battery

One of the most useful power sources for our project is the 5V power. To convert a 50V AC or 240V AC input into a 5V DC output, a combination of transformers, diodes, and transistors can be utilized. We used a capacitor to clean up the DC voltage. With current technology, 5 volts is the ideal balance of speed, power consumption, and noise immunity. By using the same voltage to link circuits like sensors and other devices, the need for additional power supply may be reduced.

Fig 4.4 12V Battery

4.5.1 Working Principle

- Stores electrical energy received from the solar charge controller
- Supplies power to the system during low sunlight or night
- Provides a stable 12V DC output
- Feeds power to USB and wireless charging circuits
- Ensures continuous and reliable operation of the charger

CHAPTER 5

RESULTS AND DISCUSSION

5.1 Data Table

Table1: Solar panel performance

S/N	Condition	Time	Voltage (V)	Current (A)	Power (W)
1	Cloudy	10:00	13.80	1.31	18.078
2	Cloudy	11:00	13.71	1.28	17.5488
3	Sunny	14:30	15.92	1.31	19.44

Table 1 represents the performance of the solar panel under different weather conditions and at different times of the day. The table shows the measured voltage (V), current (A), and output power (W) for both cloudy and sunny conditions.

Under cloudy conditions at 10:00 AM and 11:00 AM, the finding voltages are 13.80 V and 13.71(V), with corresponding with power outputs of 18.078(W) and 17.5488(W). In sunny conditions at 2:30 PM, the voltage increases to 15.92(V) and the output power reaches its maximum value of 19.44(W).

These results indicate that the solar panel output voltage and power increase with higher solar Performance. Therefore, weather conditions and time of day have a direct impact on the performance of the solar panel.

Table2: Battery Charging Characteristics

S/N	Time(Min)	Battery Voltage(V)	Charging Current(A)	State Of Charge(%)
1	0	12.3	4.1	28
2	30	12.6	3.9	40
3	60	12.8	2.8	60

This table indicate the battery charging behavior over time. At the initial stage (0 minutes), the battery voltage is 12.3(V) with a charging current of 4.1(A), and the state of charge (SOC) is 28%. After 30 minutes, the voltage increases to 12.6(V) while the charging current gradually decreases to 3.9(A), and the SOC rises to 40%. At 60 minutes, the battery voltage reaches 12.8(V), the current reduces further to 2.8 A, and the SOC increases to 60%. The battery charges improve its voltage and charge increase, while the charging current gradually decreases. This behavior indicates a normal and stable charging process, where the battery being full charge with reduced current to prevent overcharging and ensure safety.

Table3: Test For The C solar Power Bank+Wireless Charging Cable

S/N	Number Of Test	Time(Min)	Phone Percentage Increase	Phone Temperature
1	05 Jan 2026	10:00-10:20, 20 Min	80%-98%, 18% Increase	Normal
2	05 Jan 2026	12:00-12:30, 30 Min	50%-78%, 28% Increase	Normal
3	05 Jan 2026	14:30-15:30, 60 Min	30%-75%, 45% Increase	Normal

Upper table illustrates the performance of the solar power bank with a wireless charging cable under different test durations on the same day (05 January 2026). In the first test of 20-minute charging period increased the phone battery from 80% to 98%, achieving an 18% gain with normal temperature. In the second test, a 30-minute session raised the phone charge from 50% to 78%, resulting the charge 28% increase, also with normal temperature. In the third test, a longer 60-minute charging period increased the phone battery from 30% to 75%, achieving the highest improvement of 45%, while maintaining normal temperature. These results illustrate that longer charging durations lead to greater battery percentage increases, and the system operates efficiently without causing overheating, This performance indicate the Safety and security of the solar power bank with wireless charging.

Table 4: Wireless Charging Input

S/N	Date and Time	Solar Panel		Battery		Wireless Charging Output	
		Voltage(V)	Current(A)	Voltage(V)	Current(A)	Voltage(V)	Current(A)
1.	09 Jan 2026, 14:35	13.8V	1.15 A	12.90V	1.14 A	12.87V	1.09A
2.	10 Jan 2026, 12:40	12.57V	1.13A	12.45V	1.12A	12.47V	1.13A
3.	11 Jan 2026, 11:35	13.08 V	1.15 A	12.90 V	1.14 A	12.87 V	1.09 A
4.	12 Jan 2026, 17:00	12.44V	1.12A	12.34V	1.11A	12.32V	1.09A
5.	13 Jan 2026, 12:00	12.59V	1.15A	12.52V	1.15A	12.47V	1.12A
6.	14 Jan 2026, 16:00	12.46V	1.13A	12.40V	1.11A	12.37V	1.11A

At the end of our experiment, we take wireless charging input for the solar panel voltage varies between approximately 12.44(V) and 13.8(V), while the current remains around 1.12(A) to 1.15(A), indicating stable energy generation under different daylight conditions. The battery voltage ranges from 12.34 (V) to 12.90(V) with a charging current close to 1.11(A)- 1.15 (A), showing consistent charging performance and minimal losses between the panel and the battery.

The wireless charging output closely follows the battery values, with output voltage between 12.32(V) and 12.87(V) and current ranging from 1.09 (A) to 1.13 (A). This small voltage and current drop confirms efficient power transfer from the battery to the wireless charging module. Overall, the results demonstrate that the system maintains stable operation over multiple days, providing reliable wireless charging with minimal energy loss and consistent performance under varying solar conditions.

5.2 Discussion

The experimental results indicate that the solar-based wireless charging system operates efficiently and reliably under varying environmental conditions. The system performs best during peak daylight hours, where higher solar irradiance results in faster charging and maximum efficiency, while still maintaining a stable wireless output voltage close to 5V. As solar input decreases under cloudy or indoor lighting conditions, charging time increases and efficiency reduces; however, the system continues to function effectively, demonstrating good adaptability. Throughout all test cases, the temperature of both the project hardware and the smartphone remained within the normal range, confirming safe thermal behavior due to controlled power output, efficient energy conversion, and effective heat dissipation. These observations validate the system’s suitability for long-term, eco-friendly, and portable wireless charging applications, especially in outdoor and off-grid environments.

5.3 Cost of the project

Component Category	**Component**	**Estimate Cost (BDT)**
Solar Pannel	20W Mono Panel	800-1000 Tk
Battery	Li-ion or Lead Acid (12V)	1200-1500 Tk
Electronics	Controller+Wireless Pad	1500-1800 Tk
Structure	Metal Frame+Box+Paint	1200-1500 Tk
Wiring	USB Cable And Connectors	200-400 Tk
Total Cost		4900-6200 Tk

Developer Note:

This project was designed and assembled manually. By handling the fabrication and circuit assembly personally, the overall project cost was reduced by approximately 15-20% compared to hiring professional labor.

CHAPTER 6

CONCLUSION AND FUTURE STUDY

6.1 Conclusion

The solar-based wireless charging system successfully demonstrates efficient, stable, and safe operation under varying environmental conditions. Experimental results confirm that the system achieves maximum performance during peak sunlight hours while maintaining a consistent 5 V wireless output suitable for smartphone charging. Even under low-light and indoor conditions, the system remains functional, though with reduced efficiency. Throughout all test cases, normal operating temperatures were maintained, indicating effective thermal management and safe power delivery. Overall, the proposed system proves to be a reliable, eco-friendly, and practical solution for portable and off-grid wireless charging applications

6.2 Recommendations And Further Study

- Implement advanced MPPT algorithms to improve solar energy harvesting
- Use higher-capacity batteries for longer backup time
- Improve DC–DC converter efficiency to reduce power loss
- Enhance wireless charging efficiency using better coils and alignment
- Add IoT-based monitoring for voltage, current, and temperature
- Reduce system size and cost through compact design
- Extend the system for higher-power device charging
- Explore use in large-scale and off-grid applications

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