DEPARTMENT OF ELECTRONIC AND TELECOMMUNICATION ENGINEERING

UNIVERSITY OF MORATUWA

EN2160 - Electronic Design Realization

Report - Conceptual Design

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200488E

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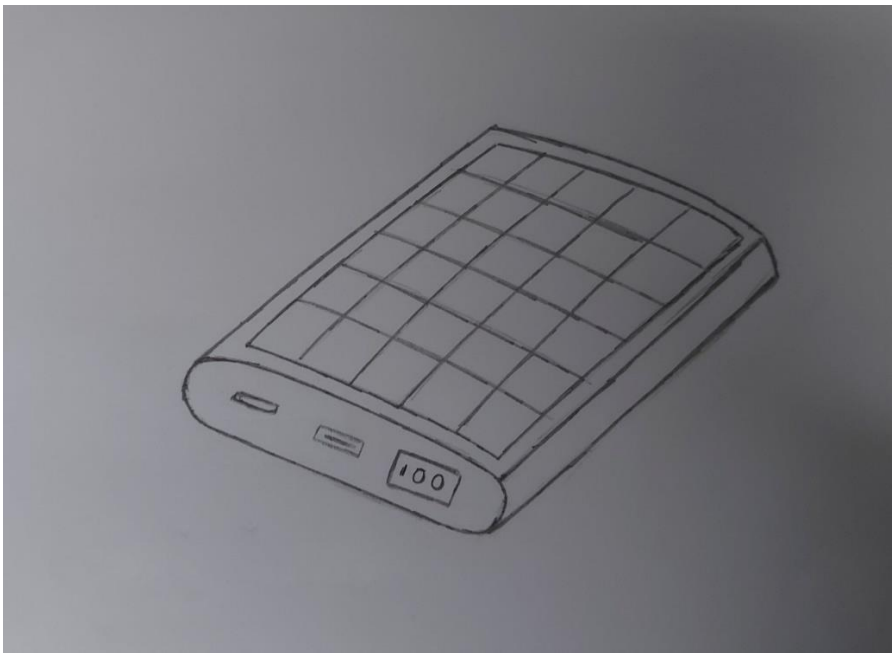
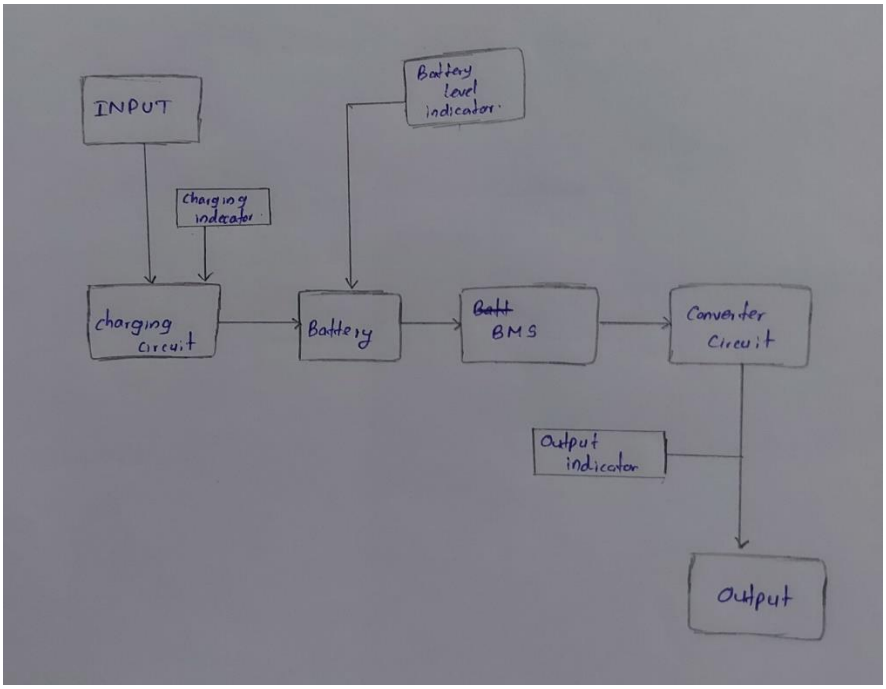
Initial design

Proposed Sketch



Functional block diagram



Product Specification

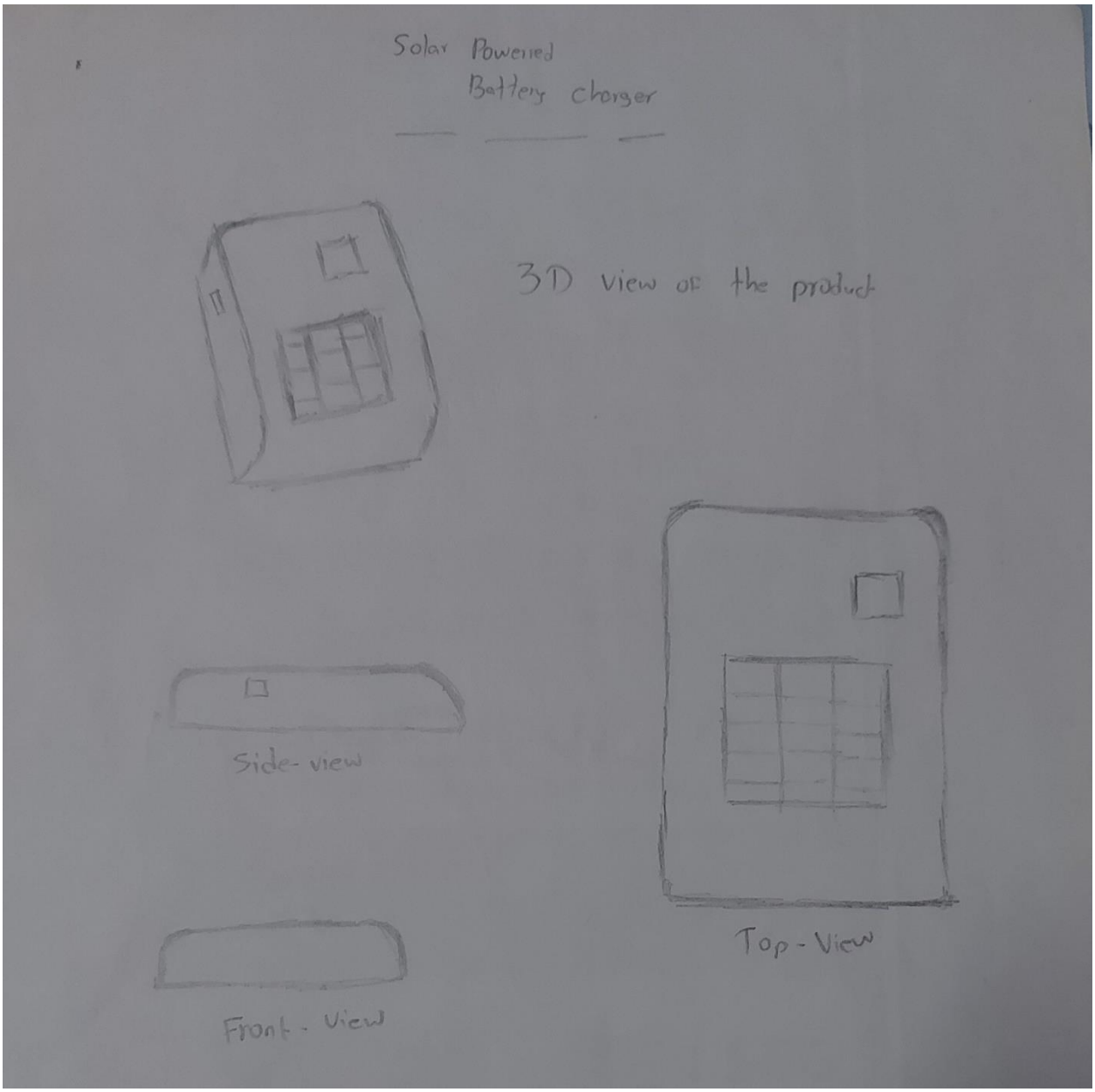
- 2 to 4-cell Li-ion batteries
- Can charge using solar panels and a normal power supply.
- Should indicate battery level.
- USB-A and USB-C output ports
- USB ports can use bi-directional.

The design underwent three iterations of design-driven innovation cycles, resulting in three new designs that are presented in this report. The individuals who actively contributed to the design cycle include:

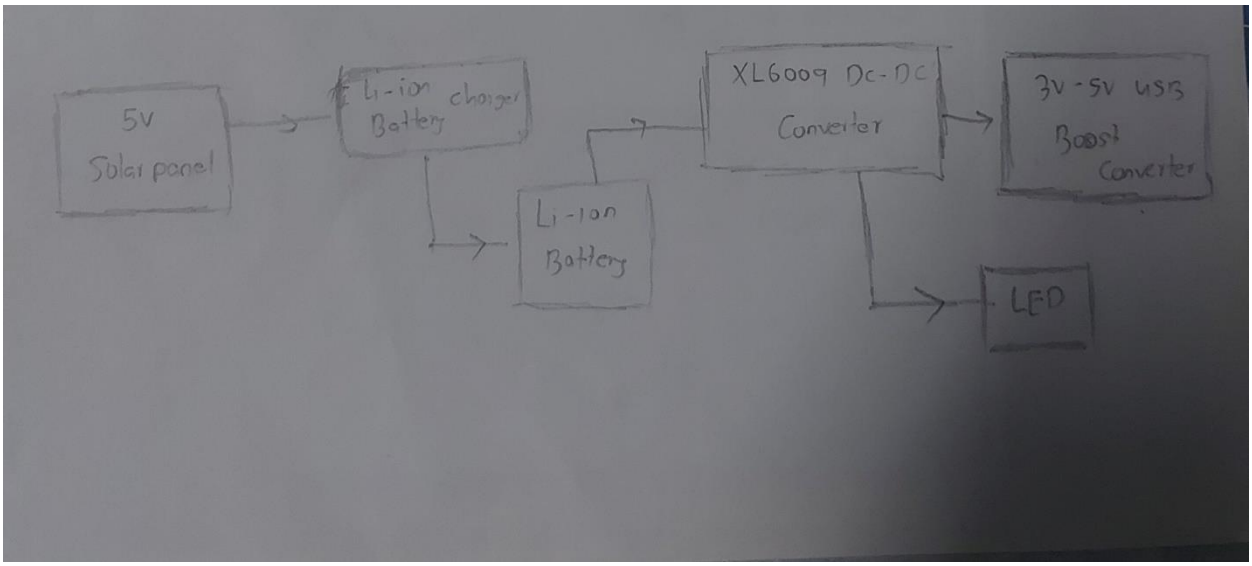
Index No	Name
1. 200029B	Amarasinghe Y.E.
2. 200488E	Pushpakumara H.M.R.M.
3. 200686J	Vishagar A.
4. 200352H	Liyanage P.H.S.
5. 200326A	Lokugeegana D.L.
6. 200366E	Madushan A.K.C.S.
7. 200014B	Ahamed M.B.S.A.
8. 200552V	Sairisan R.

Design 1

This sketch and functional block diagram design by Vishagar A. (200686J) and here he is supposed to attach the solar panel within the power bank. And also, this design has the basic appearance, and the thickness of the design is somewhat higher.

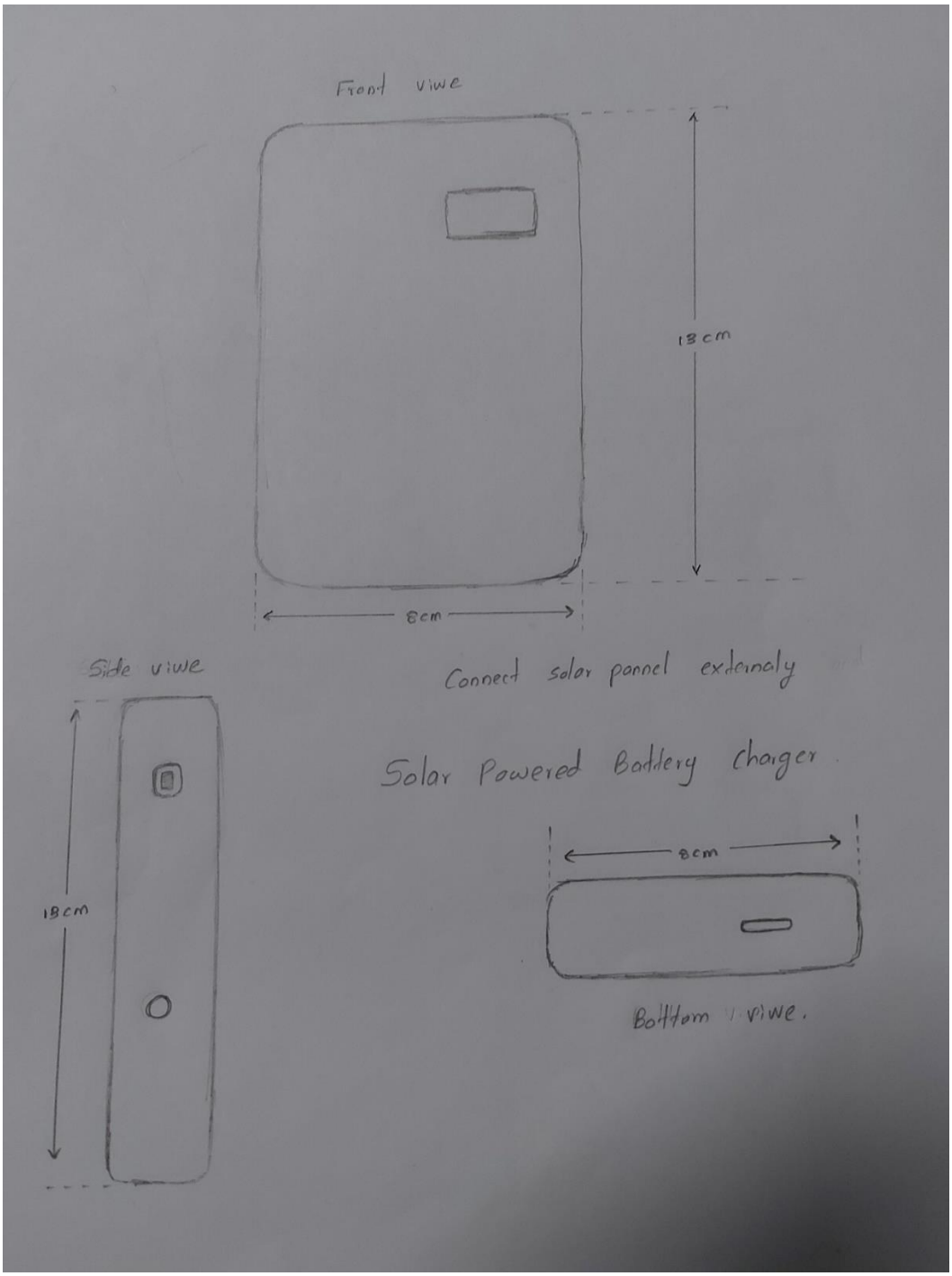


The functional bock diagram that he supposed is contained Li-ion battery charger and it use to charge the battery. The only power source for the power bank is the solar panels.

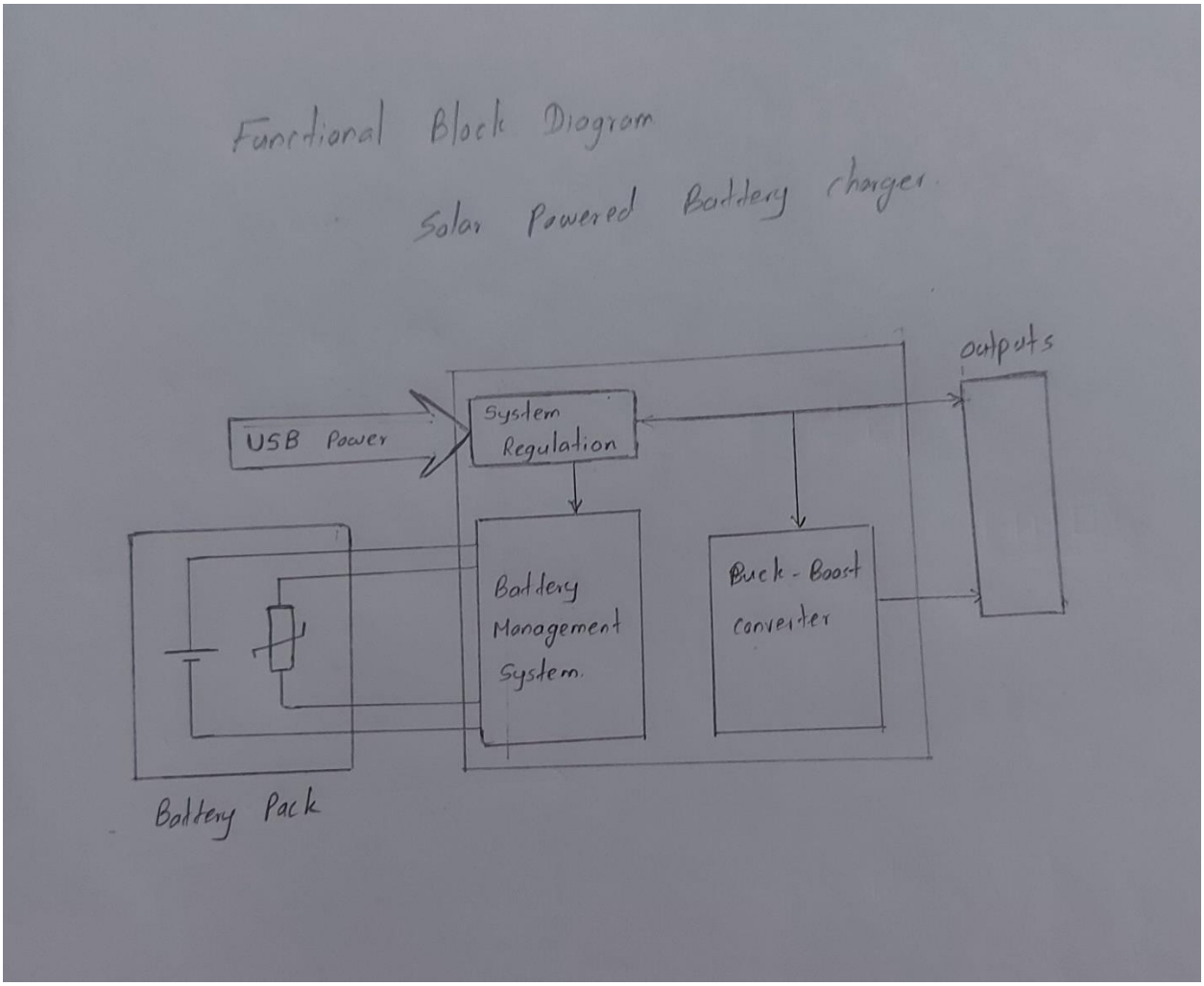


Design 2

This design is proposed by Amarasinghe Y.E. (200029B) and here he designed this to connect solar panels externally. And the design of this one seems more attractive, and it has enough space to include all the PCB, Batteries, and other stuff.

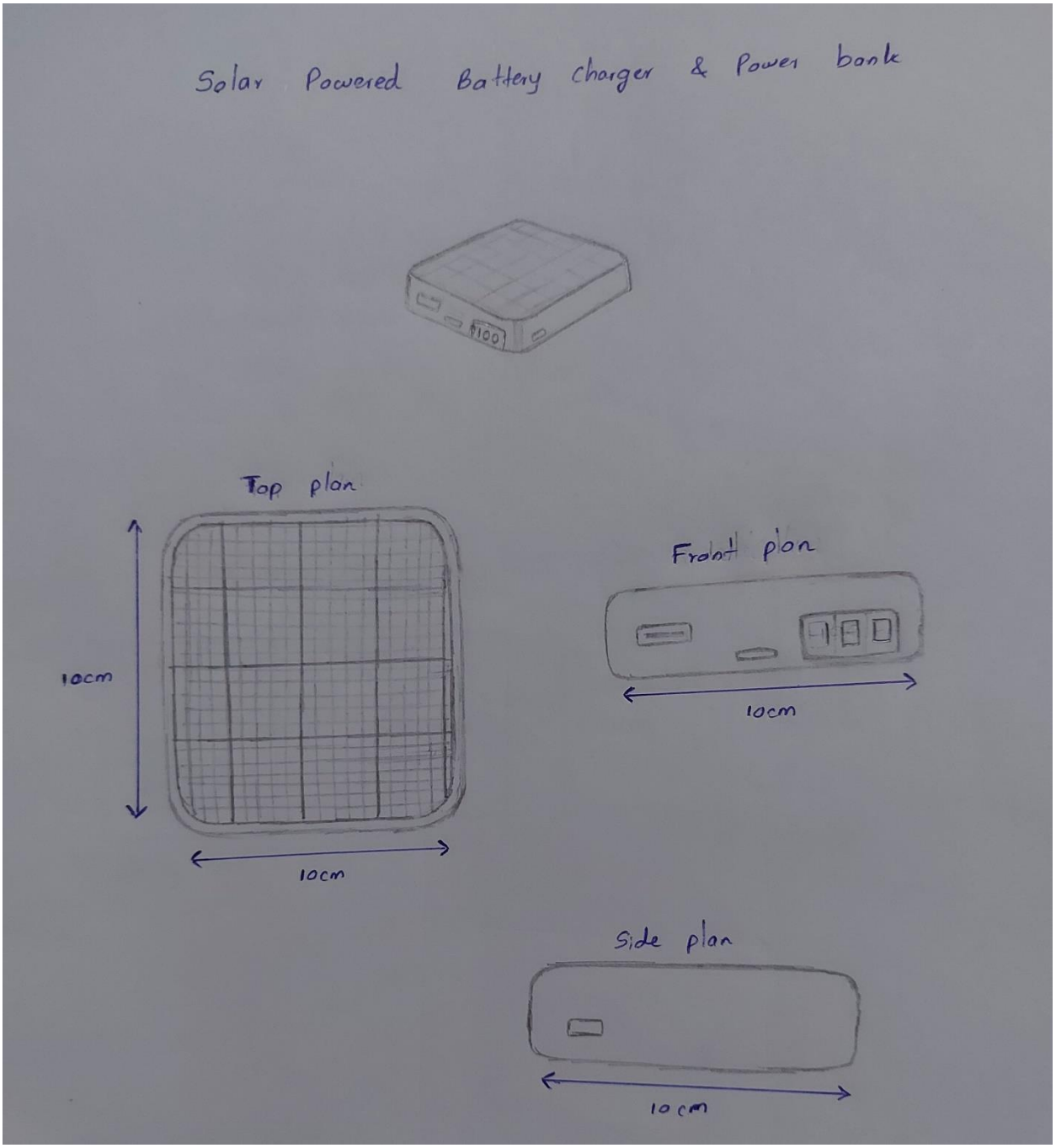


This is the functional block diagram that he has proposed and here we should use different ports to charge and discharge the power bank. Here, he has used the Battery Management module to charge the battery and the buck-boost converter to create the necessary voltage when discharging the battery.

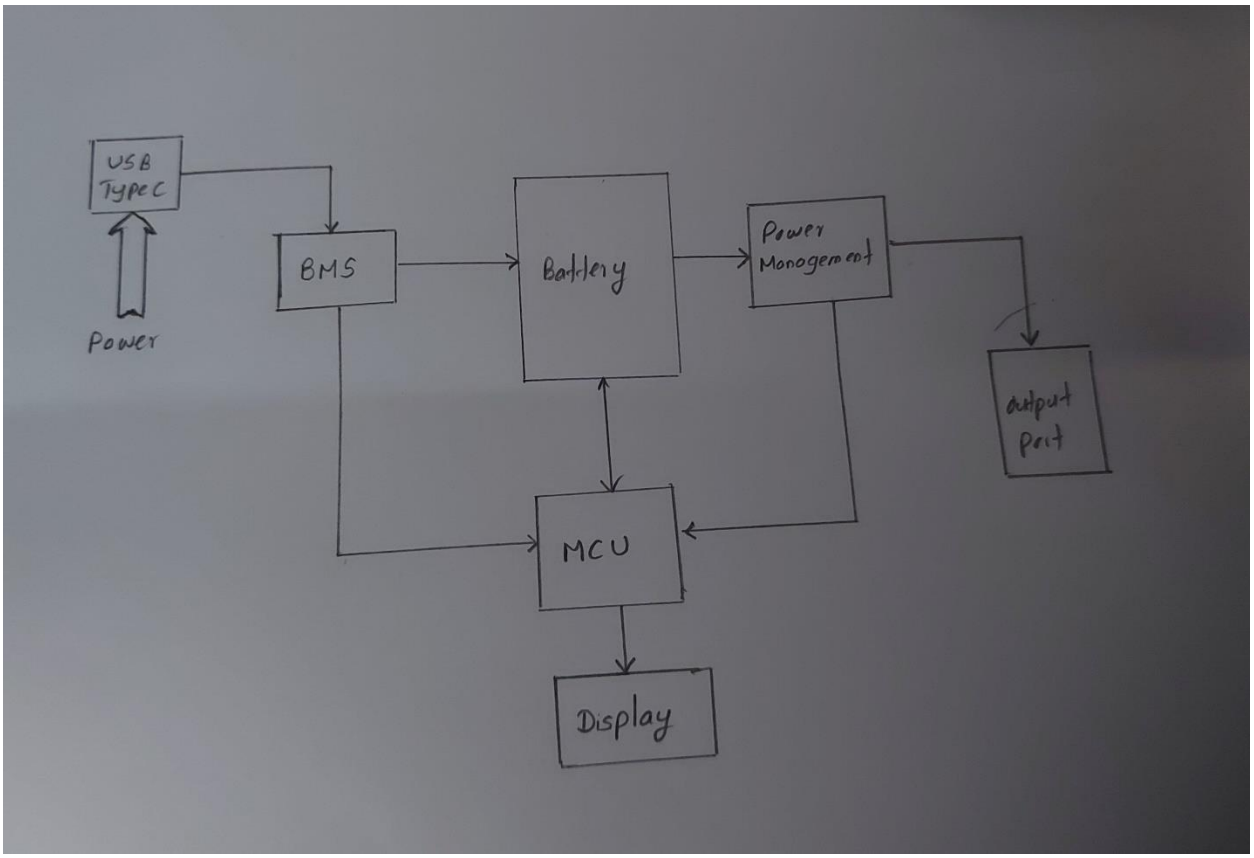


Design 3

This design is proposed by Liyanage P.H.S. (200352H) and this is seems to be like a square shape one and the solar panel already attached to the power bank.



In the functional block diagram, BMS has use to charge the battery and it has separate power input and output ports.



User-centered design

User survey

To obtain diverse user feedback and identify potential areas for improvement, we conducted surveys among university undergraduates and external individuals regarding the initial design. To achieve this, we developed a questionnaire containing the following inquiries.

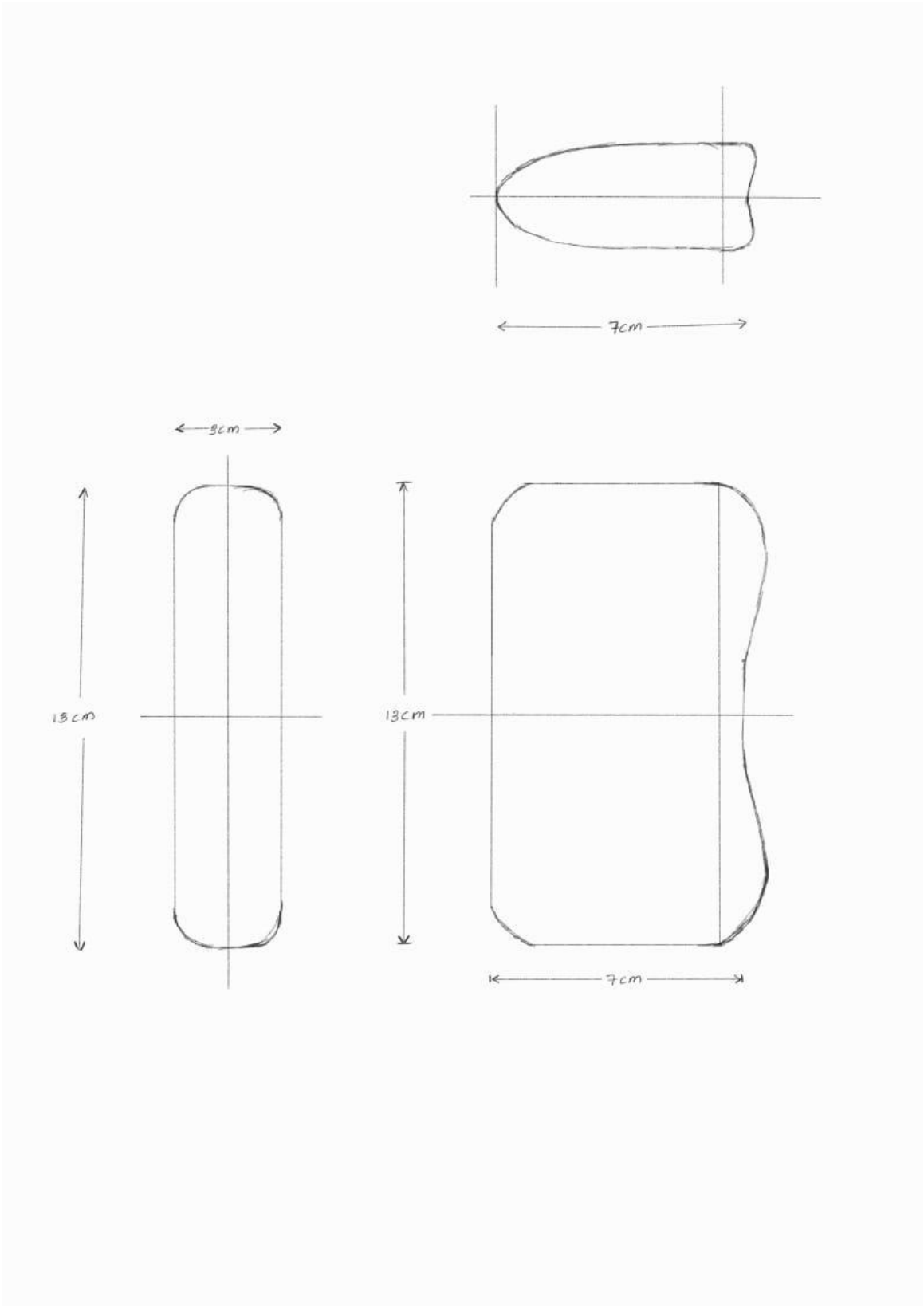
1. How frequently do you use a power bank and for what purposes?
2. What are the most critical features or capabilities you look for in a power bank?
3. What is your preferred battery capacity (mAh) for a power bank?
4. How important is the size and weight of a power bank to you?
5. Are there any specific charging ports or compatibility requirements you need the power bank to have?

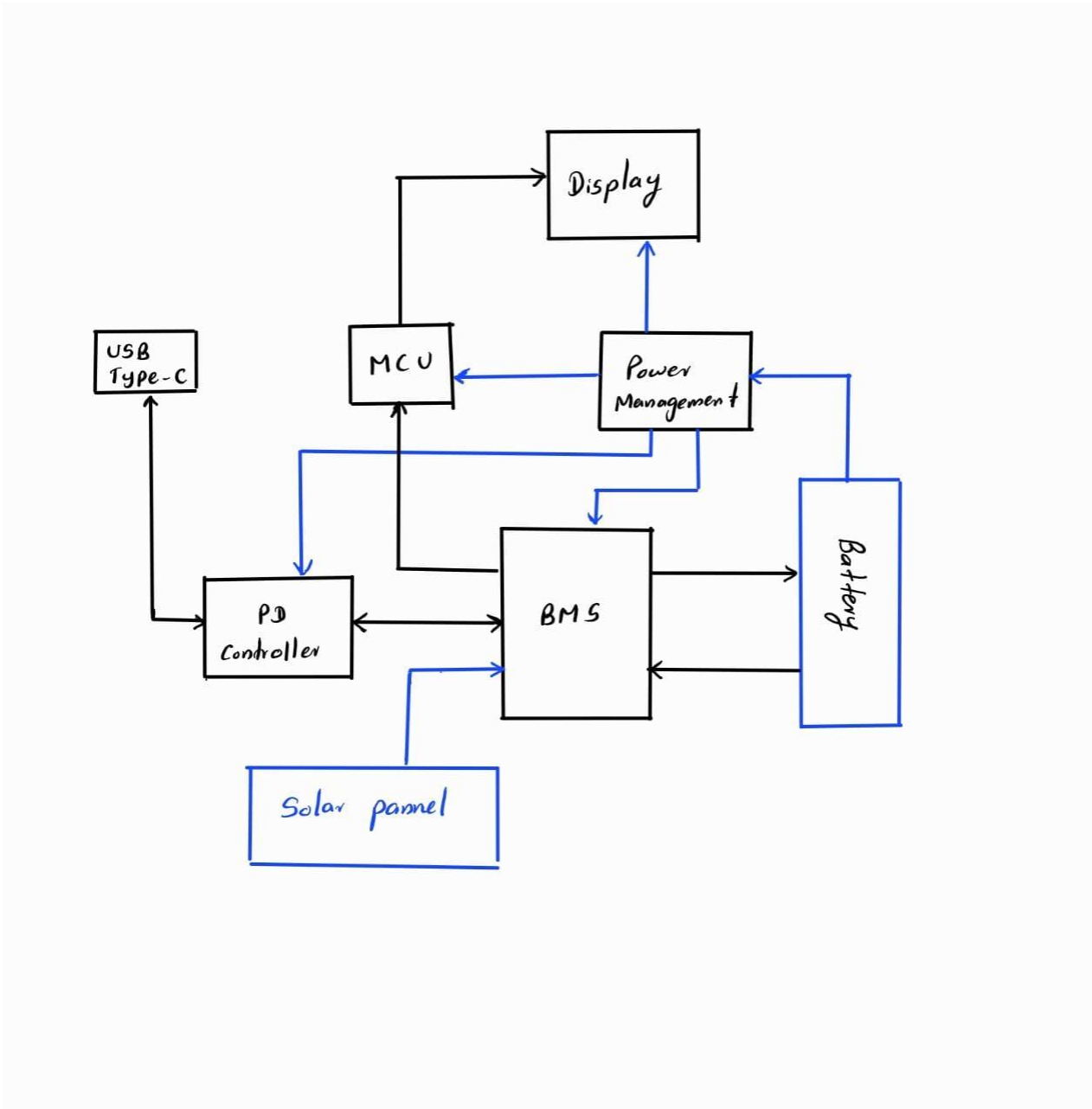
User Feedback

1. I use a power bank at least once a week when I'm traveling or in situations where I can't access a power outlet.
2. Fast charging, multiple USB ports, and a compact design are important features for me.
3. I prefer a power bank with a battery capacity of around 10,000mAh. That's usually enough to charge my phone multiple times.
4. I value a compact and lightweight power bank that I can easily carry in my pocket or bag without adding much weight.
5. It would be great if the power bank has both USB-A and USB-C ports to charge different devices. Compatibility with both Android and iPhone devices is also important.

Therefore, by considering above needs, we designed a new power bank

Design 4




Display
USB Type-C
MCU
Power Management
PD Controller
BMS
Battery
Solar pannel

Selection Matrix

I decided to use the following criteria to create my performance matrix for choose the best **sketch** out of these things.

1. Aesthetics: Assess the overall visual appeal and design of each power bank sketch. Factors such as the shape, color, texture, and overall attractiveness of the design.

2. Ergonomics: Evaluate the ergonomics of each power bank sketch, considering factors such as the size, weight, and comfort of holding and handling the power bank.

3. Port Accessibility: Assess the accessibility and placement of ports on each power bank sketch. Factors such as the ease of plugging and unplugging devices into the power bank are considered.

4. Button/Control Placement: Evaluate the placement and functionality of buttons or controls on each power bank sketch. Factors such as the ease of use and accessibility of the power bank's controls are considered.

5. Durability: Assess the perceived durability of each power bank sketch. I considered factors such as the material quality and construction of the power bank's outer design.

6. Branding/Logo Placement: Evaluate the positioning and visibility of branding elements or logos on each power bank sketch. Considered factors such as the prominence and alignment of branding on the power bank's design.

7. Versatility/Compatibility: Assess the versatility and compatibility of each power bank sketch with different devices. Considered factors such as the size and shape of the power bank's design, may impact its compatibility with various devices.

8. User Feedback/Preference: Consideration of user feedback or preferences when evaluating the power bank sketches. This could be gathered through surveys, interviews, or focus groups to understand user preferences for power bank designs.

In the performance matrix, I will give marks from 1 to 4. Because when we put marks from 1 to 4, I have not mid mark and it will help avoid receiving same marks for two products.

And also I added a weight for each criteria according to the importance of each one.

Criteria	Weight	Design 1	Design 2	Design 3	Design 4
Aesthetics	3	2*3	3*3	2*3	4*3
Ergonomics	2	3*2	3*2	3*2	4*2
Port Accessibility	2	3*2	2*2	4*2	3*2
Button/Control Placement	1	2*1	2*1	3*1	2*1
Durability	4	2*4	3*4	2*4	2*4
Branding/Logo Placement	2	2*2	4*2	3*2	3*2
Versatility/Compatibility	3	2*3	3*3	3*3	3*3
User Feedback/Preference	3	1*3	2*3	2*3	4*3
Total		41	56	52	63

When creating a selection matrix for the **functional block diagram**, I considered the following seven evaluation criteria:

1. Functionality: Evaluate how well the functional block diagram fulfills the required functions and meets the system requirements. Assess the completeness and effectiveness of the proposed solution in achieving the desired outcomes.

2. Modularity: Assess the degree to which the functional block diagram allows for modular design and integration. Consider the ease of adding, removing, or modifying functional blocks without causing significant disruptions or requiring extensive rework.

3. Interoperability: Evaluate the compatibility and interoperability of the functional blocks within the diagram. Consider whether the blocks can seamlessly communicate and exchange information with each other and with external systems, ensuring smooth integration into the overall system.

4. Scalability: Assess the ability of the functional block diagram to scale up or down, depending on the system requirements. Consider whether it can accommodate future expansion, additional functionalities, or changes in system size without significant redesign or reconfiguration.

5. Reliability: Evaluate the reliability and robustness of the functional block diagram. Consider factors such as fault tolerance, error handling, and the ability to recover from failures. Assess the impact of failures in one functional block on the overall system performance.

6. Performance: Assess the performance characteristics of the functional block diagram, such as speed, throughput, latency, and efficiency. Evaluate whether the diagram meets the required performance metrics and whether it optimizes

resource utilization, minimizes bottlenecks, and achieves acceptable levels of responsiveness.

7. Maintainability: Consider the ease of maintaining and updating the functional block diagram throughout its lifecycle. Evaluate factors such as documentation, clarity of design, ease of troubleshooting, and the availability of tools and resources for maintenance and support.

Criteria	Weight	Design 1	Design 2	Design 3	Design 4
Functionality	3	3*3	3*3	3*3	4*3
Modularity	2	1*2	2*2	4*2	3*2
Interoperability	2	1*2	2*2	3*2	3*2
Scalability	1	2*1	3*1	3*1	3*1
Reliability	4	3*4	3*4	3*4	4*4
Performance	3	2*2	3*2	3*2	4*2
Maintainability	2	2*3	3*3	3*3	3*3
Total		37	47	53	60

Conclusion

Therefore, according to the selection matrix that we have created above, the most suitable sketch and the most suitable functional block diagram are the sketch and the functional block diagram that are in **Design 4.**