Construction of an Emergency Portable Dynamo Mobile Phone Charging Station by Means of a Solar Panel and Hand-Crank Gear Mechanism

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ABSTRACT

The researchers aim to construct an emergency mobile phone charging station that runs on renewable energy and will serve as a cost-efficient alternative to more traditional powerbanks. Circuit components include a 20V / 6W solar panel supplemented by a hand-crank gear mechanism integrated with a 6V / 1A lead-acid battery, a usb output and an adjustable switch-mode power supply (SMPS) to convert excess voltage into current. Initial voltage and current outputs were measured under varying resistances. It was determined that the set-up satisfied the minimum voltage and current requirement for charging a mobile phone (5V / 1A). A subsequent phone charging test was executed using a Samsung Galaxy J2 (3.85V Li-ion battery 7.70W, Charge Voltage: 4.4V / 2000mAh) wherein it charged on an average of 0.277% per minute for the solar panel and an average of 0.263% per minute for the hand crank gear mechanism. A Mann-Whitney U statistical test was conducted to determine if the charging rate of the charging station had a significant difference from a commercially available power bank's. The calculated UA: (4) from the test was below the lower limit and the UB: (217) was above the upper limit which indicated that there was a significant difference between the charging rates. While this proved that the efficiency was below the commercial power bank's, it can still be used as an alternative charging method especially during emergencies and disasters.

BACKGROUND

- Dependence on non-renewable sources of energy
- Loss of electricity and therefore communication during times of calamity
- Lack of cost-efficient power banks

OBJECTIVES

- To construct a charging station using a solar panel and hand-crank gear mechanism
- To determine its efficiency by measuring voltage, current, and charging capacity
- To compare its efficiency with commercially available power banks

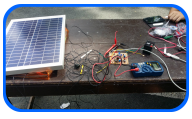
SIGNIFICANCE

Results will provide a new means of charging mobile phones during emergencies that is cost-efficient, environmentally-friendly and independent from the use of power outlets.

METHODOLOGY

Design of Diagrams
↓
Construction of Product
↓
Voltage & Current Tests
↓
Charger & Powerbank Efficiency Tests
↓
Encapsulation of Product
↓
Analysis of Data
↓
Formulation of Conclusion






RESULTS AND DISCUSSION

Even with the reliance of the hand crank on the inconsistent motion of the user, it was still able to reach the minimum current to charge a mobile phone though not as effective as the solar panel. The lead-acid battery also proved to have a high discharge rate as its voltage fell from 7.71V to 6.05V in approximately 15 minutes.

Figure 1: Solar Panel Current- Resistance Graph

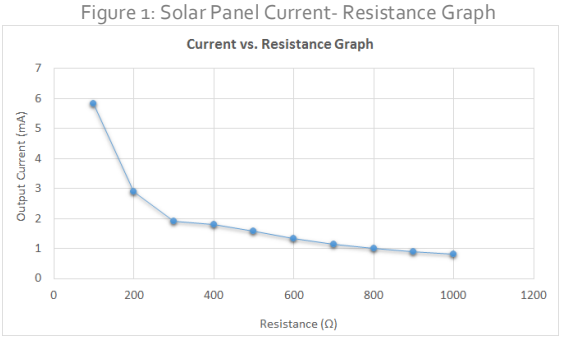


Figure 2: Solar Panel- Power Bank Charging Rates

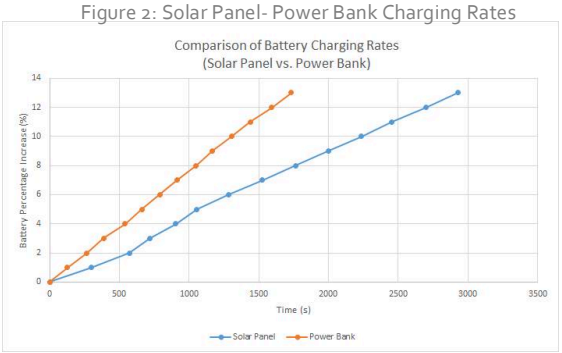


Figure 1 shows that an increase in resistance causes an exponential decrease in current output. However, it does not affect voltage output.
Figure 2 shows the solar panel is able to charge a mobile phone but is not as efficient as a commercial power bank.
The Mann-Whitney U test at a significance of 0.05:
UA: (4) < lower limit UB: (217) > upper limit shows that there is a significant difference between the charging rates of the solar panel and a commercial power bank.

CONCLUSION

In summary, while the hand-crank gear mechanism and the solar panel are able to charge a mobile phone, they are not as efficient as a commercial charger. The charging station proves to be a functional and readily available alternative to commercial power banks with minimal cost.

RECOMMENDATION:

Further studies could focus on improving the lead-acid battery to decrease its discharge rate.

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