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Renewable Technologies from E-Waste

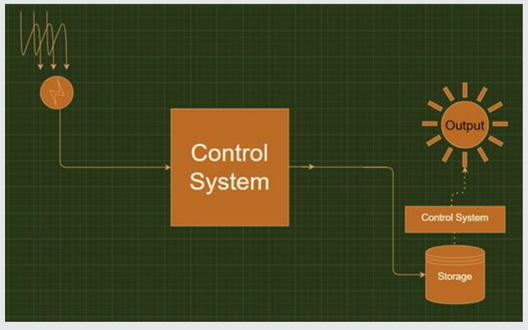
Introduction

Increasingly, less developed countries (LDC's) are being inundated with e-waste from more prosperous countries. Commonly found items in this e-waste are cell phones, laptops, and TV screens. Concurrently, the same people in LDC's face a lack of non-combustible sources of light. At a large enough scale, this combustible source of light contributes to poor air quality and also serving as a barrier to education late at night due to the time required to find combustible sources.

Our group seeks to utilize commonly found e-waste to transform it into a useable product for people in LDC's.

Design Process

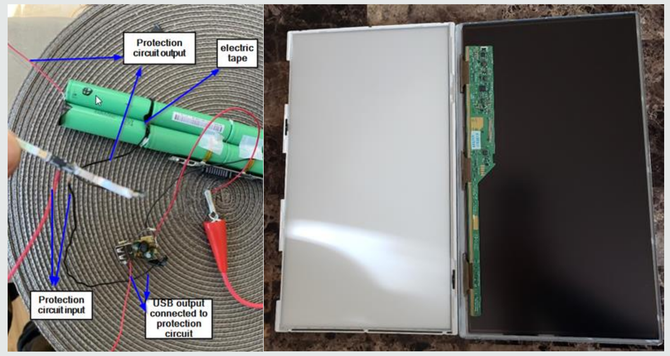
- Four design modules are required to accomplish the project. They include generation, control system, storage, and output/lighting device. The generation of the project was determined to be out of the scope of the project; however, it was assumed to be a renewable source such as solar.
- The output device consists of using an LCD panel out of a laptop and a car USB charger to power a device. The storage module consists of recycled laptop batteries and associated battery control circuit enclosed. Finally, the control circuit consists of a cell phone battery protection circuit and a USB car charger for voltage regulation.

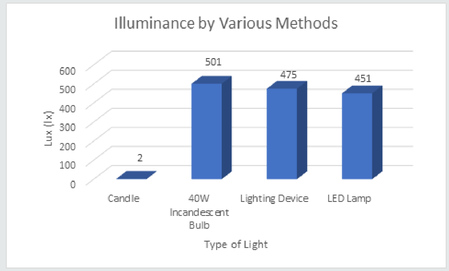


Details of Design

Our biggest goal throughout the duration of this project was to make every effort to source our parts from e-waste. Throughout the planning process, we settled on the use of discarded laptops as a main source of parts and developed a design which uses the screen of the laptop, as well as the laptop battery pack to produce the light. The last part to complete the design is a protection circuit for charging the batteries, which was sourced from an old phone battery pack. After these parts were obtained, they were reverse engineered and tailored to interface with each other to ultimately become a significant light source.

These images are of the LCD panel which houses the LEDs and of the battery circuit that is used for storage. As you can see, the storage circuit is interfacing with the protection circuit to charge when the batteries are depleted. When full, the batteries are discharged into the green PCB connected to the LCD panel to produce light.

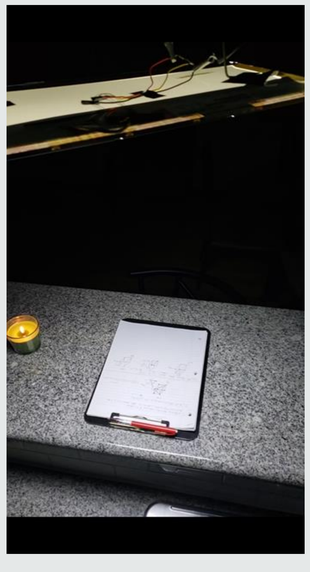




The table on to the left compares our designs luminous flux per unit area (Lux) output to that of similar means of light, as well as the Lux of a candle, which is currently a common source of light in LDCs. This data illustrates that the light produced from our design is in line with that of conventional lighting devices in more prosperous countries. Furthermore, the design vastly outperforms the candle in luminance by over a factor of 230.

The image to the right shows the device hanging above, shining light on a clipboard. Beside the clipboard is a small candle, producing an insignificant amount of light. Working on homework in the pitch dark with a small candle is how these students are getting by. It can clearly be seen in the image that the lighting device vastly outperforms the candle and provides more than enough light to work under.

A test was run to find how long the light would last, as our benchmark goal was 3 hours of useable light before the need for recharging. The lighting device vastly outperformed our goal, lasting a whole hour longer than needed, with a lifespan of 4 hours. We believe this will be more than enough time to provide light from between the time it gets dark to the time for bed.



Conclusion

Our project aims to tackle two problems that LDC's face. Namely, the abundance of e-waste and the lack of energy. To do so our team worked on creating a system that stores energy and then discharges it to provide light and cell phone charging.

- The main components of the system are :
- LCD Panels salvaged from laptops
- Lithium-ion Battery pack salvaged from laptops, for energy storage and over-discharge protection
- USB car charge, for voltage regulation and phone charging.
- Protection circuit board salvaged from phone lithium-ion batteries, for overcurrent and overcharge protection.

The design allows for safe battery charging and discharging to maintain batteries life span. However, it is limited to charging one of the three parallel battery sets at a time. The battery pack can provide 4 hours of lighting before requiring recharge.

Recommendations

To improve the design in future iterations, there are multiple recommendations:

- A protection circuit for each set to charge multiple battery sets at a time.
- Usage of multiple port USB, each port can be used to regulate the voltage for each protection circuit. Also, multiple port USB permit the usage of power sources with higher current limits
- Orange film could be placed inside the metal bezel of the LCD frame to improve the light quality.
- Testing the possibility of charging the battery pack directly

References

- United Nations Conference on Trade and Development. (n.d.). Map of the least developed countries | UNCTAD. UNCTAD. https://unctad.org/topic/least-developed-countries/map