DESIGN AND CONSTRUCTION OF 4400mah POWER BANK

BY

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A PROJECT WORK SUBMITTED TO THE DEPARTMENT OF PHYSICAL SCIENCE LABORATORY TECHNOLOGY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF HIGHER NATIONAL DIPLOMA (HND) IN PHYSICS/ELECTRONICS OPTION, AUCHI POLYTECHNIC, AUCHI, EDO STATE.

NOVEMBER, 2022.

CERTIFICATION

This is to certify that the project work titled "Design and Construction of 4400mAh Power Bank" was done

BY

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Under the supervision of Mr. Umukoro Edafewhuotu as part of the requirements for the award of Higher National Diploma in Physics/Electronics Option of Auchi Polytechnic, Auchi, Edo state.

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(Head of Department)	(Project Supervisor)
_____	_____
Sign/Date	Sign/Date

DEDICATION

The project is dedicated to GOD Almighty for making it possible for the completion of this final year project work which is really a very big challenge to me.

Also, for making it possible for the successful completion of this Higher National Diploma (HND) program in Auchi Polytechnic, Auchi in peace, healthiness and for the great achievement that I cannot mention.

And also, to my great parent for their caring, who have passion for education, who also led me through the right path. And also, for their moral, financial and spiritual support giving to me during and after this final year project.

I pray that they will reap the fruit of their labour in the name of Almighty ALLAH. Ameen.

I pray that they will, live long to witness my greatness. Ameen.

Finally, I want to dedicate this final year project work to all my friends and guidance for their advice during my time in school. Thank you and God bless you all.

ACKNOWLEDGEMENT

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I acknowledge with great gratitude to my humble and well-respected supervisor, the person of **MR. UMUKORO EDAFEWHUOTU** for his tireless help and effort. I pray that God will increase his strength.

And also, to the effort of **MR JAFARU BRAIMAH** (HOD) and my technologist **MR. AIBOJE**, I pray that God Almighty will reward their hard work. I thank you all for your support throughout this program and I pray that our wonderful and blessed saviour will never leave nor forsake you rather He will always continue to meet you at the point of all your needs.

I want to appreciate the effort of **ENGR. ADE** for his great support during my project practical, may the Almighty God bless you sir.

With great joy in my heart, I want to sincerely the effort my parents the persons of **MR.** and **MRS. AUDU YUSUF** words are not enough to appreciate you both, I pray may Almighty ALLAH give you both long life and may you both eat the of your labour Ameen, I love you my lucky parents.

ABSTRACT

This project involves the construction of 4400mAh power bank, it consists of three different units which are; charging unit, battery protection unit and amplifying unit. All these units consist of different circuit in other to perform their main functions.

The charging unit combined with a capacitor includes a power supply adapted to be connected to the capacitor, and the battery. The circuit includes an electronic switch connected to the power supply. The electronic switch is responsive to switch between a conducting state to allow current and a non-conducting state to prevent current flow.

Battery protection unit is a piece of hardware utilized to protect the battery pack from getting degrades or damage permanently. To enable this feature, it limits the maximum charging level to 85%. Once this feature is enabled, the phone will stop charging immediately once the battery level reaches 95%.

In other to ensure that the device is portable to be carrying all around, the amplifying unit is a DC power supply that can be boosted by a high-frequency switching pulse way this prototype schematic uses the same principle to bring high voltage output from a low voltage input.

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CHAPTER ONE

Introduction

The power bank plays a vital role in communication system even as an entertainment system in the present modern society. The size of the electronic devices has shrunk from macro to micro and then transforming to nanometer scale with advancement of electronics technology. The unique features of this power bank are any USB-charged devices. Cameras, MP3 players, mobile phones, tablets etc. as long the power bank is charged. This power bank was developed by using both AC source and a DC source of producing electricity. The device will not work by itself; it requires electrical energy. The device must be supplied with sufficient amount of electric enough to produce and store power or charges in the battery. With the rapid development of global economy, people continued to carry more portable electronic products, as mentioned earlier, which are drained or discharged as a result of longtime uses. The design of power bank comes to my thoughts about the trends happening in the world and people now have their own cache of gadgets to keep up with technological and social trends, but because these devices are electronic, they lose power after many hours of use. This is where power banks come into play.

Charging of mobile phones is another trend of designing power bank, the primary purpose of power banks is to supply modern gadgets with power when they run out. These portable chargers are helpful when the phone battery runs down. Travelers find power banks useful during a power outage or any accident occurred along the way where there is no electricity to contact the police for a

rescue. They will not have to wait for electricity to charge their mobile phones. This might spell the difference between life and death should an emergency come up during such calamity. Important calls and texts will not be interrupted as well because they can conveniently charge their phone with a power bank. It gives them the freedom to charge their gadget's battery when there are no options left at the moment. A single device can charge for up to four times with a portable charger of 10,050mAh. The higher the power capacity of the power source, the more you can charge your device.

Prestige Value, in today's age where technology is rapidly evolving, having multiple gadgets is one indication that you are keeping up with the trends. Adding power banks to your gadget collection can increase their prestige value as it is one of the indicators of their ability to keep up with social and technological demands. Low Cost, despite the stylish appearance of power banks and their beneficial features, these power sources are very affordable. Many manufacturers and individuals are now deigning different types of power banks, and this lets the price value of the gadget go down because of the competition.

1.1 Aims and Objective

1.1.1 Aims

The design of power bank is electronic devices because it is easily portable. You can carry your power bank with you anywhere and everywhere. After all, it is a portable charger. This device is quite small in size and it can easily fit into your pocket, too. The compactness of this device makes it a popular buy. It is quite a convenient device that can assure you back up for your mobile phone, tablet or any USB devices. Also, because it will come to the rescue when your device is running out of battery. Running out of battery always puts you in a sticky situation.

Just imagine. You are preparing a presentation on your phone while you are on your way to work and your phone's battery dies, all that hard work has gone to waste. This is one of the reasons why buying a portable charger becomes kind of a necessity. Also think about it this way, it isn't always that you'll find a charging point. For situations like this you should carry a power bank with you at all times.

1.1.2 Objectives

The objectives of this project work are as follow;

- to design a charging unit,
- to design an amplifying unit,
- to design charging protection circuit,
- to construct a power bank circuitry and
- to evaluate the output performance with the existing ones.

1.2 Statement of problem

The existing power bank are customized and it makes its difficult to repair when it is faulty and it is expensive. Most people can not communicate with friends and relative when their inbuilt battery runs down. This bring a gap information dissemination and insecurity in the society home. Hence, there is need to design and construct a portable power supply device which will provide energy to our cell phone.

1.3 Significance of the study

The power bank serves as an extra battery or external charger for your phone or other electronic devices. Power bank helps to ensure longer hours of texting, phone calls, or web browsing using your mobile phone.

The benefits of this design include;

- Charging of mobile phones when it's runs out of battery.
- It is portable, is neither heavy nor inconvenient to carry.
- It has a multiple socket for all kinds of phone
- It can charge all kinds of USB device's
- Power bank is a very affordable tool.

1.4 Limitation of the study

The limitation of this design is that it can only be used for the charging of devices with voltage of 5 v and current of 1 A. it should not be used for devices with high voltage and high current.

CHAPTER TWO

Literature Review

2.1 Background of study

Power bank charging equipment specifically designed for the mobile phones of majority of large power consumption. This device is suitable for the system on all smart phones, such as iOS, Androids, Blackberry OS, Symbian, 5v LED light and 5v DC Fan. With an increased number of features, mobile devices like smart phones, tablets etc. are requiring more power. To extend their operating life, manufacturing try to use bigger batteries but are limited because of the weight and size. To provide users additional power when their devices are running low, many users are learning to relay upon power banks, a portable energy source that can be carried in a pocket or backpack. Power banks store energy in an internal lithium-Ion battery and can charge the mobile devices.

Domestic Solar Power Bank was done by some students in Covenant University Canaan land and University of Johannesburg, Auckland Park, Johannesburg, South Africa (M. E. Emetere et al., 2018). The method of their Solar Power Bank (SPB) is that it was constructed with local materials based on their individual properties. The functionality of the SPB was tested in a convective environment. Davis automatic Weather Station (DWS) was used to get the weather parameters (like solar irradiance, solar energy and temperature) for each day the SPB was tested. The maximum solar irradiance for four days (during the experiment) was 220 W/m2, 208 W/m2, 450 W/m2 and 900 W/m2. The maximum solar energy was 0.33 J, 03 J, 0.64 J and 1.33 J. And their result was that the maximum voltage and power obtained from the Solar Power Bank (SPB) was 0.18V and 0.065W respectively. Their design showed tremendous heat energy

entrapment during solar irradiance peak as the temperature in the SPB was about three times the DWS. And very importantly what I observed in their project is the type of batteries they make use of and it was a LEAD Battery which I believe those not have enough current compared to the Lithium-Ion batteries that I used in my project, with this my work and theirs may serve the same purpose but is totally different from mine which is portable and long lasting.

Similar works was carried out also by some persons (Sambandh, D. B. J Emetere et al., 2016) who constructed Solar Powered Mobile Power Bank Systems in American Journal of Electrical and Electronic Engineering. Their design was based on the fact that the power bank could be used for charging DC rechargeable electronic gadgets with three independent outputs currents of 0.5, 1.0 A and 1.5 A at 5 Volts. The choice of output currents and the voltage were done based on the following information given. Then a particular person did similar design (Qutaiba, A.I. 2011), Design & Implementation of a Mobile Phone Charging System Based on Solar Energy Harvesting Iraq J. Electrical and Electronic Engineering. The similarities between my work and theirs are that some of the components used in their project are also used in my work but the difference is that my designed project has only one output.

These same students constructed a power bank with two input sources, a backup battery and three output terminals. Results show that the power bank is effective when compared with the conventional power bank. I believe that the power bank has both AC and DC input power source.

CHAPTER THREE

Methodology/ Materials

3.1 Material

- Breadboard.
- Lead
- USB connector
- Vero board.
- Battery casing
- Pattrex casing
- Transformer.
- Diode
- Resistor
- Capacitor
- Transistor
- Zener diode
- Variable resistor
- LED
- Battery
- Switch.

3.1.1 Transformer: This is a device that transfers electric current energy from one alternating current circuit to one or more other circuits, either increasing (stepping up) or reducing (stepping down) the voltage. As shown in figure 3.1 below

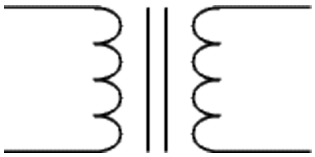

Fig. 3.1: Transformer

3.1.2 Diode (1N4007, 1N4148): Is a device which only allows current to flow in one direction, 1N4007 is rectification diode which does the conversion of AC supply DC supply while 1N4148 is mainly used as a protecting diode. As shown in figure 3.2 below

Anode  Cathode

Fig. 3.2: Diode

3.1.3 Capacitor: This is a device for storing electrical energy, consisting of two conductors in close proximity and insulated from each other. As shown in figure 3.3 below

Fig. 3.3: Capacitor

3.1.4 Resistor: A resistor is an electrical component that limits or regulate the flow of electrical current in an electronic circuit. As shown in figure 3.4 below

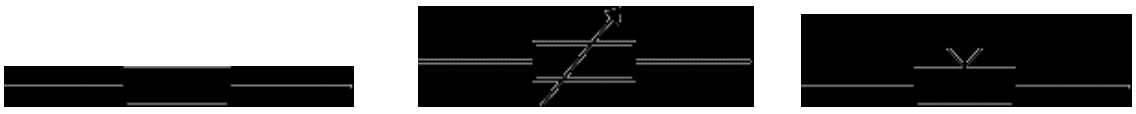

Fig. 3.4: Resistor

3.1.5 Transistor: A transistor is a miniature semi-conductor that regulates or controls current or voltage flow in addition amplifying and generating these electrical signals and acting as a switch or gate for them. As shown in figure 3.5.

Fig. 3.5: Transistor

3.1.6 Zener diode: Is a special diode which is used to maintain a fixed voltage across its terminals. It is reversely connected in other to act as a voltage regulator but when it is forward bias it acts as a normal diode. As shown in figure 3.6 below

Anode  Cathode

Fig. 3.6: Zener Diode

3.2 Methodology

The power bank system consists of the following units charging unit, battery protection unit and amplifying unit. These are represented as shown below:

3.2.1 Charging unit

A circuit for charging a battery combined with a capacitor includes a power supply adapted to be connected to the capacitor, and the battery. The circuit includes an electronic switch connected to the power supply. The electronic switch is responsive to switch between a conducting state to allow current and a non-conducting state to prevent current flow. The circuit includes a control device connected to the switch and is operable to generate a control signal to continuously

switch the electronic switch between the conducting and non-conducting states to charge the battery. As shown in Figure 3.7

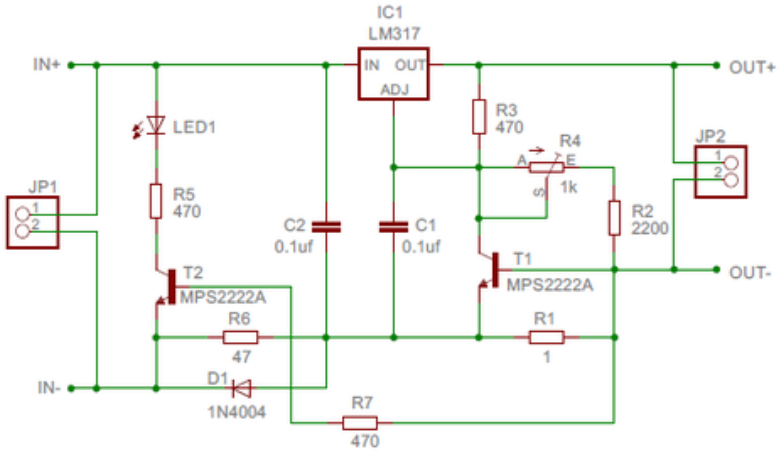

Fig. 3.7: Charging unit circuit diagram

3.4.2 Battery protection unit

The battery protection unit is a piece of hardware utilized to protect the battery pack from getting degrades or damage permanently. To enable this feature, it limits the maximum charging level to 85%. Once this feature is enabled, the phone will stop charging immediately once the battery level reaches 85%. As shown in the figure 3.8

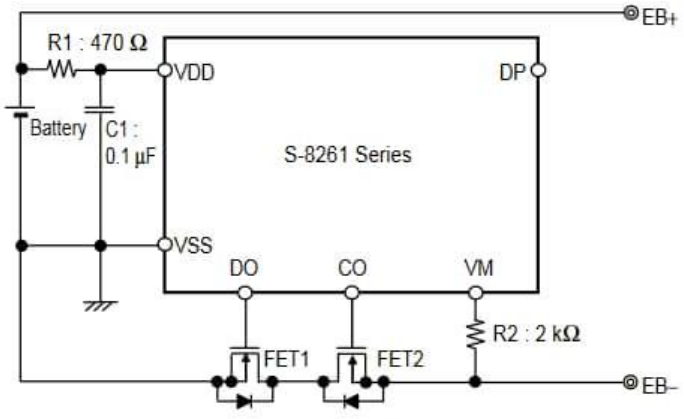

Fig. 3.8: Battery protection unit

3.4.3 Amplifying unit

A 3.7V to 5V amplifying circuit is designed with DC/DC Step-up Converter ME2108 Series; IC ME2108 is a step-up DC/DC converter with a low supply current. As we know DC power supply can be boosted by a high-frequency switching pulse way this prototype schematic uses the same principle to bring high voltage output from a low voltage input. This IC ME2108 reduces high frequency switching noise and output can be programmed between 2.0V to 7.0V. Due to internal architecture, the IC ME2108 uses minimum external components. It requires Inductor at the input and a Schottky diode then Capacitors at the output. This IC can deliver 400mA output current if the input voltage is 3.0V and the output voltage is fixed at 5.0V. It uses 180 KHz maximum switching frequency by the value of Inductor and output capacitor we can change the output voltage range. As shown in figure 3.9 below

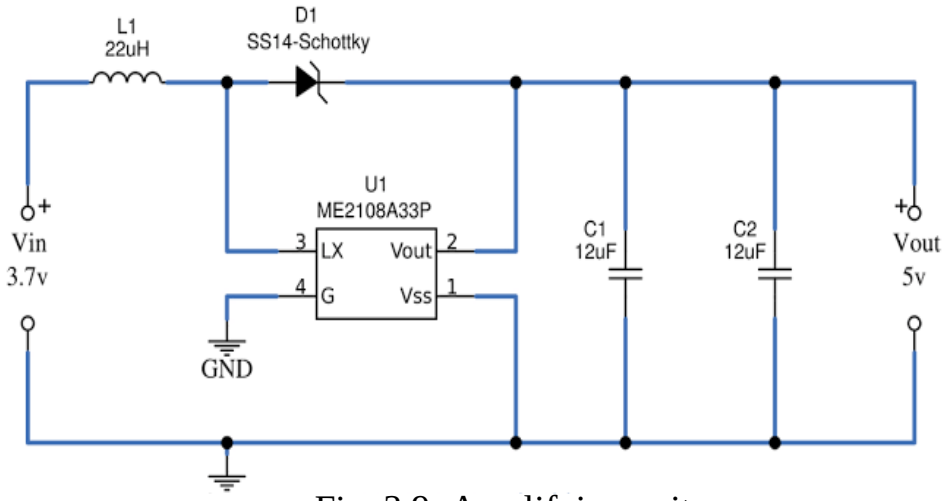

Fig. 3.9: Amplifying unit

CHAPTER FOUR

Implementation, Testing, Results and Evaluation.

4.1 Implementation

After the different units (charging unit, battery protection unit and amplifying unit) had been constructed and tested for normal working condition they were enclosed in a plastic casing as shown in the figures below.

Fig. 4.1: Charging input and output unit

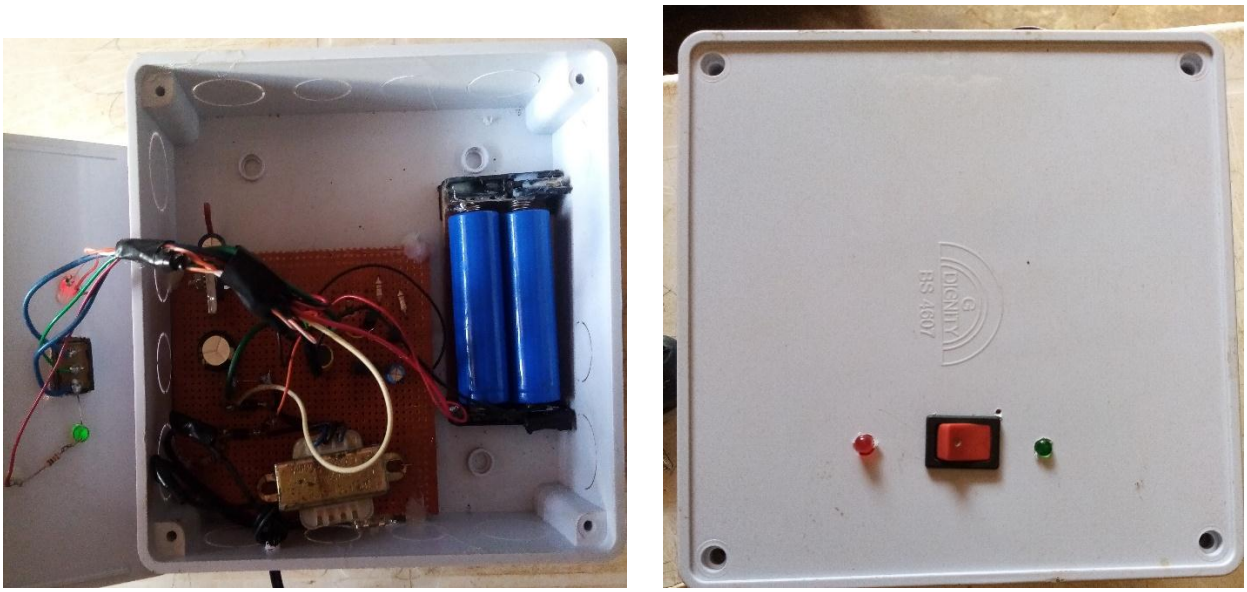

Fig. 4.2: Charging indicators and switch

4.2 Testing and Result

When the power supply plug is connected to the 240V AC supply and the power switch is turn ON then the red indicator lights up showing that electricity has been supplied to the circuit and the battery charging unit start charging, when the battery has fully charged the transistor will trip off thereby preventing the battery from being over charged.

The power bank has USB connector interface through which the mobile device can be connected for charging when the phone charging unit is turned ON.

The power bank has the ability to charge two mobile devices at the same time. After the overall construction the device (Power bank) was allowed to charge for some times in other to restore the battery to its fully charged level.

4.3 Cost Evaluation and Analysis

4.3.1 Cost Analysis of Components and Materials Used

S/N	NAME OF COMPONENT	QUANTITY	UNIT PRICE	TOTAL
1	Transformer (12V, 2A)	1	1600	1600
2	Breadboard	1	1000	1000
4	Rechargeable pen battery	2	1000	2000
3	Battery holder	2	300	600
4	Vero board	1	100	300
5	Plastic casing	1	1000	1000
6	Soldering lead	1 roll	400	400
7	Jumpers	4roll	100	400
8	Transistors	10	200	2000
9	Resistors	10	20	200
10	Capacitors	10	50	1000
11	Diodes	5	120	600
12	Power cable	1	80	80
13	USB connector	1	50	50
14	USB phone charger	1	300	300
15	Switch	4	50	200
16	LED (red, green)	10	10	100
17	Power plug	1	80	80
18	Flexible wire	4yards	50	200
19	Battery	2	1000	2000
			TOTAL	14,110

CHAPTER FIVE

Conclusion and Recommendation

5.1. Conclusion

Power bank has made a lot of impact both on human's life as a result of the fact that people find it difficult to do away with their mobile devices switch off or drained out while they are away from their home or offices or which can be as a result of outage or interrupted AC power supply. It has also improved the economy tremendously as more people buy it as a necessity for the purpose of charging their mobile devices.

5.2. Recommendation

This project is recommended for use in office or at any locations for the charging of mobile devices when there is interruption of electric power supply and should not in any case use to charge high consuming devices like laptop computer and car batteries.

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