Smart Solar Power Bank with Wireless Charging

Hemant Vishwakarma[1], Dr. Shailja Pandey[2], Kamal Kishor Mishra[3], Lokesh Tripathi[4]
[1,3,4]BBDITM (Lucknow) Dept. of Information Technology
[2](Associate Professor) BBDITM (Lucknow) Dept. of Information Technology

***Abstract*— The designed solar power bank integrates high-performance photovoltaic panels, a rechargeable battery pack, and a Qi-compatible wireless transmission circuit within a compact unit. Its primary goal is to utilize solar energy for self-charging during daylight and to enable cable-free charging for electronic devices. The system employs foldable solar panels that enhance surface coverage and energy capture efficiency while maintaining portability. A regulated DC–DC converter and battery management circuit ensure steady power output, whereas the inductive transmitter coil facilitates wireless charging based on the Qi standard. Collectively, these features establish an environmentally sustain-able and mobile energy source suitable for smartphones and wearable devices. By combining renewable solar energy utilization with wireless convenience, the device promotes eco-friendly and user-centric charging practices. Experimental observations indicate that the power bank can fully charge a mobile device within approximately six to eight hours under standard conditions, and its internal bat-tery requires about four to six hours for complete re-charging. Future design enhancements may include reducing casing dimensions, increasing battery capacity, and improving the wireless transmitter performance to optimize efficiency.**

***Keywords*— Hardware Description, Wireless battery charger circuit principle, working principle, Future scope, Conclusion**

I. INTRODUCTION

The device that is solar power bank with wireless charging also known as wireless charger, it allows devices to use electrical energy to charge their bat-tery without a wired connection . it is an advancing technology of charging electronics devices . it is based on the concept of mutual inductance principle. Mutual inductance is nothing but transmissing the electrical energy from transmitter to receiver without any wired connection using electromagnetic induction. Using the electromagnetic principle al-lows it to transfer their electrical energy in very short distance that helps in wireless charging. In the de-vice a solar panel is used that can be charge without any electricity using sun light and it converts the solar energy into electrical energy and stores that energy into power bank modulo.

The smart solar power bank integrates lithium battery pack with solar panels battery protection and wireless charging coils using dc power boosters and charge controllers to provide for a feature packed power bank.[2]
The device has 4 li-ion battery of capacity 2600 mAh. That can charge 2 mobile phones of 5500 mAh from 0-100. After discharging it needs a charging that is not that much hard just put the device into sunlight it can be charge by it self using sun light. The integration of solar panels, energy storage units, and a wireless transmitter makes this design both eco-friendly and practical. It addresses the growing demand for sustainable charging options while aligning with global efforts toward renewable energy adoption. In today's portable device-driven environment, uninterrupted and flexible power sources are essential. Therefore, this study aims to develop a solar-powered wireless charging system that ensures reliability, environmental sustainability, and ease of use. The overall objective is to optimize system efficiency and improve power conversion performance while maintaining portability and user convenience

II. LITERATURE SURVEYS

Rupali Tirale et al. developed a solar-powered power bank integrated with an inverter system capable of generating a 230 V AC output for mobile charging applications. Their design utilized electromagnetic induction for wireless power transfer and demonstrated the ability to operate with minimal circuit components. The project aimed to provide both wired and wireless charging options for portable de-vices, presenting a practical off-grid solution for users in transit or areas without stable electricity access[1].
Arun Agarwal and Sambandh Dhal proposed a fold-able solar power bank that supports both solar

charging and wireless power transfer. Their model emphasized energy independence and portability by enabling users to recharge devices during travel without relying on fixed power outlets. The compact design integrated efficient energy storage and conversion circuits to enhance overall usability [2].

A study by Nevon Projects highlighted the increasing popularity of solar power banks with wireless charging features, emphasizing their eco-friendly characteristics and suitability for mobile applications. However, the research also noted certain challenges, including dependency on sunlight, slower charging rates, and reduced efficiency under shaded or indoor conditions [3].

Studies conducted between 2017 and 2022 suggest that users generally perceive solar-based wireless power systems positively, though optimization in performance and cost-efficiency remains necessary. Factors such as sunlight intensity, panel orientation, environmental temperature, and receiver compatibility significantly influence output power and charging duration. A deeper understanding of these aspects will contribute to future design improvements, enhancing both practicality and energy con-version efficiency of solar power banks with integrated wireless charging systems. This literature re-view of research conducted between 2017 to 2022 shows that while users generally have positive attitudes towards these devices, further research is needed to improve their performance and usability. Factors such as sunlight intensity, temperature, and device compatibility can affect their efficiency and charging speed. Understanding these advantages and limitations can help users make informed decisions about a solar power bank with wireless charging aligns with their charging needs and priorities.

III. HARDWARE DESCRIPTION

The hardware part used in this solar power bank are mentioned below.

Solar Panel:

Fig. 1[1]

A solar panel consists of multiple interconnected solar photovoltaic modules. It coverts the solar energy to the electric energy. In the project we are using a solar panel build from Polycrystalline silicone Sealed with epoxy resin for outdoor durability. and 135 × 65 × 3 mm. in the dimension. The dimension helps to reduces its size.

DC – DC Buck Converter LM2596 :

Fig. 2[1]

The LM2596 power supply module is a step-down switching regulator designed to efficiently drive loads up to 3 Amps while maintaining excellent line and load regulation. it has fixed output voltages of 3.3V, 5V, and 12V. and has a frequency of 150kHz, the LM2596 that can be switched. it helps to use of smaller filter components compared to regulators.

Wireless Charging Module :

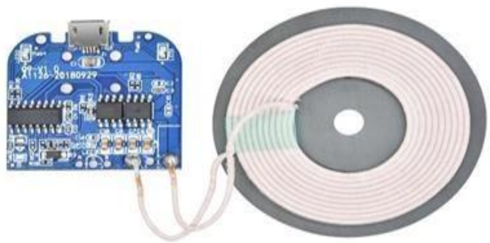


Fig. 3[1]

The wireless charging module has 5V, 2A output voltage based on Qi wireless charging Standard and has a Circuit PCBA (Printed Circuit Board Assembly). Uses inductive coupling to transfer power wirelessly between the transmitter coil (in the module) and the receiver coil (in the device). Qi standard ensures compatibility with most smart phones and wearable devices.

Wireless Power TX/RX Module :

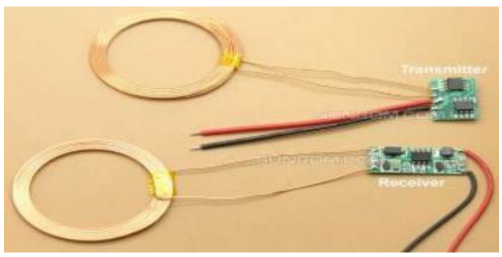


Fig. 4[1]

This Wireless Power Transfer and Charging Module facilitates short-range wireless power delivery. It mainly used for charging various common electronic devices with wireless facility. Comprising a transmitter, receiver, and associated coils, it can function as a stable 5V wireless power supply with a maximum output current of 600mA, potentially replacing traditional wired power connections.

Battery Level Indicator :

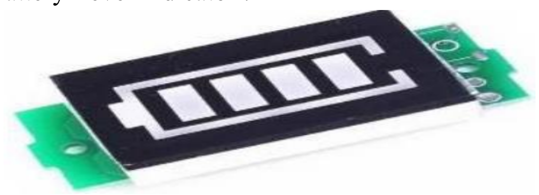


Fig. 5[1]

This battery capacity indicator module provides a clear and visually appealing display of battery charge levels.. To operate the display, simply connect its positive and negative terminals to the corresponding terminals of the battery being tested. The digital display will then show the battery's real-time power.

Power Bank Circuit Board :

Fig. 6[1]

The power bank has Input Voltage of 3.7V (from the 18650 battery). And Output Voltage of 5V. that carry Minimum Output Current of 1A and Maximum Output Current of 2A. it Converts the battery's 3.7V out-put to 5V via a DC-DC boost converter and Integrates USB ports for wired charging and power transfer. It mainly Designed to balance output between multiple devices, including wireless and wired charging.

Battery:

Fig. 7[1]

The battery is 18650 LI-ion battery of Voltage 3.7V. the Capacity of battery 2600mAh per cell. Based on Technology of High energy density ensures a lightweight and compact power bank.. it Supports a robust lifecycle with consistent performance

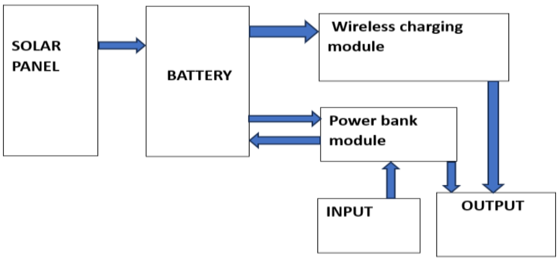
IV. WIRELESS BATTERY CHARGER CIRCUIT PRINCIPLE

The fundamental operating principle of this circuit is based on mutual inductance. Mutual inductance is nothing but transfer the power between transmitter and the receiver based on principle of inductive coupling. Inductive coupling is nothing but phenomena of mutual inductance. When a current carrying conductor placed around another, a conductor voltage is induced in that conductor which is placed near the current carrying conductor. If a current is flowing in the conductor there is a magnetic flux induced in it and it is the main reason of flowing current in an-other conductor cause it got an contact in magnetic flux of another conductor

V. WORKING PRINCIPLE

The working principle of a solar power bank with wireless charging involves several steps. Firstly, the solar panel on the power bank collects solar energy and converts it into electrical energy. This electrical energy is then stored in the battery for later use. When a compatible device is placed on the power bank for wireless charging, the wireless charging circuit is activated. This circuit generates an electromagnetic field that induces an electrical current in the device being charged. This electrical current is used to boost the device's battery power until it is fully charged. The wireless charging process continues until the power bank's battery dies or the device's battery is fully charged. This means that the solar power bank with wireless charging functions by using a solar panel to collect sunlight and convert it into electrical energy, which is stored in a battery for later use. When a compatible device is placed on the power bank for wireless charging, energy is transferred from the power bank to the device's battery using electromagnetic induction. The solar power bank with wireless charging operates based on an integration of renewable energy harvesting, energy storage, and modern wireless power transfer.

Block Diagram:



VI. FUTURE SCOPE

The study on solar power banks has identified several prospects for this technology. These prospects include :

- broad market demand : in upcoming few years it can be highly demanding device due to broad use of electronics devices.
- Advancements in Technology : The study has identified several areas for improvement in the technology used in solar power banks. These include increasing battery storage capacity improving charging speed and reducing costs.
- Integration with Smart Homes: In some years there is a decade of smart homes and it can be very useful to the homes that has all smart appliences.

VII. CONCLUSION

This paper involves the importance and a technics of wireless charging with solar panel and it is very efficient device. As we give input supply by solar panel so that we can use device anywhere. Normally wireless chargers are so much power consuming, but we use renewable source of energy so there is no such issue arises. We can also use this as normal wireless charger. We provide a wire system as well as cause some mobiles don't support wireless charging . In India, there are many towns and villages where electricity is a big concern, so here we can use wireless solar charger. We can make any smart phone compatible for wireless charging. This device is compatible with all smartphones, it has very less chance of mobile overcharging, less chance of mobile accident. It will be also providing safety from electric shock and it will be very much user and environment friendly. The world is rapidly going wireless. Within a span of a few decades, phones and internet became wireless, and now charging has become wireless. Even though wireless charging is still pretty much in its early stages, the technology is anticipated to evolve dramatically over the next few years. The technology has now found its way into a wide array of practical applications ranging from smartphones and laptops to wearables, kitchen appliances, and even electric vehicles. There are several wireless charging technologies in use today, all aimed at cutting cables. Automotive, healthcare, and manufacturing industries are increasingly embracing the technology as wireless charging promises improved mobility and advances that could enable Internet of Things (IoT) devices to be powered from a distance. The global wireless charging market size is estimated to be worth more than $30 billion by 2026. It offers ultimate convenience to users and ensures safe charging in hazardous environments where an electrical spark could lead to an explosion.[6]

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