

EN1190 - Engineering Design Project

Detailed Design Project Proposal

Group EN-10

Team Members

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|------------------------------|---------|
| 1. Jayasuriya C. L. | 200262G |
| 2. Kandegedara P. M. I. R. B | 200284B |
| 3. Kannangara N. V. | 200285E |
| 4. Kariyawasam K. K. D. | 200289U |

Task allocation among the group members.

Task	Group Member	Index Number
1) Problem description, motivation and justification for selection.	Kandegedara P. M. I. R. B	200284B
2) Technical feasibility.	Jayasuriya C. L.	200262G
3) Technical specifications.	Kariyawasam K. K. D.	200289U
4) Product architecture.	Kannangara N. V.	200285E
5) Initial and finalized sketches of the product enclosures.	Jayasuriya C. L.	200262G
6) User Interface design.	Kannangara N. V.	200285E
7) Marketing, sales and beyond.	Kandegedara P. M. I. R. B	200284B
8) Project Budget with Bill of Quantities.	Kariyawasam K. K. D.	200289U

Problem Description

1. Problems faced by the public

Nowadays, electricity is an integral part of our daily life. But due to the economic crisis and fuel shortage prevailing in Sri Lanka, frequent power cuts occur daily maybe at day or at night. According to the survey we conducted, power outages occur in most areas for approximately 2-3 hours at night. Due to these power outages at night, people are facing various difficulties.

Many household chores have been disrupted due to daily power cuts. Most home appliances today are powered by electricity. This includes cooking appliances, bulbs, and lamps. People must carry out all household chores in the dark due to power outages at night. Although the government is now urging people to work according to the work-from-home concept, it has been severely hampered by daily power cuts. This has created a situation where it is not possible to charge electronic devices required to work from home. Also, maintaining a continuous internet connection is very important in this task, but it is also obstructed by frequent power cuts.

A similar kind of problematic situation has arisen among the students all around the country. Already, the power cuts at night have severely affected their education. When there is a power outage at night, students must stop their studies altogether, which directly interferes with their continuous learning process. Also, online education is still being continued in some schools and universities. Hence, students have to spend a lot of time dealing with devices like smart phones, laptops, ear buds etc. As a result, they need to charge the devices constantly. Thus, in a power outage, online education also get hampered.

In addition, power outages at night have had a significant impact on outdoor activities as well. For example, non-operation of street lamps during power outages can cause problematic situations for pedestrians.

2. Problems faced by campers

Talking about problems regarding camping, when you go for a hike at night you have no source of lighting except the battery powered flashlight or flashlight from your phone. In the survey we conducted, the majority answered this product would be useful for campers. As shown below.

A hiker can charge this flashlight during their daytime hike free of charge using solar energy, unlike those ordinary battery powered flashlights. Another big problem during camping is that there's no way to charge your phones from a power outlet, since you are literally in the middle of a jungle.

3. Problems faced by senior citizens and people with disabilities

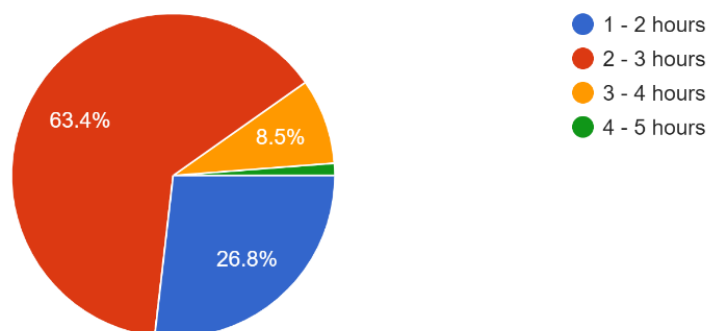
During complete blackouts at night, elderly and disabled find it difficult to locate the exact location of the emergency lamp to turn it on. As most of them need some aid, it is difficult to find something, especially in dark. If they could switch the lamp on via a simple mobile application, that task would be much more convenient for them. So, as we can see, this is a considerable problem for disabled and elderly people as the products currently available in the market do not have such a function available.

Motivation

- People's inability to engage in their day-to-day work, especially at night. Their inability to charge their electronic devices so people can't work at night since there's no light. It's a huge waste of their time since most of the locals experience 2-3 hours of power cuts during the night. We acquired that from the survey we conducted. Here are the results.

How many hours of blackouts do you experience at night? (On average)

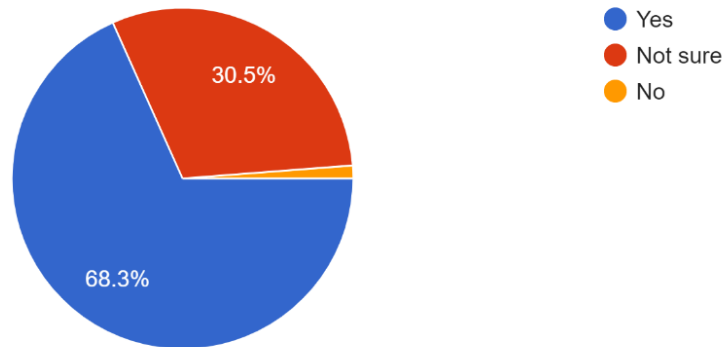
82 responses



- Other than having no light, people can't charge their electronic devices. It's a major step back. People are even willing to spend an extra 1000 Rs. For an additional charger. Down below is what we obtained from our survey.

Would you like to spend an additional Rs. 1000 for an efficient power bank?

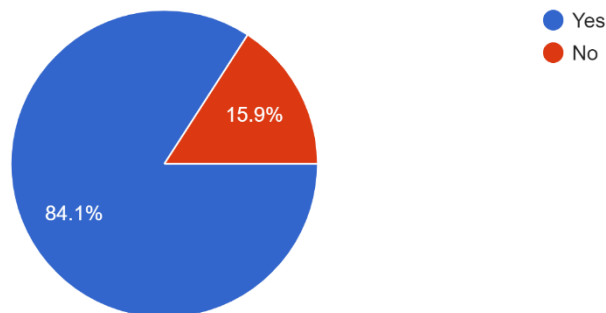
82 responses



- The current lamps in the market are a bit difficult to operate for the elderly and disabled people. Another thing is that during a blackout finding the lamp is a massive struggle since one can't see anything. This is the result we got when we asked whether people would like a mobile app that works via Bluetooth to control the lamp.

If a free mobile app is available to control the light via Bluetooth during a blackout, would it be useful to you?

82 responses

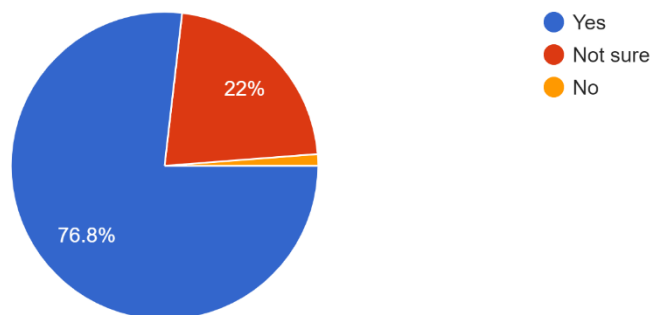


- Majority of the people liked our idea. The mobile app will be very useful for the elderly and disabled people and also for finding the lamp in the dark.
- However due to time constraints we decided to omit the mobile app from our project.
- Hikers / campers have no way of finding a power source in the middle of a hike other than devices that they bring with themselves since they are in the middle of the forest. These devices in the market right now only can be charged from an AC source.

- Since this lamp can charge from the solar power it will be a great help for a hiker. Since they are hiking during the daytime, they can easily charge their lamp for them to use at night when they set up camp.
- Additional power bank can be used to charge their mobile phones. This is the response we got when we asked on the survey whether our product would be useful for campers.

Do you think that this product will be useful for campers?

82 responses



- The low charging rate of the current solar powered lamps in the market is another issue. That's why we are adding a large solar panel to increase the charging rate.

Who benefits from this solution?

- Students who are unable to engage in their studies during the night and older people who are unable to engage in their jobs because of the power cut. As mentioned before, this product especially benefits elderly and disabled people because of the mobile app which is very much simplified and straight forward.
- So, all sorts of people can benefit from this product. This product would make lives of many easier.

Solution (Justification for the selection)

- **The lamp and power bank** are for the people whose day to day work has messed up due to the power cuts. Lamp is for the people having no light to work and the power bank is to charge one's electronics. (it's much easier for campers/ hikers to charge their electronics during their hike)
- **Solar powered** lamp is used as an easier charging method (ex. For campers/hikers) and also since solar power is a renewable energy.
- **The additional solar panel** which is for much faster charging, is used because of the lower capacity of the current solar powered lamps in the market.

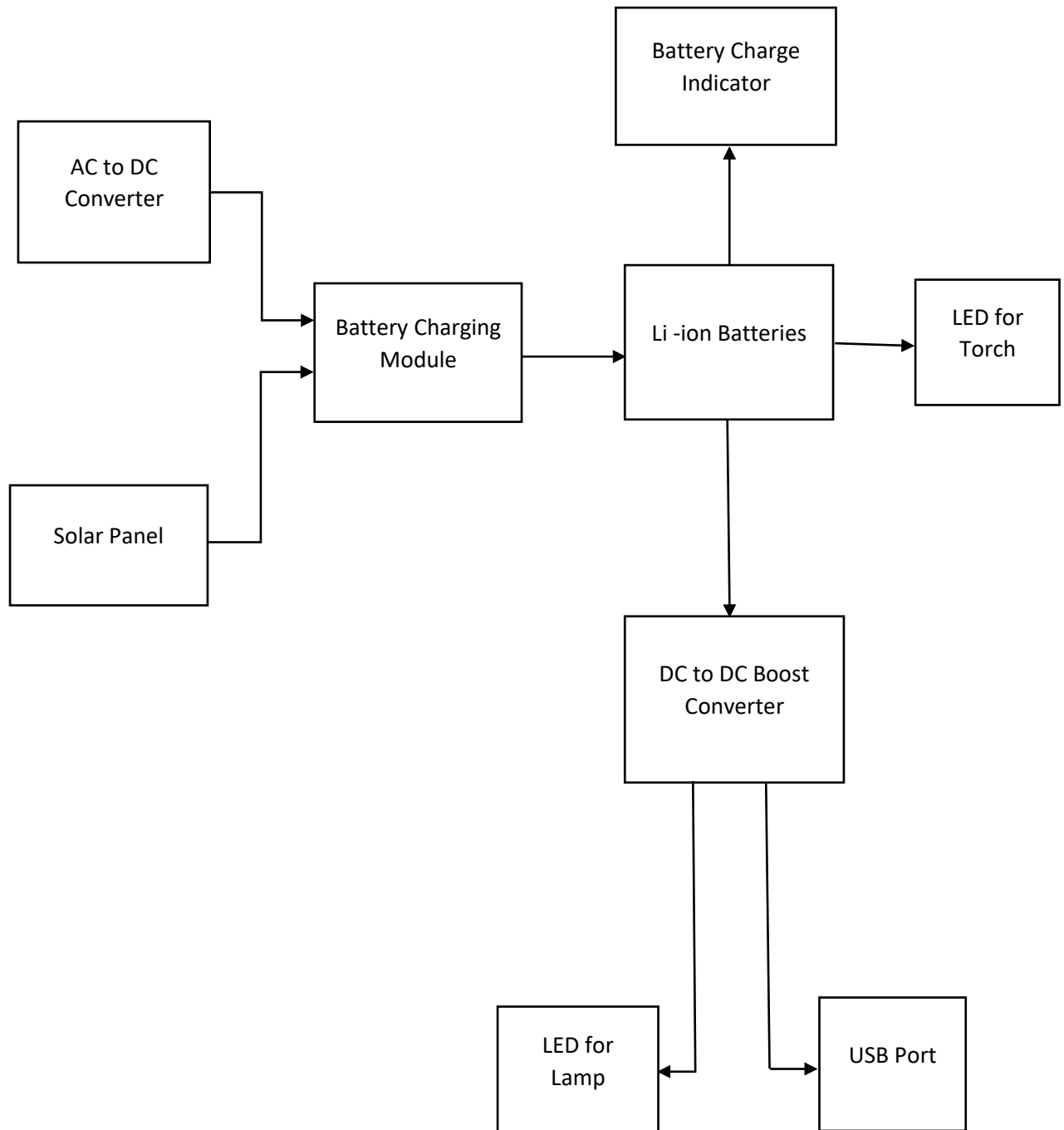
Technical feasibility

- The current level of our knowledge regarding the project would be sufficient for us to continue and we will gather all required information from respective sources to enhance our technical knowledge and skills.
- The components we intend to use in this project are mostly available currently. However, if we fail to get certain components, we will move forward with almost equivalent alternatives.
- The major components in our list are a bit expensive but we have a very limited choice due to the current crisis in the country. These components include the ICs, Solar panel, powerful LEDs.

Technical Specifications

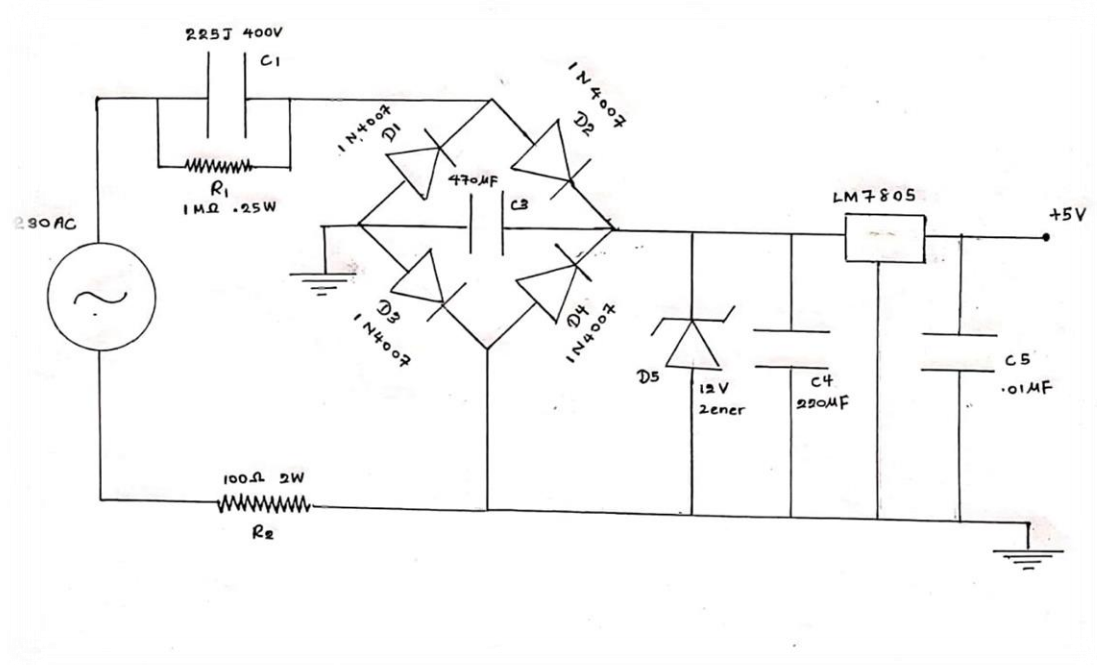
- Charging source : Solar panel or AC adapter
- Charging time : 8-10 h with solar charging or 4-5 h with AC charging
- Product size : 22*14*35 cm
- Product weight : 350g
- Dimensions of packaging : 24*16*36 cm
- Battery capacity : 2600mAh Li-ion battery * 4
(4 such batteries connected parallelly)
- Solar panel : 2.5 W
- Power consumption : 2.94 W
- Lighting hours : Lamp – 2-3 hours, Torch – 3-4 hours
- Indication for charging : Red LED light up when charging and a green LED light up when full charged. In between two yellow LEDs light up to indicate the charging level.
- Indication for battery level : 4 LEDs for four charging levels.
- One USB output port to facilitate use as a power bank.
- Lifetime : 3 - 4 years
- Warranty : 1 year warranty

PRODUCT ARCHITECTURE



AC to DC Converter

- Convert 230 V AC voltage to 12V DC via bridge rectifier and 12V DC to 5V DC via Buck Converter.



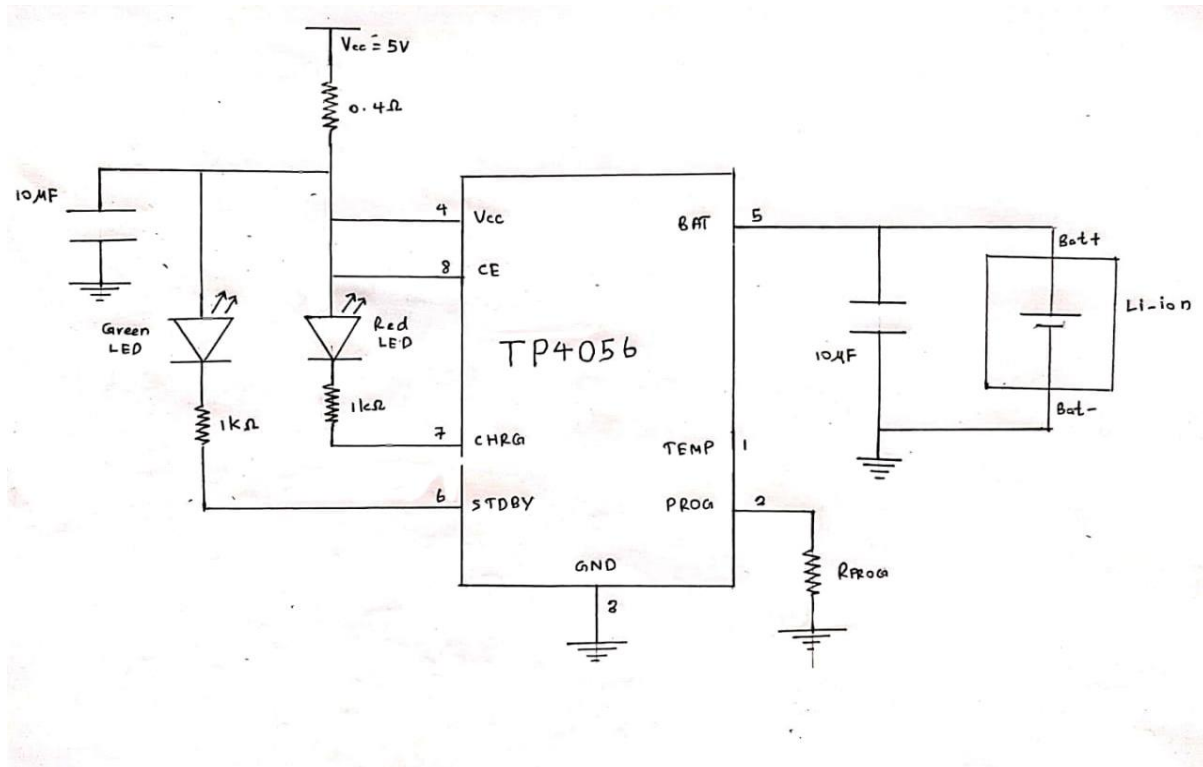
- Components needed are,
 - LM7805 IC
 - 12V Zener Diode
 - 1N4007 Diode x 4
 - 100Ω Resistor
 - 1MΩ Resistor
 - 470μF Capacitor
 - 220μF Capacitor
 - .01μF Capacitor
 - 225J 400V Capacitor

Solar Panel

- Use sunlight as a source of energy to generate direct current electricity(5V).
- Component needed is,
 - 2.5W/5V Solar Panel

Battery Charging Module

- This module is used to charge rechargeable lithium-ion batteries using constant - current/ constant-voltage method. In addition to safely charging a lithium battery the module also provides necessary protection required by lithium batteries.



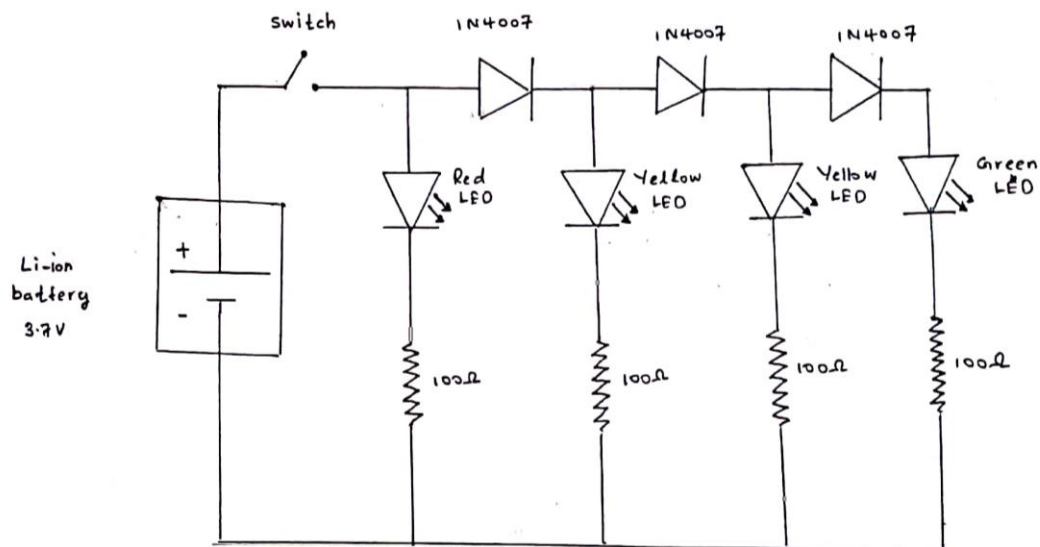
- Components needed are,
 - TP4056 IC
 - LED x 2 (red and green)
 - $1k\Omega$ Resistor x 2
 - 0.4Ω Resistor
 - $10\mu F$ Capacitor x 2
 - $1.2k\Omega$ Resistor (R_{PROG})

Li-ion Batteries

- Used to store high-capacity power. Li-ion battery operates between 3.0V-4.2V.
- Components needed are,
 - Li-ion 18650 battery(2600mAh) x 4

Battery Charging Indicator

- Used to indicate Battery charging levels of Li-ion batteries. Red LED will glow when the battery is charged with 2.5V. Red and one yellow LED will glow when the battery is charged with 3.0V. Red and two yellow LEDs will glow when the battery is charged with 3.7V. All LEDs will glow when the battery is charged with 4.2V.



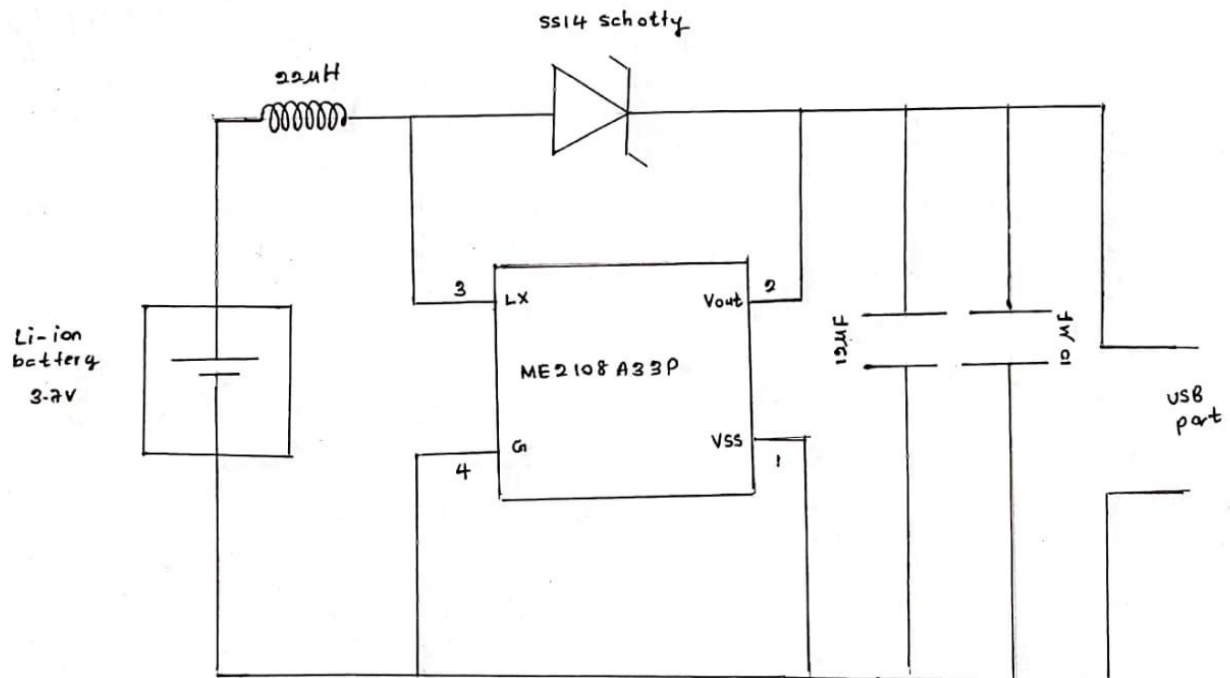
- Components needed are,
 - LED x 4 (Red, Yellow x 2 and Green)
 - 1N4007 Diode x 3
 - 100Ω Resistor x 4

LED for Torch/ LED for Lamp

- Convert electrical energy directly into light.
- Components needed are,
 - 1W 3V-3.7V LED (White)- for torch
 - DC 5V 2W COB LED Strip Bar Light Source-For lamp

DC to DC Boost Converter

- Convert 3.7V DC voltage to 5V DC voltage.



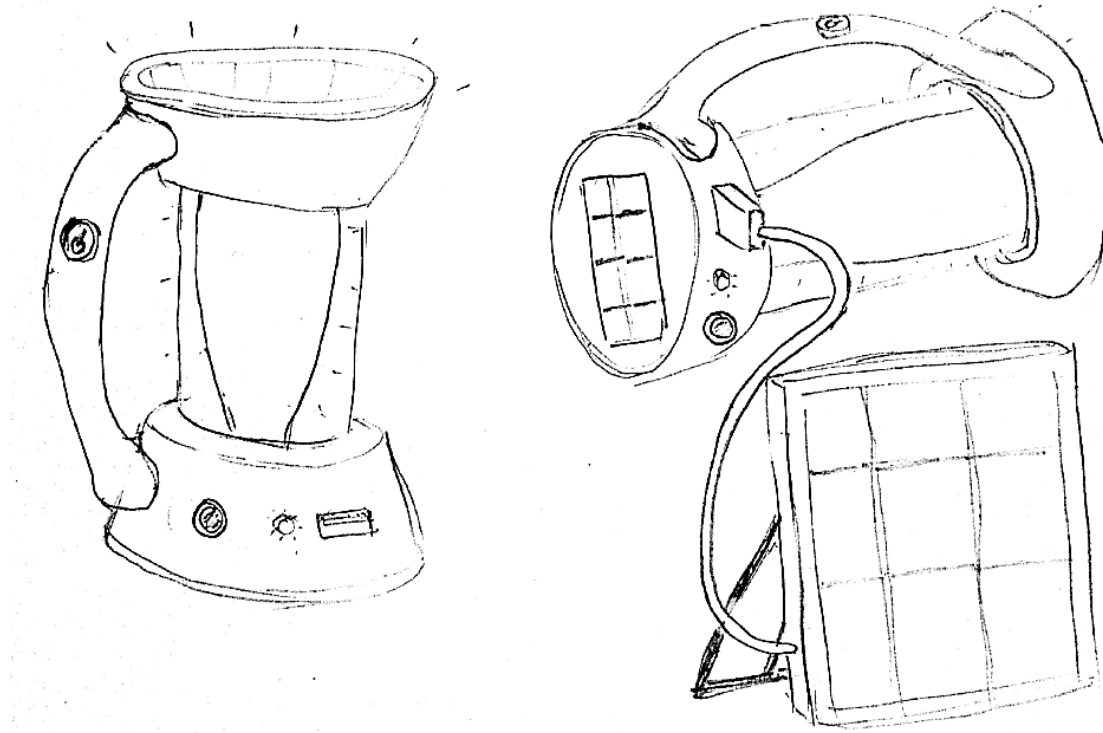
- Components needed are,
 - 22μH Inductor
 - 5514-Schottky Diode
 - ME2108A33P IC
 - 12μF Capacitor
 - 10μF Capacitor

USB Port

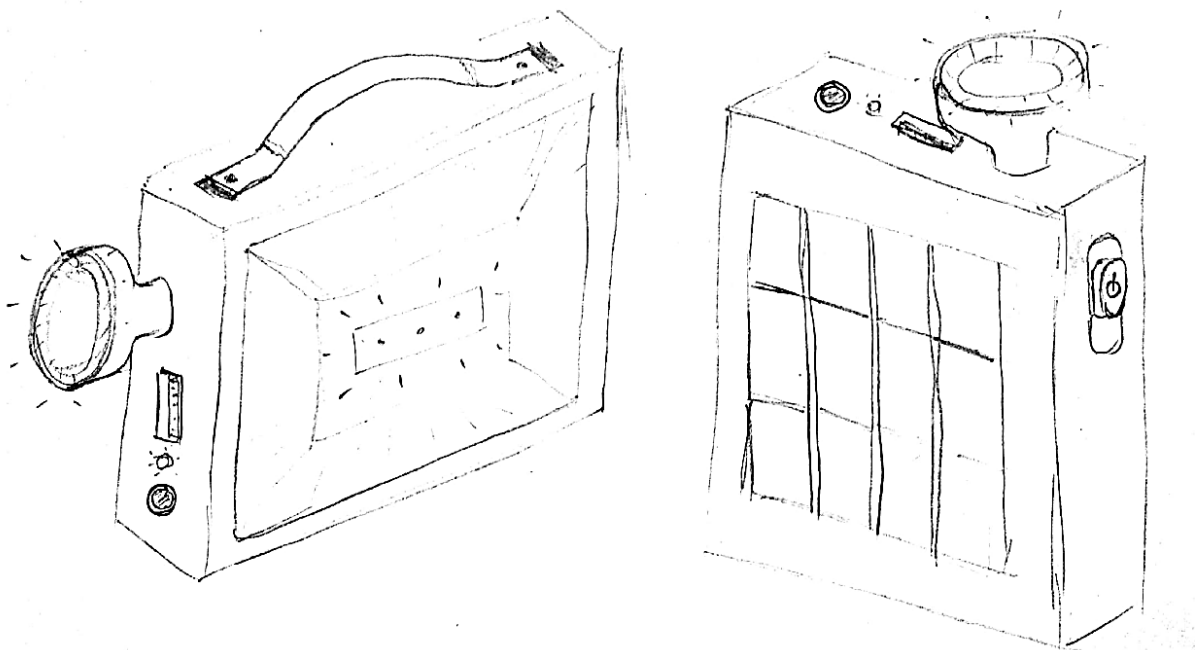
- Since our device can be used as a power bank, USB port is used to charge phones, air pods, tablets etc.

Initial Sketches

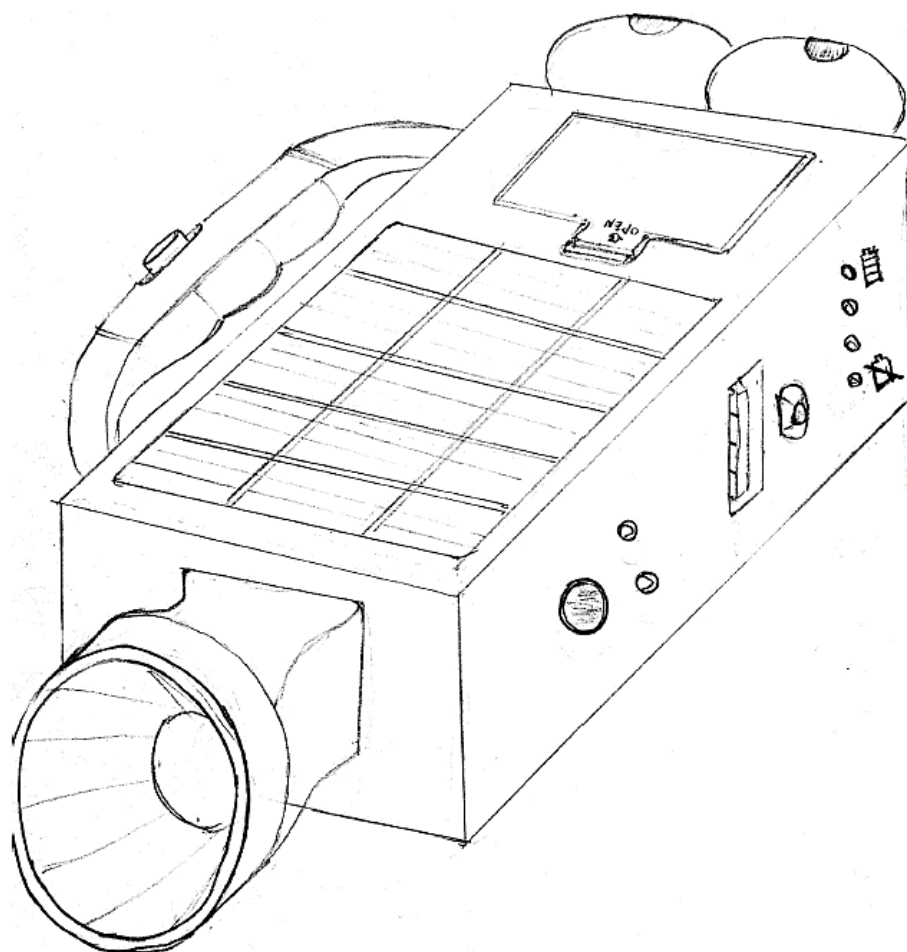
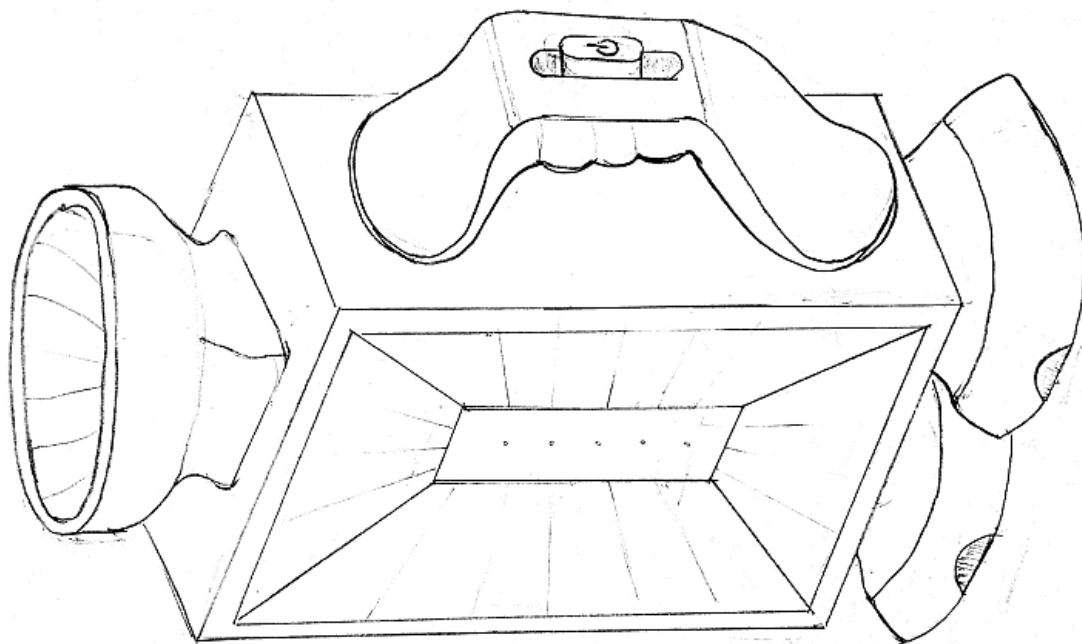
Initial sketch 01



Initial sketch 02

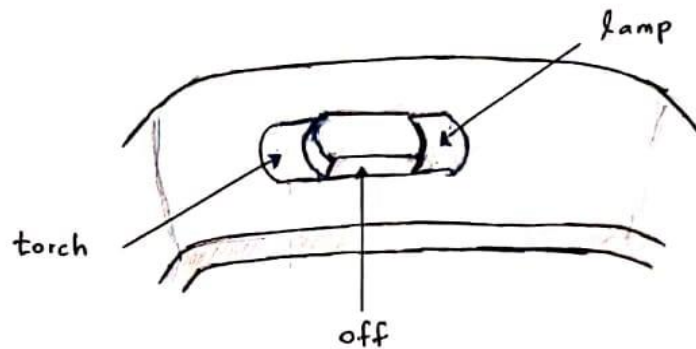


Final Sketches

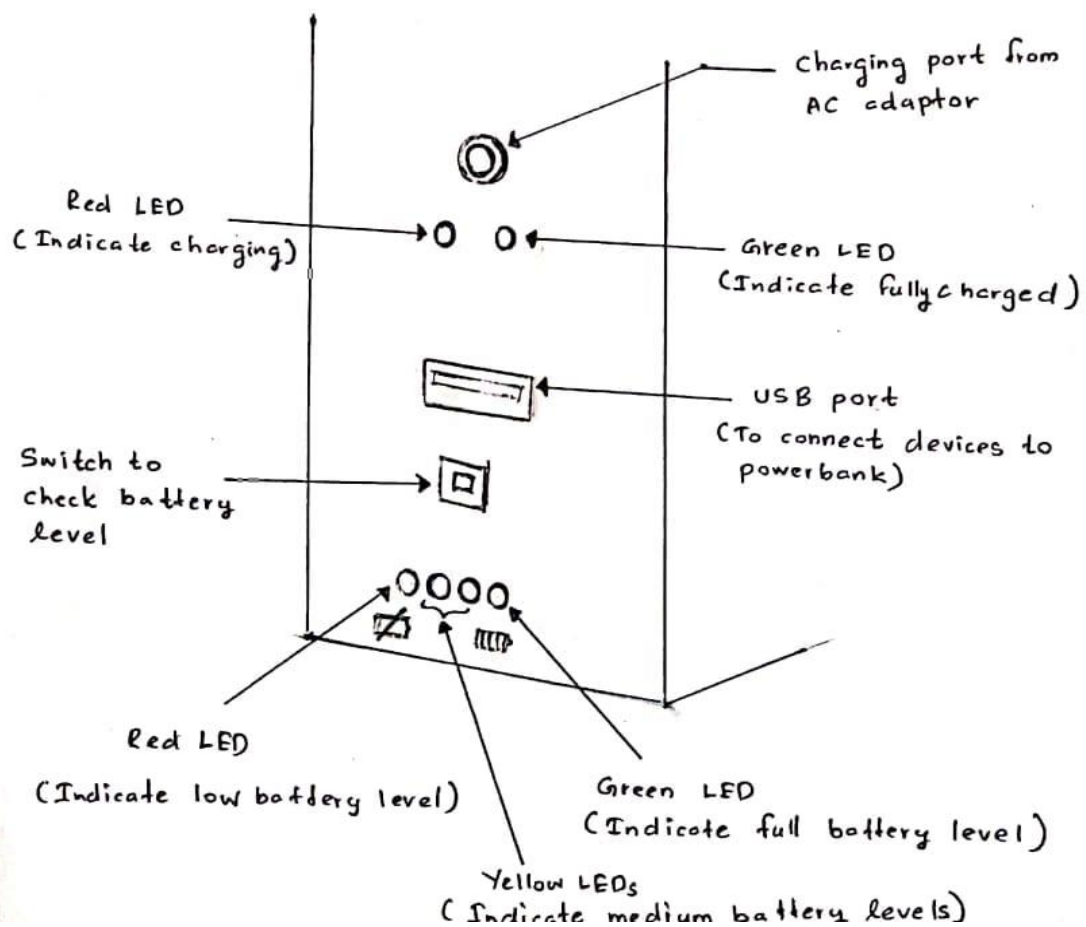


USER INTERFACE DESIGN

Switch



Charging port & USB out



Market, Sales and Beyond

Packaging

- Lamp/ power bank and the additional solar panel will be in wrapped in sealed polythene separately.
- Then these will be contained in retail boxes (so that the packaging would be compact). The outside of the box would have an eye-catching design.
- All the packaging is done while considering the corrosion and the safety of the equipment inside.

Maintenance

- Maintenance must be done by a professional technician. Also, we provide a datasheet and a manual for technician.
- We recommend cleaning all solar panels once every 6 months.
- We also provide maintenance for free once every 3 months for 2 years.

Repair

- Repairing also must be done by a skilled professional.
- We also provide free repairing for 2 years (i.e., our warranty lasts for 2 years)

Reuse/Recycle

- Customer must bring the product to us for recycling. We are recycling every equipment of the product. From the PCBs to the casing.
- We are giving a 40% discount on their next purchase for the customers who bring us the device for recycling.

Disposal

- We are taking products which have expired their lifetime while giving a significant discount to the customer.
- Some of the equipment could contain Pb. So, we won't be disposing the devices and equipment to the environment.
- Our major goal is to recycle the product other than disposing material that can be used again.

Budget

No	Component	Quantity	Unit price (Rs)	Price (Rs)
1	Solar panel	1	2500.00	2500.00
2	TP4056 IC	1	170.00	170.00
3	LM7805 IC	1	35.00	35.00
4	Li-ion 18650 Battery (2600 mAh)	4	360.00	1440.00
5	ME2108A33P IC	1	180.00	180.00
6	Li-22uF (coil)	1	9.00	9.00
7	Capacitors	8	12.50	100.00
8	Resistors	10	1.50	15.00
9	Diodes (1N4007)	4	5.00	20.00
10	Zener diode (12V)	1	10.00	10.00
11	SS14 Schottky diode	1	550.00	550.00
12	LED bulb (green, red)	2	1.25	2.50
13	LED white 1W (E10) 3V – 3.7V	1	100.00	100.00
14	LED light - DC 5V COB chip bar light source	1	1070.00	1070.00
15	Enclosure and wiring	1	2000.00	2000.00
	Total			<u>8201.50</u>

- Note that this BOQ is for a single product.