Decay Story

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Content

Introduction

The entire journey of the Product Design Master's Program was all about bringing in previous experiences to create a risky new design that wasn't done in the past. I have had experience with different verticals of design (such as furniture design, lifestyle accessories, transport design, sustainable material design, and interior design) but haven't worked or practiced in the desired industry, which is consumer electronic design.

This is the risk that was taken to achieve in this master's program, taking up the challenge to make something functional and a working prototype that comes under consumer electronic design. Considering that I have absolutely no knowledge about bringing technology together and making them come alive, this was indeed a hectic task to pull off.

In the first semester, there was some exploration and experiments done on creating sustainable materials for lifestyle products. The second semester consisted of designing a system or utility that followed the Sustainable Development Goals (SDG) that were created by the United Nation for maintaining a balanced future for our eco-system.

As for my Major Project, I shall be merging the two knowledge and experience I have gained from the previous semesters.

In a literal manner, a biodegradable material will be created using the skills learned from the first semester and consumer electronic assets as well (Arduino). The main concept of the second semester will be carried to the third semester (i.e., Actively tracing pollutant gases in your environment).

Perks

The plus point in the major project is the collaboration with two different courses working with similar goals.

The collaboration is done with a Master of Arts in Game Design and a Master of Arts in Textile Design. Our goals and criteria are in line with the global cause and sustainability of society.

Connection with Game Design

A team of three (Aviroop Roy, Bhuvanesh Tekavde, and Dhruv Jalgaonkar) from MA Game Design are working on a VR Experience that focuses on the problem "Climate Change".

Hence, our goals are aligned, and thought of featuring our concepts in each other projects to give added value to their VR experience and a purpose for the product.

Connection with Textile Design

Aditi Abraham MA Textile Design student is designing a garment that is integrated with smart textile for woman's safety. The functionality of the garment is to trigger sound and light when the perpetrator is in contact with the consumer.

This collaboration is trading off our skillsets in each other's projects. Aditi's project needed technology to work around her garment, which she does not have the skills on. Since I began to learn about Arduino and python scripting for my project, it was convenient to apply it to her project as well. At a later stage in my project, I needed her help in bringing the pieces together to form a product. It would be shameful to drop the spoiler now, but there will be a lot of help from her during the phases of this project.

Aditi Abraham

TEXTILE DESIGN

Bhuvanesh Tekavde

Aviroop Roy

Dhruv Jalgaonkar

GAME DESIGN

The Concept & Problem

The factors affecting our planet come from many sources in terms of pollution. There are manufacturing products, disposing of them after consumption, mining material, chemically making materials that emit an anti-ecological particle, and the consumption of products that emits the same. However, this can be divided into two sources:

The Domestic World

This is the trigger point to mass manufacturing because as the company researches the demand for the product from the general mass (Domestic World), there is a green light given to start production.

Every product has different functionality and purposes that exist in a person's life. There are some which need to exist such as essential hygienic products (toothbrush, tissue rolls, dental floss, gels, etc.), consumer electronics (smartphones, power bricks, cables, etc.), and food packaging (bottles, boxes, and containers). While there are other products which are not a necessity such as a personal vehicle in an urban city while there's public transport, using a kettle to heat water while the consumer has an electric hob or gas station which cooks food as well.

Apart from product consumption that leads to wastage and landfill, there is a product that is used for long-term purposes such as machinery (i.e., refrigerator, heater, air conditioner, etc.) which emits Chlorofloro Carbon (CFC), Carbon Dioxide, and Carbon Monoxide. Hence these products used collectively by a society (or even by the entire city) cause the change in the climate.

The Commercial World

In this world, many initiation roots trigger events to harm our planet. It all begins with creating a need to have something that does not exist yet or it can be just to make our lifestyle easier, an innovation. Then the pitch, the idea to create something that will stir up the demands and needs of this world. Based on an "average" number of demands which usually exceeds twice the amount, the decision of material selection is made and their respective sources extracted. Such as metals for mining and plastic for harvesting. From this process onwards, there is consistent damage to the environment in every aspect (i.e., Climate change, landslides, deforestation, etc.) to extract the required materials to be manufactured massively. When the product is out for sale, consumers utilize the product up until they meet their satisfaction and dump it to either recycle the materials or create mountains of garbage that decays the environment further.

Hence, the scale of production is too large which makes it difficult to suppress the damage to our planet since there is a large demand.

THE TWO WORLDS

Domestic World

- Consumes until satisfied.
- Create the demand for products and innovations.
- Selective Emotions.

Commercial World

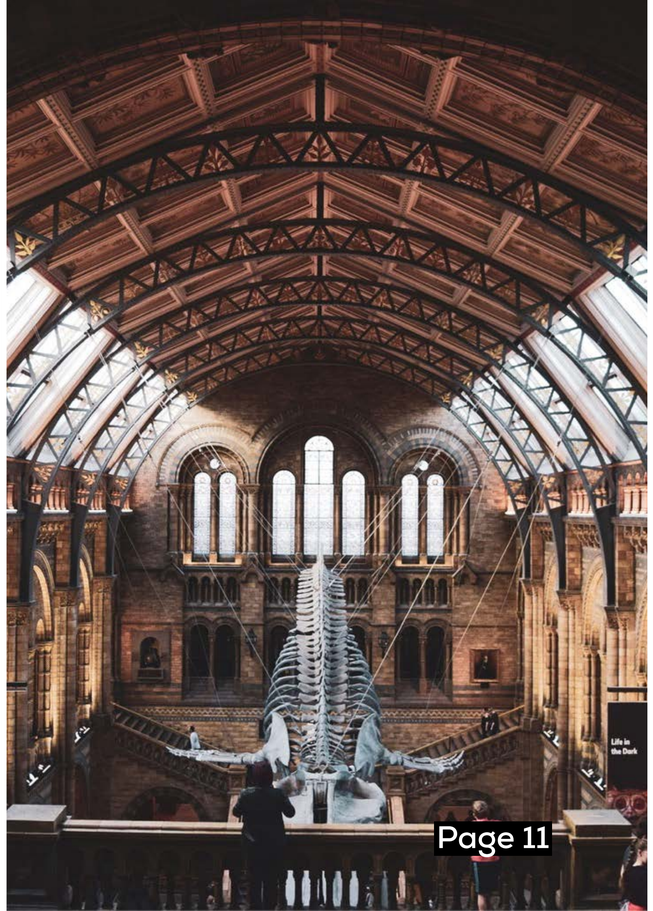
- Manufacture products beyond the limited capacity.
- Quantity produced exceed world population.
- Cannot afford to make changes for better climate control.

Coda

Comparing both worlds, the Commercial world functions based on demand and supply which leads to mass manufacturing to the bottleneck of its capacity in today's world. This world cannot afford to make changes within its process to adapt to stabilized climate control or mass wastage. But there a weak point in the commercial world is that the domestic world controls it indirectly, hence if there is no demand for a product then there is production needed for it. There is a small domino effect created between these two worlds and if there is a way to make the domestic world understand the facts of our current crisis, they may be able to adjust their lifestyle and choices of purchasing goods, etc.

Phase 1

The phase where all the research and surveys are conducted to provide the purpose of existence to a product before visualizing its design and form.



Existence & Purpose of a Product

One of the basic purposes of any entity which tangibly exists is to rely on, provide, or be functional/utilized for another entity. This is a conclusive statement on Charles Darwin's life work as I observed him in the Natural history Museum London. The reason for the visit to this specific museum was to understand why there is a history of any kind of knowledge or entity that has been preserved for decades and centuries together, and why they have been passed down through generations and being acknowledged. The concept of preservation to be continuing to exist is something that I would like to question about my product for the project.

Having sustainability as a design element would help the environment and humanity in many ways, but the word itself originates from an organic synonym. This brings us to the timeline of life and death. There is an end to some organic elements but in the context of product durability, it might be even lesser time to continue itself. The controversy of designing a product that shall make the user re-experience its moments but shall not last longer than expected is possibly the key element for this project. Maybe the user does not have to preserve the product, maybe the product's existence doesn't necessarily have to be forgotten. What if there is a legacy carried on for the product where the user feels responsible for an entity? Since the project is focused on sustainability, the product can die as an incentive for the nature of the user's ethos.

This can also be a possibility to promote and educate a sustainable/ green mindset because another entity comes into the user's life and is held responsible for sustaining it. There is also a ping-pong effect created where the user was relying on the product to receive personal satisfaction, while post discarded processes the product will rely on the user to live on. Hence, during this process, the user shall get insight into life, nature, and sustainability while actively taking care of life.

Mass Manufacturing and its Wastage

Manufacturing processes of products nowadays mostly consisted of multiple parts that come into one piece. Depending on the form and structure of the product, it is usually quite hard to manufacture the product with lesser or simpler parts. This leads to more making of molds for each part of the product which is normally injection molding or blows molding, etc. But in the case of mass manufacturing products, the molds are used repeatedly for a long period which may not lead to industrial wastage. The material used to manufacture products such as HDPE (High-Density Polyethylene), PP (Polypropylene), LDPE (Low-Density Polyethylene), Glass, Metal, etc. usually have a bi-product in the making process. Which are claimed to be an industrial waste since it is a small amount of material from one unit that cannot be used for the product, considering there's mass manufacturing involved in this process there will be a large amount of bi-product waste that can cause landfills, ocean dumps, pollutions, etc.

The consumer electronic industry was influenced by the engineering and design of the "big three" (Philip, Braun, and Sony) during the 1950s and the 1970s. There were multiple iterations and explorations done on material exploration with plastic and metals. The former designer of Braun Dieter Rams had always welcomed all kinds of plastic and appealing the properties of synthetic for its functions and utility. There's no doubt that synthetic is one of the most versatile materials that can provide different forms and structures. Hence, these materials were encouraged during that time when no designers and engineers were to predict the future where landfills, ocean dumps, and climate change became a global crisis. The discoveries made by the "big three" in terms of technology and user experience are great, but all they saw was satisfaction regardless of the criteria of population demands and mining material scarcity. Just recently when the Corona-virus pandemic occurred, the whole world decided to go digital which led to a rising in demand for consumer electronic devices and a shortage of silicon chips which are the processing brainpower of every electronic device today. For example, gold being a rare mineral made the Japan Olympics 2021 come up with a sustainable solution to recycle gold from used or thrown electronic devices to make medals. It took 72,000 tons of electronic waste to make around 5,000 gold, silver, and copper.

Circular Economy

If the industry of today's standard can meet the concept of sustainability and manufacturing with organic material, then there would be a depletion in the amount of inorganic waste going to cause multiple environmental issues. Yet it is hard to invent or explore new organic materials and very difficult to deviate from the world's greed on plastic, metal, glass, etc. because of its durability, strength structure, and CMF (color, material and feel). The possibilities are endless with in-organic materials and limited with organic materials. Another problem with organic material is the availability itself is lesser compared to inorganic material. Apart from metal, plastic is mostly chemically made, and glass is developed from sand which is one of the most abundant materials available on this planet [14]. Hence, the scarcity is on the other side too.

A Possible Thesis

But there is a way that might be able to conquer this problem which is the concept of the circular economy. The circular economy is a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing, and recycling existing materials and products for a longer period. Which is widely being used in the current times of industrial waste. The concept of circular economy has been promoted in various industries such as the consumer electronic industry, textile industry, furniture industry, etc. And they have been used in their recycling process but comprise the method of the circular economy. But this model hasn't been 100% introduced to the world, there are still manufacturers and engineers producing new materials from scratch because of the demand for quality. As we know second-time use of anything isn't the best output in terms of durability and quality, the whites become yellow, and the black becomes brown. At some point, the decaying process begins on every material in its second use. The best example that could explain such a process is the recycling of paper, as the paper gets further recycled it starts to lose its fiber and become grayer/paler. Hence, the last stage of recycled paper is a newsprint sheet where the fibers are delicate and thinner.

Another problem with organic material is the availability itself is lesser compared to inorganic material. Apart from metal, plastic is mostly chemically made, and glass is developed from sand which is one of the most abundant materials available on this planet. Hence, the scarcity is on the other side too.

In theory, if the circular economy can be pushed in 100%, stop manufacturing new material and focus on the growth of the organic material to a level where it can be replaced with the existing in-organic material. There can be a chance to achieve a sustainable ecosystem, but that's only in theory. The education of a sustainable mindset isn't promoted well enough for people to realize that their demands for high-quality in-organic product is being given birth to a planet killer. And with the large population of this planet having too many minds to convince may not be feasible.

Approaching the Problem

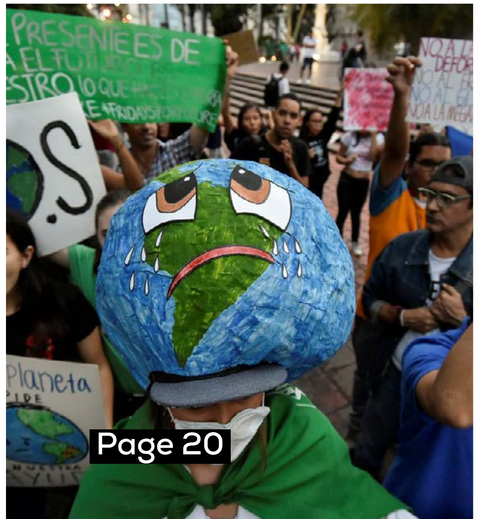
To be able to design a system that can change the general mass mindset of their lifestyle by one movement is a challenge itself. But to be able to convince an individual onto the movement is a step to take.

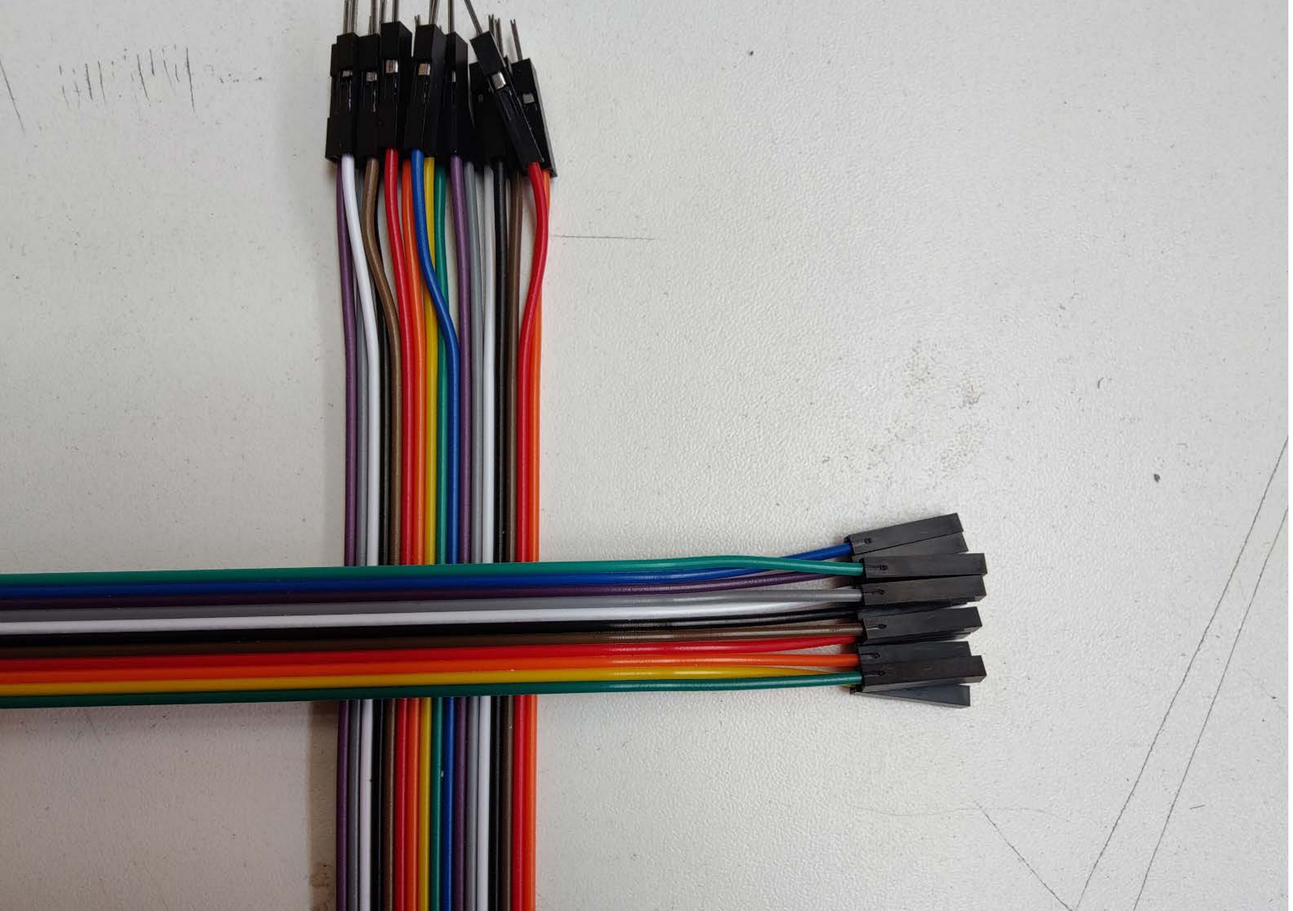
Being an influencer is a fun job in my opinion. A specific occupation to bring in people in a movement or trend. This is also a dangerous job since they have followers and be able to convince the general mass to be in the trend of IOTs.

It's one of the methodologies to bring change to one's life, but I feel there is a fine line between understanding the trend and following just because others are. The fact is that climate change is not a trend but a live issue. Hence, the effective way is to make an individual do an action to have a clear understanding of the problem and approach the solution.
In this solution, there are two major effect taking place:

The Butterfly Effect: it is said that a "flap of a butterfly's wing can lead to a tornado on the other side of the world". Which means a small decision we make can cause a large impact in our lives. Similar provide a sustainable activity from this product can possibly change their daily lifestyle decision to sustainable choices.

The Domino Effect: "a cumulative effect produced when one event initiates a succession of similar events". There's always that one neighbor in a society who tends to copy certain things you do, or your ethos consist of. With this repeated process the entire society will fall into the sustainable trend that you initiate. In laymen's it's called FOMO (fear of missing out).





Phase 2

The phase where design, prototyping and development are to come into action.

The Design

The design of this project will be approached according to my interests and knowledge of product design. As per the current trend of consumer electronic design wearable seems the line I should follow because the product that is to be designed is in constant contact with the user and can alarm them on the needed information.

For now, to understand how I could go about designing the system, it's better to provide minimal output to the user and as the project progresses it can blend with other things that can be added. In a direct sense, I shall provide the carbon footprint of the user itself and they can solve the issue as per their knowledge and liking.

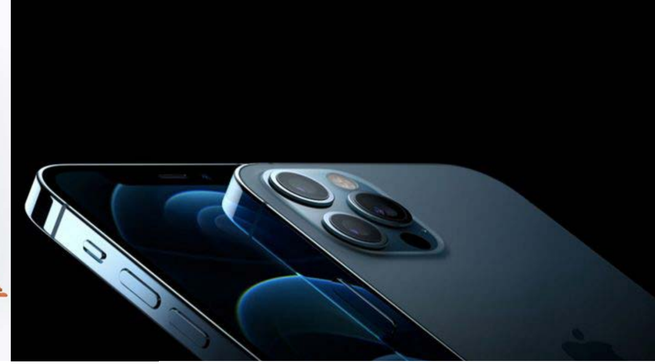
Design Language

The goal is to be able to blend the product into daily lives as well as embrace the internal technology to the people who see the consumer wearing it. Minimalism is an ideal language to follow when it comes to blending features, but it contradicts the concept of embracement. To find a middle ground between two different design languages, I have pulled some research from the consumer electronics industry design languages and manufacturers' approaches to their products. The big apple from this industry is true "Apple" the tech giant. Their approach to designing products was original to appreciate art forms and aesthetics over any high technological feature the products consisted of. Product usability and user experience are what they focused on and sold the most in their various range of products, and they were able to paint the brand image prominently in the working days of Steve Jobs. For most of the Apple events that took place, Steve Jobs would introduce the feature of the products first and end it with how easy it fits into our daily life. For example, during the iPod launch, he said, "You will be able to fit 1000 songs in your pocket". At the iPhone launch, he said, "An iPod, a revolutionary cell phone and an internet communicator in your pocket". There is a consistent highlight of how it comes down to ease of use or portability which most of the users wanted. It's not that other tech companies like Nokia, Sony, or Motorola never succeeded the same, but they couldn't outsell Apple's product. The reason is it's a minimalistic and simple design that were comforting the user from the hardware to the software. The secret of their minimalistic design was to not give so much freedom to the user, it would complicate the interface and experience if there were freedom given such as customization or versatility tools. Most of Apple's product physical interfaces are also minimal and aesthetically pleasing because there were either two or three materials encasing the product (Aluminum body and plastic) which had contrasting colors to differentiate and soft edges for the ergonomics.

Keeping this in mind one of the design languages would be following the exterior of most Apple products as an inspiration (Soft edges and contrasting colors).

One of the Macintosh Apple had launched, consisted of a unique design trying to embrace the technology subtly. The iMac G3 was one of the most overpowered PC that provided a smooth workflow but have the design language that is accepted in households. The back cover of this device had a translucent colored plastic back body that subtly reveals the internal technology of the product to showcase the beastly performance of this device. This design succeeded as desired and is considered to be the best PC design of that period.

Hence, the second design language that creates a middle ground between minimalistic and embracement is the translucent feature taken from the iMac G3 design language as an inspiration.



Design System

The user interface is supposed to be something very simple and easily caught up on by anyone with common knowledge. There is a device known as the Aranet 4 that displays the CO2 level, humidity, temperature, and atmospheric level through numbers. By following the principle of design created by Dieter Rams "Good design is as little design as possible", the Aranet 4 seems to complicate the user on having much information in the form of numbers. For that users need to know what is the number that is a dangerous amount of CO2, which is perceivable or couldn't be bothered to educate themselves because many other things revolve around the user's life.

If the product would be targeting a general audience and acceptable to most knowledge, there needs to be a simpler method and a required amount of information to not confuse the user.
There is one design system noticed that most of the population follows the color variation and the design behind "Red, Yellow and Green". This system is a universal design since it is applied for traffic lights, emergency indications, alarms, etc. This system is a universal design, and it is acceptable to most of the general masses.

The most significant one is the traffic light because this device was patented in the year 1910 and ever since then it has become a muscular memory today to react to these lights while crossing the road or driving a car. This shows that we as a human has developed and adapted as per the system that is designed where we (mostly) obey the law.

Therefore, by using the concept of the traffic light design, I can indicate the level of CO2. This will allow me to create a parameter to show the danger level of harmful gases through light. Green Light is a normal level, Yellow Light is mild and Red Light is severe.

The User's Knowledge

I conducted a focus group to gather information on how much can a normal person know what to do if they find out the increase in the level of carbon dioxide, the group consisted of students from University for the Creative Arts coming from different courses and countries. There were students from India, China, UAE, Singapore, and Taiwan. Hence, it was good to see the cultural differences because it would give me more ideas and context on their societal mindset and upbringing. There were moments where we found that certain countries don't keep garages in their house or most of the families have electric cars, etc.

As the discussion went ahead, most of the common knowledge of what to do "if they found that carbon dioxide level is increasing", led to temperature control of any kind. Whether be coming from the cooking station, refrigerator, air conditioners, etc. The idea was to increase the ventilation in the room and find the source that is causing the temperature issue to turn it off. There were some suggestions were having indoor plants to reduce the level of carbon dioxide, but this is a long-term sustainable solution and not immediate action.

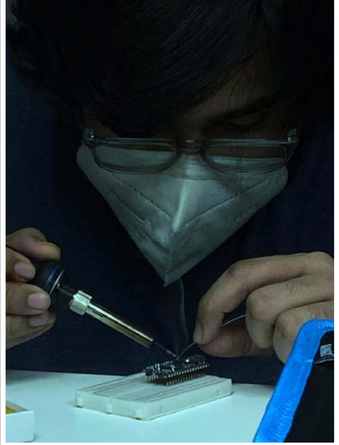
Therefore, this group discussion has a clear idea that I should design a manual for the user containing basics and simple suggestions on what to do if they are alerted about their environment.

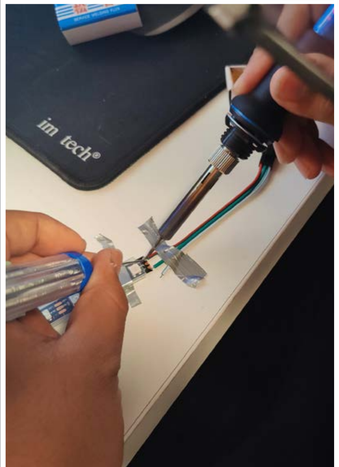
Technical Aspect

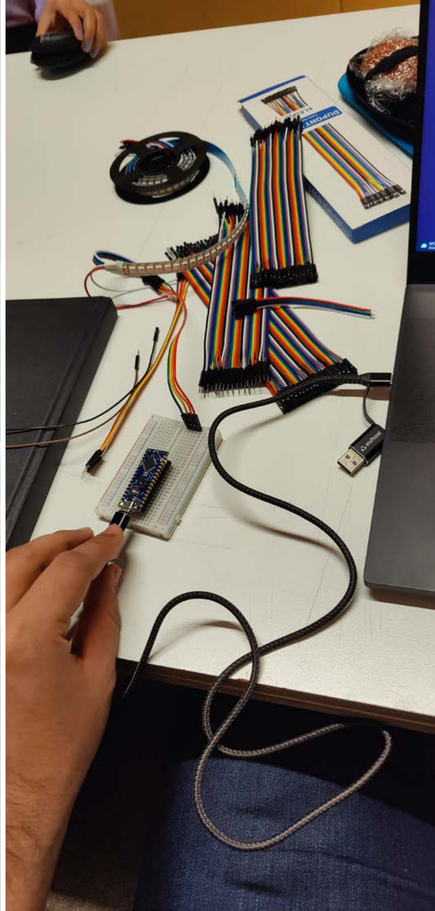
To measure the carbon footprint there needs to be a gas sensor and a reader to receive the data. In this case, Arduino Nano is going to help me test, verify and provide results for this. Arduino is an open-source software and hardware company where users can test and experiment with projects modularly. The Arduino allows me to try and understand how sensors work according to the indications.

I had to reach out to the Arduino community on Reddit and other platforms for requiring guidance on how to begin, the projects. A lot of users have been helpful and suggested useful simpler techniques to bring the project to life. The most difficult part in this process is to understand the coding language, which was C++ fused with python, I have basic knowledge of creating statements in code but no idea of how to merge different functions on one page. Hence this was a big learning curve for me, and it did take nearly a month to understand how the machine works with the sensors.


```
#include <Wire.h>
#include "src/Adafruit_NeoPixel.h"
#ifdef __AVR__
#include <avr/power.h> // Required for 16 MHz Adafruit Trinket
#endif

#define SENSOR_PIN A0
#define NEO_PIN       6
#define NUMPIXELS 60

Adafruit_NeoPixel pixels(NUMPIXELS, NEO_PIN, NEO_GRB + NEO_KHZ800);


void setup() {
  // put your setup code here, to run once:
  Serial.begin(9600);
  pixels.begin(); // INITIALIZE NeoPixel strip object (REQUIRED)
  pinMode(SENSOR_PIN, INPUT);

}

void loop() {
  // put your main code here, to run repeatedly:
  static unsigned long prev_ms = millis();
  if ((millis() - prev_ms) > 1000) {
    int sensor_read = analogRead(SENSOR_PIN);
    int index = map(sensor_read, 0, 1023, 0, 5) ;
    Serial.println(sensor_read);
    update_color(index);
    prev_ms = millis();
  }

}


void update_color(int index) {
  pixels.clear(); // Set all pixel colors to 'off'
  static uint32_t color;

  //Color Selection
  switch (index) {
    case 0:
    case 1:
      color = pixels.Color(0, 250, 0); // Set all pixel colors to 'off'
      break;

    case 2:
    case 3:
      color = pixels.Color(250, 125, 0);
      break;

    case 4:
    case 5:
      color = pixels.Color(250, 0, 0);
      break;
  }

  for (int i = 0; i < NUMPIXELS; i++) { // For each pixel
    pixels.setPixelColor(i, color);
  }
  pixels.show();
}
```





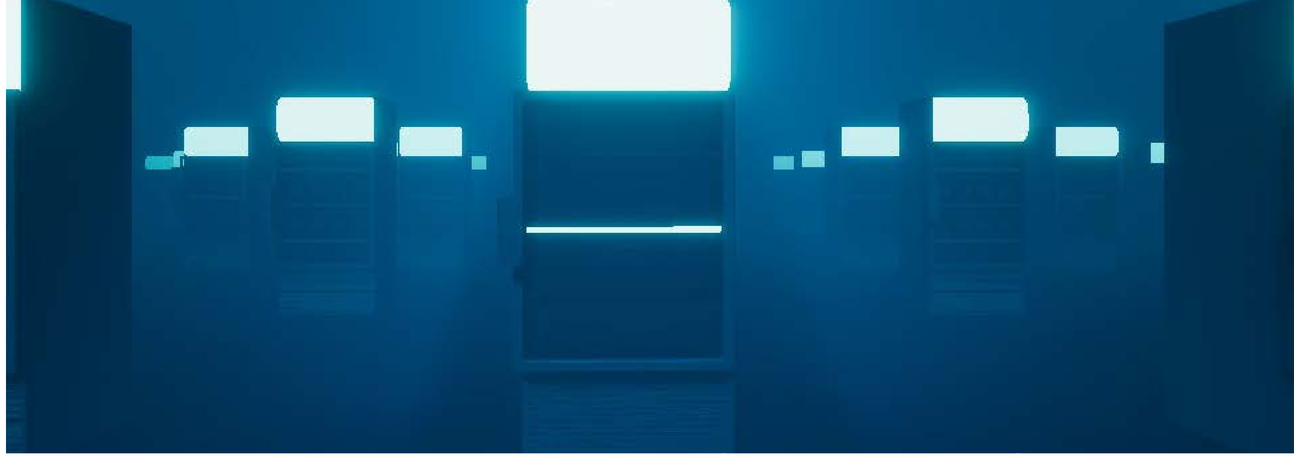
The VR Experience

The game is set in a world where Earth has been destroyed and humanity has shifted to interstellar living standards. Here, there lies a virtual museum that helps the people understand the mistakes that were made by humans leading to the destruction of Earth. You play as a character that has ventured into this VR Museum and is trying to re-learn Earth.

The game deals with serious issues in a metaphorical format by using human emotional traits to paint, the canvas of how Earth is in danger due to our issues. This Virtual Reality experience talks about Environmental issues and how as humans our day-to-day activity might lead to inevitable extinction.

The intention of the watch is to help regular humans detect their carbon footprint so that they can decrease it on a personal level which will benefit the world.

In the game, the character wears a futuristic version of the watch and it helps us draw comparisons of different scenarios.

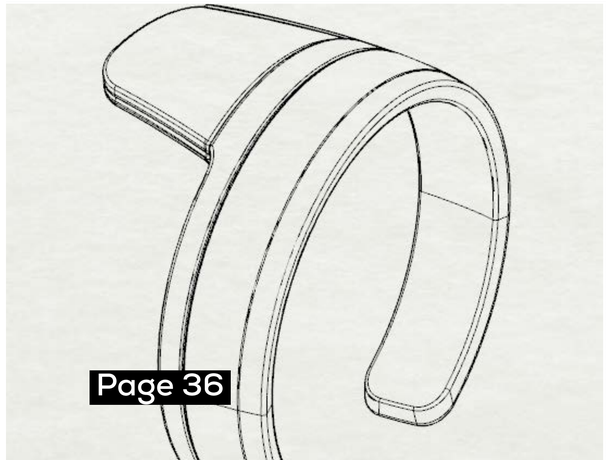


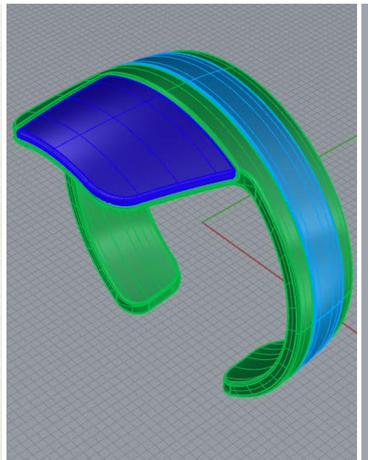
The Future “Band”

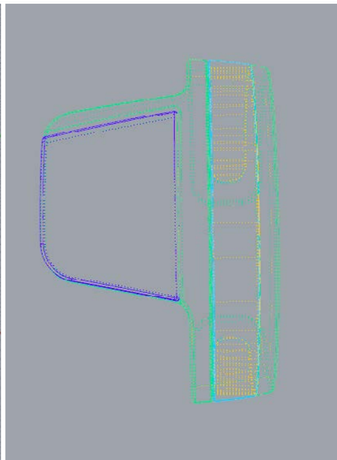
According to the VR Experience, the timeline is in the year 2050. The story that has been developed where the band was made in the year 2022 and has progressed to create multiple versions. Since the destruction of earth took place due to climate change caused by the greed of humanity, it has become a necessity for humanity have the band as a part of their lifestyle for being aware of their surrounding and taking responsibility to avoid the same disaster they caused in Earth.

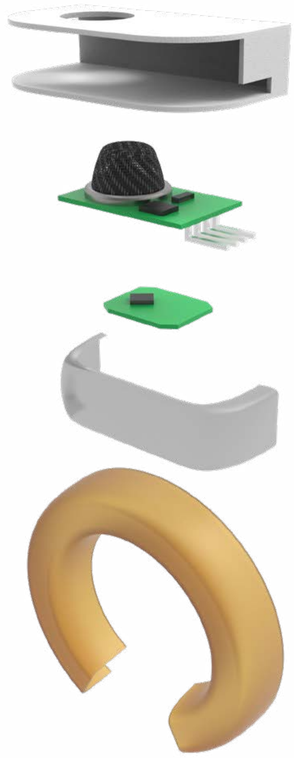
The band in future is developed to integrate with multiple platforms and the consumer’s surrounding. A technology is developed to scan radioactive waves, toxic gases and sustainability level of products sold in supermarkets to record personal footprints.

The design of the band contains a screen that showcases detail information for the users in the future, due to the disaster it has become a common knowledge to understand each and every scientific aspect of the environment.









Material Exploration

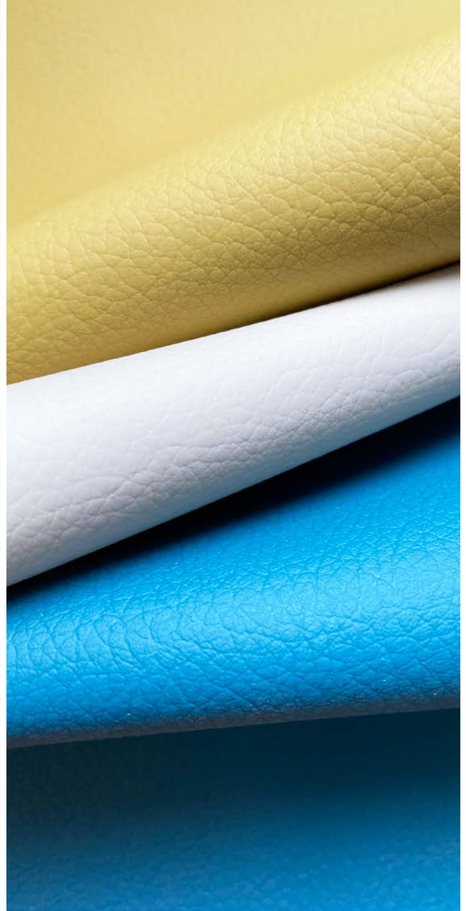
Existing Materials

The important factor of this project is to bring in as much sustainable scope in each department of the product. Since the product is wearable, the property of the materials needs to be comforting, soft, versatile, and flexible. Traditional material in this industry would ideally be a fabric textile, leather, or silicon. Out of these three materials, two of them are the opposite of sustainability:

Leather: Traditionally made from animal felt where it is required to deskin the certain animals and process it to its final form is "Leather". This indicates the basic flaw, which is disrupting the ecosystem and life cycle of the environment due to the death tolls of certain animals. In the current modern era, there has been a discovery of "vegan leather" which is made from mushrooms. This material is still in the development process since it doesn't replace the functionality and properties of traditional leather. Another disadvantage to "vegan leather" is being expensive since it requires a specific controlled process and close monitoring to develop itself. The making of "vegan leather" depends on high-tech machinery and DNA modification which also involves micro-biology equipment.

Fabric textile: This material isn't considered to be non-sustainable material in the process of making the fabric that originates from cotton or wool fiber. But it is non-sustainable when it comes to dyeing the fabric to the desired color. The process of dyeing requires gallons of clear water to wash through the fabric which later infuses toxins in the water. Certain fast fashion brands such as H&M, Zara, Primark, etc. have mass manufacturing units in the Philippines where the water outlet of these units is connected to the river line of nearby accommodations of the citizens. These citizens depend on the river line as the necessity for hydration purposes that unfortunately gives children and adults water-borne diseases (Typhoid, Jaundice, etc.) due to the toxin waste infused in the water supply from the manufacturing units. Apart from socio-lifestyle disturbances, the land soil around the river line loses its fertility and fiber of holding themselves together causing landslides and erosion. These are natural calamities caused by man-made creation and greed, which doesn't hold our ecosystem to sustain due to limited/scarce resources which are co-dependent to sustain.

Silicon: An artificial chemically generated material that works in the property of polymers that can be versatile and adaptable to any demand in the context of the material building. To create such material on a larger scale, the atmosphere will have to deal with greenhouse gases and toxins that are generated as a byproduct in the process of making silicon/polymers. Hence, the sole cause of climate change comes from the catastrophe of the product to encourage the increase of Carbon Emissions.



Sustainable Options

Based on the research of traditional materials, I decided to explore fiber textile and find viable options that integrate well with sustainability. These three types of sustainable fabrics:

Bio-Textile: An Ideal material that has no flaw in sense of sustainability. This material can be made using various methods if it's flexible and versatile. The counterpoint for fabric textile with this bio-textile is that it can be dyed according to any color of legumes or natural dyes (example: orange, ground coffee, tea leaves, strawberry, etc.). The only flaw of this material is the organic durability lifespan is lesser compared to fabric textile, this brings back to the topic of "Existence & purpose of the product" under "Phase 1" Title.

Recycled Fabric: A process that involves shredding of the original fabric to fibers and re-aligning it to yarn. This method is not followed well in the industry due to the inability of segregating colors to the specific demands of the manufacturer. An additional reason being recycled is not bonded strong enough compared to their original form.

Pressed Recycled Fabric: This method is a similar alternative to the first one where instead of the shredded fabrics being re-aligned to the yarn, they are heat pressed at a very high density to make a block of fibers. The utility of this product is applied not to the fashion or textile industry but to the packaging industry for the cover of fragile products to avoid shock and damage. This method is not to be considered in this project due to the lack of access to hydraulic press machinery and facility along with the factor of its properties not being able to match the requirement of the project. As the scale of the pressed recycled fabrics goes smaller, it doesn't provide a flexible and versatile feature to a normal fabric textile.

The Reach

With my research, limited access, and capabilities I have as a student on campus, I went with the Bio-textile for further progress.

In the process of understanding how bio-textile works and its key elements required, there are certain constrain it must be a bio-textile:

- Fibers: for maintaining the strength and elasticity of the material
- Adhesive: to avoid tearing and breaking of ingredients.
- Anti-Moisture agent: Avoid the ability to absorb moisture in the environment for fungal growth since bio-textile is organic-based material.

I stumbled upon a brilliant discovery, research, and practices of organic bio-textile from Fab Lab Barcelona. Fab Lab Barcelona is an institution that specializes in students in sustainable material design in multiple industries. There is one research highlighted about making organic leather from orange and sodium alginate. I had reached out to inquire about the making process and testing of the material, it had met my requirement for the project.

Bio-plastic

I embarked on a journey to test and experiment with organic leather. To break down the concept of the bio-textile further, the base structure of this material is made from bioplastic (Starch/sodium alginate + glycerin + vegetable gelatin). Hence, I dived in to experiment with understanding the difference in proportions of making multiple types of bioplastics containing different densities and strengths to reach an appropriate point.

There were different samples made from variants of ingredients inputted in the material. The reason why I had to try these samples was to find out what exactly I need for the material property to have to decide the purpose of the product. Some samples had more starch, there were some which had more glycerol and there were some which had more vegetable gelatin. The ones that had more starch were brighter in color and brittle as a biscuit, this made the material feel heavier and ease to break while handling it. The ones that had less glycerol became hard as a brick and were giving out starch particles each time the material was in contact with something. The ones that had more vegetable gelatin became a semi-liquid form (similar property of a jelly). In conclusion, it gave me the idea to balance the ingredient at a fair point where the surface should be like the one which had more gelatin sheet, the hardness as the one which had more starch to promote a flexible and versatile material. The important factor to keep in mind is the time taken to dry (i.e., 3-5 days). This implies for smaller scale sample. Considering that my final prototype material would be larger for trials and errors, it would take longer.

Lab Report

Once I got a grasp of the bioplastic, moved into the next step which is the fiber and dying. The plan is to make a 70 x 70cm organic leather sheet as a final prototype. In this process I'll be dealing with:

Ingredients

- **Sodium Alginate** 135g: Being the base structure and the adhesive agent for the bio-textile.
- **Orange peels** 120g: For the color of the textile which is orange.
- **Glycerol** 421g: To keep the binding of the material together and not let sodium alginate dry to complete hardness.
- **Calcium Chloride** 200g: Moisture absorbent to avoid fungal growth in the process of drying the textile.
- **Vegetable gelatin** 150g: To promote the property of being flexible and versatile.
- **Wool Fiber** 20g: To build the internal structure strength.
- **Coconut Oil** 56g: For ease of blending all the ingredients together.
- **Water** 5L: For a mixture of all the ingredients and keep them intact until dried.

Procedure

1. The orange peels are kept in the oven at baking 120°C for 90 minutes to be completely dry with zero moisture.
2. Grind the peels in a blender to a fine powder.
3. In a large tub, mix sodium alginate, orange peel, glycerol, gelatin, coconut oil, and water. Blend with a hand blender to fasten the process. Blend until its liquid thickens and bubbles rise at the top layer.
4. Set aside 24 hours for the gases to release themselves from the liquid.
5. Mix the wool fiber with a spatula into the mixture, until the fibers are separated from each other and blended with the mixture.
6. Create a frame with the dimension of 70x70x5 cm (length x breadth x height) and nail one side with a canvas sheet and base floor structure for the mixture to settle.
7. Mix calcium chloride with 750 ml water in a spray bottle and spray over the canvas sheet nailed on the frame.
8. Pour the mixture onto the frame and spread evenly with a spatula according to desired thickness.
9. Spray the calcium chloride on the mixture.
10. Sun both the frame and the mixture for 4-7 days.

Conclusion

It creates a similar property to leather in terms of strength and flexibility but not with the feel and texture. But it gives the basic purpose of the biomaterial needed in this project.

Other Components

Internal Structure (Components Encasing): The internal support structure of the product is protected by PLA (Polylactic Acid), which is the cartridge from 3D printers. PLA is not considered to be 100% biodegradable; it is compostable and biodegradable. Under controlled temperature and humidity, PLA can be converted to soil fertilizer since the material originates from beetroot syrup starch. Through bacterial fermentation of PLA, it produces fertilizer.

LED Encasing: Between the LED and the bio-textile, there is an encasing of hemp organza silk which is a sustainable and biodegradable material. This fabric is made from a dilution of hemp fibers which is one of the natural fertilizers post composting.

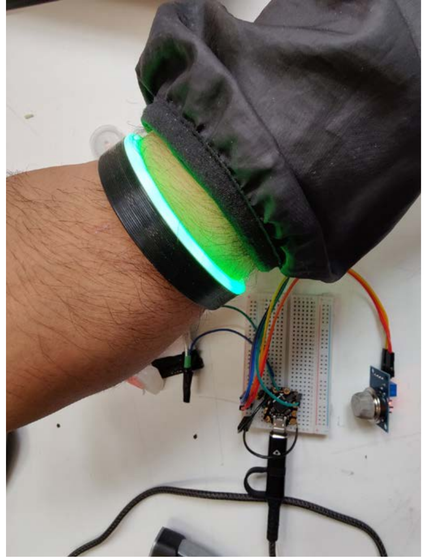
Elastic Band: To fit the band onto the user's hand, I'll be using cotton-made stretchable band which is a sustainable material and biodegradable as well.

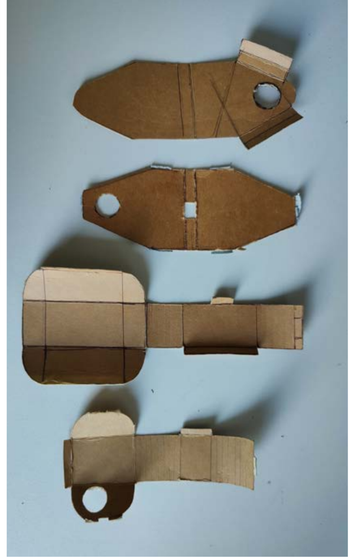
Assembly

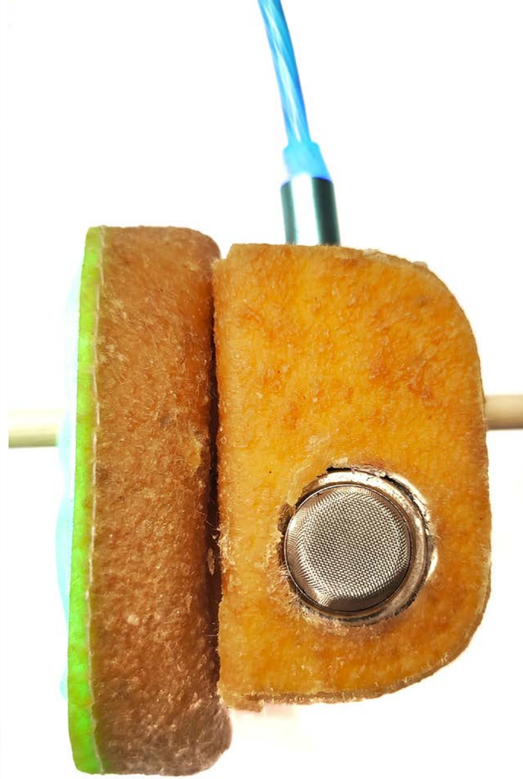
Bringing all the parts is the most fun part of the project since I really love disassembling and reassembling them back at my own risk. It answers most of my curious questions on how a product is made.

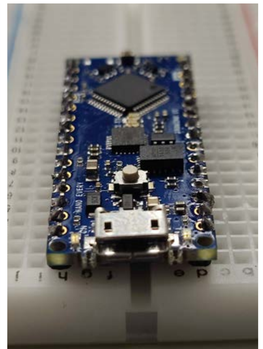
The assembling is broken down into five processes:

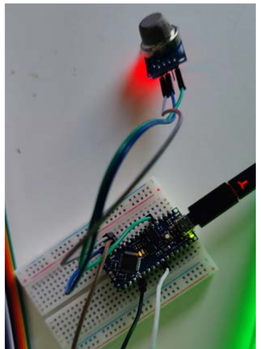
1. Applying the Arduino, gas sensor and the vibration motor in the components encasing.
2. Covering the front side of the encasing with bioplastic.
3. Cutting the bio-textile according to the component encasing to wrap around it.
4. Creating a sleeve with desired cut out for the wire to run through for the LED which is a mix medium of bio-textile and organza.
5. Connecting the elastic band from both ends of the LED sleeve and covering for the band.











Conclusion

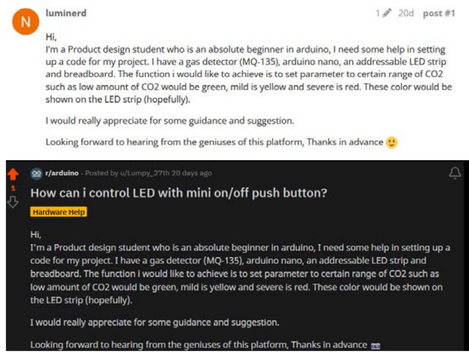
In an ideal mass manufacturing process, there wouldn't be an Arduino or a large gas sensor protruding outwards from the product. The entire internals would be made out on a printed circuit board consisting of the components that controls the flow of power supply from the battery as well. Which would make the product thinner and sleeker more fitting design to a wearable. Since this was a student project, there were multiple things I couldn't achieve:

- Making the prototype operate on battery.
- Create a proportional sized product that blend with user body proportion.

The list can go on, but the biggest achievement is being able to bring in the core functionality and purpose of the product to life.

Majority of the experience and progression of the came from the collaboration factor. If there wasn't a connection with the MA Game Design students, the concept of this product wouldn't be developed this far. And if there wasn't a collaboration with the MA Textile student, it wouldn't have been assembled with this refinement.

A lot has been gained in this project from collaboration technical and material designing perspective, which broadened the ideology of understanding design itself. It gave an idea that everything from the slightest is a design you create for itself. The concept of collaborating to develop each other's project is a design that we created for ourselves, so is the collaboration with developing the prototype where it has its own purpose. The technical skills that I learnt in this project was to design a system that works on itself. The main goal of this project was to integrate sustainable materials with consumer electronic products to conquer the traditional usage of material in this industry. I'm glad to see this achievement, but I received a larger perspective about designing. Just like the butterfly effect.



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