Design of a Portable AC/DC Power Bank Using 32650 Lifepo4 Battery Pack

ANTONIO, JOHN DAVID P.[1], CAYANAN, JAMES R.[2], ORTALEZA, NICOLE M.[3], REGALA, ARGIE G.[4], SUNGA, MARK BRYAN G.[5], REYNALDO H. GOMEZ JR[6], FRENEIL PAMPO[7]
[1, 2, 3, 4, 5, 6, 7] *Department of Electrical Engineering, College of Engineering and Architecture, Don Honorio Ventura State University*

Abstract- Due to the newly developed cars that use Battery instead of Gas to run the car, Elon Musk the Richest person in the world who owned the company of Tesla that designed the new type of car operation. Philippines is located in the Pacific Ocean along the Ring of Fire which the sun light is always present, During the day, the country receives a substantial and consistent amount of solar energy. It would be a waste if this energy was not used to generate electricity. The design of a small-scale, cost-effective portable solar power system is described in this work. A solar panel is included in the final product to capture and convert solar energy to electrical energy. The electrical energy was stored in a rechargeable battery that was regulated by a solar charge controller. The AC power supply required for the functioning of low power rated household gadgets was generated using a low-cost sine wave inverter. For charging handheld devices such as smartphones and tablets, a voltage regulator was built to step down the 12V DC voltage to a regulated 5V DC power supply. The final product weighs 15kg and functions as a portable 220V AC power generator

I. INTRODUCTION

The Philippines is facing more and more energy problems as the Malampaya gas field, which supplies 30% of Luzon's energy demand, is expected to be depleted by 2024 (PEMITA, 2020). Population growth, a government development boom, and some of Southeast Asia's highest electricity tariffs combine to create serious problems. The Philippine National Grid Corporation (NGCP) has deployed to Luzon Island when the island is suffering from inadequate power grid yellow and red alerts. A spinning power outage lasts less than an hour and affects Metro Manila and neighboring states. This power bank will assist typhoons and disaster-prone areas of the Philippines. Use this emergency generator for medical equipment emergencies where you need Power for oxygen tanks, electric wheelchairs, dialysis machines, hearing aids, and more. Normally electricity is required to operate. Using a portable generator during a power outage You can leave the lights on. This is especially important for older people and their families. Children have difficulty moving in the dark. It should also reduce the risk of crime to reduce the risk of accidents and injuries.

Don Honorio Ventura State University of Technology (formerly known as Don Honorio Ventura College of Arts and Trades) is known as the oldest professional school in the Far East. It has six odd school sites in Apalit, Candaba, Porac, Mexico, Santo Tomas, and Lubao in the province of Pampanga. DHVSU was founded in 1861. In the past year, the storm that rarely made landfall in Pampanga was Hurricane Ulysses, which caused sudden power outages in the area. Portable AC/DC power supplies can be useful in many ways, especially during emergencies.

On May 31, 2021, CNN (PH) The National Grid Corporation of the Philippines (NGCP) placed the regional power grid on red alert regarding rotating blackouts to manage reduced supply. and increasing demand. In Metro Manila, a large number of residents in Caloocan, Manila, Muntinlupa, Marikina, Paranaque, Pasay, Pasig, Taguig, Valenzuela and Quezon City have been affected. In climate change discussions, renewables are usually at the top of the list of changes. The world can do to stop the worst effects of rising temperatures. that is Renewable energy sources such as the sun and wind do not emit carbon dioxide or other greenhouse gases Gas that contributes to global warming. For the last 150 years,

people have been heavily dependent on its Coal, petroleum, and other fossil fuels power everything from light bulbs to cars to factories. fossil Fuel is embedded in almost everything we do, resulting in the release of greenhouse gases. Combustion of these fuels has reached historically high levels (Nunez, May 2021).

Without a study like this, people would be completely unaware of these facts. Scientists and experts are studying better ways to minimize the possible effects of the mentioned problems. Researchers have proposed one of many devices that people can use to avoid new global conflicts and rely more on renewable energy. In addition, this study will prove its claim - a carbon-free, practical and safe device. Today, energy has become important in life. Fluctuating energy prices can affect people's daily activities, contributing to political and economic stability. This is because fossil fuel energy sources are decreasing day by day. Fossil fuels pollute the environment and increase global temperatures. However, solar energy is not common in Malaysia. About 99% of the energy consumed in 2008 was produced from fossil fuels and hydroelectricity. The main problem with the solar system is that the price is still high compared to conventional energy sources. Generators are widely used if there is no grid power. Generators are used by street vendors such as in the night market (Pasar Malam) in Malaysia. Business at night markets in Malaysia usually starts at 5 pm and lasts until 10 pm. The main problem with a generator is that it needs gasoline or diesel to generate electricity. Due to the war between Russia and Ukraine the price of Gasoline and Diesel as of May 23, 2022 increased to almost 80 Pesos per liter.

The building process of a small-scale, cost-effective portable solar power supply. The end product comes with a solar panel to capture and convert solar energy to electrical energy. The electrical energy was stored in a rechargeable battery with a charge controller to regulate the charging process. A battery level indicator was in place to monitor the battery storage capacity. A low-cost square wave inverter was built to generate the AC power supply required for the operation of low-power-rated household devices. A voltage regulator was constructed to step down the 12V DC voltage to a regulated 5V DC power supply for the charging of handheld devices like smartphones and tablets. The final product carries a weight of 5.5kg that provides both simultaneously a portable 230V 50W AC power generator and a regulated 5V 1W DC power supply source in times of emergency. Electricity has played an important role from its discovery to the present day. Technologists and scientific experts are still inventing new ways to make life easy and worth living. Most of these technologies run on electricity. Nowadays, we use power banks to extend the life of electronic devices like mobile phones, but these chargers are not enough to power devices/tools heavy. This study aims to show the importance of a portable AC/DC power bank using a 32650 LifePO4 battery pack for the College of Electrical Engineering. Recently, people are experiencing total power cuts in some areas due to a lack of power supply from different power companies. In addition, there are people in remote areas without electricity. Therefore, the researchers decided to present the idea of having a portable AC/DC power bank using 32650 LifePO4 batteries, especially for courses that might use this product, such as the Department of Electrical Engineering. This portable AC/DC power bank uses a 32650 LifePO4 battery pack that is beyond the capabilities of a wireless power bank. The research aims to answer the following questions (1) Is it safe to use AC/DC power banks? (2) What are the advantages and disadvantages of AC/DC power supplies? (3) Is the AC/DC power supply efficient using 32650 LifePO4 batteries?

The study aims (1) to promote a clean, quiet and safe operation with no moving parts when using the portable power bank, (2) to perceive the advantages and disadvantages of Portable AC/DC Power Bank, and (3) to indicate the efficiency of Portable AC/DC Power Bank using 32650 LifePO4 Battery. This study focuses on the impact of portable emergency generators on people in need, especially in the event of a disaster emergency. No participants are participating in this study. This study focused only on living experience and lack of energy resources, so only those in distress who lacked electricity and needed a portable standby generator were included in the study. The purpose of this study is to create opportunities to promote the use of renewable energy. As mentioned earlier, the Philippines is part of the Pacific region where typhoons are very common and power outages occur frequently. The product is very important in this

situation. The study will ultimately benefit electrical engineering students, especially future researchers, at Don Honorio Ventura State University in Bacolor, Pampanga. This study explores generating electricity through AC/DC Power Banks. This is not a new concept but it is not widely used. The concept of a portable AC/DC power bank is an efficient way to raise human awareness regarding energy conversion, energy consumption, and energy loss due to energy transfer. To determine the effectiveness of portable emergency generators powered by 32650 LifePO4 battery packs.

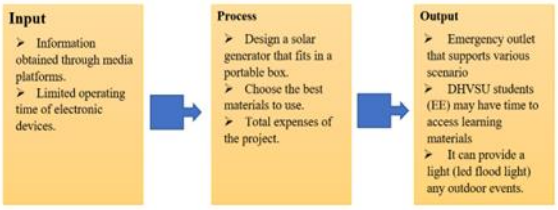


Figure 1: Conceptual Framework

Figure 1 shows the researchers' input regarding the problem's root cause and the study's findings. "More tropical cyclones are invading the Philippines' Responsible Area (PAR) than anyplace else in the world," writes PAGASA on its website. There are an average of twenty tropical cyclones every year in this region, of which eight or nine cross the Philippines. According to the Techrank UP chart (2021), the battery life of a smartphone is up to 8 hours to 25 hours. The process table shows how to develop a power bank, the cost, and the correct selection procedure of the best material. Solar For the construction of a generator. The last table shows the power already produced by the designed solar generator and already shows the benefits of the product.

II. METHODOLOGY

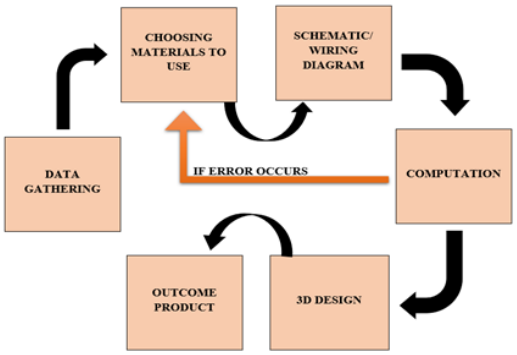


Figure 2: Methods in Constructing AC/DC Power Bank

As portrayed in Figure 2, the research design depicts numerous design and assembly procedures for the AC/DC Power Bank. It includes Data Collection, Material Selection, Schematics/Wiring Diagrams, Computation, 3D Design, and Outcome Product.

- Results and Discussion

Data collecting is the initial step in establishing an AC/DC power bank. The data is gathered through research, Journals, Articles, Online sites, and watching numerous educational videos to gain a deeper understanding of how solar generators function. The researchers consulted numerous manuals and publications to understand more about solar energy systems.

- Project Materials

The second phase is to choose the best materials for the AC/DC power bank design. This is one of the most difficult aspects of academic study, as selecting the best materials may cost a high price. Researchers may need to choose the optimal component for the AC/DC power supply. Researchers are familiar with the product's dimensions, performance, and durability. Researchers had to determine which battery type would be the best fit for the device, which is difficult because there are numerous battery varieties.

- Solar Charger Controller

MPPT vs PWM Multi Point Power Tracking (MPPT) is claimed to increase solar power production up to 30% compared to Pulse Width Modulation. But there's a number of catches: As the solar panel heats up, MPPT drops off and is comparable to PWM.

Under the best real-world conditions, MPPT increases production about 20%. MPPT is much more expensive than PWM. Looking at the output of a 45-watt panel, production is increased by about half an amp per sun hour. Keep in mind, such increase only occurs when the solar panel is operating in a cooler climate. For portable solar generators, PWM offers the best price to performance. Solar Charge Controllers regulate the power generated by solar panels by reducing the average DC voltage when required. These devices regulate the average DC voltage at the battery terminals by turning ON and OFF. For this project a PWM charge controller is to be used. Following steps will enable us to size the required charge controller. Voltage level of the system: 12V Maximum amperage: 30 A There a PWM controller should be used with 12 V and 30 A with rated voltage and current specifications.

- Solar Panel

Solar photovoltaic (PV) cells generate solar energy. PV generates electricity by taking advantage of the semiconductors' unique properties. This semiconductor converts sun energy directly into electricity. The semiconductors are laid out in a wafer-like pattern. This makes you more sensitive to sunshine. It generates a small direct current when exposed to light. The photoelectric effect is another name for this mechanism. Monocrystalline cells, polycrystalline cells, and amorphous cells are the three types of solar cells (thin-film).

Solar cell	Monocrystalline cells	Polycrystalline cells	Amorphous cells
Advantages	highest efficiency rate -space efficient -has long lifespan	-manufacturing cost is cheaper and simpler	-mass production is simple -look appealing -flexible heat -high heat tolerance
Disadvantages	-most expensive -more efficient in warm weather -highly sensitive (circuit can break down if solar cell is partially covered)	-efficiency is very low (13%-16%) -lower space -efficiency -not appealing	-low space -low efficiency -degrade faster

Advantage and Disadvantage of Solar Panel

For this project the researchers choose the best option to fit in portability of the product. It may be more expensive than the other types of solar panels but the portability of the product is more important. All powers 100w foldable solar panel 18V Polycrystalline Solar cells is the solar panel that researchers decide to use. ALL POWERS foldable solar panels are designed to provide free power for charging 12V/24V batteries, for example in vehicles and boats or any other system with a 12V/24V battery or battery bank. This is the ideal solution for anyone wanting all the benefits of solar without the permanency of a mounted solar panel, as this panel can be folded and stored away when not in use. ALL POWERS Polycrystalline MC4 solar charger has high efficiency conversion rate, the transformation efficiency is up to 21%, while most of the similar products on the market are 15% or even lower. Whether you're charging a generator phone laptop or refueling a power pack, solar power has you covered. The foldable portable polycrystalline solar panels are rugged, reliable, and easy to use. Harness the sun with portable solar power in any place.

- Battery Balancer

It is a kind of electrical control device which is specially designed to control the voltage of every single battery in the battery bank. In a multicell battery (serial connection), small differences in capacity among cells appear due to production tolerances or different operating conditions and tend to increase with each charging cycle. Moreover, some cell capacity is being lost over time by self-discharge processes (typically 2–10% depending on temperature and SoC). If the temperature distribution in the pack is not equal, hotter cells tend to have higher capacity losses, this eventually leading to an imbalance. Such weaker cells become also overstressed during charging. This continuing imbalance causes a drift in capacity, until the weakest cell eventually fails. Cell balancing is a way of equalizing the charge of all cells in the chain. Many different balancing methods exist. A basic classification is done by dividing balancing methods into active and passive ones. In case of active balancing the energy is transferred between adjacent cells. Passive balancing methods usually use a switching resistor that is switched on for the most charged cell in a battery string. The cell is discharged and energy is dissipated as heat.

- 12V To 220V Inverter

Inverter deals with the following main tasks of energy. Convert DC from PV module to AC Ensure that the cycle of alternating current cycles is 60 cycles Reduce voltage variations Ensure that the condition of the AC waveform is suitable for the application. Most system-connected inverters and most off-grid inverters can be installed from the outside Weather-resistant inverters are not available. Grid intelligent inverters are divided

into two categories: Those developed for systems with batteries and those built for systems without batteries and provide outstanding void-quality strength. The inverter should be used for matrix associations. The publication has a "useful-interactive" typeface made specifically for the title of the publication. For this project a 1000w inverter is the one to be used. Through Calculation done by the researchers the 1000w inverter is the most capable to run in the project.

- 220V AC Circuit Breaker

A circuit breaker is an overcurrent protection device that can open a circuit automatically in the event of a short circuit or overload. Circuit breakers use thermal and magnetic principles of operation to protect the circuit. The components of thermal circuit breakers are a heating element and a mechanical latching mechanism. Typically, the heating element is a bimetallic strip that heats up when an electric current passes through it. A DC circuit breaker is used to protect direct current (DC) electrical devices and includes additional arc-extinguishing measures. DC circuit breakers are a fairly new technology that is used in charging stations for electric vehicles, photovoltaics, battery storage systems, and DC distribution networks in industrial settings. A 20A CB is the most Capable in the project.

- 32650 Lifepo4 Battery Pack

There is a growing interest in energy storage. There is no longer all about living off the grid. Storage aims to address renewable energy volatility issues. Adding a solar battery to a residential network project will enable the array, instead of disconnecting or refraining from generating electricity, to maintain power at critical loads when the grid falls. Stockpiling will also reduce peak demand charges for industrial customers and significantly lower their energy costs. Storage is used to provide the grid with secondary resources and at the utility point. The need for storage would increase as states implement self-consumption and other battery-friendly laws. Lithium 32650 battery is a high-capacity cylindrical battery featuring a nominal voltage between 3.2 volts and 3.7 volts, and a nominal capacity of 6000mAh, although some manufacturers claim capacities up to 8500mAh for some of their models. Even though 32650 lifepo4 batteries are some of the smallest on the market, they have enough power to run a certain device. We provide a Data Sheet regarding the 32650 batteries (see Appendix F) for more detailed information.

NiCd, NiMH rechargeable	**1.2 V**
Alkaline primary	1.5 V
Zinc-carbon primary	**1.5 V**
Lead-acid	2 V
Lithium primary, depending on chemistry	**1.5–3 V**
Lithium-ion rechargeable, depending on chemistry	3–3.6 V

Table 2: Battery Cell Capacity

- XT60 Connectors

It is a power connector that is commonly used with lithium polymer batteries. It consists of a hard fireproof outer case and gold-plated brass pins. These pins can accept wires up to 12 AWG, which can be soldered easily.

- 5V Exhaust Fan

A fan is used to control the interior environment by venting out unwanted odors, particulates, smoke, moisture, and other contaminants which may be present in the air. The primary function is to exhaust hot air while pulling cold air into a room or larger area.

- DC to DC Converter

A process that changes one DC voltage to a different DC voltage is called DC to DC conversion. A converter is a DC-to-DC converter with an output voltage greater/lesser than the source voltage. A DC converter is sometimes called a step-up/buck converter since it "steps up or down" the source voltage. One of the main goals of the project was having a DC output having a 5V output. The DC-to-DC converter will be connected to a DC output, which is a USB type A. This buck converter can take in a range of 8 to 40V and step it down to 5V. The buck converter we are using is a 5A CNC BUCK MODULE, manufactured by linear technology. The LT1676 will take 12V in from the battery and step it down to the desired output. It has an efficiency of 85% when the current load is at 500 mA.

- DC Female Jacks For 5V Loads

A DC jack is a component used in many electronic devices that allows a steady power source to be

plugged in. The Researchers use this product in terminals for the laptop charger, and also in the output of the product to produce a 5V that can be used in different small gadgets

- 12V Laptop Charger

A power supply for electronic devices. Also called an "AC adapter" or "charger," power adapters plug into a wall outlet and convert AC to a single DC voltage. Computers use multiple DC voltages, and the power adapter is the external part of the power supply for a laptop. An 80W laptop will be used in the project. It has 12V, 6.67A. The researchers decided to use a two-way type of charging for the product, first by using Solar Panels as charger and second by using an AC outlet or Wall outlet. The product is not capable of being recharged by another type of charger. SCC doesn't support wind and wave turbines because it is only capable of solar.

- Battery Management System (BMS)

The Battery Management System (see to Appendix C) of a lithium battery functions as a battery protector. It helps protect you from dangerous conditions and extends the life of your battery. The battery management system prevents your application from battery damage. It also secures you and your family members. That's not all, though. Your battery's performance is managed via the battery management system. It regulates temperature, measures energy, and more. As a result, it's an important part of your LiFePO4 battery. Battery Management System Benefits it protects against overcharging and undercharging, Extends the life of your lithium battery, Calculates state of charge (gauges how much energy the battery has left), Checks for problems (shorts, defective cells, loose connections, etc.), Balances cells, Regulates temperature, Sends real-time information to your charger and shuts battery down when it detects unsafe conditions

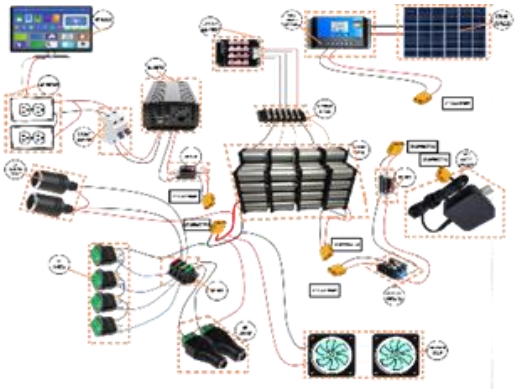
The battery management system of Ionic consists of a circuit board that monitors each battery cell. It determines how much current the battery can safely accept and how much it can be discharged. This information is sent to the battery charger to prevent the battery from being overcharged or over drained. This is one way in which the BMS secures the battery and extends its life. A lithium battery BMS also measures the amount of incoming and outgoing energy. This is how it can provide information regarding the state of charge, or the amount of energy remaining in the battery pack at a given time. When the battery is too drained, the system will shut it down to prevent damage.

BMS is important it keeps battery working in optimal condition, Prevents thermal runaway and fires, Makes your lithium LiFePO4 batteries safe for operation and Shuts your battery off when a problem occurs to prevent damage

To prevent overcharging, the BMS calculates current limits and sends that information to your battery charger so that it won't overcharge your battery. When discharging, it measures how much energy can safely leave your battery and sends that information to your load (such as your power inverter or device controller). The battery management system detects the loose connections, Short circuiting, Defective battery cells, Wire insulation breakdown and defective battery fan

- Wiring Diagram

Figure below shows how the electrical wires are interconnected and can also show the Step-by-step process. Using CANVA 2022 to compile all the materials used in the product, and using paint (Computer application) to show the wiring diagram of the product.



- Wiring Diagram

The Researchers used a Paint application in the computer to do the wiring diagram, Fig. 21 Shows the step-by-step process on how to wire up a Portable Solar Generator.

- Computations

One of the most important parts is the Computation section where it is considered as the backbone of every project in the World, miss calculation will lead to disaster. Researchers test whether the power bank is up and running and each part of the product is defective. The compatibility of individual parts is very important. The red arrow indicates that if the product has an error, it will return to the selection of the best item, and if there are no errors, it will move to the next section.

Equation 1: Computation for Battery;
Given:
Vbat = 3.2 V (nominal voltage)
Cbat = 6 A-h (battery capacity)
Ns = 4 (no. of series)
Np = 24 (no. of parallel)
Formula:
Vbank = Vbat * Ns
Cbank = Cbat * Np
Solution:
Vbank = 3.2 V * 4 (series)
Vbank = 12.8 V total voltage of cells
Cbank = 6 A-h * 24 (parallel)
Cbank = 144 A-h

Equation 2: Computing the total Wattage;
Given:
Vbank = 12.8 V total voltage of cells
Cbank = 144 A-h
Formula:
P=VbankxCbank
Solution:
P= 12.8V x 144 A-h
P= 1843 Wh

Equation 3: Computing for Electrical Load;
Given:
1 no of 60W, 230 V, 0.9 P.F Fan.
1 no of 12W, 230 V, 0.9 P.F Led Bulb.
1 no of 10W, 230 V, 0.9 P.F Cellphone.
1 no of 65W, 230 V, 0.9 P.F Laptop.
1 no of 30W, 230 V, 0.9 P.F Tablet or iPad.
Formula:
P= N x Watts,
P= N x (WattsxPf),
wherein;
P= Total watts per hour
N= Quantity of Appliances
W= Hourly consumption of the Appliances
Pf= Power Factor
Computation of Load;
Fan Load= No. x Watt = 1x60= 60 watts
Fan Load= (No. x Watt)/P.F= (1x60)/0.9= 67 watts
Led Bulb Load= No. x Watt = 1x12= 12 watts
Led Bulb Load= (No. x Watt)/P.F= 1x12/0.9= 13 watts
Cellphone Load= No. x Watt = 1x10= 10 watts
Cellphone Load= (No. x Watt)/P.F= 1x10/0.9= 11 watts
Laptop Load= No. x Watt = 1x65= 65 watts
Laptop Load= (No. x Watt)/P.F= 1x65/0.9= 72 watts
Tablet or iPad Load= No. x Watt = 1x30= 30 watts
Tablet or iPad Load= (No. x Watt)/P.F= 1x30/0.9= 33 watts
Total Electrical Load(w/o PF)= 60W+12W+10W+65W+30W= 177 watts
Total Electrical Load(with PF)= 67W+13W+11W+72W+33W= 196 watts
Total Electrical Load (range)= 177W~196W

Equation 4: Computing for Inverter;
Given:
Additional Further Load Expansion = 20%
Efficiency of Inverter = 80%
Battery Bank Voltage = 12V DC
Battery Efficiency = 90%
Depth of Discharge = 50%
Battery Operating Temperature = 45 degrees
Formula's:
Size of inverter = Total load + (1+Additional Load)/Efficiency of inverter
Solution:
Size of inverter = 196 + (1+20%)/80%
Size of inverter = 294 VA

Equation 5: Computing for Solar Charger Controller;
Given:
P=1843W
Peak Hr.= 3hrs ~ 5hrs
Formula:
Total watts/no. of hrs. per day (sunlight)
Solution:
1843Wh/5hrs= 368.6 Watts
368.6W/ Output voltage
368.6W/12.8V= 28.8A
As per calculation the researchers will use 30A.

Equation 6: Computing for the Hours of charging using Solar Panel:
Given:
For the Project the researchers will use a 100W of Solar panel.
Peak Hr.= 3hrs ~ 5hrs
Solution:
1843Wh/day ÷ 3.5 sun hours/day = 526.57W
526.57W ÷ 0.8 (system losses) =658.21 W
658.21W/100Wh = 6.58Hrs

Project Design
3D Model

- Outcome Product

The AC/DC power bank is a small family portable energy storage system. The AC/DC power bank integrates a solar charge controller, system controller, inverter, lithium battery, DC 12V, 5V-USB, and battery management system. The clean and environmentally friendly solar energy is stored in the battery. It is used for a short time, such as lighting, computers, small power household appliances, in the case of power outage or outdoors. The product has the advantages of stable performance, safety and reliability, and convenient operation. The product charging port is positioned in the side view left corner, to work with our solar panels and be able to accept 19V solar output. Place your solar panel where it will receive the most direct sunlight. Connect the solar panel to the generator's DC INPUT connection on the front. When the LED lights shine and the battery LED indicator blinks, you know the generator is charging. When all battery segments stop flickering and remain solid, the power bank is fully charged.

- Operation and Maintenance

Environmental and preservation measures have an impact on the environment. Because of how long the power bank will last and how reliable it is, you shouldn't use it in the following places of work: First, excessive technical indications (temperature 0°C to 40°C, relative humidity 10% to 90%) of the high and low temperatures and wet places. Second, places vibrate and are prone to collisions. Lastly, gold dust, caustic chemicals, salts, and flammable fumes are found in this location.

The product should be located in a well-ventilated area away from hazardous materials including water, combustible gas, and corrosive agents. If the power bank is unassembled and used in cold temperatures, water drops may congeal; in this case, wait until the generator is completely dry inside and out before installing and using it; otherwise, electric shock may occur. If the power bank will not be used for a long period, it must be stored in a dry area with a temperature range of 0°C to 40°C. If the battery voltage drops too low, the power bank will shut down automatically. When this happens, make sure to charge the power bank within 15 days.

For more information on how it operates to ensure safety of the users, the Researchers provide a User's Manual (see Appendix G) for smooth use of the Product.

- Cost of Production

The Cost of production is calculated and shown in the APPENDIX E, The total expenses of 8080 PHP. The total outputs are 12.8V and 144-Ah which gives you an ideal power of almost 1843wh. If every KWHr cost around 12 Pesos, for every full charge it gains 21.60 Pesos. The researchers also consider the Portable Solar Panels (see in Fig. 6) which is 5000 PHP. The total cost of the product is 13,080 PHP. The Return of Investments (ROI) is 605.55 cycles and the total cycles of batteries is more than 2000 cycles according to the data sheet of the battery (see Appendix F). . In 605.55cycles we divided by 365 days is equal to 1.66 years is equivalent to 489 days. It concludes that after 1 year and 8 months of continuous use of the product, the return on investment will be given.
Product Parameters

CONCLUSION

This paper proposes an improved LifePO4 Battery Power Bank that considers the self-discharge impact as well as the temperature effect that all batteries experience. Sketchup (version 2021) was used to simulate the model, and the findings were discussed. A battery management system (BMS) should be used to protect and maintain the voltage and current of the battery within safety limits. The battery's thermal management system protects it from overheating and underheating, as well as short circuit situations.

Finally, a seventy-two (72) 32650 Lithium-ion phosphate cells are connected in a series and parallel combination to increase the potential (voltage)level up to 12V which is produced by connecting 3.7V Lithium-ion phosphate cells in series and to improve/increase the current level up to 25A through the Lithium-ion phosphate cells are arranged in parallel and the output from the battery is given to different loads like mobile charging, electric fan, and lights such as LEDs.

RECOMMENDATION

This AC/DC Power Bank is recommended for use in the real-world residential sector, and it is due to the fact that it can provide power to both AC and DC loads. This system's integration into the residential sector will save energy and money. Multiple solar panels and a software monitoring system will be added to the project in the future. Multiple solar panels and a software monitoring system can boost the AC/DC Power Bank's efficiency to greater levels, use Prismatic battery for more capacity and efficiency and upgrade the enclosure and maximize the space available inside the enclosure.

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