SOLAR POWERED MULTIPURPOSE PLATFORM, ASSEMBLY AND FURTHER PROGRESS

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ABSTRACT: The solar powered multipurpose platform is a product that delivers green energy both to USB ports and an accumulator assembly, while being connected to an Arduino UNO board that reads temperature, humidity, and light intensity in real time, the product having a buzzer attached to the circuits that will buzz to announce when the temperature is too high or there is too much light for the product to generate energy, also the LED or LEDs will turn on or off based on the temperature level. The product uses 100% green energy and does not require any external energy. The product is being built with materials and components into a factual prototype. The electrical components undergo different building, development, and improvement stages, during 3 different prototypes, which help understand the best way of solving the challenge of circuitry and additive manufacturing. The parameters will be stored and taken into consideration for the final product.

KEY WORDS: Arduino UNO, Prototypes, Circuitry

1. Introduction

The solar powered multipurpose platform is a product that delivers green energy both to USB ports and an accumulator assembly, while being connected to an Arduino UNO board that reads temperature, humidity, and light intensity in real time, the product has a buzzer attached to the circuits that will buzz to announce when the temperature is too high or there is too much light for the product to generate energy; Also, the LED will turn on or off based on the temperature level. The product then sends this accumulated information to a website that will register all the information in graphs and display it accordingly. The product uses 100% green energy and does not require any external energy. In the 2 years in which the product was developed, it went through distinctive design and improvement stages that helped the product innovate itself. At first it was a simple idea, about the existence of a product that would produce enough energy to charge simple products such as smartphones, portable devices or power on a computer that measures some information, that information being sent to a website where it could be visible at any time from the same IP with the correct username and password. The research went underway and resulted that the market was lacking an affordable product which would be both easy to use and provide a user-friendly interface. The stages that the product went through, from an idea to an actual product: Initial stages of production from the assembly design to the current stage, used the exact measurements of the actual components used in the prototype, to assure the least error and challenge possible.

2. Actual Stage

In present, the product is being built with materials and components into a factual prototype. This stage will help seek out the best way to solve the challenge of building it. The components that the prototype will be built with are fulfilling, as follows, either structural roles or industrial use of electrical, technical, and software-based roles. Solar rays will be captured from the

monocrystalline and then using the photovoltaic panel, will be transferred safely to the solar charger.

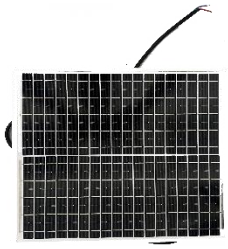

Fig. 1. Photovoltaic panel

The solar panel will be connected using the cables to the charger, the charger has the role to collect all the energy that the photovoltaic panel generates and either store it into the accumulators or use the USB Hub to power up some energy to the ports connected to it (if needed). The charger's display also operates and indicates different information and is helpful to indicate the status of the product and its photovoltaic panel.

Fig. 2. Solar charger

The accumulators have the role of storing the power generated by the photovoltaic panel and distributed by the solar charger. When the charger has a demand of energy, the accumulators will send the stored energy to the charger which then chooses how it will make use of it.

Fig. 2. Accumulators

Arduino UNO and Arduino UNO Components:

Fig. 4. Arduino UNO

"When building your Arduino projects, you use resistors to limit the amount of current going to certain components in the circuit, such as LEDs and integrated circuits. To calculate the resistance, you should use a modified version of Ohm's Law." [1]

The product will take use of 2 types of resistors: 220 Ohm will be connected to the RGB Led and a 10k Ohm will be connected to the Piezo buzzer and to the photo sensitive sensor.

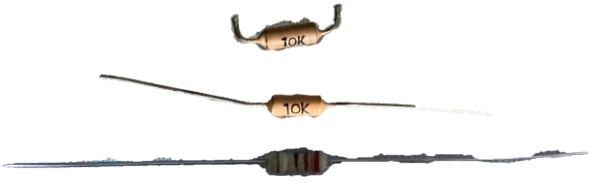

Fig. 5. Resistors

The circuits used in Arduino projects are used for creating ways of transportation for the energy between the Arduino UNO and the components.

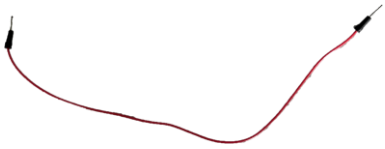

Fig. 6. Circuits

The photosensitive sensor is used to receive and read the level of light that reaches its surface.

Fig. 7. Photosensitive sensor

The temperature and humidity sensor are used to measure read and indicate the exact levels of humidity and temperature.

Fig. 8. Temperature and Humidity sensor

The piezo buzzer is used as an alarm for tracking attention to the user, in moments in which the user has no attention over the product, to alert the user that the temperature is too much, or the humidity is too much or that the light is not bright enough.

Fig. 9. Buzzer

Building the Solar Powered Multipurpose Platform:

According to the operating manual for the charger, firstly the accumulators need to be connected to the photovoltaic charger positive and negative ports, as first connecting the solar panel would result in complications such as: the solar panel would transfer energy to an inexistent source, the charger then not being able to read a source, would result in transferring the energy back to the photovoltaic panel, this resulting in a "bottleneck" [2], this bottleneck, could cause serious damage to the charger.

Secondly, the solar panel cables are connected into the ports of the solar charger, the exact order needed for this operation is the following: first circuit cable connected is the positive pole, afterwards the negative pole is connected to the solar charger's ports. The photovoltaic panel would then display the current voltage stock of the accumulators. As soon as the monocrystalline receives any sort of light, being either artificial (under certain conditions) or natural light (either through a window or directly from the sun), the solar charger's display would show a solar panel that sends the energy to a set of batteries, and the set of batteries that sends the energy to connectable ports, while also displaying the exact voltage that the controller has at the time.

Arduino Uno is able to receive the code needed for compiling and running the exact program sketch through a special cable, an USB B with a male connector to USB A male connector cable, this connector having the ability to send big packages of information from a computer to the Arduino, using the Arduino IDE software, which compiles and runs the program firstly in a software based "test site" that assures there are no errors, then sending the package to the hardware, the Arduino UNO. The Arduino UNO assembly and the breadboard with the different components connected, are then carefully introduced in the special encasing solar cover. Solar Cover board assembly is custom created, designed and improved especially for this product, as it serves the role of keeping the Arduino UNO device and components safe from environmental conditions.

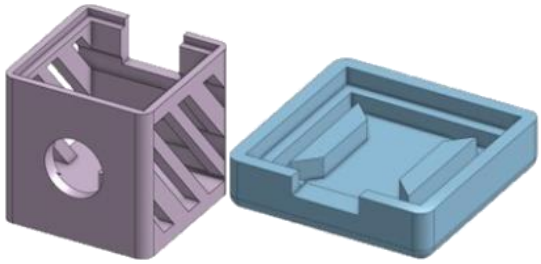

Fig. 10. The Solar Encasing Assembly

3. Prototype tests

For the prototype product, the Arduino UNO LED components will be slightly modified to 3 different LEDs as opposed to the RGB LED found in the sketch. This change will determine more accurate results, coding processes and experience. After the final prototype tests, when moving on to the construction of the product, the LED present in that assembly would be an RGB LED and not 3 different LED components.

Test 0 for the prototype

To evaluate the prototype product 0, a computer mouse is connected to the output USB port of the charger, measuring the voltage that the product is generating and checking if the USB port sends the needed energy to the computer mouse.

The test is a success, the computer mouse lights turn on, this means that it receives the needed energy.

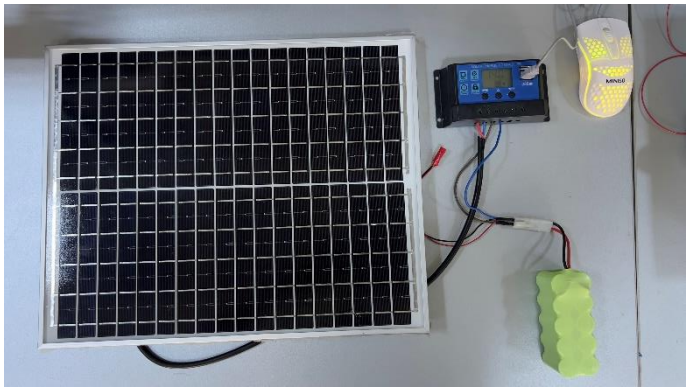

Fig. 11. Prototype 0

Test 1 for the prototype

While the photovoltaic panel was set inside a classroom that received solar light through a window, the monocrystalline was partially covered with a hand, to see the differences, it would make in charging voltage. The results were that the photovoltaic panel on the display of the charger disappeared, meaning that if 60% of the monocrystalline would be covered, and the main source of sun would touch that exact spot, then the photovoltaic panel's monocrystalline would not be able to generate any green energy from the remaining 40% of its surface.

The test was a success, the prototype assembly only displays the photovoltaic panel on the solar charger's display while at least 50% of the monocrystalline is not covered.

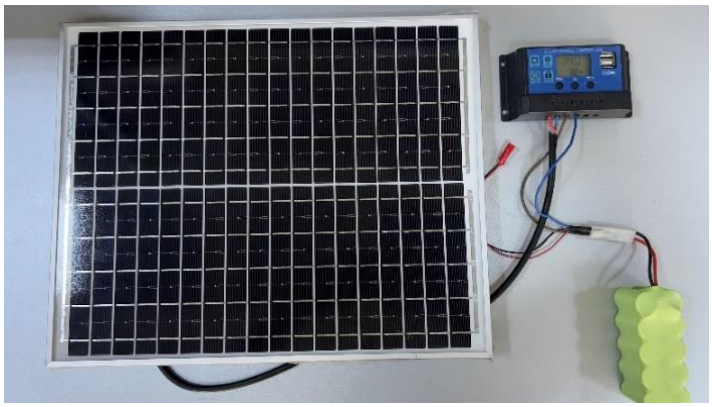

Fig. 12. Prototype 1

Test 2 for the prototype

While the Arduino UNO is connected to the charger and receives the needed energy to work, the board will signal by lighting an LED if the temperature is constant and not rising or falling above or under the limits set. The LED will blink from 5 seconds to 5 seconds, indicating the constant temperature. If the temperature changes dramatically, the other LED will light up, indicating changes of temperature. This prototype assembly would not have the light sensor connected as in this case, would not serve any purpose.

The test results in a success, the LED lights signal the consistency in temperature, and signal it every 5 seconds.

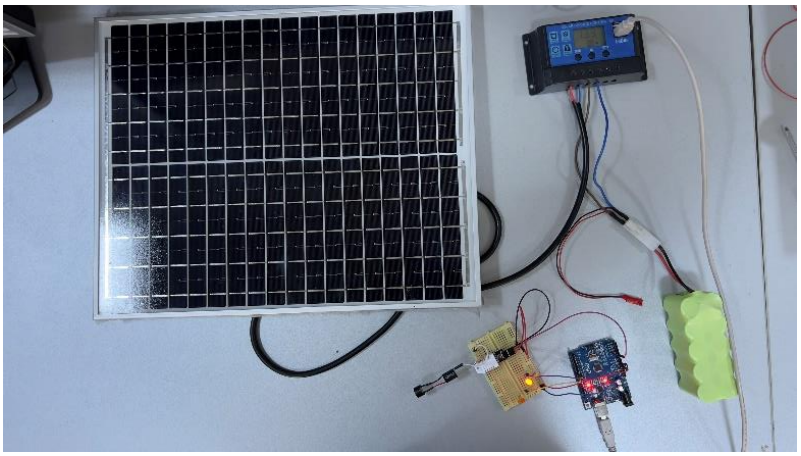

Fig. 13. Prototype 2

Test 3 for the prototype

The third prototype has all the Arduino UNO components, and, while running the code, the light sensor receives the data that the light level is either neutral (no LED turned on), more than the needed amount (the right LED turned on) or less than the needed amount (the left LED turned on). Even if the sensor observes this light level as less than the needed amount, the photovoltaic panel's crystalline will still receive energy if the needed amount is not an exact 0 (or the monocrystalline is not entirely covered)

This test lights up the right LED as the third prototype Arduino UNO received the desired data amount of the needed limit, lighting up the LED at a low level first, afterwards it lit up instantly.

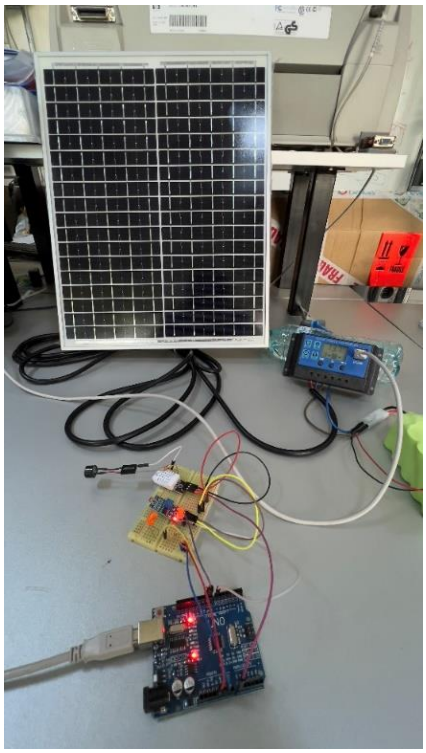

Fig. 14. Prototype 3

4. Printing of the Solar Powered Multipurpose Platform's Solar Encasing Assembly

The manufactured parts, the solar case cover, and the solar case, would be 3D printed using the available resources for the printing process, some design improvements would be taken into consideration and done, under exceptional circumstances for the prototype.

Prototype 1

For this prototype, the parts will be printed at a 75% smaller scale to observe form needs and improvements. The parts were printed in the prototype stage using PLA material due to convenience of stock.

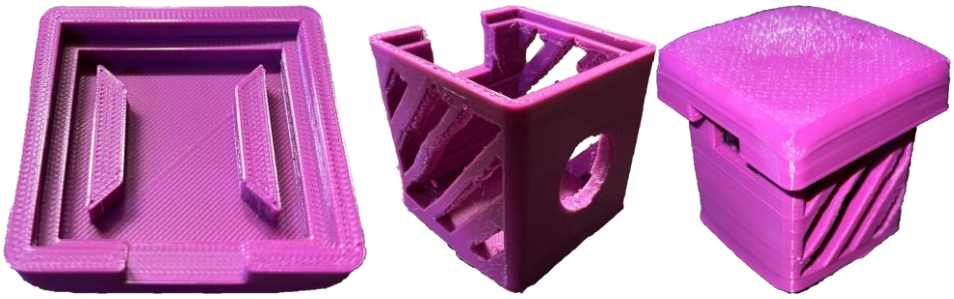

Fig. 15. Prototype 1 Printing of the Solar Encasing Assembly

Table 1. Printing observations

Observation	*Solar Case*	*Solar Case Cover*
Software	On Shape + Ultimaker CURA	On Shape + Ultimaker CURA
File size	130 KB	540 KB
Time	2 hours 12 minutes	1 hour 14 minutes
Grams	13	9
Material	PLA	PLA

5. Conclusions

Each prototype served its own purpose without any failures or problems.

The 3D printing process and prototype of the manufactured components reached its goal of finding the existence of differences between the initial measurements and the final measurements (solar case cover and solar case).

In conclusion, the prototypes used for the assembly of the product will help serve the purpose of creating a development curve that has the important role in understanding the challenges, creating new goals and achievements, fixing any existent errors and time scheduling the process for the finished product to an almost precise accuracy (taking into consideration various other errors that may surface and are unforeseen).

6. Words

Bottleneck= “In engineering, a bottleneck is a phenomenon by which the performance or capacity of an entire system is severely limited by a single component. The component is sometimes called a bottleneck point. The term is metaphorically derived from the neck of a bottle, where the flow speed of the liquid is limited by its neck.” [2]

Arduino UNO= “The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc” (…) “is equipped with sets of digital and analog input/output pins that may be interfaced to various expansion boards and other circuits.” [3]

Prototypes= “A prototype is an early sample, model, or release of a product built to test a concept or process” [4]

Circuitry=” the circuits that an electrical or electronic device contains, considered as a single system” [5]

7. Bibliography

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