CONSTRUCTION OF PORTABLE SOLAR MOBILE CHARGER

BY

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AST/2372060405

NOVEMBER, 2022

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A PROJECT SUBMITTED TO THE DEPARTMENT OF PHYSICAL SCIENCE LABORATORY TECHNOLOGY, SCHOOL OF APPLIED SCIENCE AND TECHNOLOGY, AUCHI POLYTECHNIC, AUCHI.

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF HIGHER NATIONAL DIPLOMA (HND) IN PHYSICS AND ELECTRONICS OPTION.

NOVEMBER, 2022

CERTIFICATION

We, the undersigned, certify that this project work titled "**CONSTRUCTION OF PORTABLE SOLAR MOBILE CHARGER"** was carried out by **OYEWOLE PATIENCE AINA,** with Matric No.**: AST/2372060405** in the Department of Physical Science Laboratory Technology (Physics and Electronics), Auchi Polytechnic, Auchi.

We also certify that the work is adequate in scope and quality in partial fulfillment of the requirements for the award of Higher National Diploma (HND) in Office Technology and Management.

MR. OKE TEMITOPE OLUWASANMI **(Project Supervisor)**	**DATE**

MR. BRAIMAH JAFARU **(Head of Dept, Phy. Sci. Lab. Tech Dept)**	**DATE**

DEDICATION

This project work is dedicated to God Almighty for His protection in my life and mercies in the course of my study.

I also dedicate this project to my lovely husband.

ACKNOWLEDGEMENTS

My profound gratitude goes to God Almighty, for His grace and love towards me throughout my staying in school. It can only be God.

My thanks go to my Project Supervisor, **MR. OKE TEMITOPE OLUWASANMI** who ensure that this project work was a successful one. I say thank you sir.

My special thanks goes to my lovely husband, **MR. KADIRI GODSWILL ASEMHOKAI** for his support and encouragement during this programme, also, my beautiful daughter **MISS ASEMHOKAI JOANNA ITSEMEH.**

My appreciation goes to my lovely parent, **MR**. and **MRS. UMORU JOHN OYEWOLE**, for their support and prayers.

I really appreciate my eldest brother **MR. ADESUNLOYE ANDREW FEHINTI** for his support all through my studies and to my brothers and sisters I say thank you. I am grateful to my Head of department, **MR. BRAIMAH JAFARU** and all the lecturers in the department for the knowledge they have impacted in me.

I acknowledge my uncle, **MR. HENRY ADEWALE ADETONA** for the support he gave me I also acknowledge **DR. CHRIS OSAMUYI OSAGIE** and **CHIEF BARR. RAZAK O. ISENALUMHE** for their support.

Finally, I would like to thank my friends **OKORO FAITH AGNES, AKAWE DANIEL, EMEDO OLUEBUBE JANE, LAWANI CELESTINA and MUMMY DIVINE** for standing by me all through my program and all those whose names are not here I really appreciate.

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ABSTRACT

An external adjustable voltage regulator is used to obtain the desired constant voltage. A zener diode switches on to ensure charging is cut off at the saturation point. One 3.7v lithium ion batteries is used as backup; an operational amplifier works here as a comparator to signify when backup is fully charged. Ultimately, 11V and 160mA is supplied by the panel under full sunlight. This charger has an output voltage of 5V and an average of 500mA current to charge a mobile phone. This system charges a phone fully between 4-5hours and it has a capacity of 4800mA. This device charges all mobile phone by all manufacturers using a universal serial bus connector.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Given the current energy crisis and increasing need for sustainable energy, we endeavored to create a cost-effective, small-scale electrical generator which could be used to power consumer electronics. Solar energy has proven its worth as an alternative energy source because it is low-impact and emission-free. It has been implemented with much success for power grids with hundreds of acres of enormous solar concentrators. In the small-scale, solar energy has been harvested through the use of photovoltaic (PV) panels and have been used to power anything from an iPod to a residential home. Although PV systems are considered part of the green energy revolution, materials utilized for its construction (like silicon) are extremely dangerous to the environment and much care must be taken to ensure that they are recycled properly (Ventre, *et al.,* 2010), PV cells also only utilize the energy stored in specific wavelengths of light and therefore have an approximate efficiency between 14-19%. Sunlight, however, produces immense amounts of heat which only serves to heat up the surface of the solar cell. Although there are some PV cells that have reached efficiency levels over 40% (world record is 41.6%), they are enormously complex and expensive. Concentrated solar power (CSP) works differently because it focuses solar energy in its entirety rather than absorb it. Ultimately, our group will be designing and producing a Solar Powered Battery (Messenger and Ventre, 2010).

Solar cell phone battery charger is an electrical device that converts the energy of light directly into electricity by the photovoltaic effect. Solar cell phone chargers use solar panels to charge cell phone batteries. They are an alternative to conventional electrical cell phone chargers and in some cases can be plugged into an electrical outlet. There are also public solar chargers for mobile phones which can be installed permanently in public places such as streets, park and squares. Some models of cell phones have a built in solar charger and are commercially available for GSM cell phone models. Solar cell phone chargers come in different shapes and configurations including folding and rotating types. They also come in the form of straps, with solar cells on the outer surface and a nickel metal hydride battery within. They are capable to charge a mobile device fully within six hours of exposure to the Sun resulting in 40 minutes of talk time. Solar chargers are also available for other cell phone accessories, such as Bluetooth headsets and speaker phones. (Shyr, 2017)

Africa is one of the planets in the world that is endowed with natural resources. Prominent among these resources is Sunshine which gives pure and inexhaustible solar form of energy. This source of energy is clear, safe and free. One of the major edges of solar energy amongst others us that it is gotten from a source which exist naturally. Electricity generation from fossil fuels create green house gas emission and air pollution. Photovoltaic system provides a better and cleaner energy that is not dangerous to human health and environmental friendliness. Radiation of solar is converted into electricity and in great way reduces environmental impact on the society. Due to the insufficient supply of power from the national grid to the various household in Nigeria, individual power generation (use of fuel plants like generator) is then turned to as a source of power supply and its unclean and unhealthy to the human health thus providing electric from the Sun is a better and viable option to having steady power supply and healthy environment. (Ali, *et al.*, 2011).

1.2 Statement of the Problem

Constant power supply is the desire of any nation and people living in it, however in Nigeria today, the rate of electricity supply failure is on the high side. This failure in supply and its inconsistency has led to insecurity of life and property, distribution of electrical loads and appliances leading to malfunctioning, reduction in equipments lifespan and sometimes burnt of electronics appliances. Failure in power supply also leads to inadequate dissemination of information and low communication hence depriving the common man from achieving some set goals. In the case of generating plants, the cost of maintenance such as: buying of petro or diesel is on the high side and moreover the fume of carbon monoxide, which is the by-product from generating plants is very injurious to human health. In order to avoid or minimize these challenges that are associated with generating plants, hence this project work was embarked upon, "Construction of a Portable Solar Mobile Charger.

1.3 Research question

i. What will help keep a mobile phone service charger?

ii. What can be use to examine a portable personal charging system?

iii. What can be use to examine a portable personal charging system?

1.4 Purpose of the Study

Objective of this work is to design a device that will help keep mobile phone service by providing you with a portable personal charging system. To provide constant electricity supply or those on the go with portable solar power charging systems (with or without battery) to power their mobile phones to enable them make & receive calls.

1.5 Scope of the Study

The idea of a solar cell phone charger is an excellent one in that it's meant to allow you an option for charging your phone when you're in a remote area or just don't have access to an electrical outlet or car charger. There are a few on the market today that will do what they say they will do, whereas others are not living up to high expectations Cell phones can be a real lifesaver in emergency situations. People have come to depend on this technology greatly over the last few years. Technologies such as iPods, MP3 players, and hand-held games have also become quite popular. All of these require fully charged batteries to function at their optimal level. Solar chargers are great for those times you are not close to a power source. Another benefit of these chargers is that they're free to use since they use the sun's energy. The backup battery stores energy even when it's not actively charging, so you can enjoy more time in between having to charge your cell phone battery via electric.

1.6 Significance of the study

There are several advantages you enjoy when you use a solar charger instead of a conventional phone charger. The energy savings. Unlike conventional energy resources that produce and consume a lot of waste energy from a solar cell phone charger draws energy from renewable sources and produces no waste. You can phone solar charger to use, you can go anywhere, provided you have access to solar energy. The main advantage behind the invention of these solar powered cell phone charges is to save large amount of electrical energy. The solar panels of which will help in converting the solar energy from the sun into electrical energy through various reactions. (Hund, *et al.*, 2012)

Other advantages of solar powered cell phone charges reside in the fact that they allow you to access power outside the national grid. You can charge yours phones even while traveling without depending on electricity. This property has made it possible to make use of these cell phone chargers at any possible place.

The last one is these solar powered cell phone charges are eco/environment-friendly. They don't produce harmful waste, and can be used anytime and anywhere that there is daylight.

1.7 Limitation of the Study

There are some disadvantages to cell phone chargers powered by the sun. The most obvious of course is that if it's a cloudy or overcast day, your solar powered charger isn't going to be able to garner the energy it needs from the sun in order to function. Usually, it needs direct sun in order to store enough in the battery to work efficiently.

Another disadvantage to the current solar phone chargers is that the amount of power they are capable of generating isn't always enough to keep up with the amount of power required by today's highly functional cell phones.

Some analysts say that in order to meet and exceed the power needs of most cell phones, the solar cell phone charger will have to be larger in order to capture more of the sun's energy more quickly. However, this poses a problem when it comes to the transport and convenience of the charger. Another drawback is that solar mobile phone chargers are not typically able to generate enough power for a full charge.

1.8 Definition of term

Solar panel: Solar panels use sunlight as a source of energy to generate direct current electricity

Fixed voltage regulator: A fixed voltage regulator produces a fixed DC output voltage, which is either positive or negative. In other words, some fixed voltage regulators produce positive fixed DC voltage values, while others produce negative fixed DC voltage values.

Rechargeable battery: A rechargeable battery, storage battery, or secondary cell (formally a type of energy accumulator), is a type of electrical battery which can be charged, discharged into a load, and recharged many times, as opposed to a disposable or primary battery, which is supplied fully charged and discarded after use.

Schmitt trigger: a bistable circuit in which the output increases to a steady maximum when the input rises above a certain threshold, and decreases almost to zero when the input voltage falls below another threshold.

Micro-controller: A microcontroller (MCU for microcontroller unit) is a small computer on a single VLSI integrated circuit (IC) chip.

LCD: A liquid-crystal display is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals combined with polarizers.

CHAPTER TWO

LITERIATURE REVIEW

2.1 Introduction to the Study

A **battery charger**, or **recharger**, is a device that stores energy in a battery by running an electric current through it. The charging protocol (how much voltage or current for how long, and what to do when charging is complete) depends on the size and type of the battery being charged. Some battery types have high tolerance for overcharging (i.e., continued charging after the battery has been fully charged) and can be recharged by connection to a constant voltage source or a constant current source, depending on battery type. Simple chargers of this type must be manually disconnected at the end of the charge cycle. Other battery types use a timer to cut off when charging should be complete. Other battery types cannot withstand over-charging, becoming damaged (reduced capacity, reduced lifetime), over heating or even exploding. The charger may have temperature or voltage sensing circuits and a microprocessor controller to safely adjust the charging current and voltage, determine the state of charge, and cut off at the end of charge. (Ali, *et al.,* 2011)

Chargers may elevate the output voltage proportionally with current to compensate for impedance in the wires. A trickle charger provides a relatively small amount of current, only enough to counteract self-discharge of a battery that is idle for a long time. Some battery types cannot tolerate trickle charging; attempts to do so may result in damage. Lithium-ion batteries cannot handle indefinite trickle charging. Slow battery chargers may take several hours to complete a charge. High-rate chargers may restore most capacity much faster, but high rate chargers can be more than some battery types can tolerate. Such batteries require active monitoring of the battery to protect it from overcharging. Electric vehicles ideally need high-rate chargers. For public access, installation of such chargers and the distribution support for them is an issue in the proposed adoption of electric cars. Solar portable charger is very effective for everyday use. It is suitable for use in rural area where electricity is not available or load shading frequently occur. Travelers and advantageous people can also use this type portable charger.

The Cell phone Battery charger uses household current to put an electric charge into a discharged battery. The charger's circuits convert 240-volt household alternating current (AC) to the 9-volt direct current (DC), then regulate to 5v that the cell phone battery needs. This charger will charge any cell phone battery that is rated 5v. It is fully automatic and will charge at a rate up to about 800mA until the battery voltage reaches a preset point at which it will switch to a very low current float charge. If the battery voltage drops again the charger will begin charging until the voltage once again reaches the maximum level and then stop charging. In this way it can be left connected to a battery indefinitely to maintain full charge without causing damage. An LED indicates when the battery is fully charged (Hammons, 2013).

2.2 Current Literature Review

2.2.1 Solar System

The Solar System is the gravitationally bound planetary system of the Sun and the objects that orbit it, either directly or indirectly. Of the objects that orbit the Sun directly, the largest are the eight planets,[c] with the remainder being smaller objects, such as the five dwarf planets and small Solar System bodies. Of the objects that orbit the Sun indirectly—the moons—two are larger than the smallest planet, Mercury. The Solar System formed 4.6 billion years ago from the gravitational collapse of a giant interstellar molecular cloud. The vast majority of the system's mass is in the Sun, with the majority of the remaining mass contained in Jupiter. The four smaller inner planets, Mercury, Venus, Earth and Mars, are terrestrial planets, being primarily composed of rock and metal. The four outer planets are giant planets, being substantially more massive than the terrestrials. The two largest, Jupiter and Saturn, are gas giants, being composed mainly of hydrogen and helium; the two outermost planets, Uranus and Neptune, are ice giants, being composed mostly of substances with relatively high melting points compared with hydrogen and helium, called volatiles, such as water, ammonia and methane. All eight planets have almost circular orbits that lie within a nearly flat disc called the ecliptic.

The Solar System also contains smaller objects. The asteroid belt, which lies between the orbits of Mars and Jupiter, mostly contains objects composed, like the terrestrial planets, of rock and metal. Beyond Neptune's orbit lie the Kuiper, which are populations of trans-Neptunian objects composed mostly of ices and beyond them a newly discovered population of sednoids. Within these populations are several dozen to possibly tens of thousands of objects large enough that they have been rounded by their own gravity. Such objects are categorized as dwarf planets. Identified dwarf planets include the asteroid Ceres and the trans-Neptunian objects Pluto and Eris. In addition to these two regions, various other small-body populations, including comets, centaurs and interplanetary dust clouds, freely travel between regions.

Six of the planets, at least four of the dwarf planets, and many of the smaller bodies are orbited by natural satellites, usually termed "moons" after the Moon. Each of the outer planets is encircled by planetary rings of dust and other small objects.

The solar wind, a stream of charged particles flowing outwards from the Sun, creates a bubble-like region in the interstellar medium known as the heliosphere. The heliopause is the point at which pressure from the solar wind is equal to the opposing pressure of the interstellar medium; it extends out to the edge of the , which is thought to be the source for long-period comets, may also exist at a distance roughly a thousand times further than the hemisphere. The Solar System is located in the Orion Arm, 26,000 light-years from the center of the Milky Way galaxy. (Shyr, 2017)

2.2.2 Interested in Benefiting from Solar Power?

Solar panels are installed at three main scales: residential, commercial, and utility. Residential-scale solar is typically installed on rooftops of homes or in open land (ground-mounted) and is generally between 5 and 20 kilowatts (kW), depending on the size of a property. Commercial solar energy projects are generally installed at a greater scale than residential solar. Though individual installations can vary greatly in size, commercial-scale solar serves a consistent purpose: to provide on-site solar power to businesses and non-profits. Finally, utility-scale solar projects are typically large, several megawatt (MW) installations that provide solar energy to a large number of utility customers.

For some solar shoppers who may not be able to install solar on their property, community solar is a viable solar option that more directly connects utility-scale solar energy projects to residential consumers. As such, community solar farms are typically built in a central location as opposed to on any single customer's property. Residential consumers can subscribe to a community solar project to receive many of the benefits of solar power without installing solar panels on their property. Among the most common devices used to capture solar energy and convert it to thermal energy are flat-plate collectors, which are used for solar heating applications. Because the intensity of solar radiation at Earth's surface is so low, these collectors must be large in area. Even in sunny parts of the world's temperate regions, for instance, a collector must have a surface area of about 40 square metres (430 square feet) to gather enough energy to serve the energy needs of one person (Davis *et al.*, 2003).

The most widely used flat-plate collectors consist of a blackened metal plate, covered with one or two sheets of glass, that is heated by the sunlight falling on it. This heat is then transferred to air or water, called carrier fluids, that flow past the back of the plate. The heat may be used directly, or it may be transferred to another medium for storage. Flat-plate collectors are commonly used for solar water heaters and house heating. The storage of heat for use at night or on cloudy days is commonly accomplished by using insulated tanks to store the water heated during sunny periods. Such a system can supply a home with hot water drawn from the storage tank, or, with the warmed water flowing through tubes in floors and ceilings, it can provide space heating. Flat-plate collectors typically heat carrier fluids to temperatures ranging from 66 to 93 °C (150 to 200 °F). The efficiency of such collectors (i.e., the proportion of the energy received that they convert into usable energy) ranges from 20 to 80 percent, depending on the design of the collector. Another method of thermal energy conversion is found in solar ponds, which are bodies of salt water designed to collect and store solar energy. The heat extracted from such ponds enables the production of chemicals, food, textiles, and other industrial products and can also be used to warm greenhouses, swimming pools, and livestock buildings.

Engine, a relatively efficient and economical means of solar energy conversion, which is especially useful in remote locations. Solar ponds are fairly expensive to install and maintain and are generally limited to warm rural areas. On a smaller scale, the Sun's energy can also be harnessed to cook food in specially designed solar ovens. Solar ovens typically concentrate sunlight from over a wide area to a central point, where a black-surfaced vessel converts the sunlight into heat. The ovens are typically portable and require no other fuel inputs (Hiranvarodom et al., 2006).

2.2.3 A Brief History of Solar Power

In 1954, Bell Labs developed the first silicon photovoltaic cell. Although solar energy had previously been captured and converted into usable energy through various methods, only after 1954 did solar power begin to become a viable source of electricity to power devices over extended periods of time. The first solar cells converted solar radiation to electricity at efficiency of 4 percent - for reference, many widely available solar panels today can convert sunlight to solar power at above 20 percent efficiency, a number constantly on the rise. Although adoption of solar energy was slow at first, a number of state and federal incentives and policies contributed to driving down the cost of solar panels far enough to become more widely adopted. At this point, solar power accounts for enough capacity to power 11 million of the 126 million households in the country (Ventre, 2010).

2.2.4 The cost of Solar Energy

Concurrent with an increase in solar panel efficiency, the cost of solar energy has fallen substantially. In the last decade alone, the cost of a solar panel installation fell over 60 percent, and many industry experts predict that prices will continue to fall in the years to come: Additionally, depending upon where you live, several rebates or incentives for solar power may contribute towards lowering the cost of solar energy even further. Nationwide, the federal Investment Tax Credit (ITC) is one of the primary incentives available to anyone interested in solar energy, as it allows you to deduct 30 percent of the cost of installing a solar system from your federal taxes. Many states and utilities offer further incentives (such as net metering) in addition to the federal ITC, dropping the cost of solar power even further (Shyr, 2017).

2.2.5 Portable Solar energy is a renewable power source

Solar energy is a clean, inexpensive, renewable power source that is harnessable nearly everywhere in the world - any point where sunlight hits the surface of the earth is a potential location to generate solar power. And since solar energy comes from the sun, it represents a limitless source of power. Renewable energy technologies generate electricity from resources that are infinite. Compare, for instance, producing electricity with renewable resources to doing so with fossil fuels. It took hundreds of thousands of years for oil, gas and coal to form, so every time one of those resources are burned to create electricity, that finite resource is moved marginally closer to depletion. Using a renewable resource - such as wind, solar and hydropower - to generate electricity, does not deplete that resource. There will always be consistent sunlight shining on Earth's surface, and after turning sunlight into electricity, there is still an infinite amount of sunlight to turn into electricity in the future. That is what makes solar power, by nature, renewable energy.

While the current electricity mix in the United States is still made up largely of fossil fuels like oil and gas, renewable energy sources like solar are steadily becoming a larger part of the country's energy profile. As the cost of solar and other renewable technologies continues to be competitive (Panguloori 2014).

2.2.6 What Is a Portable Charger?

A portable charger, sometimes called a portable mobile charger/power bank, is a reusable battery that's small enough to fit in your hand. Covered by a protective casing, it connects to any input and output source, allowing you to charge various devices (a smartphone or a laptop, for example) from almost anywhere without the need for a wall outlet. Portable chargers come in a variety of forms and have a range of features. The most essential aspect is that these chargers have a rechargeable battery built-in that extends the power and use time of your other devices.

Smartphones use battery capacities measured in milliamp hours. These capacities range between 2,000mAh and 5,000mAh, though there are occasional differences. Typical battery banks used for powering phones and laptops also have battery capacity measured in milliamp hours, which makes it easy to determine which size charger you need for a specific device.

2.2.7 What Are the Different Types of Portable mobile charger/power banks?

Portable mobile charger/power banks come in a variety of different shapes and sizes. Some portable mobile charger/power banks have multiple uses in addition to charging your electronic devices!

The different types of portable mobile charger/power banks include:

- Block portable mobile charger/power bank
- Credit card portable mobile charger/power bank
- Keychain portable mobile charger/power bank
- Wireless portable mobile charger/power bank
- Flashlight portable mobile charger/power bank
- Speaker portable mobile charger/power bank
- Novelty portable mobile charger/power bank
- Bluetooth earbud portable mobile charger/power bank
- Lantern portable mobile charger/power bank
- Solar portable mobile charger/power bank
- High capacity portable mobile charger/power bank

2.2.8 Portable Solar energy + battery Storage, Electric Vehicles

The rapid proliferation of solar power nationwide and globally has also led to parallel growth in several adjacent areas. Notably, energy storage systems and electric vehicles are two sectors poised to explode alongside solar power by augmenting the benefits of solar. Given that solar panels can only produce power when the sun is shining, storing produced but unused energy throughout the day for use at a later time has become increasingly important. For instance, solar batteries store electricity and can be drawn on during periods of low solar production. What's more, solar-plus-storage solutions work for all scales of solar panel installations and provide many added benefits, from energy reliability to grid resiliency and lower-cost power.

Electric vehicles are a second product poised to ride the wave of solar energy adoption. With lower maintenance costs, lower fuel costs, and a lower environmental footprint than traditional internal combustion engine vehicles, electric vehicles are set to be an important piece of the automobile industry for years to come. With increasing electric vehicle adoption also comes a growing need for electricity to run the vehicles, a perfect fit for solar energy. Distributed solar installations provide cheap and reliable power for electric vehicles directly from the sun. In a world of increased electrification throughout the home, solar power is one of the most inexpensive, reliable, and cleanest ways to fuel our electrified future (Schinca et al., 2010).

2.2.9 How Portable Chargers Work

Instead of charging your phone, tablet, or another device from a wall outlet, you charge it from the power stored in the portable charger by inserting the charger (or charger cable) into the device that needs power. Given the short lifespan of many smartphones, the popular and best portable chargers are USB devices. These usually are on the smaller side and can easily come along with you in a pocket or purse and extend your phone's battery life.

Portable chargers are often equipped with one or more USB ports and can connect to nearly any variety of cable used to charge modern smartphones. Standard Micro-USB, USB-C, and Apple Lightning cables ending with a USB Type-A are the common connections you'll need to use with a portable charger.

2.2.10 How to Use a Portable Charger

Portable chargers come in an incredible variety. That means there's no hard-and-fast rule about how these chargers work or how to charge them. Many of the smaller portable chargers recharge over Micro-USB or USB Type-C connections. Larger battery banks may use DC connectors like those found on laptops and other electronics. There are also solar-powered portable chargers on the market. Portable mobile charger/power banks charge like other electronic devices with a rechargeable battery. Some may charge faster because of the connector or because a smaller-capacity battery recharges more quickly. To charge a device using a portable charger, connect the device to the portable charger, and turn on the charger's power. It begins charging the dead or low-powered device. Some chargers provide an indicator that shows when the charge is done; some do not.

While the most basic portable chargers only offer a USB output to charge one device, other (usually more expensive) chargers offer a host of special features. Some offer support for quick charging technologies, letting you top up your smartphone extra quickly. Some include multiple USB ports, so you can keep multiple devices charging at the same time.

Some portable chargers offer more utility, with three-prong outlets, DC power, and flashlights. Some portable chargers for laptops store a ton of power to keep energy-hungry computers powered. There are also specialized portable mobile charger/power banks for jumping cars that include a port to connect alligator-clip cables.

Solar portable charger/Portable mobile charger/power banks are commonplace and with our increasing use of battery powered equipment: everything from mobile phones to battery powered headphones, portable speakers, MP3 players can be charged via a portable mobile charger/power bank. They are effectively a portable charger. All they need is a USB charging interface. Portable mobile charger/power banks come in a variety of shapes and sizes and to suit many different people and their needs. In recent years, the use of portable mobile charger/power banks has risen significantly as they provide a very convenient and easy method of charging smartphones and other devices when away from mains power. Wireless charging portable mobile charger/power banks have also been introduced for those devices that can be charged wirelessly (Ali et al., 2011) .

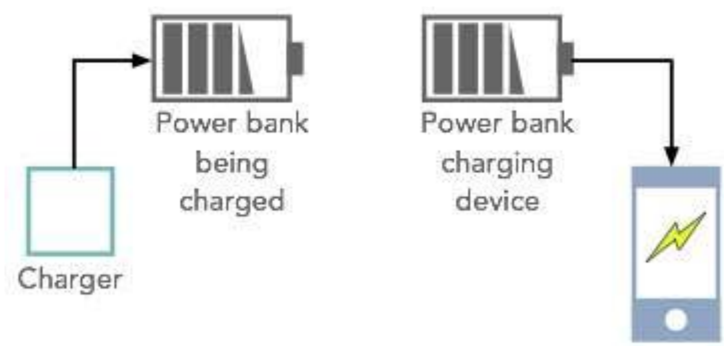
2.2.11 Building Block of A Solar Panel

Assemblies of photovoltaic cells are used to make solar modules which generate electrical power from sunlight. Multiple cells in an integrated group, all oriented in one plane, constitute a solar photovoltaic panel or "solar photovoltaic module," as distinguished from a "solar thermal module" or "solar hot water panel." The electrical energy generated from solar modules, referred to as solar power, is an example of solar energy. A group of connected solar modules (such as prior to installation on a pole-mounted tracker system) is called an "array."

2.2.12 Solar Portable/Portable mobile charger/power bank Definition

Portable mobile charger/power banks, sometimes speed as power banks, can be defined as portable batteries that use circuitry to control any power in and power out. They can charged up using a USB charger when power is available, and then used to charge battery powered items like mobile phones and a host of other devices that would normally use a USB charger.

The name portable mobile charger/power bank can be likened to a financial bank where funds can be deposited, stored, and withdrawn when needed. These items are also often referred to as portable chargers, as they can charge items like mobile phones without the need to be connected to the mains during charging, although they will need to be charged, and this normally requires a mains charger Nunoo et al., 2010).



Operation of a typical portable mobile charger/power bank

2.2.13 Type of Solar Portable Charger

There are a few different types of portable mobile charger/power bank portable charger that can be bought. Obviously the size is one of the main criteria, but there are some other categories that can be considered.

The main types of USB portable mobile charger/power banks include the following:

- ***Universal or standard portable mobile charger/power bank:*** These are the normal portable mobile charger/power bank portable chargers which are available in the stores and online. They are charged from the normal USB sources like USB chargers.

  These portable mobile charger/power banks are normally charged from a standard USB charger and there is some indication on the portable mobile charger/power bank as to its state of charge. This may be a row of small LED lamps or a simple alphanumeric display that indicates the charge level as a percentage of full charge. Typically a micro USB connector is used as the power in connection.

  Once fully charged the portable mobile charger/power bank can be used to charge other devices. There may be one of more Type A USB sockets (dependent upon the particular portable mobile charger/power bank) that can deliver charge to the devices needing charging.

- ***Solar portable mobile charger/power bank:*** As the name indicates, these solar portable mobile charger/power banks can use sunlight to charge up. To do this they have photovoltaic panels. These are really only able to trickle-charge the internal battery when placed in sunlight because the solar cells are relatively small, but nevertheless this can be a very useful function, but really only in very sunny or bright conditions.

A solar powered portable mobile charger/power bank

It can also be charged in the normal way, using the solar power for a slow trickle charge

As the solar charging is slow, they can also be charged from a USB charger as well. The solar charging is a useful back-up, especially if you are travelling away from mains power. To ensure that the maximum amount of solar energy can be converted, some of the more advanced solar portable mobile charger/power banks have solar panels that fold out to present a larger area to the Sun. Even so, it can take over 24 hours to charge some, and as there obviously isn't bright sun at night, or even all day, it can take a considerable while to charge. As charge times, capacities, etc vary considerably, it is always best to take a close look at the figures, if there is a possibility of buying one.

Like the standard wired portable mobile charger/power bank, these solar powered ones have standard Type A USB connectors for the output or outputs and a micro USB for the input from a USB charger (Harrington et al., 2012).

- ***Wireless portable mobile charger/power bank:*** With many gadgets like phones, ear-pods and the like now having the capability to be charged wirelessly, this concept has been adopted by the portable mobile charger/power bank industry.

It is possible to obtain power banks that are themselves charged from a standard USB source, but they are able to charge phones and other wireless charging compatible electronic devices wirelessly.

Wireless portable mobile charger/power bank

These power banks use the Qi standard that has been adopted by virtually all electronic devices that can be charged wirelessly. The electronic device to be changed is placed on the portable mobile charger/power bank - orientation is often important, so check with the instructions, a button typically has to be pressed to turn on the wireless charging capability, and then it all proceeds until the device is charged. (Messenger and Ventre, (2010).

It is best to turn off the wireless charging portable mobile charger/power bank once the charging is complete and then the wireless charging circuitry is disabled and the power bank will not be discharged unnecessarily.

2.3 Relevant Theories of the Review

2.3.1 Solar Portable mobile charge lifetime

There are two main forms of lifetime that are associated with portable mobile charger/power banks.

- ***Charge discharge cycles:*** Any rechargeable battery will gradually wear out. Normally the lifetime of a battery is quoted in terms of the number of charge discharge cycles it can undergo before its performance falls by a given degree. Some cheaper portable mobile charger/power banks may only have a life of 500 or so charge discharge cycles, but better ones will have lifetimes of many more charge discharge cycles.
- ***Self discharge time:*** All battery cells, whether rechargeable or primary have a certain level of self discharge. For rechargeable batteries these days with their own control circuitry, a small amount of power is required to keep these circuits alive. As a result there is only a finite time that a battery will remain charged. A good portable mobile charger/power bank can hold charge for up to 6 months with only a small loss of charge, but lower quality ones may only retain a useful charge for about a month. These figures are for room temperature, but storing them outside these temperatures considerably reduces their performance (Hammons et al., 2013).

2.3.2 Solar Portable mobile charge & current capabilities

The level of charge that can be stored in portable mobile charger/power banks has risen as the need has grown. Smartphones are one of the chief items to be charged by them, and n recent years the battery capacities have increased significantly to provide longer times between charge.

Older portable mobile charger/power banks had capacities of possibly 1000mA hours, where as some of the latest ones available can offer huge capacities of 25000 mA hours.

Also the current that can be delivered by them is large as well. Often they can deliver 2.5A, enabling them to provide a fast charge for many electronic devices.

2.3.3 Portable mobile charger/power bank battery technology

All portable mobile charger/power banks use rechargeable batteries based around lithium technology. Lithium-Ion and Lithium-Polymer batteries are most commonly used for portable mobile charger/power banks but don't be surprised if other types start to hit the market before long. Battery technology is key to many new developments: everything from mobile phones to electric vehicles, and as a result it is quite likely there will be some spin-offs into portable mobile charger/power banks.

The two technologies that are currently used have slightly different properties:

- ***Lithium-ion:*** Lithium-Ion batteries have a higher energy density, i.e. they can store more electrical charge in a given size or volume, and are cheaper to manufacture, but they can have issues with ageing.
- ***Lithium-polymer :*** Lithium-polymer portable mobile charger/power banks do not suffer from ageing to the same extent so are a better choice. However they are more costly to manufacture and as a result they may not suit all budgets. Sometimes it may be that it is best to spend less, especially if they are likely to be accidentally lost.

Portable mobile charger/power bank portable chargers are particularly useful as they enable battery powered items to be charged on the go. As it is not always possible to reach a mains power point every time a mobile phone or other battery powered item needs charging, these portable mobile charger/power banks are have now become an established product and they are very useful, especially when travelling.

2.4 Summary of the Chapter

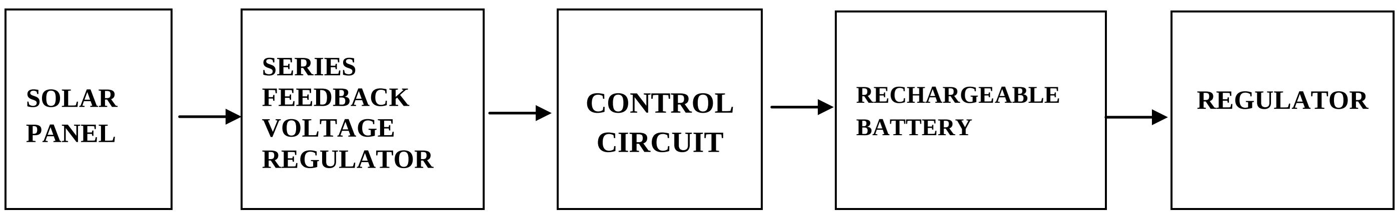
The study reviewed several studies on the construction of portable solar mobile charger, from the chapters, it was noted that device that stores energy in a battery by running an electric current through it. The charging protocol (how much voltage or current for how long, and what to do when charging is complete) depends on the size and type of the battery being charged. A trickle charger provides a relatively small amount of current, only enough to counteract self-discharge of a battery that is idle for a long time. Some battery types cannot tolerate trickle charging; attempts to do so may result in damage. Lithium-ion batteries cannot handle indefinite trickle charging. Slow battery chargers may take several hours to complete a charge. High-rate chargers may restore most capacity much faster, but high rate chargers can be more than some battery types can tolerate.

CHAPTER THREE

METHODOLOGY

3.1 Block Diagram

The block diagram for the proposed design is given is Figure 3.1. It consist of a solar panel module, a regulator stage, a control circuit that switches between solar power and battery power depending on the availability, a rechargeable battery to store energy, and a regulator circuit which charges the mobile phone battery.



3.2 Solar Panel

Solar panels are those devices which are used to absorb the sun's rays and convert them into electricity or heat.

A solar panel is actually a collection of solar (or photovoltaic) cells, which can be used to generate electricity through photovoltaic effect. These cells are arranged in a grid-like pattern on the surface of solar panels. Thus, it may also be described as a set of photovoltaic modules, mounted on a structure supporting it. A photovoltaic (PV) module is a packaged and connected assembly of 6×10 solar cells. When it comes to wear-and-tear, these panels are very hardy. Solar panels wear out extremely slow. In a year, their effectiveness decreases only about one to two per cent (at times, even lesser).Most solar panels are made up using crystalline silicon solar cells (Holger & Dieter 2022).

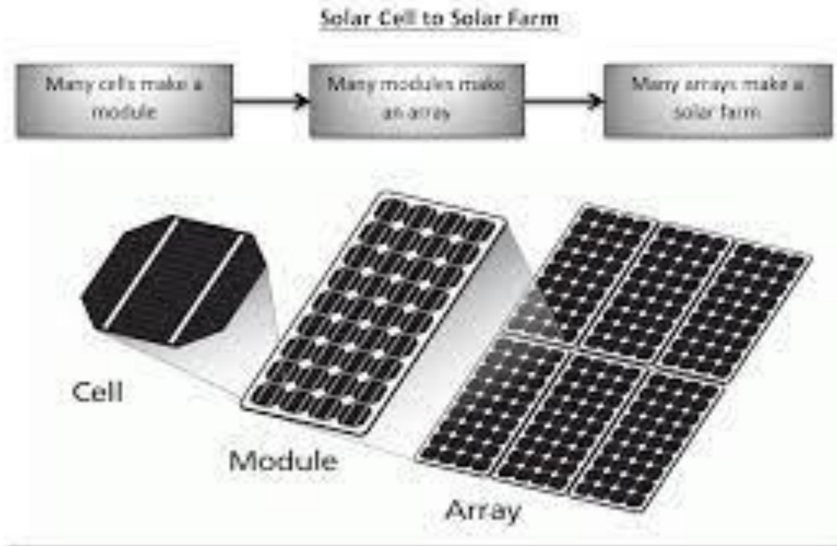


fig: 1: Diagram of a solar panel

2.3 Series Feedback Voltage Regulator

As to keep the output voltage constant (almost constant) despite changes in the load current and line voltage, it employs principles of negative feedback.

Operation of Series Feedback Voltage Regulator

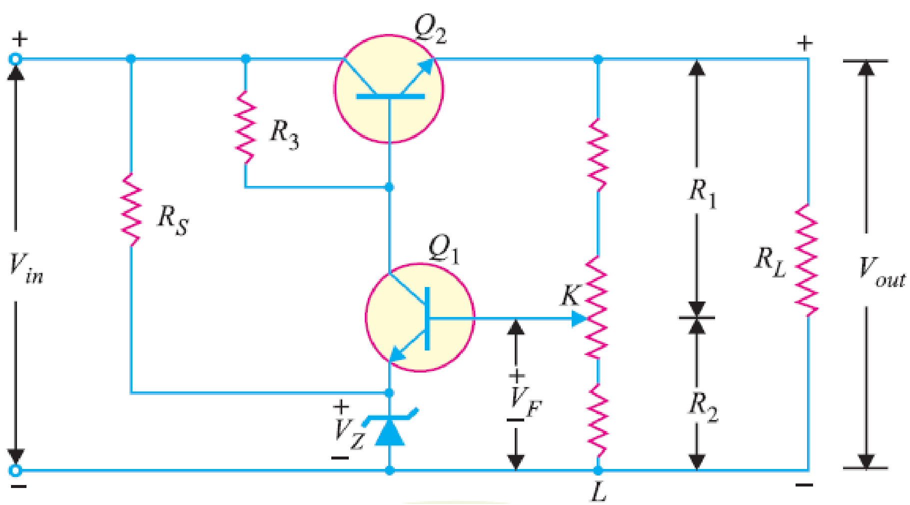


Fig: 2: Series Feedback Voltage Regulator

All the load current passes through the transistor Q2 and that's why it is called a pass transistor. The voltage divider consisting of R1 and R2 is the sample and adjust circuit. The function of the voltage divider is to sample the output voltage and then deliver a negative feedback voltage to the base of Q1. The collector current of Q1 is controlled by the feedback voltage VF.

As you can see in the circuit diagram, we feed the unregulated d.c. supply to the voltage regulator. The function of the circuit is to maintain constant output voltage despite variations in load or input voltage.

The series voltage regulator or as it is sometimes called the series pass regulator is the most commonly used approach for providing the final voltage regulation in a linear regulated power supply. The series linear regulator provides a high level of performance, especially when low noise, ripple and transients are required in the regulated output.

3.4 Control circuit

Control circuits can be simple two-wire on/off devices that energize a motor starter, or they can be more involved three-wire circuits with multiple pushbutton locations and motors that start in sequence.

One of the key advantages of control circuits is that they can operate at a lower voltage than the motor that they control. This allows an operator to push a 120V pushbutton, which then energizes a 120V starter coil whose contacts then close on a 600V motor. If a dangerous fault occurs, the high-voltage switching happens in a location away from the operator.

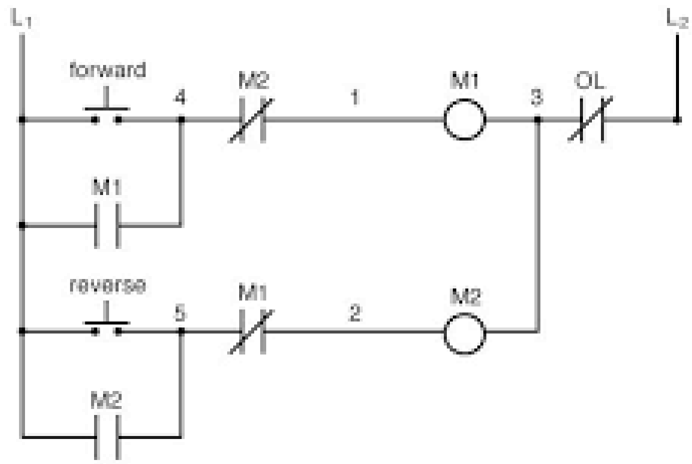


Fig: 3: Diagram of a control circuit

3.5 Rechargeable batteries

A rechargeable battery, storage battery, or secondary cell (formally a type of energy accumulator), is a type of electrical battery which can be charged, discharged into a load, and recharged many times, as opposed to a disposable or primary battery, which is supplied fully charged and discarded after use. It is composed of one or more electrochemical cells. The term "accumulator" is used as it accumulates and stores energy through a reversible electrochemical reaction. Rechargeable batteries are produced in many different shapes and sizes, ranging from button cells to megawatt systems connected to stabilize an electrical distribution network. Several different combinations of electrode materials and electrolytes are used, including lead–acid, zinc–air, nickel–cadmium (NiCd), nickel–metal hydride (NiMH), lithium-ion (Li-ion), lithium iron phosphate (LiFePO4), and lithium-ion polymer (Li-ion polymer).

Fig: 4: Diagram of a rechargeable battery

3.6 Regulator

A regulator is a device or mechanism that automatically controls something, such as the temperature in a room or the growth of a person's body.

Regulator (automatic control), a device that maintains a designated characteristic, as in:

- Battery regulator
- Pressure regulator
- Diving regulator
- Voltage regulator

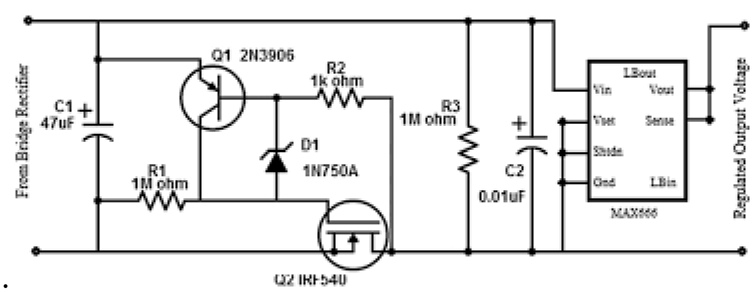


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Fig: 4: Diagram of a regulator

3.7 Materials use for the construction

The material used for the construction are as follows:

- Solar panel
- Rechargeable Battery
- Resistor
- Capacitor
- Transistor
- Diode
- Inductor
- Vero board
- Soldering iron
- Soldering lead

Table 1: Material use for construction

S/N	Materials	Quantity	Specification
1	Resistor	6	1k
2	Diode	1	In400
3	Transistor (NPN)	3	945
4	Inductor	1	30H
5	Capacitor	1	1000µf-35v
6	Vero board	1	6cm-3cm
7	Rechargeable Battery	1	500mAh

CHAPTER FOUR

RESULT AND DISCUSSION

4.0 Result and Discussion

Testing results of phone battery charger was found satisfactory. It took almost same amount of time to be fully charged from main. Storing of charge and also charging from the reservoir were checked and found satisfactory. Performance of storing of charge and charging of battery were found satisfactory and both were found satisfactory and both were delayed in cloudy sky was also observed.

4.1 Construction

In its most widely used context, construction covers the processes involved in delivering buildings, infrastructure, industrial facilities and associated activities through to the end of their life. It typically starts with planning, financing, and design, and continues until the asset is built and ready for use; construction also covers repairs and maintenance work, any works to expand, extend and improve the asset, and its eventual demolition, dismantling or decommissioning.

4.2 Testing of system operation

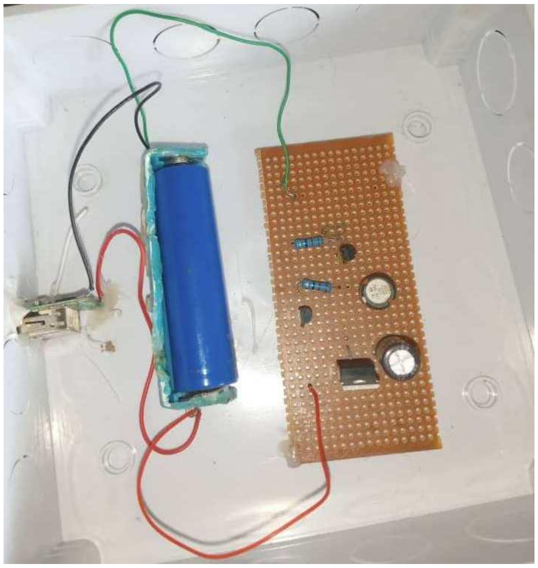
Batteries were charged both at stationary and moving conditions. In both the cases it was observed to charge the battery successfully. The performance of portable charger depends on solar intensity that was also observed while charging in sunny and cloudy sky. Storing of charge in the reservoir was checked by charging battery at night successfully.

4.5 Casing and assembling of the system

Having provide the casing and having finished the construction of the sections of this system, the assembling into the casing followed. The sections were properly laid and assembling into the casing where the general coupling and linkages into the peripheral devices took place.

4.6 Construction and Testing

After a level of assurance was attained from the preliminary examinations on Proteus and Veroboard, the respective components were soldered to form the device. The Green LED D4 comes ON as soon as the output voltage at pin1 of the Op-Amp was greater than or equal to 2.17242V. Blue LED D5 glows to show delivery to load while the Red LED D1 glows throughout as it indicates the presence of a D.C source as the Solar Panel.



Problem Encounter

Several problem where encounter during the process of construction

- Problem of Power Holding (unsteady power)
- Fake component was another problem we encounter
- To obtain a neat or nice soldering was not ease.

CHAPTER FIVE

Conclusion/Recommendation

The portable portable mobile charger/power bank is an innovative device that has stolen the heart of possibly every phone/laptop owner. This is not surprising because no one wants to feel limited by electricity or the absence of it. With portable mobile charger/power banks, you're rest assured that your devices will not go off abruptly due to low battery. To add icing on the cake, they're also super affordable and easy to carry around. The charging circuit is designed to be able to charge the battery at peak hour. Meanwhile the battery level indicator circuits are able to detect condition of battery. In addition, the converter circuit 5V DC and inverter device are capable to produce output for loads especially for electronic and electrical equipment.

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