Project Deliverable D – Conceptual Design

GNG1103F – Team 10

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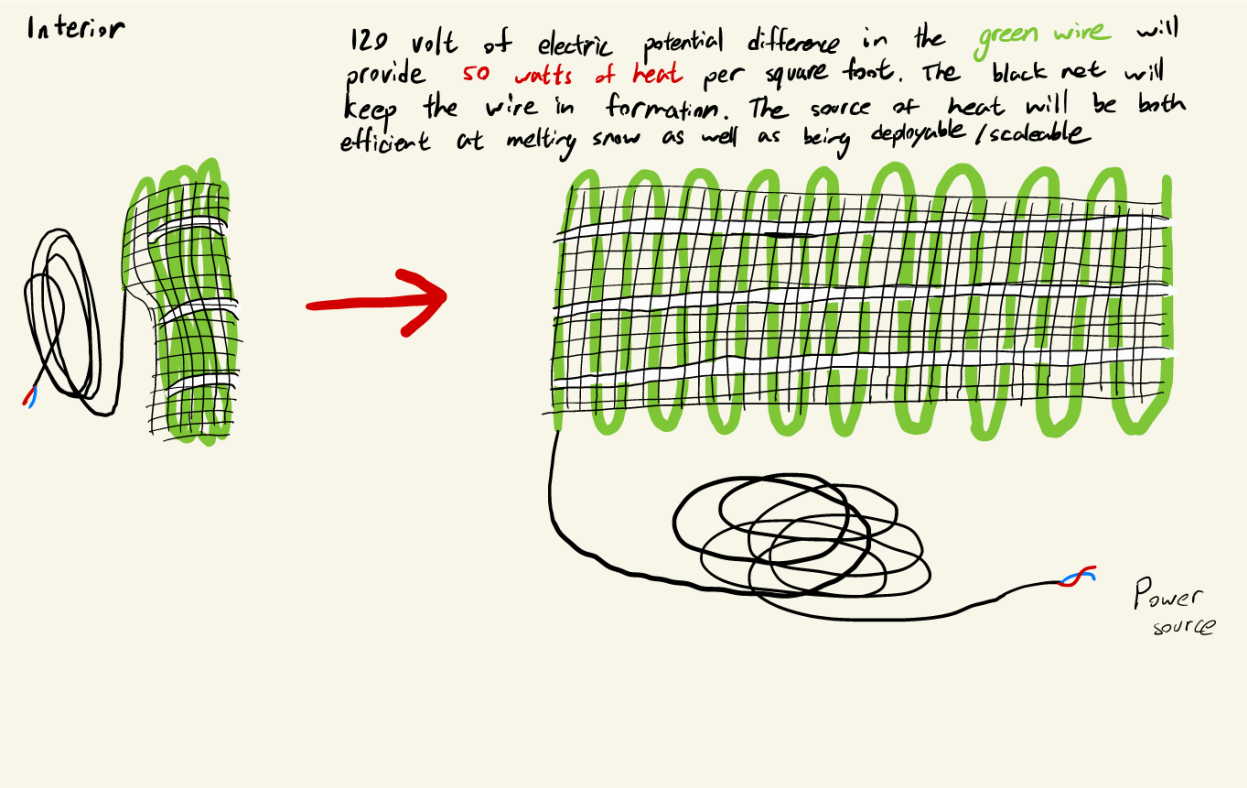
Introduction

The team had decided that as a reference, an electrical mat would be used in the previous deliverable, thus the subsystems that are developed were influenced by the idea of electrical mats. The team divided the three subsystems into the interior, the exterior, and the energy-saving component. The interior must be designed in terms of wiring, source of power and heating component. The exterior deals with aesthetics, grips, portability, connection ports, and maintainability. The final subsystem of energy-saving component is developed through exploring sensors and other energy-saving mechanisms to reduce the total energy being consumed. After developing ideas for each subsystem and comparing it to the prioritized design criteria, the team finally concluded at two functional solutions.

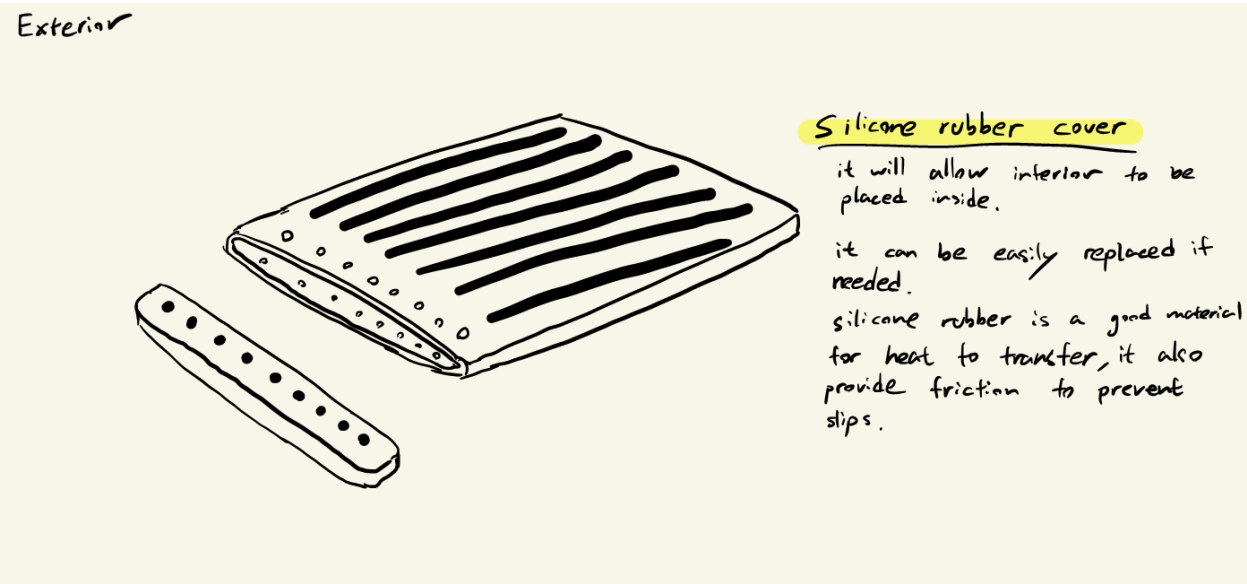
Concept Design

Eric's Ideas

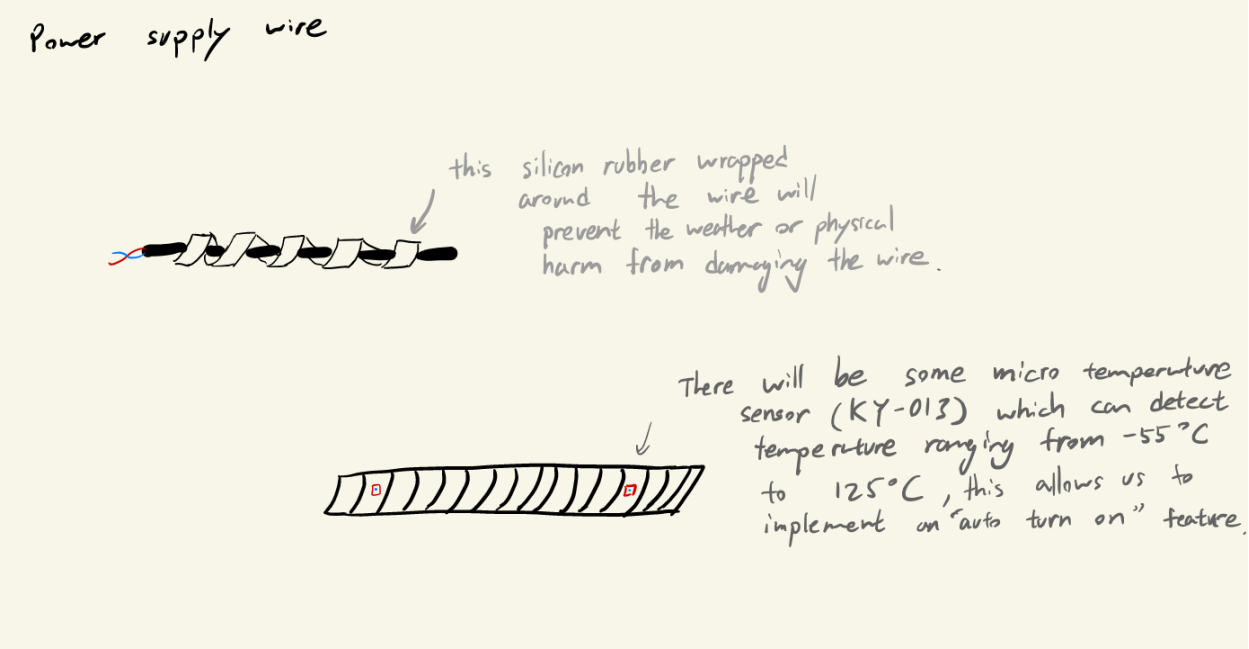
Interior



Exterior

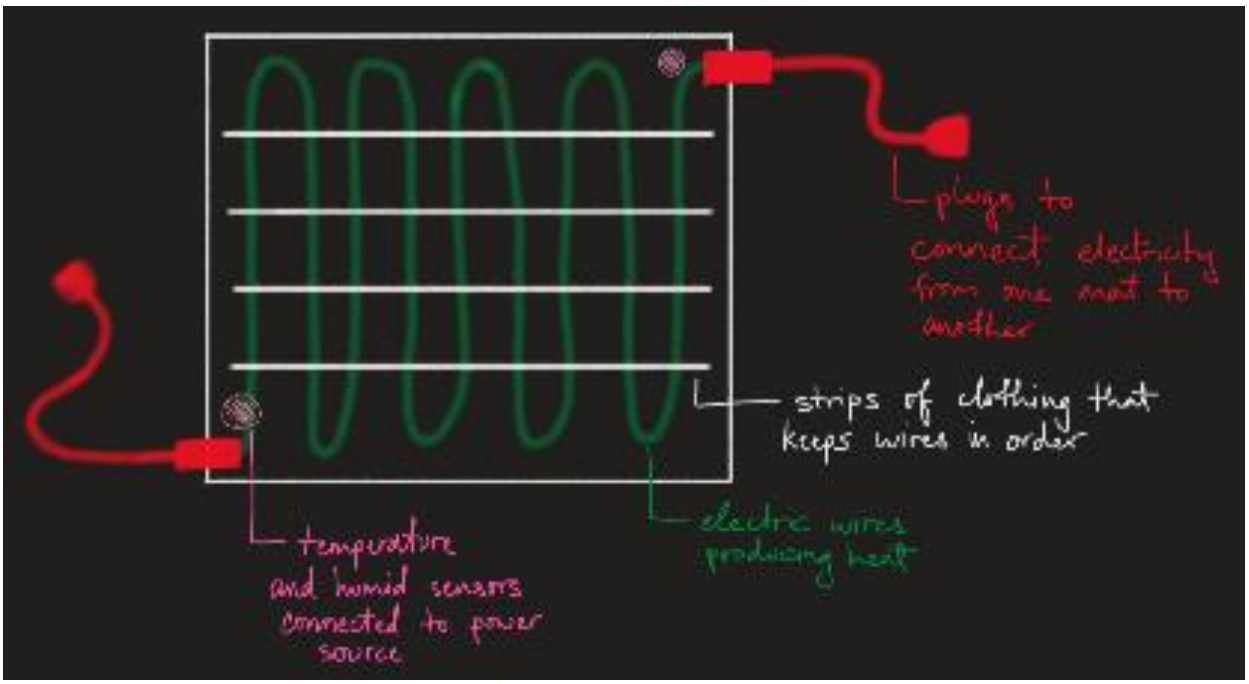


Saving-Energy Component

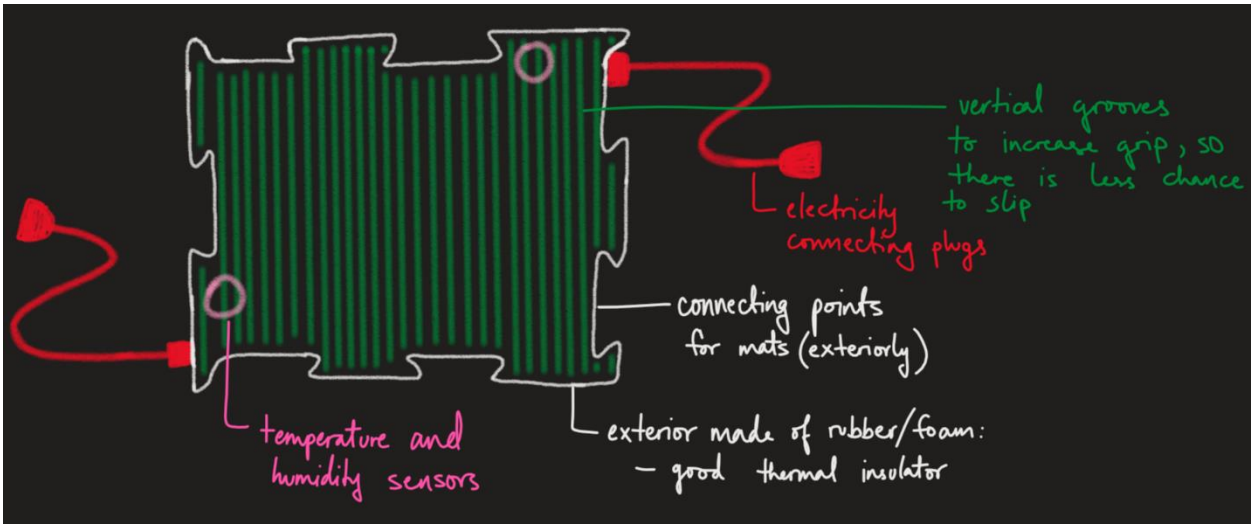


Chelse's Ideas

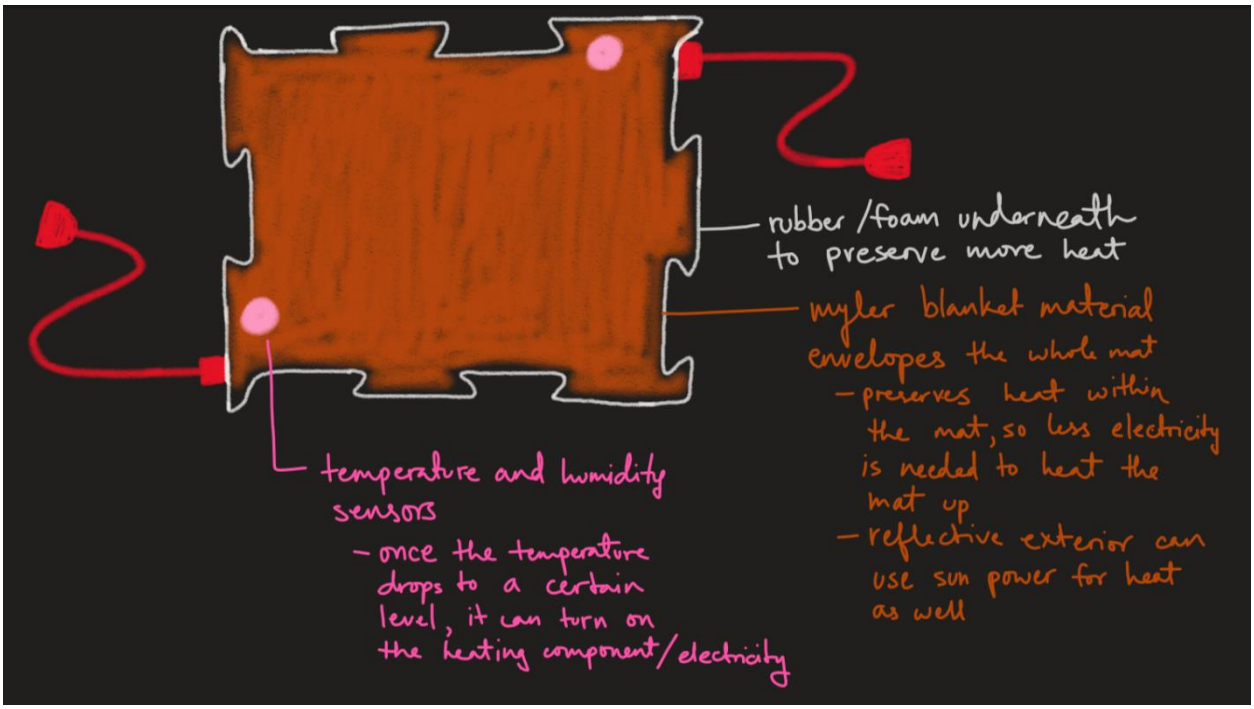
Interior



Exterior

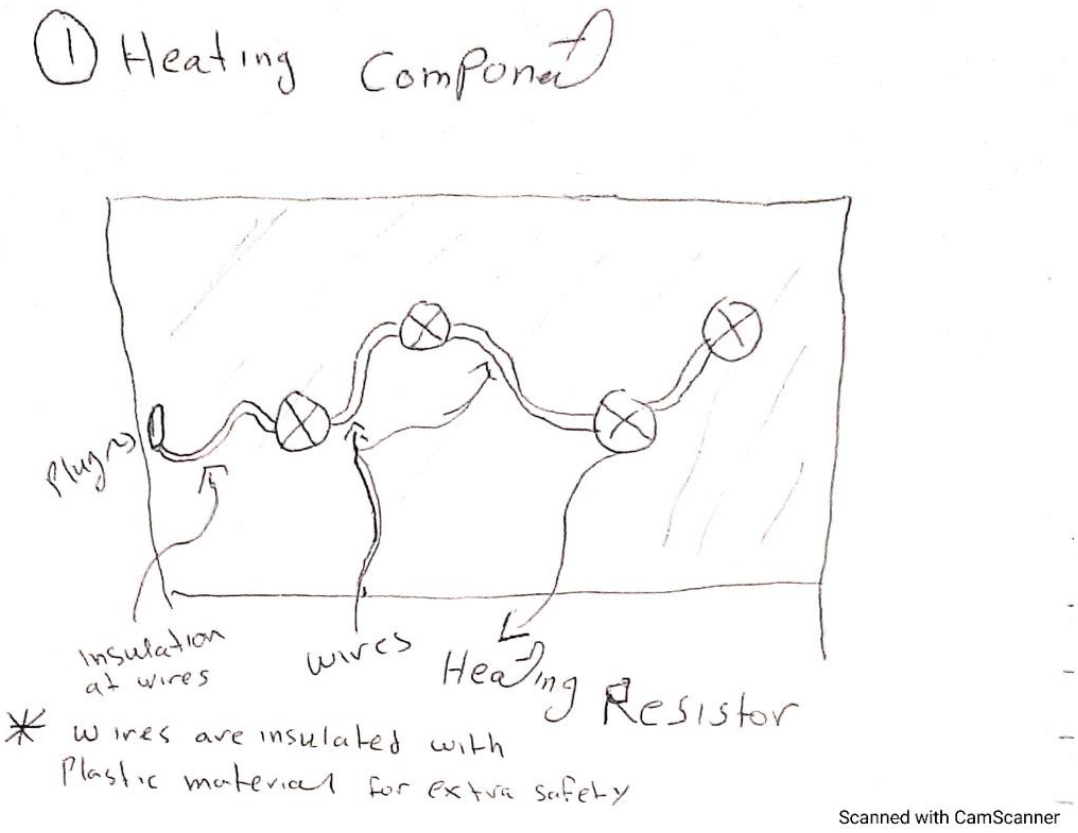


Energy-Saving Component

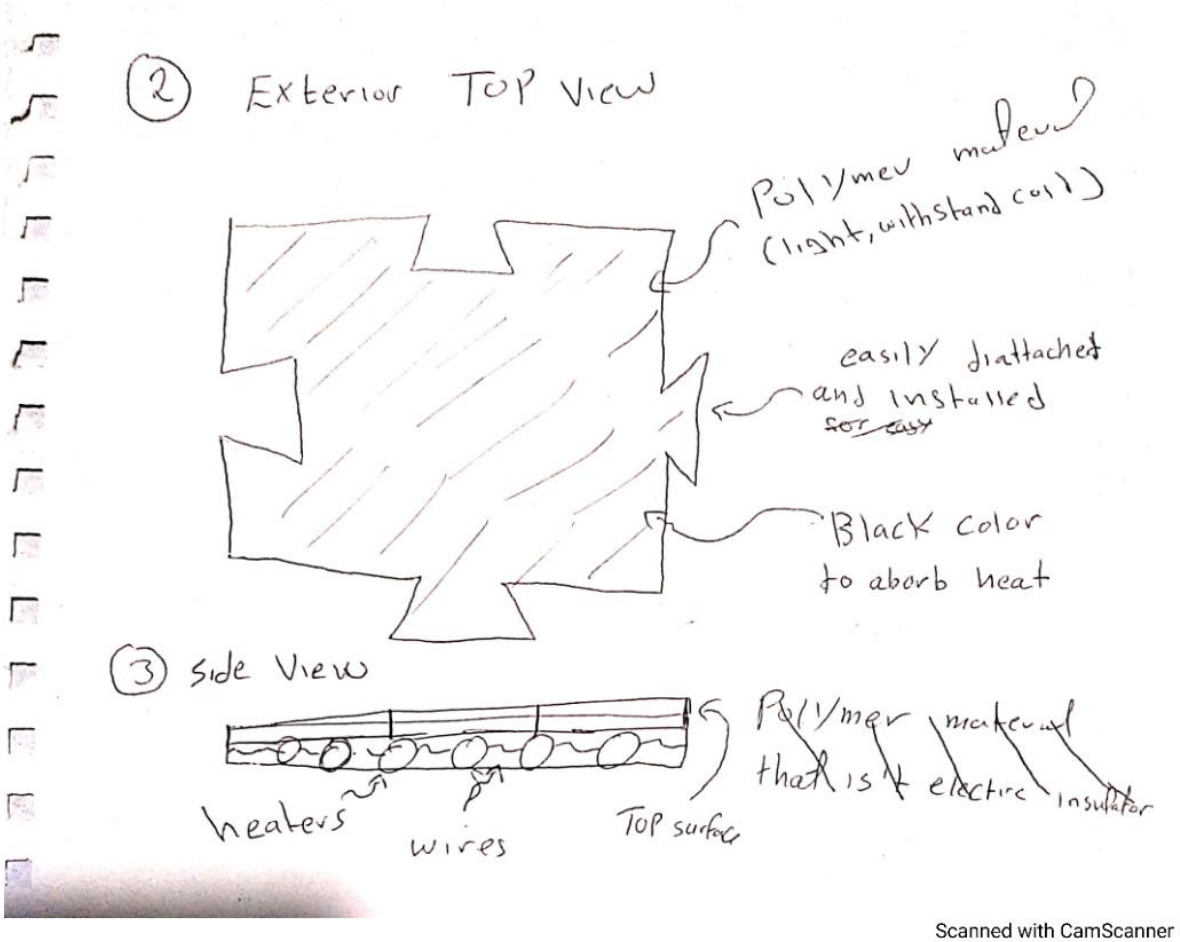


Ahmad's Ideas

Interior

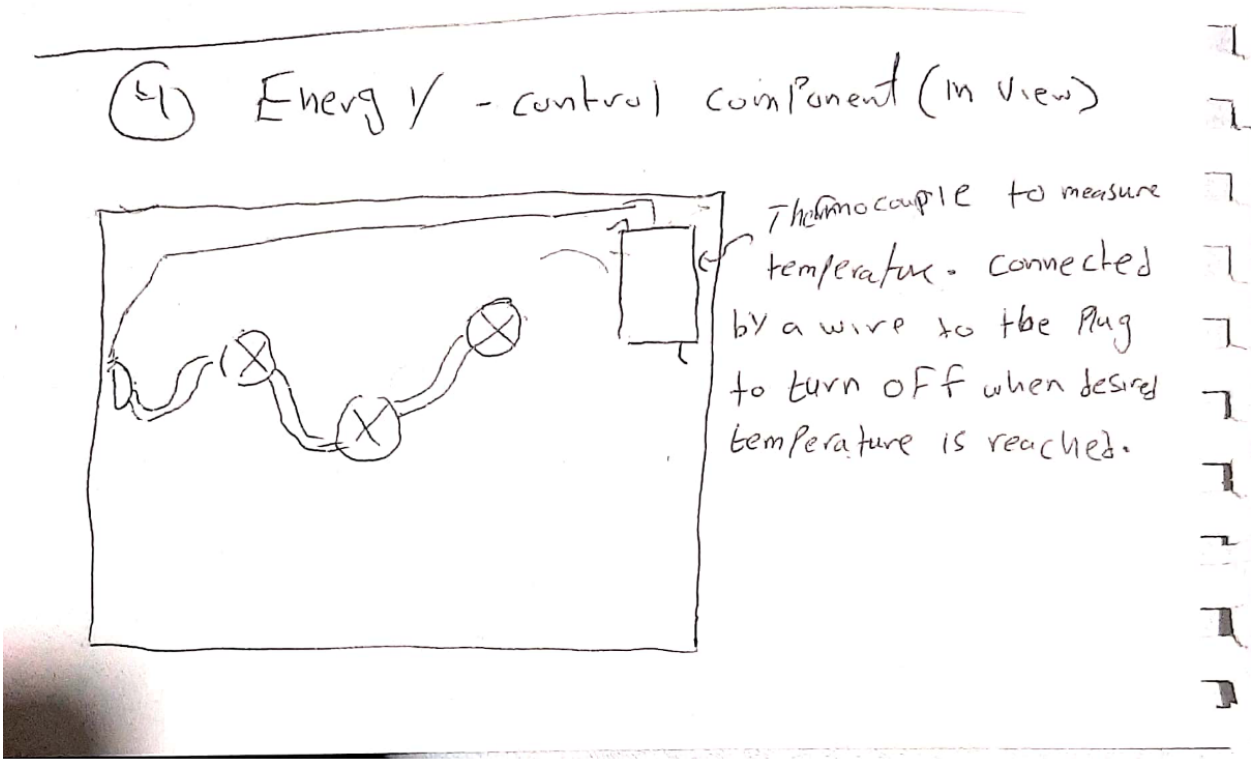


Exterior



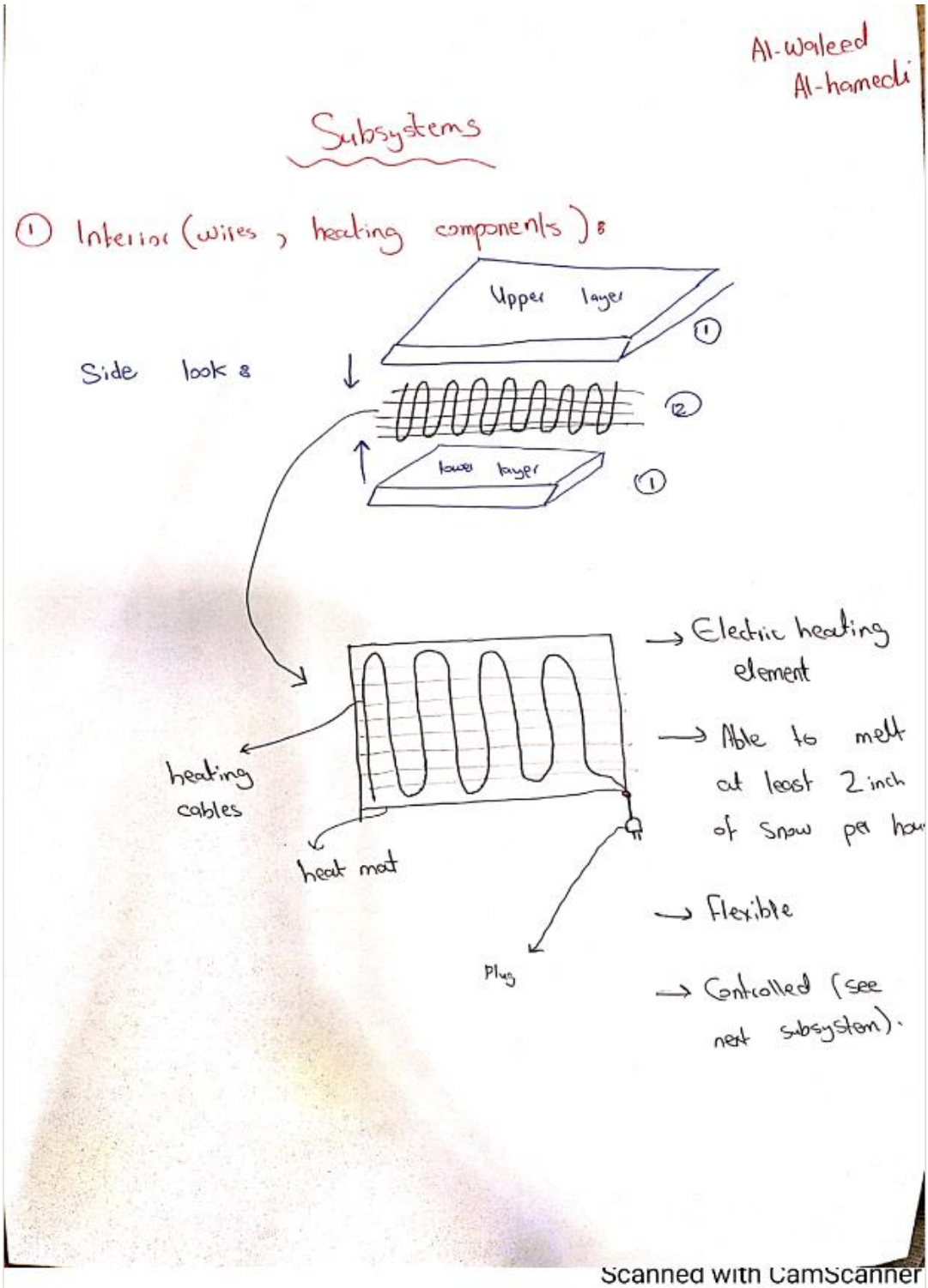
Scanned with CamScanner

Energy-Saving Component

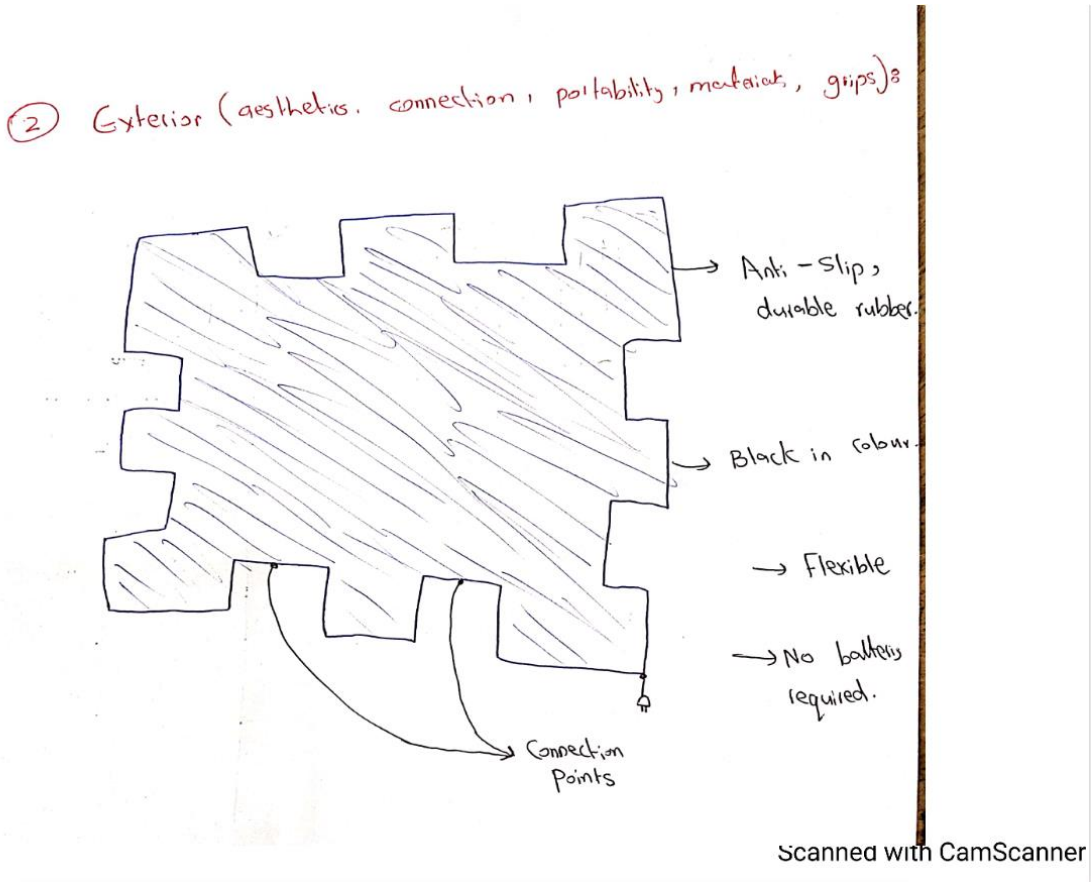


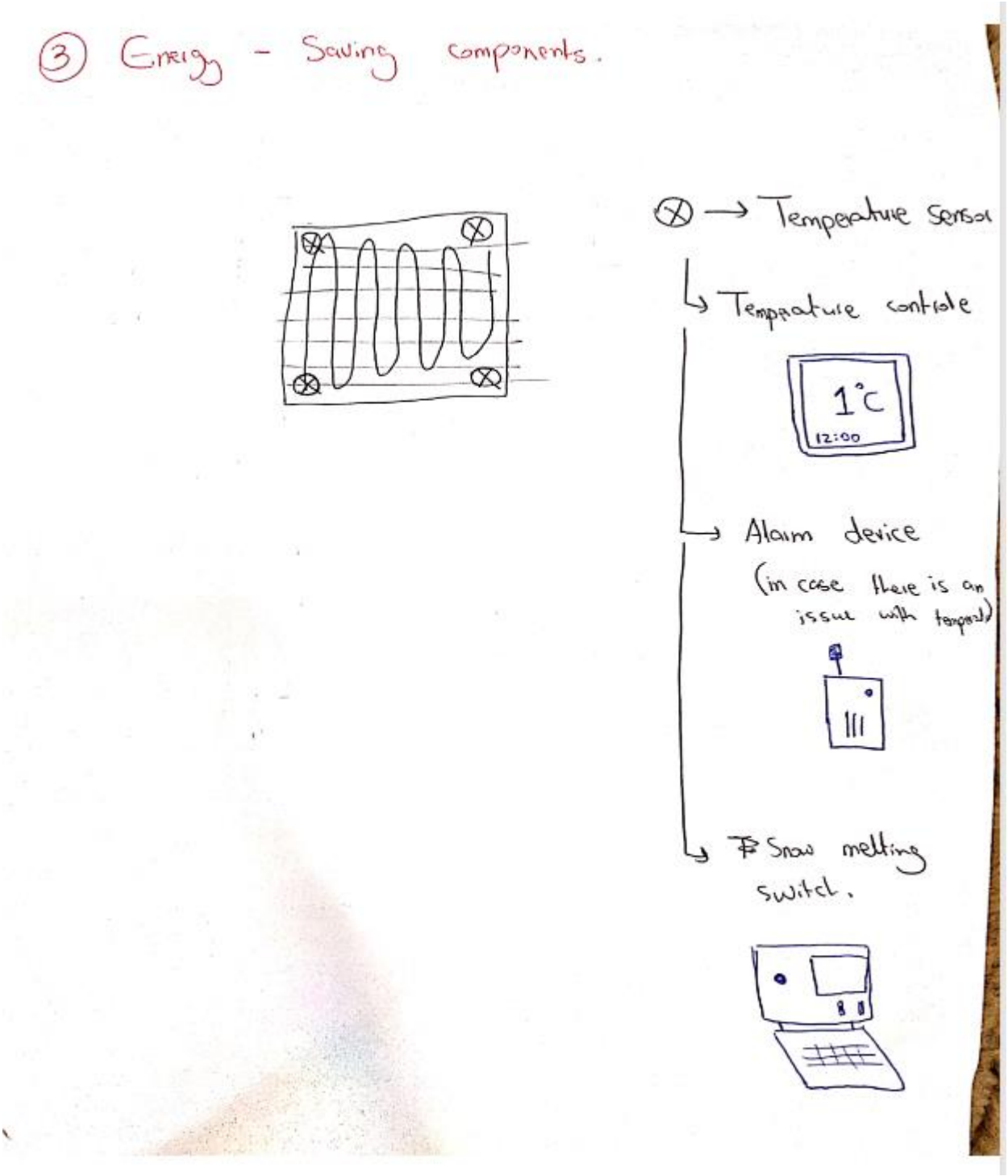
Al-Waleed's Ideas

Interior



Exterior


(2) Exterior (aesthetics. connection, portability, material, grips)
Anti-slip, durable rubber.
Black in colour.
Flexible
No battery required.
Connection Points
Scanned with CamScanner


③ Energy - Saving components.
→ Temperature Sensor
Temperature controle
1°C
12:00
Alarm device
(in case there is an issue with temperature)
Snow melting switch.

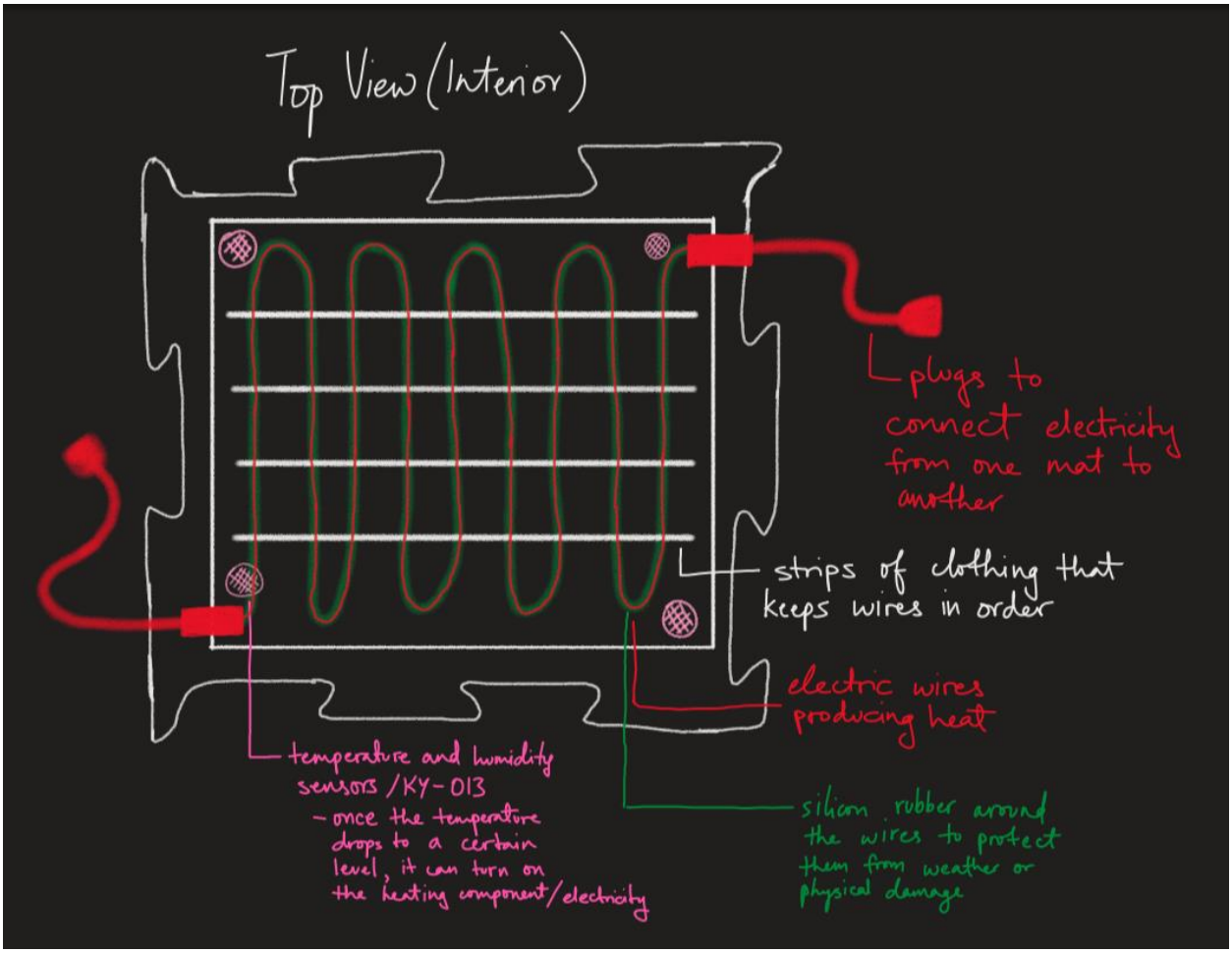
3 Functional Solutions

Table 1. Likes and Dislikes of each Team Member's Ideas

Team Member	Likes	Dislikes
Eric	• Electric wiring component (interior) • Silicon casing – cheap and durable • Silicon around wire – cheap and durable	• No plug or connection to energy source
Chelse	• Vertical grooves – anti slip component • Plug connecting mechanism. • Connection grooves	• Rubber material is not as durable or cheap as silicon
Ahmad	• Polymer material – cheap and durable • Connection grooves (exterior) • Temperature sensors	• Wiring system is not as effective as the other models
Al-Waleed	• Black exterior • Plug connecting mechanism. • All of energy saving components	• Rubber material is not as durable or cheap as silicon

Three Global Concepts and their Advantages and Disadvantages

Global Concept 1



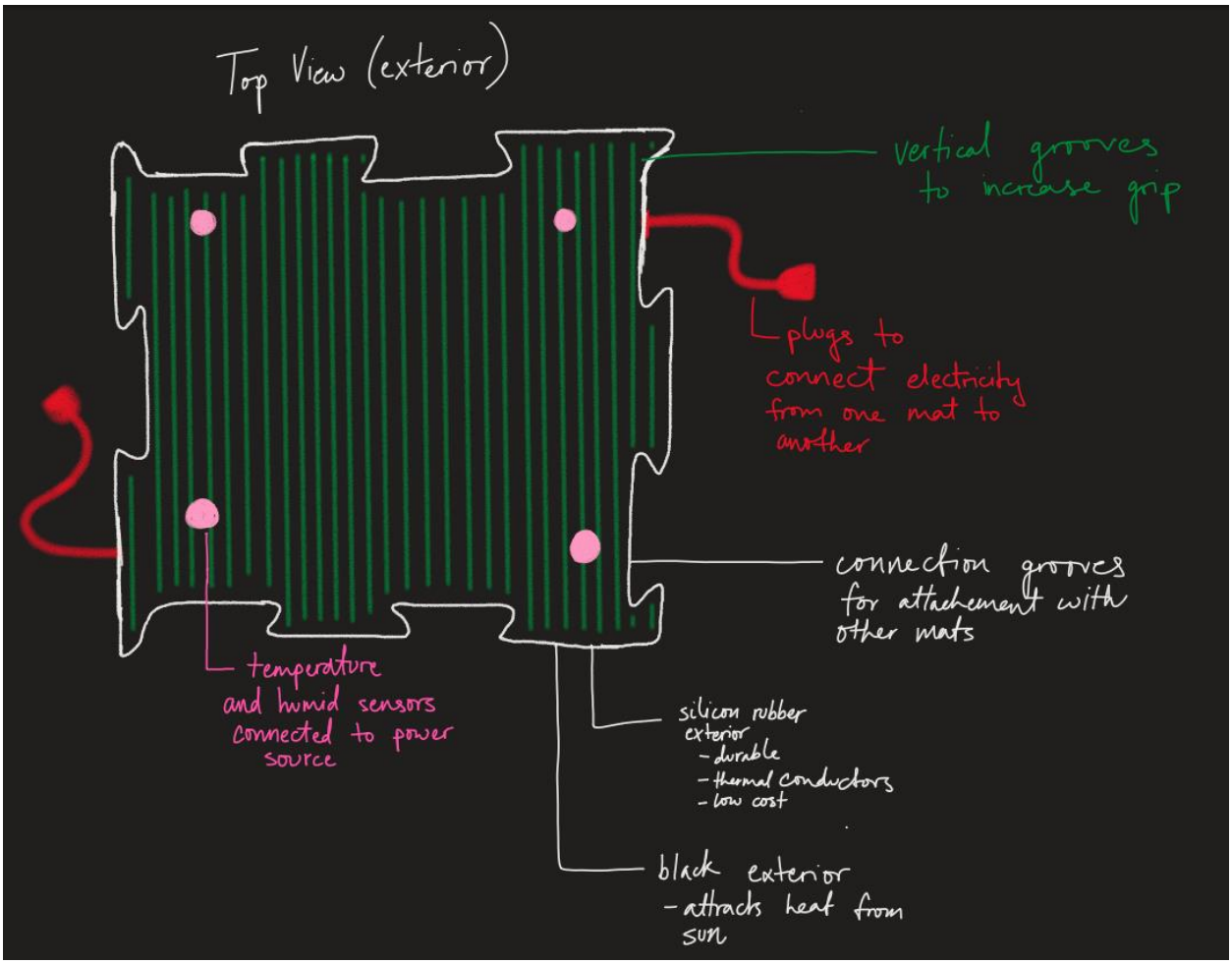
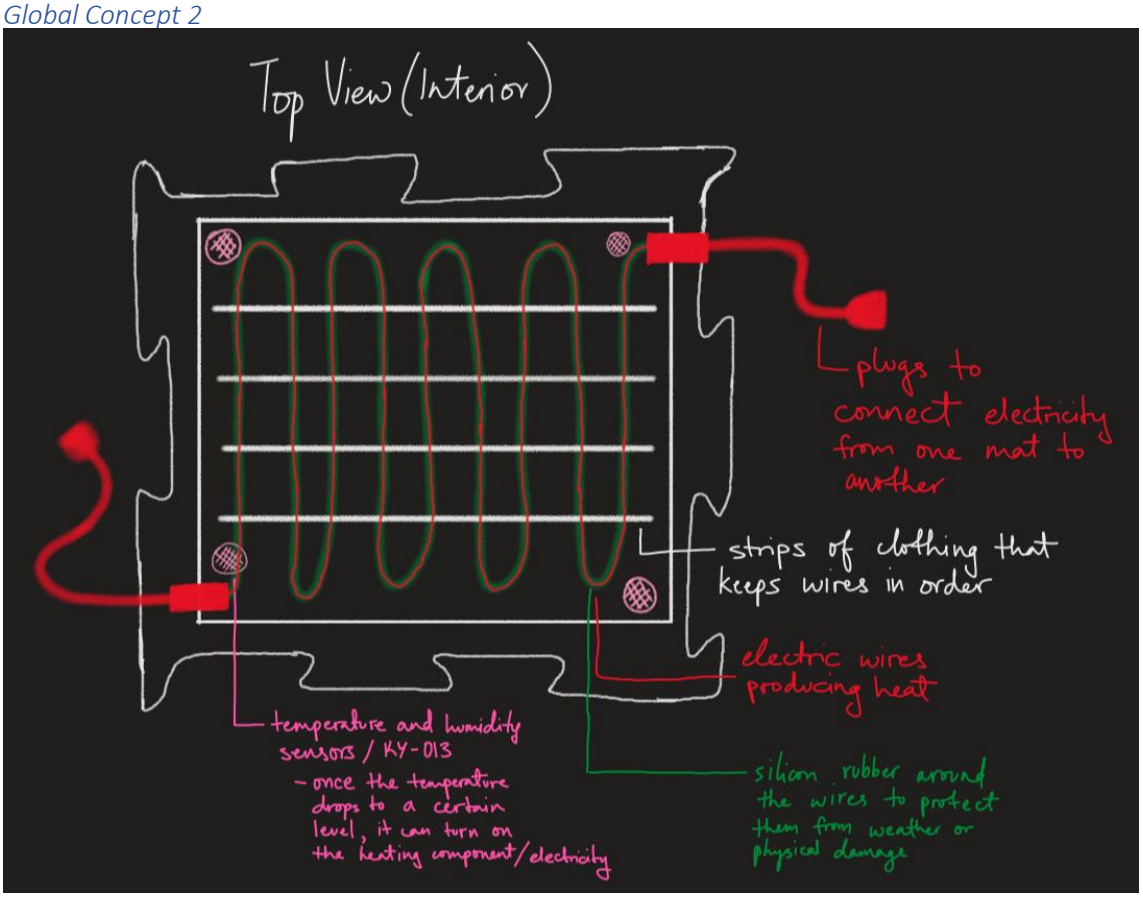


Table 2. Advantages and Disadvantages of Global Concept 1

Advantages	Disadvantages
• Vertical grooves for grip • Four Temperature and humidity sensors • Silicone rubber on exterior – durable and low cost • Connection grooves • Connecting plugs • Black exterior to attract heat. • Silicon Rubber covering wires for protection. • Exterior material lasts 45 years	• Silicon rubber on exterior – thermal conductors, heat will be lost too quickly. • Vertical grooves are not very useful as the silicon rubber material will have its own grip.

Global Concept 2



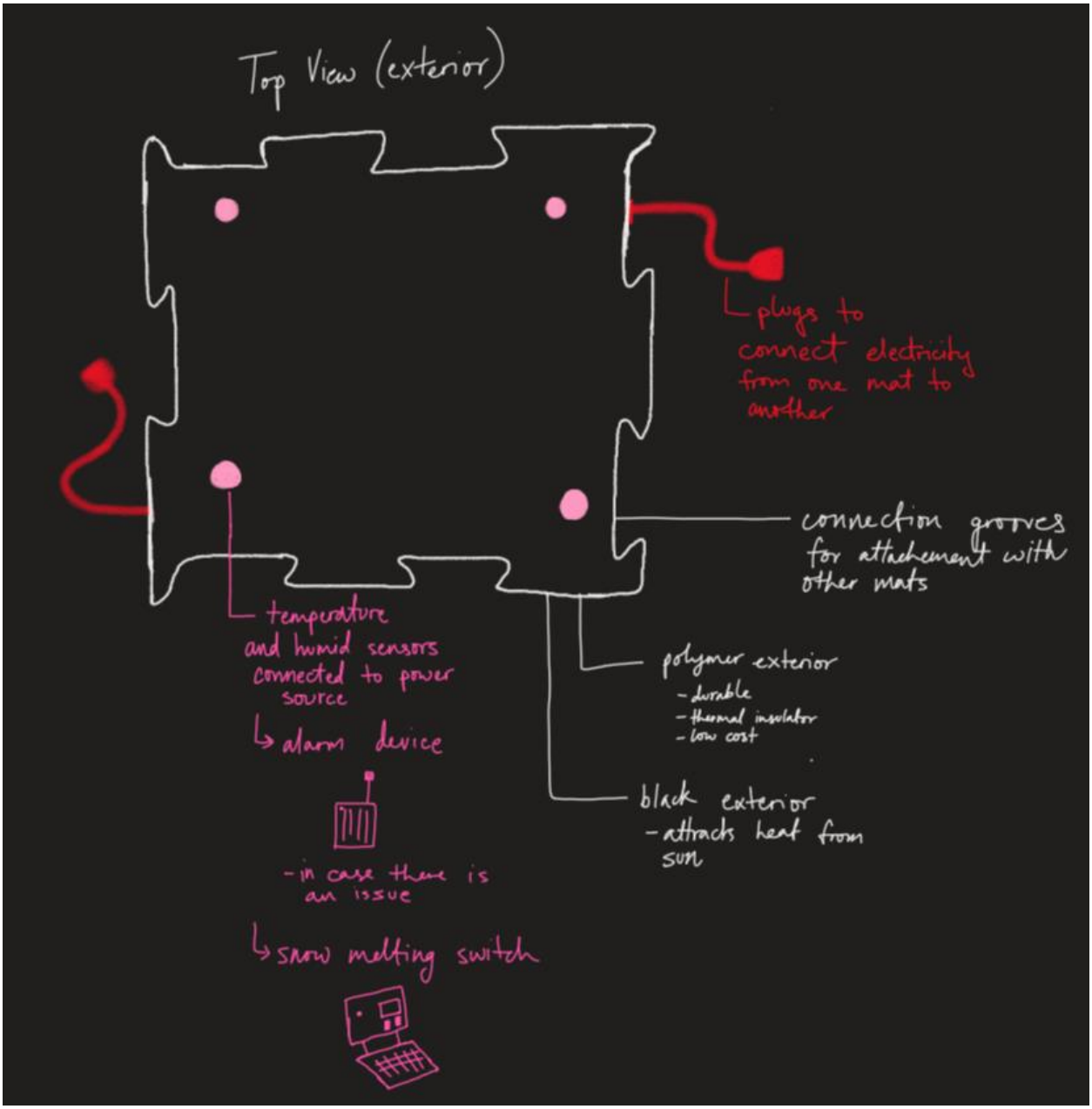
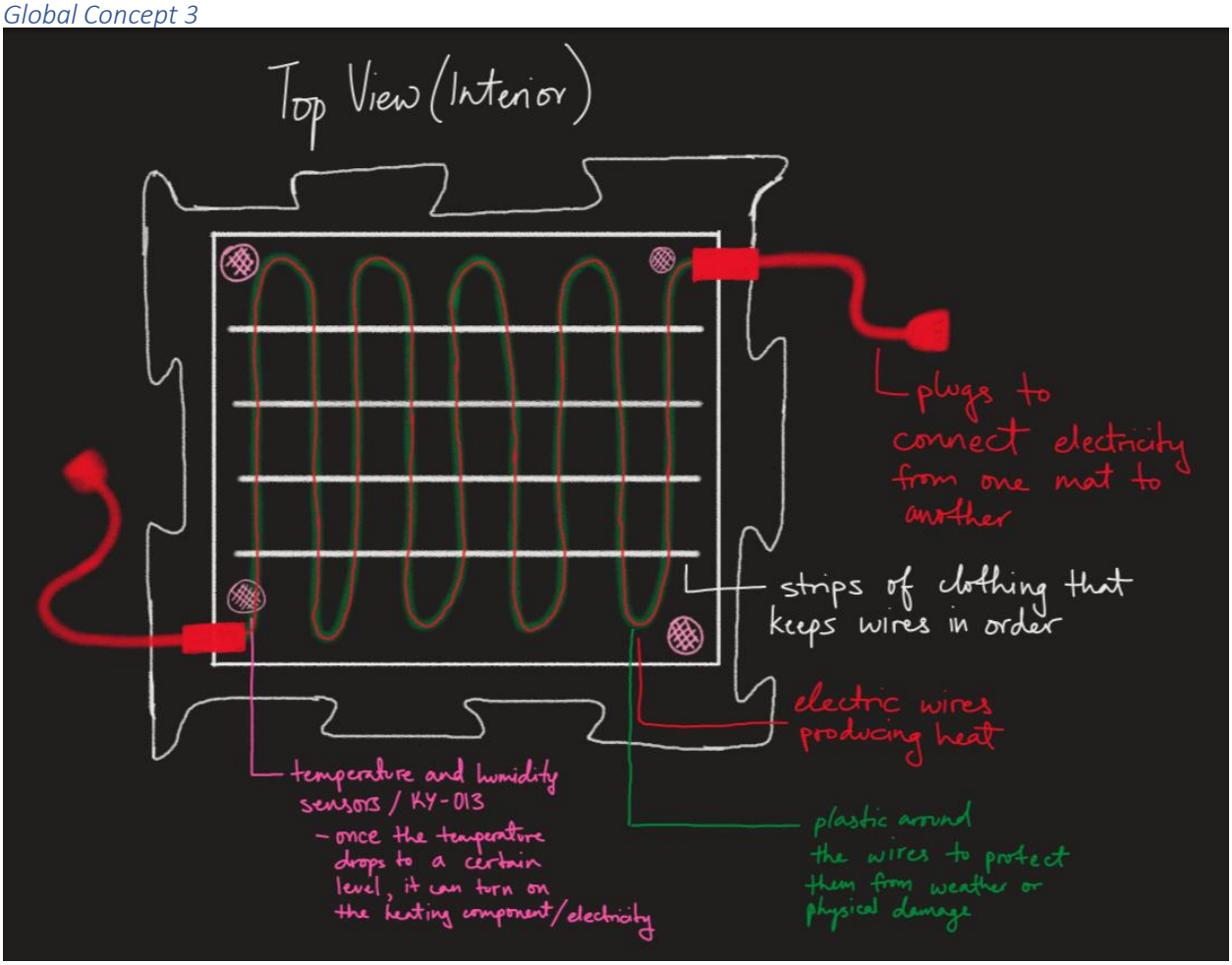


Table 3. Advantages and Disadvantages of Global Concept 2

Advantages	Disadvantages
• Four Temperature and humidity sensors • Alarm system • Snow melting switch. • Polymer on exterior – durable, thermal insulator and low cost • Connection grooves • Connecting plugs • Black exterior to attract heat.	• Polymer does not have a high capacity, so there is a limit as to how much heat can be given into the mats. • Polymer is also not easily recyclable.

• Silicon Rubber covering wires for protection. • Exterior material lasts 30 to 50 years	

Global Concept 3



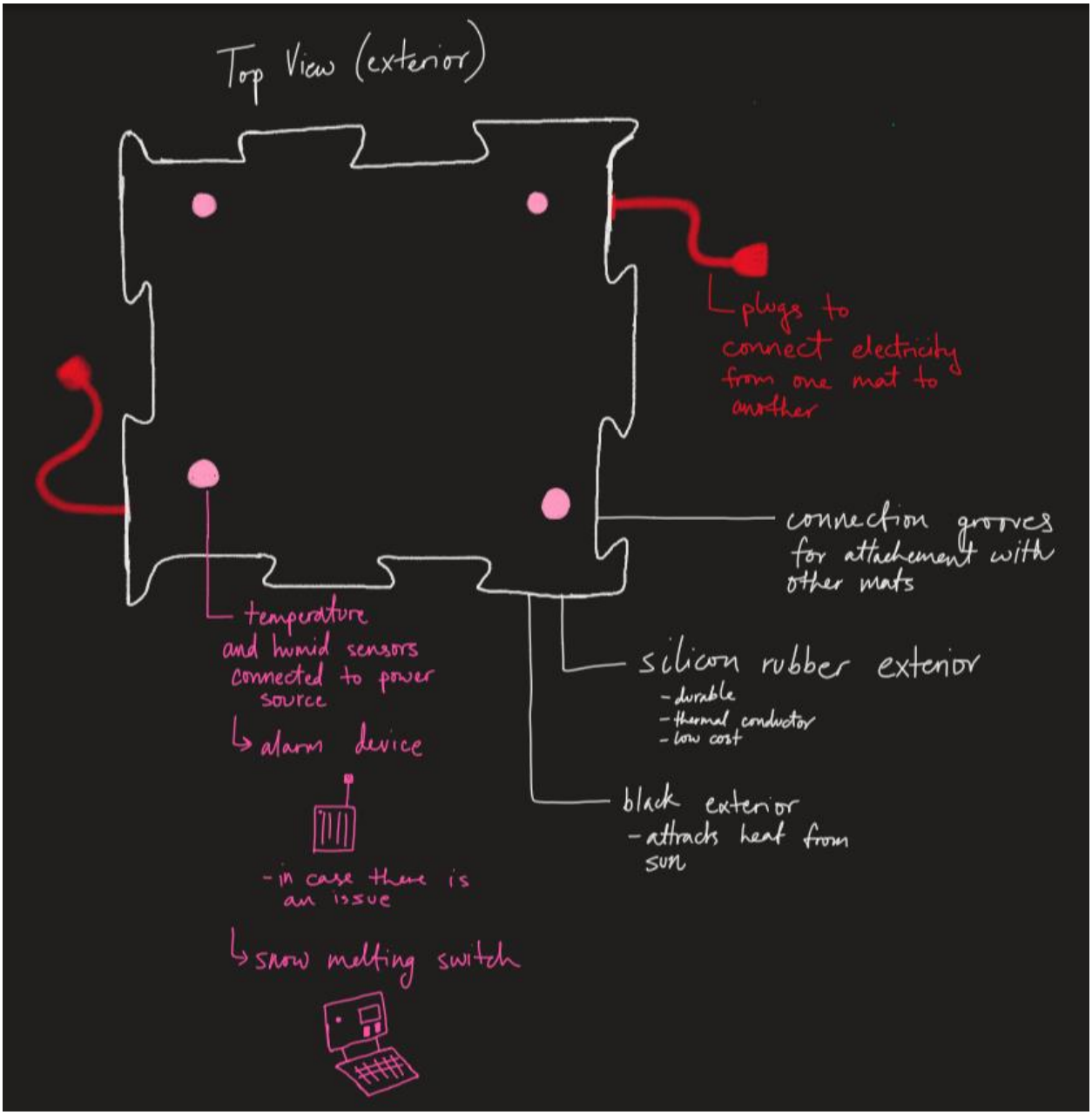


Table 4. Advantages and Disadvantages of Global Concept 3

Advantages	Disadvantages
• Four Temperature and humidity sensors • Alarm system • Snow melting switch. • Silicon Rubber on exterior – durable and low cost • Connection grooves • Connecting plugs • Black exterior to attract heat. • Plastic covering wires for protection	• Silicon rubber on exterior – thermal conductors, heat will be lost too quickly.

• Exterior material lasts 45 years	

Design Criteria Benchmarking

Table 5. Comparing three Concepts to Design Criteria and Priority. Red = 1, Yellow = 2, Green = 3. The totals were calculated by adding up the product of the colour system and priority. This total was used to find the most ideal global concepts for the client.

Design Criteria	Priority	Concept 1	Concept 2	Concept 3
Ensuring safety	5	3	3	3
Operating conditions	5	3	3	3
Melt snow above mat	5	3	2	3
Longevity	4	2	3	2
Relatively low cost	4	2	3	2
Scalability	4	3	3	3
Energy use	3	1	3	2
Modularity	2	3	3	3
Maintainability	2	2	3	2
Ease of repair	2	3	3	3
Environment friendly	1	3	2	3
Total		95	105	98

Final Functional Global Concepts / Solutions

After comparing the three global concepts and benchmarking all of them against the design criteria, the best global concepts are 2 and 3. The first concept was not as advanced as the other two concepts due to the lack of additional sensors and materials used. The second concept had the advantage of being advanced in terms of sensors. Polymer was used exteriorly, which was advantageous as it was a thermal insulator thus helping conserve heat, but it has a low heat capacity, which could affect the efficiency of the mat's heat melting component. It was also cost-efficient as it had the longest longevity at a lower rate of cost, therefore giving it a very high total in the deign criteria benchmarking.

The third concept only had the second-best score in the design criteria benchmarking, but the team thinks it is a great option as it has a higher "environment friendly" mark. The exterior

material used for this product is silicon rubber which is more stable and reliable than polymer. It can resist many substances such as acid, bases, oil, water, and more. Also, it can withstand wind, rain, and UV rays without undergoing any physical change for long periods of time. The disadvantage with this concept is its cost- inefficiency and it uses up more electricity. Unlike polymer's thermal insulating abilities, silicone rubber is thermal conductor, making its ability to preserve heat less which then requires the use of more electricity to keep the mats warm. Concept 3 has a lot of advantages along with disadvantages.

Conclusion

After comparing the disadvantages and advantages of each global concept the team had developed, it was decided that concept 2 and 3 are the final solutions. Both concepts are not perfect but is more advantageous than concept 1. Concept 2 does have a higher design criteria benchmark score, but concept 3 has more advantages than disadvantages. Going forward, the team hopes to implement these concepts and ideas in a manner more suitable to the client's needs.