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Design And Development of Solar Power Bank with Wireless Charging /Final Paper

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Abstract–

Power banks are one of the need to have product these days. But even power banks need charging. For that one needs to get the power bank charged in a power plug. This is not always possible when travelling so here we design a smart solar powered folding power bank.

The solar power bank integrates solar charging with efficient battery support and wireless charging to provide a multi functional unique power bank product. The device is able to self charge anywhere during day time so that he user never runs out of power. This Wireless charging solar power bank provides the following advantages:

- Easy Wireless Charging for compatible phones.
- Solar Self Charging.
- Foldable Design for Portability.
- 20000maH battery backup.
- Added USB Type Charging port availability.

1.INTRODUCTION

Wireless charging is an emerging technology now a days. Wireless charging is also known as wireless power transfer; here the power is transferred to load without interconnecting cords. In 2015 Samsung introduced wireless charging into galaxy s6 mobiles. Wireless charging is also called as inductive charging. Wireless charging mainly eliminates the cable required for charging. It reduces the wear and tear of the hardware ports.

Compared to wire charging, wireless charging has more benefits as follows.

•It is user friendly, as there are no cables. Different mobiles can use the same charging pad.

• Provides flexibility, where connecting cables for charging are costly.

• It does not have any radiation effects

Wireless charging technology is gradually advancing towards two major directions, i.e., radiative wireless charging or radio frequency (RF) based wireless charging and inductive charging or coupling-based wireless charging. Radiative wireless charging adopts electromagnetic waves, generally microwaves and RF waves is used to deliver energy in a form of radiation. The energy is transferred based on the electric field of an electromagnetic wave, which is radiative. Further due to the safety issues raised by RF exposure, radio frequency based wireless charging operates in a low power region. Inductive charging is based on mutual induction concept where magnetic field couples between two coils. Also the magnetic field of an electromagnetic wave attenuates much faster than the electric field hence the power transfer distance is largely limited. Due to safety and implementation the inductive charging is used in our day today life.

2.SCOPE OF PROJECT

The main scope behind our design is the creation of a product that makes the charging of mobile devices more convenient. In our current use of handheld devices, we are tethered by a cord to charge everything. Not only is a cord in hand required, but there is also a need to have a proper outlet nearby to supply power. Our product is an attempt at alleviating this pressure for the cord-outlet system by having its own internal power generation and a cordless charging system. If a product like ours were to become widespread, charging devices would become much less of a hassle by allowing devices to be charged in more convenient locations. On top of convenience, we were also motivated to make our product using a renewable source of energy, which is where solar power comes in. Using only energy collected from the solar cells, our product can play an interesting role as an off-the-grid power source. Aiming for a product that could function entirely from collecting and storing solar energy, we sought to create a product that will be usable in all kinds of different environments. This includes schools and offices, outdoor events, and could potentially be adapted for use in developing countries where there is not a power grid set up. Harnessing solar energy to avoid a dependency on a wall outlet is not a brand-new idea, but we hoped to bring it down to a smaller scale in a user-friendly way.

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3.WIRELESS CHARGING: ENHANCING USERCONVENIENCE

Wireless charging, based on inductive charging Principles, allows for the transfer of energy between two Coils—one in the charging station and the other in the Device—without the need for physical connectors. This Technology, standardized by the Wireless Power Consortium

Under the Qi standard , offers several benefits:

- **Elimination of Physical Connectors:** Reduces wear And tear on charging ports.
- **User-Friendly Experience:** Simplifies the charging Process, especially in challenging environments.
- **Safety:** Minimizes the risk of electrical short circuits And corrosion.

4. COMPONENTS USED-

1. Solar Panel

Solar panels and electric cars are a match made in heaven – when you install a solar energy system on your home, you can use it to both power your home and charge your electric car for emissions-free transportation. The cost of solar is falling rapidly, and companies from Tesla to Nissan are manufacturing electric cars for your daily use. Now, the ability to install a solar PV system large enough to power both your home and your car is an option within reach. But even with incentives and rebates available for both technologies, most homeowners still can't afford to install solar and buy an electric car at the same time. Luckily, it's easy to install a solar energy system today that takes your future electricity consumption into account, if you take a few additional factors into consideration.

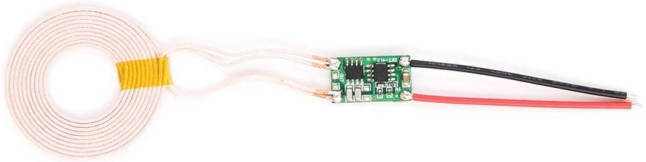
Specification:

Solar Panel PV Cell- 16.8V TO 21 VOLTS WITH ALUMINIUM BODY
Key Features:
Nominal Power – Pmax (Watts) 5W
VMP- 16.8V
IMP – 0.3A
Open circuit Voltage – Voc (Volts) 21V
Short Circuit Current – Isc (Amps) 0.32
Solar Cells per Modules – Unit 36 (12×3 Matrix)

2.Charge Controller

A charge controller, or charge regulator is similar to the voltage regulator. It regulates the voltage and current coming from the solar panels going to the battery. Most "12 volt" panels put out about 16 to 20 volts, so if there is no regulation, the batteries will be damaged from overcharging. Most batteries need around 14 to 14.5 volts to get fully charged, from the charge controller given to the battery.

3. Wireless Coil 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.
- Wireless power transmitter ICs are intelligent devices used to take a DC input power supply and convert and condition that supply into an AC signal used to drive an inductive coil for the purpose of transmitting power wirelessly.

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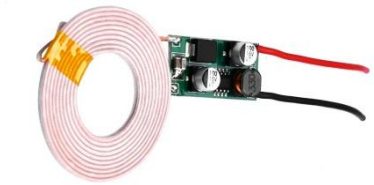
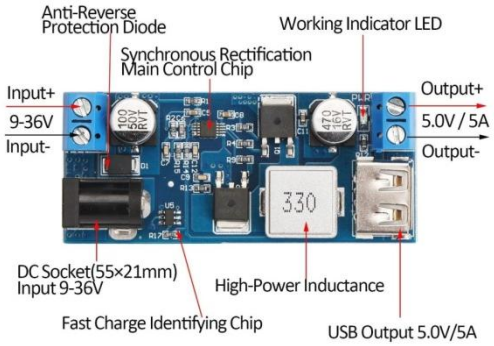
4. Wireless Charging Receiver



- 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.
- This current is then converted into direct current (DC), which in turn charges the built-in battery.

5. 12V To 5V Convertor

Step-Down (buck) Switching Converter 5V 5A (6A max.) with wide voltage input, high current output, and high efficiency.
This module comes ready assembled and tested.
The output voltage is fixed at 5.2V for an input voltage of 9 to 36V DC.
The input is a screw terminal block or standard axial DC port (5.5/2.1mm), the output is a screw terminal block or USB-A port.



Specifications:

Input voltage: 9 to 36V DC
Output voltage: 5.2V / 6A (Vin <24V) Output voltage: 5.2V / 5A (Vin 24-32V) Output voltage: 5.2V / 3.5A (Vin >32V)
Dimensions: 6.3 * 2.7 * 1cm
Weight: 22g

6. Battery (12 V)

Batteries are a collection of one or more cells whose chemical reactions create a flow of electrons in a circuit. All batteries are made up of three basic components: an anode (the '-' side), a cathode (the '+' side), and some kind of electrolyte (a substance that chemically reacts with the anode and cathode).
When the anode and cathode of a battery is connected to a circuit, a chemical reaction takes place between the anode and the electrolyte. This reaction causes electrons to flow through the circuit and back into the cathode where another chemical reaction takes place. When the material in the cathode or anode is consumed or no longer able to be used in the reaction, the battery is unable to produce electricity. At that point, your battery is "dead."
Batteries that must be thrown away after use are known as primary batteries. Batteries that can be recharged are called secondary batteries.
12-volt battery, in its most common form was introduced for the early transistor radios. It has a rectangular prism shape with rounded edges and a polarized snap connector at the top. This type is commonly used in walkie talkies, clocks and smoke detectors. They are also used as backup power to keep the time in certain electronic clocks.
This format is commonly available in primary carbon-zinc and alkaline chemistry, in primary lithium iron disulfide, and in rechargeable form in nickel cadmium, nickel-metal hydride and lithium-ion. Mercury oxide batteries in this form have not been manufactured in many years due to their mercury content. 12V battery has a rectangular prism shape with rounded edges and a polarized snap connector at the top. A zinc–carbon (6F22) battery is a dry cell battery that delivers a potential of 1.5 volts between a zinc metal electrode and a carbon rod from an electrochemical reaction between zinc and manganese dioxide mediated by a suitable electrolyte.
It was introduced for the early transistor radios. It is usually conveniently packaged in a zinc can which also serves as the anode with a negative potential, while the inert carbon rod is the positive cathode. An advantage is that several nine-volt batteries can be connected to each other in series to provide higher voltages.
FEATURES:

- Output voltage: 12v
- Current capacity: 2.5Ah
- Approximate Volume: 0.2 cu. in. (3.3 cu. cm.)
- Approximate Weight: 0.4 oz. (11 gm.)

APPLICATIONS:

- Walkie talkies.
- It is used to assorted electronics projects.
- Use a 12V battery clip to easily connect your 9V battery to your Arduino.
- The "12V clip" is also used on some batter holders of assorted voltages.

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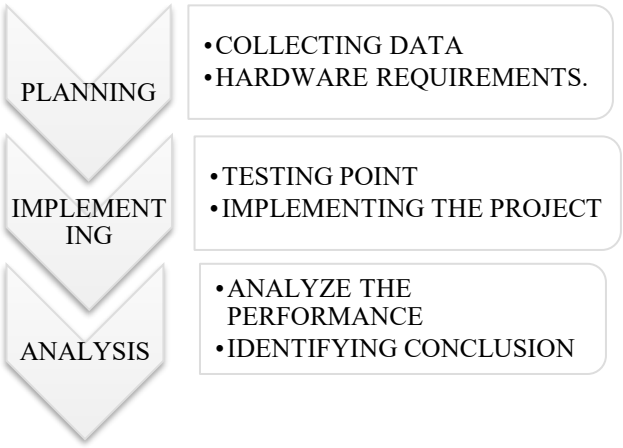
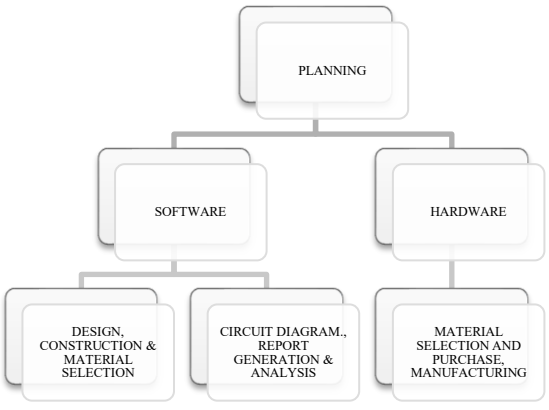
This is a lead acid rechargeable battery. This machine consists of three batteries which gives output such as 1.8A, 12V for operation of setup.

5. PROCESS CHART



1. Planning



2. Implementing

Manufacturing Process :-

1. Gathering material
2. Fitting
3. Testing
4. Assembling
5. Electrification
6. Soldering

6.WORK PLAN

STAGE 1: Collecting the Materials

Basic structure is designed for model purpose.
Electronic components will bring from an electronic shop. Hardware and other material will bring from hardware shop. After completing these works the structure would be designed.

STAGE 2: Purchasing of Components

STAGE 3: Cutting & Fitting

STAGE 4: Assembly and Electrification

7. DETAILS OF DESIGN, WORKING AND PROCESSES

A. Solar panel Solar panels convert solar energy into electricity. They use the concept of photoelectric effect, emission of electrons when light falls on solar panel. Solar panels are made up of silicon cells, silicon has an atomic number 14. When light falls on silicon cell, the outer most electrons of silicon i.e. two electrons are set into motion. This initiates the flow of electricity. Silicon has two different cell structures: monocrystalline and polycrystalline.

B. Batteries: Lithium ion battery is rechargeable battery. During discharging lithium ions moves from negative electrode to the positive electrode, during charging lithium ions move from negative electrode to positive electrode.

C. . Transmitter: Transmitter section basically consists of an astable multivibrator, power resistor, and inductor as shown in Fig.2. The obtained DC voltage from solar panel is converted into AC voltage using an astable multivibrator.

D. Application There are two inductors i.e. transmitting coil and receiving coil. The circuit mainly works on the principle of mutual induction. The transmitting coil has the dimensions 22.1*13.1*3.2 mm and transmitter coil inductance 3.7uH.

E. Receiver Receiver section basically consists of receiving inductor coil, bridge rectifier, voltage regulator and rechargeable battery. The AC signal received by the coil should be converted into DC signal it is done by bridge rectifier and voltage form the bridge rectifier is unregulated and this should be converted into regulated constant voltage, voltage regulator IC 7805 is used to convert the unregulated DC voltage to regulated constant DC voltage.

8. ADVANTAGES:

Usage of separate charger is eliminated (it works as a universal charger for smartphones). It can charge smartphone anywhere. It does not require wire for charging.
There is no need of electricity. It saves electricity. There is no need of specific Smartphone for wireless charging.

1 Applications: It can be used in houses, offices, airport, upcoming modern railway station.

2 Impact on Environment: It is very much environment friendly because it works on nonconventional energy source (Solar Plate). It saves electricity.

3 Possible Innovation at later stage: Further modification can be done to charge the laptop through solar wireless charger. Electric vehicles can also be charged through solar wireless charger by making proper modification in the basic circuits.

9. RESULTS:

Solar Power Bank With Wireless Charging

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