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Subject: IGCSE CAIE Design Technology

MAJOR PROJECT

CONSIDERATION OF DESIGN NEED

In this analysis I will be looking at a problem my client is facing and I will take into account both the setting and Priya's needs to devise a product the finds common ground in both.

BACKGROUND INFORMATION

Priya is a mother of two and a wife who likes to wake up early in the morning to go on a walk. She's has recently stopped working and now spends the majority of her time caring for her family. One of the ways she does this is by taking care of the family dog. Priya needs to wake up at **specific times** to **meet the dogs schedule** but often finds herself being unable to wake up. The easiest solution is using an **alarm**. Priya has tried to use her phone but she finds that having a phone on the bedside table is a distraction to her. She needs an individual device designed to **wake her up.** Along side this problem she has recently been looking for a new **apple watch charger** that allows her to maximize the space on the **bedside table**

NEEDS

- Currently Priya often struggles with the use of technology which means the device will have to be **easy to use and access**.
- The dice needs to be **compact** and should not interrupt Priya's lifestyle in anyway
- It also must be able to be somewhat **water resistant** as Priya often has drinks on the table. It should also be **resistant to heat** as her room often gets a lot of sun
- Functions should include an alarm and an attachment for her **apple watch to charge**
- She would also like it to be **portable** so she can move it around according to her needs.

Fig. 1 Priya Irani organizing her bedside table

DESIGN OPPORTUNITIES/TARGET MARKET

A clock is one device that could meet the given criteria by the client although it would need to have a alarm that would **alert her**. This clock can be digital or analogue but given that her main purpose is efficiency I would go with a digital display. There are a variety of alarm clocks available including **vibrating**, **light**, and **sound alarms**. Vibrating is not going to work as it will not be on her person and it may not be enough to wake her up. Priya is known to be a deep sleeper which means the light will most likely not be an option. This leaves the option of **sound which seems perfect** for the situation. This means that the product would have to have a speaker on it which would likely increase it's size. It is very important to take the **consideration of size** into account especially when the setting doesn't have to much space for the device in the first place. The target market would be people who need **reminders/alarms** to alert them at given times. This market ranges across ages and professions. While this appliance will be designed for bedside use it is not limited to it. It will be a durable portable device that can potentially have a variety of uses. But the association of the apple watch will limit the target market to those who own apple watches (or similar wireless gadgets).

Fig. 2 This image shows the table where the client would like the device to be located. As seen the table is quite crowded.

DESIGN BRIEF

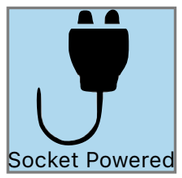
I propose to design a device that will allow Priya to **pick a specific time interval** and that the clock will proceed to sound an alarm when this time is reached. This device will have controls that are easy to use and it's primary purpose is to **alert Priya** when a given time has been completed. This device needs to have **some sort of alarm**, it needs to keep **track of time**, it must be **durable**, and it should have an attachment that helps her **charge her apple watch** efficiently, The solution will be aimed to meet all her specifications making it a device that is **customized for her use**. My clients budget will be approximately **$80** and the product will need to be completed by **March 2021.**

Research: Product Analysis

In this page I will analyse two different products which both have potential and I will identify what qualities make them unique

C1 C2 C3 C4 C5 C6 C7

iHome Black Bluetooth Alarm Clock Radio W/ Apple Watch Charger and Dual USB Charging Ports



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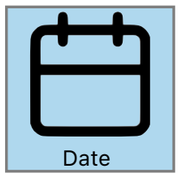


Aesthetics	This product is not extremely aesthetic as it is mainly designed for a specific purpose
Cost	Product costs $129 (expensive)
Customer	Someone who enjoys devices with multiple functions. Also someone that owns a apple watch.
Environment	The target environment is a bedroom or somewhere where it can be put on display. It must be somewhere where the conditions are relatively stable.
Sustainability	No listed sustainable features.
Safety	This product has to be plugged into a socket.
Function	Meets specifications of client
Material	Polymer with a black finish

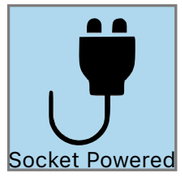
Advantage

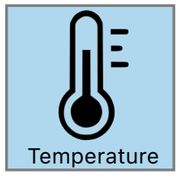
- Comes with a charger for the apple watch attached to the side
- Simple yet informative display that also gives the date

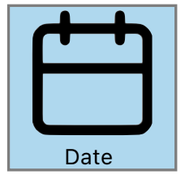
Disadvantage

- The device is more focused on the bluetooth side which my client does not need.
- The shape is quite basic and not the mot aesthetic

Digital Alarm Clock, with Wooden Electronic LED







TheNounProject.com

Advantage

- Easily visible from a variety of angles
- Natural aesthetic
- It also gives the date

Disadvantage

- Does not have an apple watch charger
- No color variety
- No protection for the user interface

Aesthetics	This product has a natural aesthetic making it a popular Choice among consumers.
Cost	This prdouct costs $25
Customer	The target consumer would be someone who is in need of a bedside clock or a more stationary additon to the setting
Environment	The target environment is a bedroom or somewhere where it can be put on display. It must be somewhere where the conditions are relatively stable.
Sustainability	Sustainability depends on what kind of energy it gets. It has the potential but it is most llikely it's unsustainable
Safety	It does requre to be plugged into an electrical socket
Function	This product is capable of showing time, temperature and setting alarms which are all useful in a cooking environment
Material	"Stylish Wooden Design"

Research: Collection of Relevant data

The collection of relevant data will help me gather more physical specifications that will give me a better idea of **size, shape and function** specifications that are required of the product

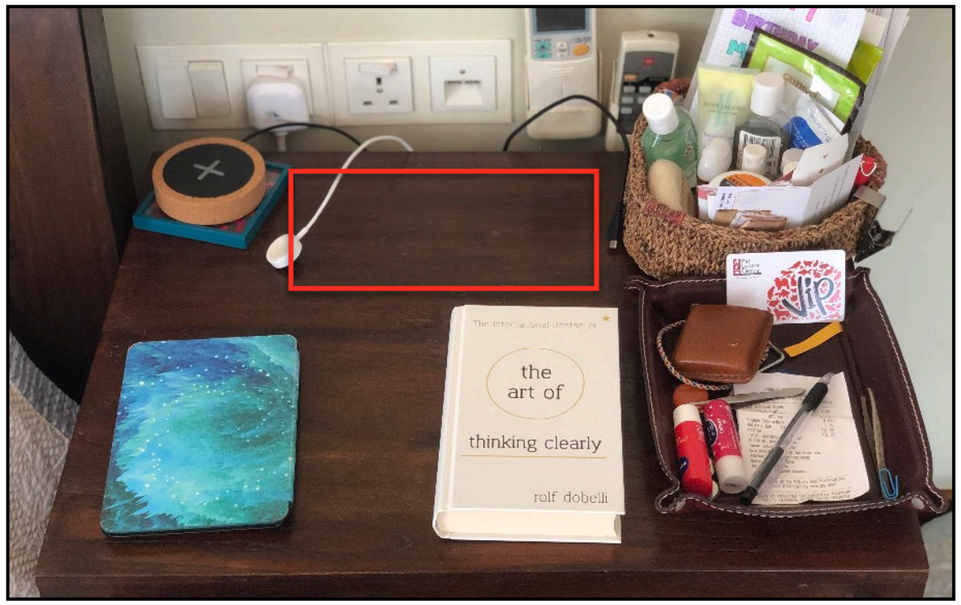


Fig. 1 Product placement

This area is quite filled with products that are essential to Priya's bedside routines though there is a free space at the back that appears to be the best place for my product.

Advantages	Disadvantages
It would be place ad the back of the table so that it doesn't interfere with the stuff in the front which the client uses more	May result in even less space available for client
Easily accessible	It sits right next to where the clients water bottle would be. (risk of spill)
Reasonably close to a socket	Objects may intervene with the clients line of sight

Measurements Analysis

From the dimensions of the counter of the kitchen I can say that the device should be something within 22cm x 10cm. From my calculations the entire table has a surface area of 2408cm^2. The area of the base of the device should be within 24cm x 14cm (336cm^2).

Conclusion

In conclusion as long as certain environmental necessities are taken into place when planning production, the allocated spot has quite a bit of potential. As my client will be looking at it from the bed for the majority of the time, it must be designed so it is **easier to view** from that position. Adjustments such as these are essential as the play a huge role on the overall effectiveness of the product. It will also be **easily accessible** in terms of ergonomics making it useful to the clients every day

Fig. 2 Pouch for essentials

Fig. 3 Book

Fig. 4 Pouch for essentials

Fig. 5 Kindle

Fig. 6 Side angle of the bedside table

Placement Analysis

In my opinion there is only one place where I can place the device. I think that the place (in the red box) is perfect for the device as there is close access to a power socket and it's visible from the bed. From looking at the table I can tell that the device is going to have to meet certain specifications (e.g size). If I do include the apple watch charger though, the device will effectively have two circuits. I will have to find a way to combine the two to fit into one socket if I choose not to use a battery.

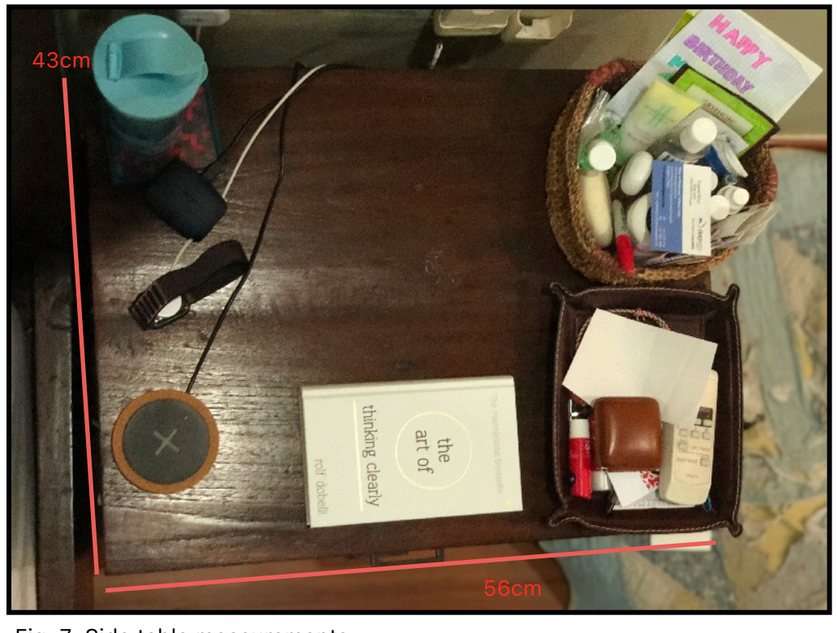


Fig. 7 Side table measurements

Research: Inspiration Board & Detailed interview with Client

In this page I will note down specific parts of my client interview and i will use an inspiration board to get me thinking about the devices physical properties

Purpose of the Interview

The purpose of the interview is to get my clients input on her situation and to give her the opportunity to **voice her needs** in regards to the specifications of the device. It will allow more efficient use as it is better **customized** to her own needs. In the interview I will be asking her about her specific needs in regards to function, size, and aesthetics. Using pictures form my inspiration board I can paint a clearer picture of what my client wants.

Existing Products

There are a variety of alarm clocks out there but fewer that allow my client to organize her watch charger, While I am sure there is a product out there that may function according to her specifications I believe customizing a device for my client will yield greater benefits. “I want a device customized specifically for my bedside table”. This includes **color, size, shape** and **function**

Inspiration Board

The inspiration board shows a variety of alarm clocks meant for different situations. One physical feature I found interesting was the creative shape the triangular clock used. While ultimately the function will be basic. That doesn’t mean the body will have to as well. I also got some colors the client likes that coincide with the color of the setting (So that the device **fits in well aesthetically**).

What did I learn?

I've learned about the many features my device should have according to my clients need and the many problems that may surround such a product in safety, sustainability, and size. According to the client her main concerns are **function** and **aesthetics**. When asked about which part comes first she said function which means she needs this to solve a problem and how the solution looks isn't as important as the solution's appearance. She made it clear that if certain problems were not solved, it would have a detrimental impact on other persons as well.

Some shapes she liked in particular were the simpler shaped rectangular bodies, though she said she would be interested in something that uses the base of the rectangle but is more **creative**. In terms of color and material she mentioned wanting the body to be **made out of wood** as it goes well with the wooden table. I showed her some colors for a theme and she chose the **6 templates** on the inspiration board

Design Specifications

In this page I will note down relevant information given to me by my client in regards to her needs. This process does not just involve my collection of the clients needs but also justification for each need in order to ensure accuracy and that there is a reason behind each specification. The method of testing also allows me to go further into solutions as to how the the process can be carried out.

C1 C2 C3 C4 C5 C6 C7

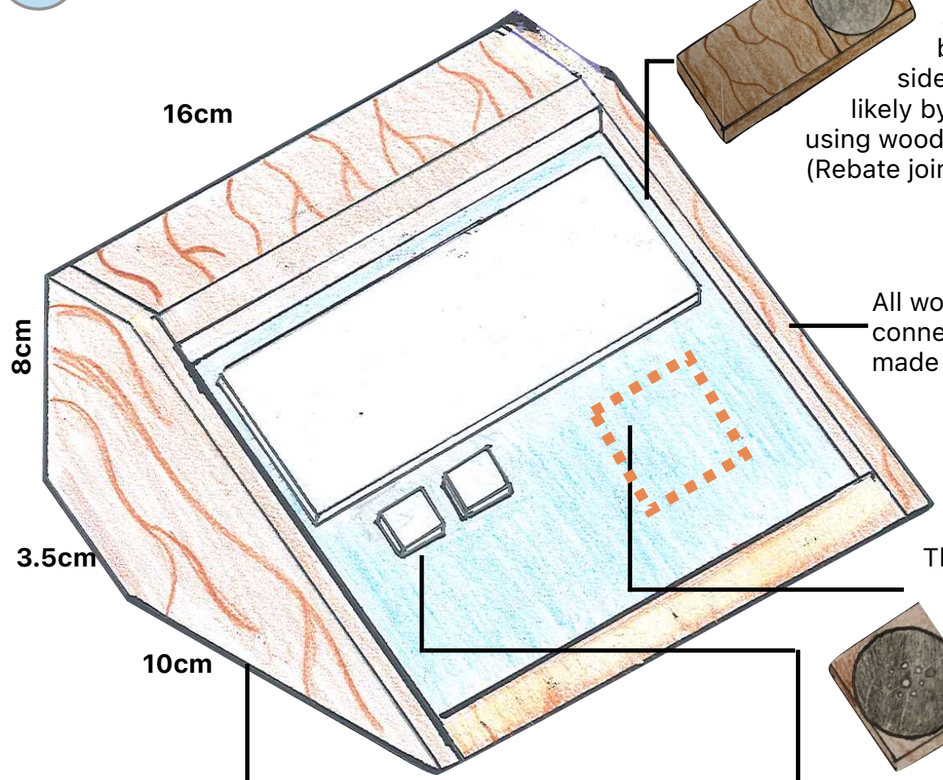
	Specification	Justification	Method of testing
Aesthetics	• The product must somewhat **match the colour scheme** of the table/bedroom • **Easily be installed** into the environment.	• The client will be using the device frequently and consistently. It's better if it is **aesthetically pleasing** to her as she is the one who will see it every day. • It should be easy to set the clock on the table without to much trouble (**should not interfere** with any of her daily routines)	Show the client some colours similar to the bedroom environment and some suitable housing possibilities to **get her opinion**
Cost	• The client has said that she would like the product to be great quality, but she doesn't want something extremely pricey or over the top. She is willing to pay **$75** (excluding the cost of an apple watch charger	• My client has been **unable to find any other devices** that meet her specifications and therefore she is willing to spend $75	Show the client prices of devices similar to the one intended to be manufactured and show her the **cost of some components** that go into most alarm clocks to give her a better idea of the cost in making such a product .
Environment	• The client wants something customized to fit into the environment. (**Durable, water resistant, stain resistant**) • It must also give her the option to be somewhat **environmentally conscious** (minimizing the energy expenditure of the product)	• This **device is intended to be in use for a** significant period of time (as long as possible).. • The client tries to be very environmentally conscious and does not wish to have a product that prevents her from that	Discuss the **conditions of the environment** (bedroom) and what steps will be taken into place to **protect the circuitry and material.** Furthermore we will discuss what kind of features she would like that allow her to be environmentally conscious
Size	• It must **fit on the free space** on the side table • Meet the clients expectations • Be big enough to **house the circuit** but not so large that it takes up too much space	• The client frequently uses the table and does not want the device to interfere with any of her routines • While my client does not want the housing to be big enough to interfere with her routine, she does not want it so small as she can't see the screen. After consulting with her I believe she wants something around **22cm x 10cm**	Show her some examples in measurements and some objects of a similar intended size to get he opinion.
Safety	• There should not be any exposed circuitry at all • the housing must be adequate enough to **protect the circuit**.	• Exposed circuitry often causes **risk around water** (It is safer to prevent the chance of something happening. • If the housing is not of good enough quality it wont protect the circuit inside from damage (not just sudden damage but also long term (durability)	Discuss **safety hazards** the device may face and get her opinion on the most crucial safety hazards/ what **she's worried about**.
Function	• In terms of function it must have some sort of alarm that can be **customized** by the client. • It also must have a **functioning clock** • It also must have a solution to **organising her apple watch more effectively**	• This is one of the **clients needs** and is considered a priority • She needs a way to constantly keep track of time • Charging her apple watch is an **important part of her routine** as she uses it throughout the day.	- Interview the client on what type of alarm would be necessary. (e.g buzzing, sound, light) - •Show her a digital display and get her opinion - Show her some ideas on how the apple watch feautre could be integrated
Material	• Aesthetic • relatively easy to change it's shape (e.g cut)	- The client requested a wood that goes well with the table - The wood shoud be easy to work with making the entire housing production process easier	- Show the client pictures of possible woods/ materials that will work - Discuss the properties of different materials and what they could contribute to the device. (What makes them good for the job? what doesn't?)

Exploration of Design Ideas

In this section, I will be analyzing 6 different possible design solutions for the two purposes of understanding how each design is composed (what will go into each idea) and how each design meets or doesn't meet my clients needs. Meets the need Maybe Does not meet the need

C1 C2 C3 C4 C5 C6 C7

1

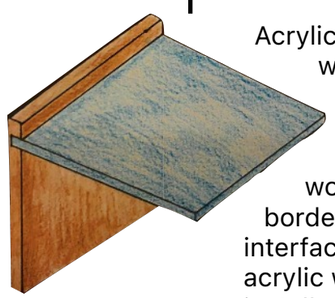


This watch charger attachment would be attached to the side of the device most likely by creating a slot and using wood glue to join the two (Rebate joint)

All wood to wood connections will be made using pva glue

The speaker for the alarm would most likely go here.

There will be a hole in the user interface for it.



Acrylic will be joined to the wood using a groove joint. The groove will be located just under the surface of the wood so it creates a border around the interface. This means the acrylic will have to be installed before the wood is put together

These are the push switches used to set the alarm.

- Aesthetics
- Environment
- Size
- Safety
- Function
- Materials

Weakness

- Bulky/Takes up to much space
- Aesthetics don't match the clients need
- LCD is too big. (takes up to much space)

Strength

- Display visible from multiple angles
- Watch charger will not interfere with clock

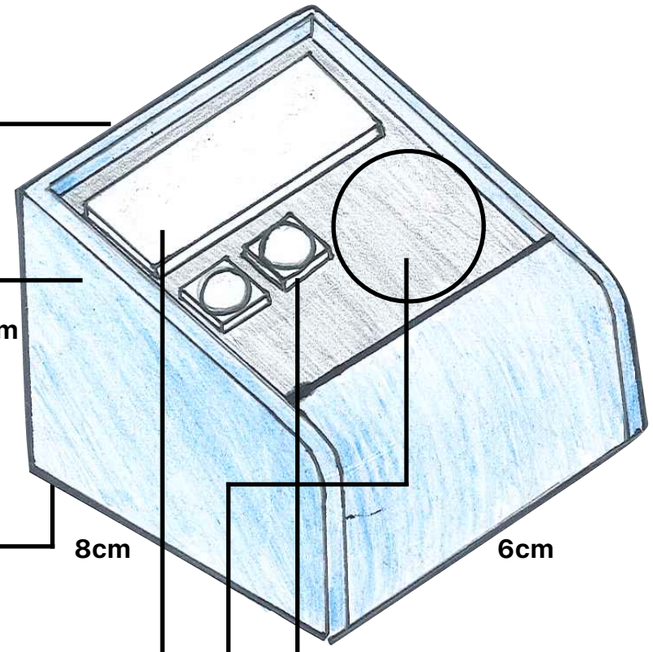
2

The body will be an ABS polymer

The user interface will be laser cut acrylic

The plastics will be joined using a cyanoacrylate adhesive. (waterproof)

The circuit will be made accessible by an acrylic plate screwed in at the bottom.



Seven segment displays

8 ohm Loudspeaker

There could be an option fit a larger speaker into the user interface here

I can use push buttons while will allow the user to set the alarm

Micro switch pushbutton

The device will be assembled by sliding the user interface into groove joints in the body and then completing the outer body to hold it in place

- Aesthetics
- Environment
- Size
- Safety
- Function
- Materials

Weakness

- No watch charger
- Not visible from the bed
- Space may not fit the seven segment

Strength

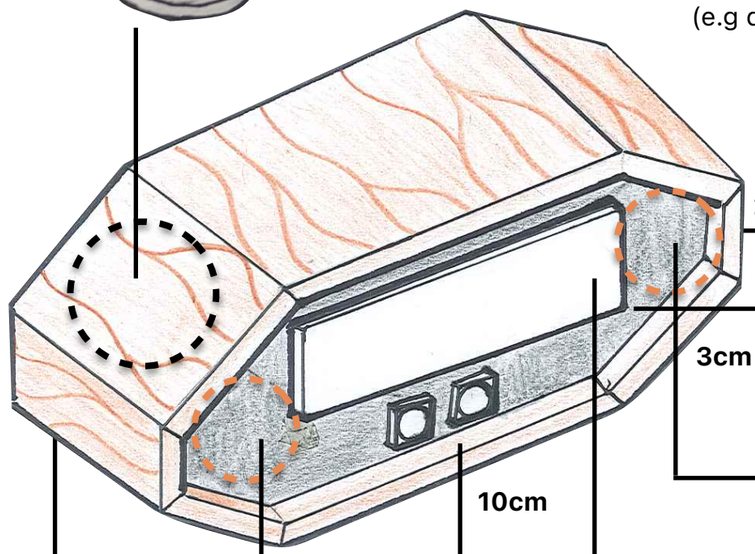
- Compact
- Looks nice
- Relatively easy to put together

Exploration of Design Ideas

3

The charger for the watch will be situated over here.

There will be no need to glue the acrylic interface as it will be held between the front piece with a groove in it, and the main body piece. This allows the use of wood glue and it beneficial as the front piece somewhat protects the interface from any physical damage. (e.g dropping the device)



Acrylic user interface

All wood to wood connections will be made using pva.

Small holes can be cut for the buzzers on both sides of the user interface.

5V Buzzer

Inspired from a backplate for a guitar

An acrylic plate will be screwed on the back so I can access the circuit easily.

There is little space so I will have to use push switches or a potentiometer.

16x2 Standard LCD

10k Potentiometer + Standard push to make switch

- [ ] Aesthetics
- [ ] Environment
- [ ] Size
- [ ] Safety
- [ ] Function
- [ ] Materials

Weakness

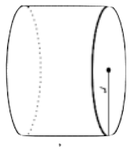
- Two circuits may take up to much space
- Placement of the charger may interfere with the clock

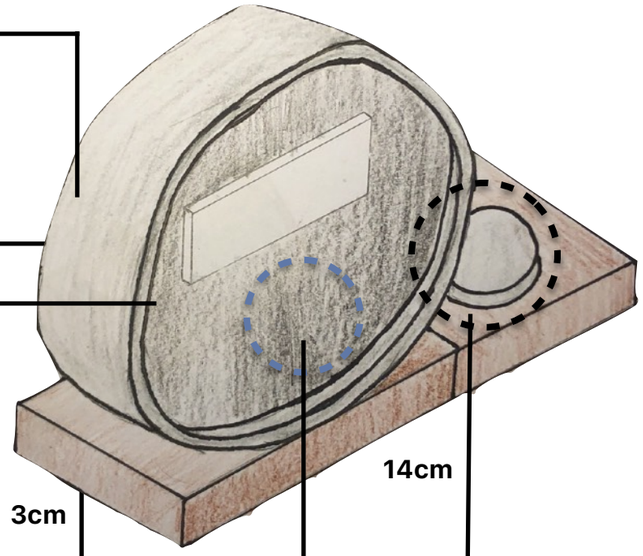
Strength

- Meets specifications of the client
- Room for further development
- Circuit is easy to access

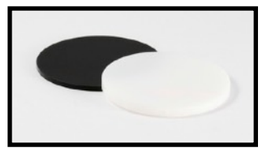
4

The shape of the circle is not extremely accurate. The actual circle will be an exact circle





Circuit will be accessed by screwed in acrylic plate on the back of the circular housing.

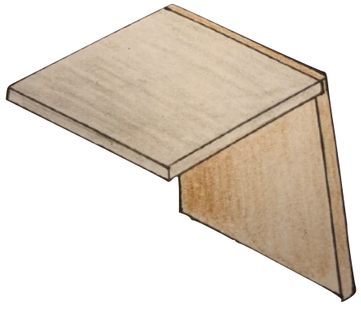


The base of the product would be made of a series of woods glue together. This would make it more aesthetic.

This is where the charger for the apple watch will be located. It hasn't been decided if I will use an apple charger or make one.

4x4 Universal 16 Key Switch Keypad

The interface will be attached using a groove seen to the right instead of the groove shown on the actual design.



- [ ] Aesthetics
- [ ] Environment
- [ ] Size
- [ ] Safety
- [ ] Function
- [ ] Materials

Weakness

- Size may be a little too big
- Hard to connect the charger to the circuitry in the body
- Inefficient use of space

Strength

- Charger won't interfere with the clock
- Unique aesthetics
- Multiple options for input

C1
C2
C3
C4
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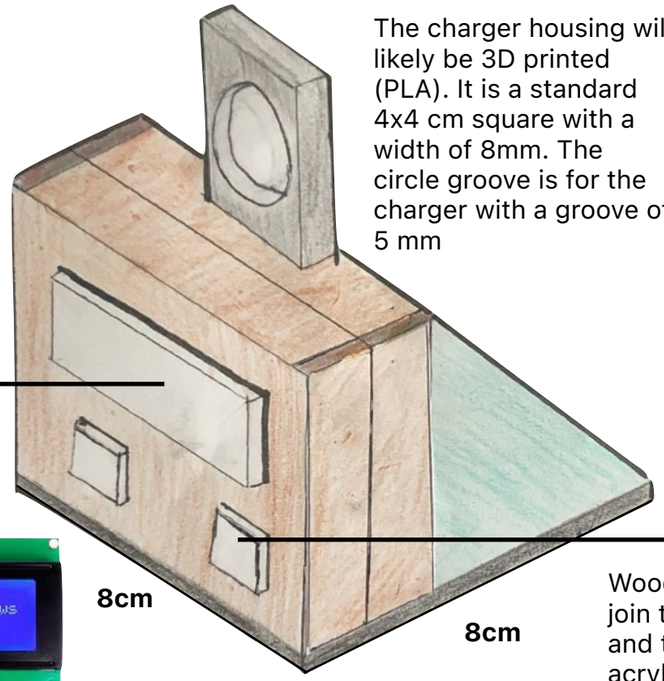
C7

Exploration of Design Ideas

5

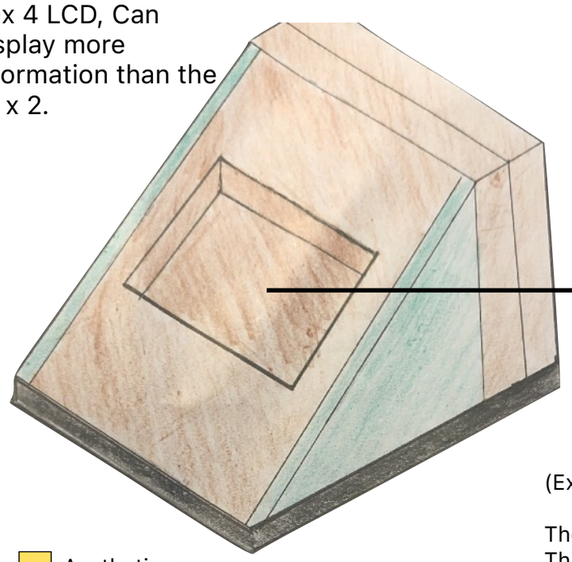


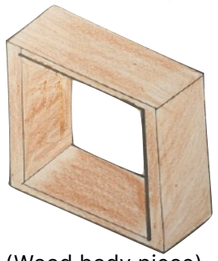
The charger housing will likely be 3D printed (PLA). It is a standard 4x4 cm square with a width of 8mm. The circle groove is for the charger with a groove of 5 mm

LED Pushbutton. It's expensive but visible at night and aesthetic

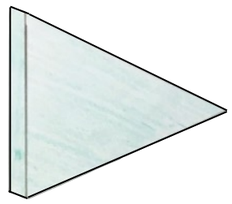
20x 4 LCD, Can display more information than the 16 x 2.

Wood glue would be used join the two wood pieces, and then epoxy resin for the acrylic pieces.

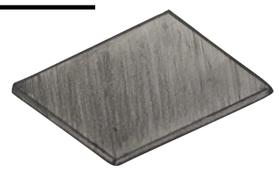




(Wood body piece)



(Acrylic side piece)



(Example of access panel)

The product will use triple a batteries.

The groove at the back is for batteries. This will be covered by a basic acrylic panel screwed in with m4 wood screws.

- Aesthetics
- Environment
- Size
- Safety
- Function
- Materials

Weakness

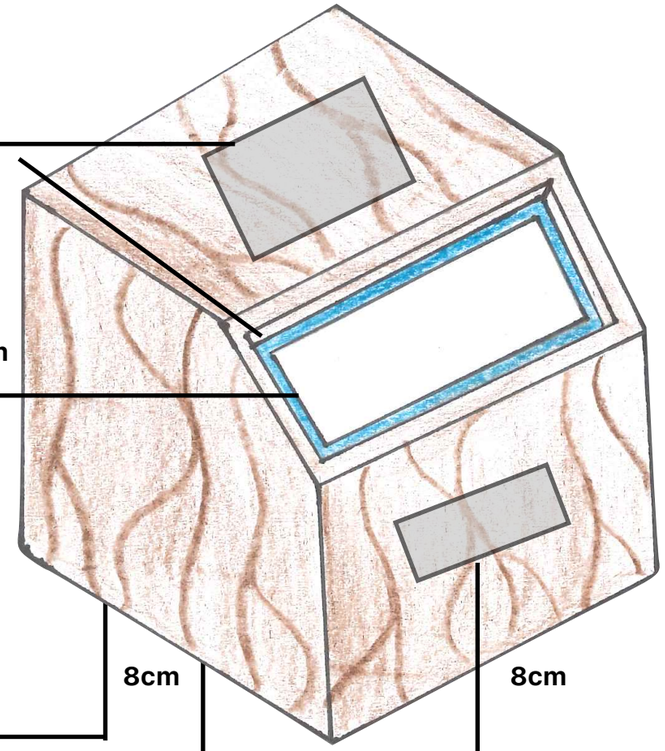
- Charger attachment is inefficient and does not suit the environment
- Switches on the side may make it hard to work with

Strength

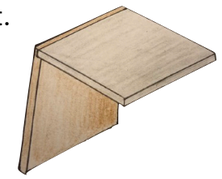
- Room for development
- Simple and Compact
- Circuit is easily accessible

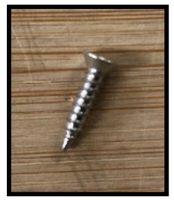
6

There could be a user interface located here where I would put a potentiometer.



The Lcd will fit into the wood as a groove joint.

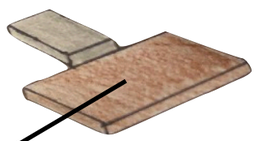




Joining methods may involve the use of PVA glue and counter sunk wood screws.

Access to the circuit can be made from the back or bottom using an acrylic plate most likely screwed into a groove joint.

This attachment is for the apple watch charger.



Apple Watch would rest on the platform

Standard apple watch charger

- Aesthetics
- Environment
- Size
- Safety
- Function
- Materials

Weakness

- No way to connect the charger to the circuit (exposed wires)
- attachment for charger takes up space

Strength

- LCD visible from multiple angles
- Circuit is easily accessible
- Simple design allows improvements

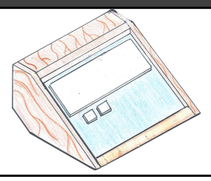
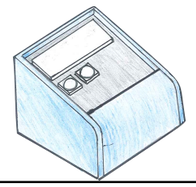
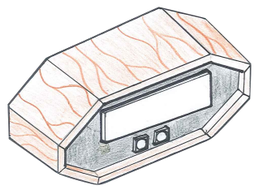
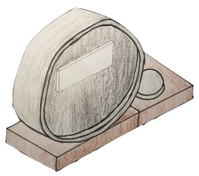
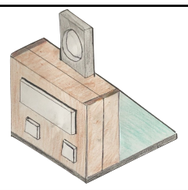
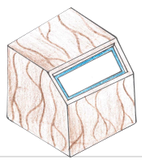
C1 C2 C3 C4 C5 C6 C7

Client Review and Self Review

In this page I will be analyzing each of the devices from the clients perspective and my own. These evaluations will take in a variety of factors and this is why I chose to develop my own grading system in which I believe it includes the major factors regarding the device

Development of the Grading System

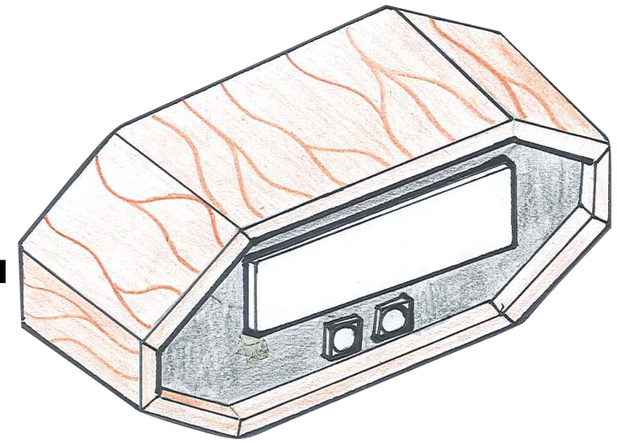
The system I am using to grade each device consists of a total of 23 marks. Up to three marks are awarded for each design aspect, up to three marks can be given from the perspective of the client and up to two marks can be given if it meets my specifications as well.

Devices	Client Review	Self Review	Mark	Conclusion
1 	"This has a bit of a large calculator feel about it. Also the base seems like it would take up alot of my side table space."	While initially I liked this design the most I think it's too bulky to fit in well with the environment.	**17/23**	While it meets all the needs in terms of function, it lacks some aspects in aesthetics. In the end I don't think this is the device for the situation.
2 	"Like I said before, I think that function is a lot more important than how it looks"	This design has major flaws as it does not meet the function requirements at all though it does have decent aesthetics	**14/23**	This device is definitely not the device for the job. Function is perhaps the most important aspect and this does not meet tohose requirements.
3 	"I like this one the most because of the unique design. I like the aesthetics but I'm a little concerned about how the apple watch is going to charger in that position"	This design meets everyone of the clients needs efficiently. I like it personally becasue while it is simple it also shows the thinking that went into the product to make it what it is.	**21/23**	This is most likely the device I will choose as it seems to meet all the criteria of my client and she has also said she like it.
4 	"This is a nice design but it feels like something you'd have in an office. The base makes it quite formal."	In my opinion the shape of the device does not fit well with the environment and in addition the device most likely won't fit due to it's length	**16/23**	My client doesn't like this device and I also don't believe it is suited for the environment.
5 	"The base seems too broad for the space I'd like to use this in."	This is a nice simple design but I don't think it's creative enough. I want to make a device the shows simplicity but also some complexity and this isn't it.	**16/23**	This device is not suitable for my clients need.
6 	"This is nice but a little boxy in it's feel. Has the look of an armoured vehicle about it."	This is a nice design but again like the previous one I think that aesthetically it is not suited for the bedside table.	**19/23**	My client does no like the asthetics of this device and in my opinion the function isn't that great either.

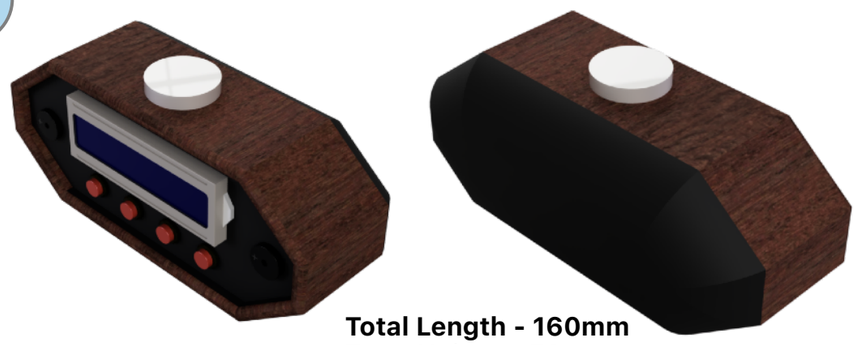
Development of Shape and Form

This page looks at the developments in the design of the product as I take into further consideration, the environment, aesthetics and also practicality

Original C3 Sketch



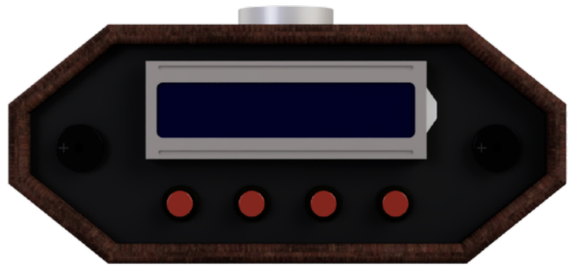
1



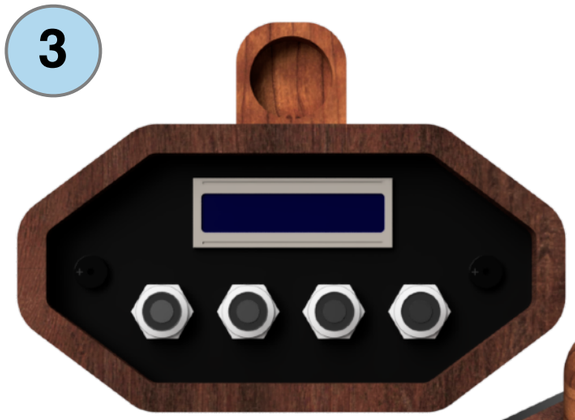
Total Length - 160mm
Total Height - 70mm

Improvements Needed

- There's to much redundant space on the user interface
- There aren't many curves on the body
- The charger cannot practically sit in that position
- Needs more space for the circuit
- Thicker outer frame needed (otherwise it's too delicate)

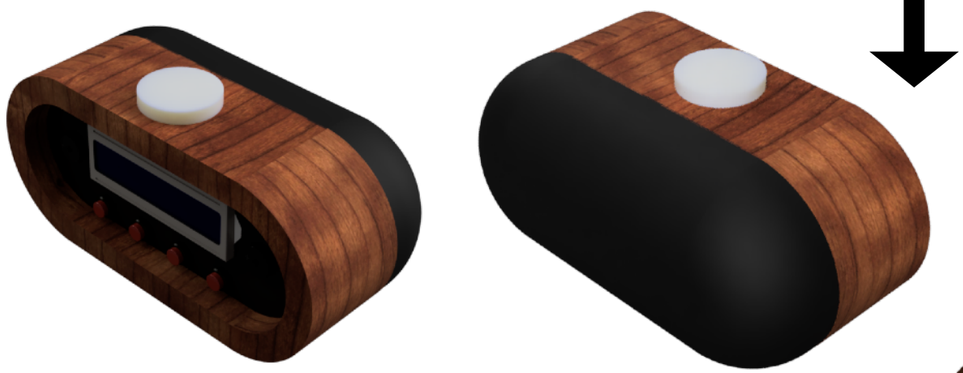


3



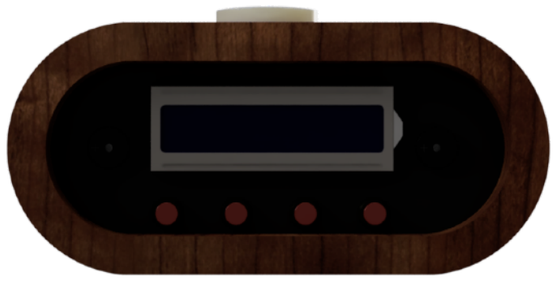
Total Length - 190mm
Total Height - 140mm (with charger)
Total Width - 80mm

2



Modifications

- Tried an entirely new curved design (it should be more like the original)
- Increased curvature of the back piece so the circuit has more space
- The charger cannot practically sit in that position



Total Length - 160mm
Total Height -80mm

Modifications

- Added housing for the charger making it easier to install
- Blended the two designs so that it looks more like the original with curves
- Increased the width to allow more space for the circuit
- Gave more room on the user interface for components

Development of Joints

This page looks at the joining methods that will be used to join the main body.

C1 C2 C3 C4 C5 C6 C7

1

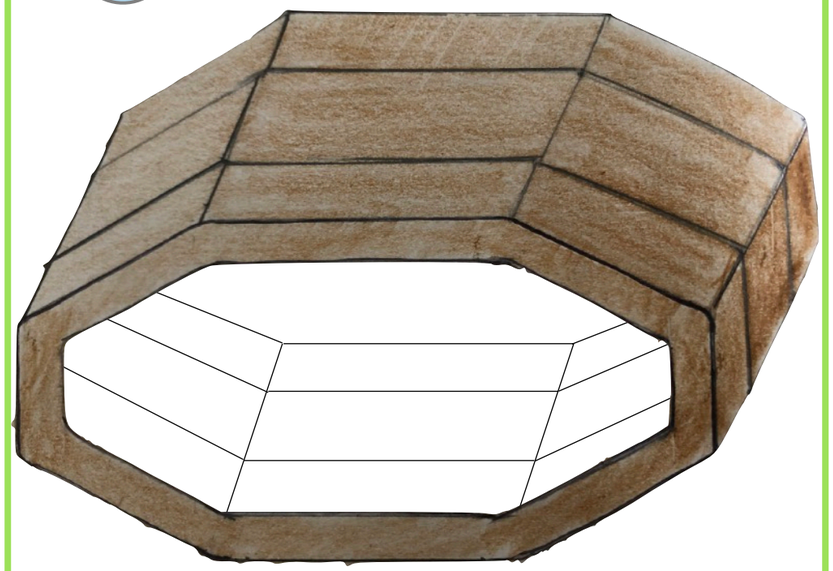
Advantages

- Less chance of anyone seeing cracks where the pieces were joined (less surface area)

Disadvantages

- Several points at which glue is needed (reduces structural integrity
- Each joint has a smaller surface area compared to option
- Made up of smaller pieces of wood (difficult to cut)

2



Advantages

- The entire surface of each piece will be glued increasing the strength/toughness of the housing.
- Easier to CNC

Disadvantages

- Will require larger pieces of wood to be cut
- More glue required

Conclusion

I've decided to go with option two because it offers more strength and it should be much easier to assemble. In addition should one of the pieces be slightly different to the others It will be much easier ti simply sand it down as opposed to it affecting the entire shape in Option 1.

Joining Methods

The way in which both the housings are assembled only allows for adhesive to be used as a joining method. I believe a wood adhesive will do well

Wood Glue

Pros

Easy to apply.
Less interference

Cons

Not Waterproof

Countersunk Wood Screws

Pros

- Option to remove in the future

Cons

- Interferes with the user interface
- Could damage the body

Development of Joints

User Interface Joint

This design incorporates a groove joint inside the first wood piece for the user interface. This will secure the User interface and keep it safe as the outer layer of wood protects it from some damage. It also looks good aesthetically.

Watch Charger Joint

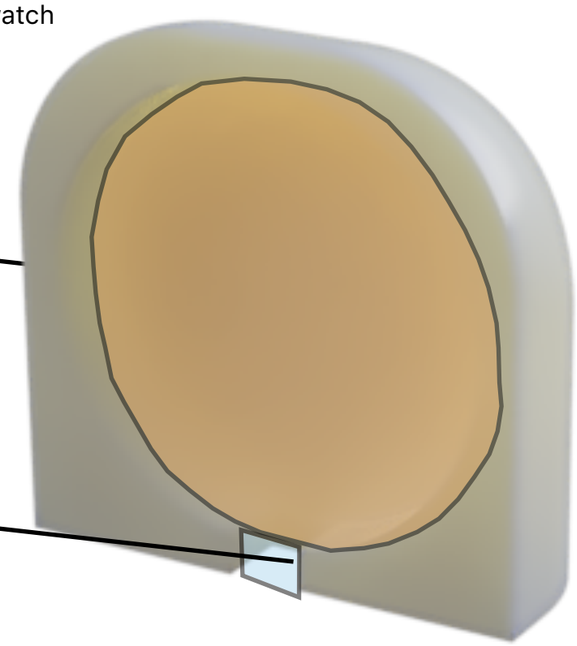
For this page we will look at the joint for the watch charger, user interface, and the backplate.

1

This design incorporates a dowel joint that will go into the main body

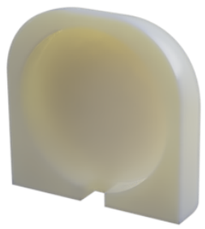
This is where the apple watch charger will sit with it's cord traveling through a hole at the bottom into the main housing

This 5mm channel allows for the cord to pass into the body



I've decided to change the color of the housing to black in order to match the acrylic. (It is white now because it's easier to see the groove.)

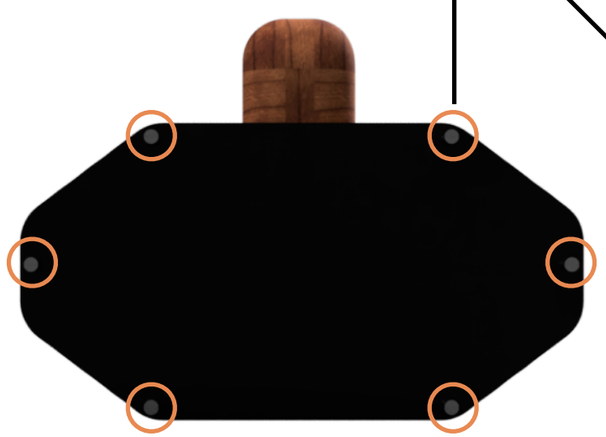
2



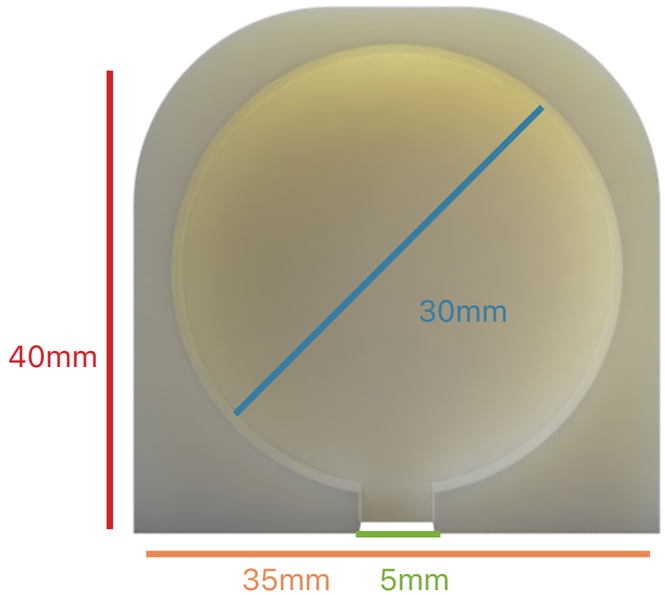
With this option I will used epoxy resin to glue the bottom to the top of the main body

Back Plate Joint

M4 Wood Screw



The placement of 6 countersunk wood screws firmly secures the back plate efficiently to avoid inadvertent damage to the inner circuit. The flat top allows it to fit easily into a groove made by countersink drill bit.



C1 C2 C3 C4 C5 C6 C7

Development of Proposed Design

This page looks at material choices for the different parts

Choice of Body Material

Pinewood

- Lightweight
- Easy to work
- Cheap
- Prone to scratches

Teak

- Harder and heavier
- Very durable
- Resistant to moisture
- Aesthetic
- Expensive

Plastic (PLA)

- Not tough
- Easy to shape
- Used for smaller parts

User Interface + Backplate Material

Aluminium

- Resistant to wear
- No color options
- Lightweight
- Malleable
- Expensive

Pinewood

- Hard to cut out holes for switches
- Thin pieces are easily snapped

Acrylic

- Variety of colors
- Tactile
- Easy to engrave words

Watch Charger Housing Material

Aluminium

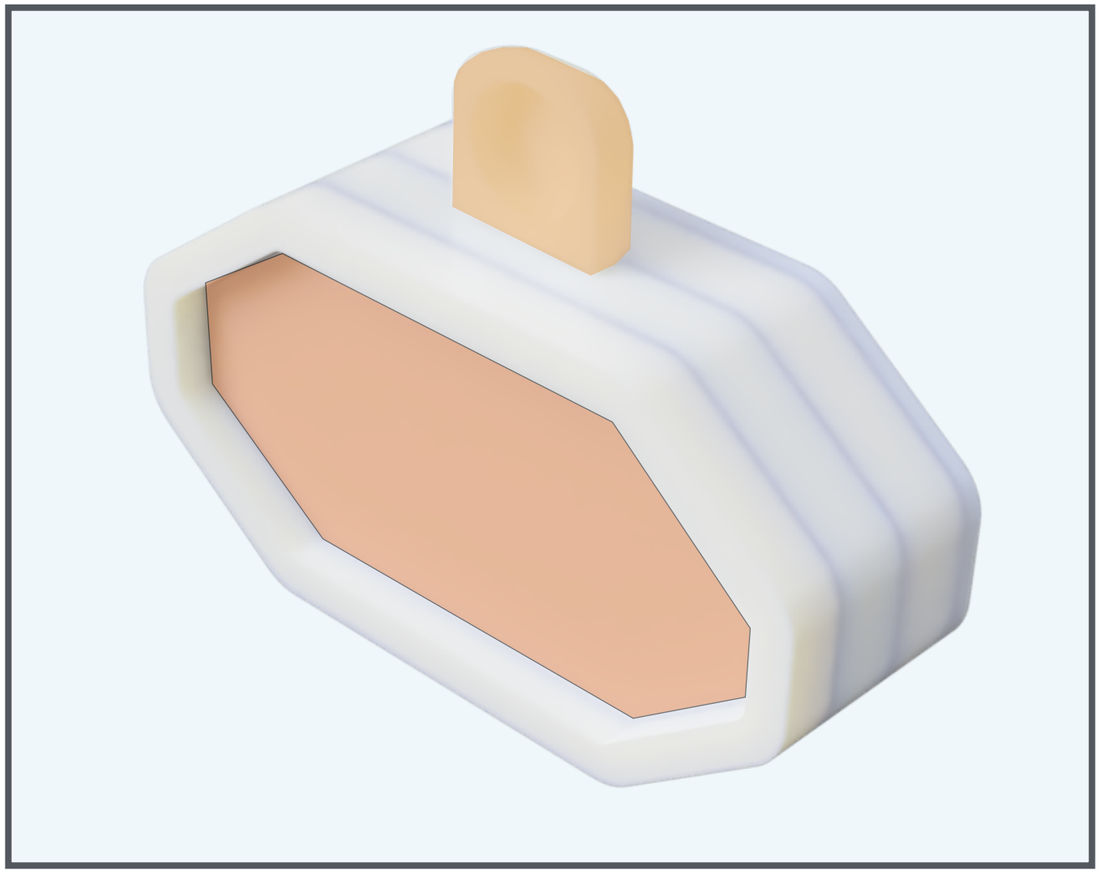
- Difficult to do complex 3D shapes

Pinewood

- Difficult to do complex 3D shapes

Plastic (PLA)

- Easy to 3D Print
- Variety of colors
- Great for complex shapes

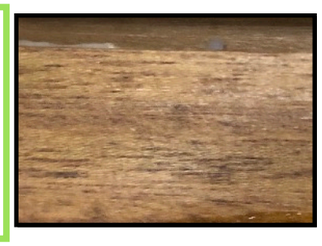


C1 C2 C3 C4 C5 C6 C7

Surface Finishes

Teak Oil

- Enhances aesthetics
- Must be applied occasionally over the year
- Easy to apply



Bees Wax

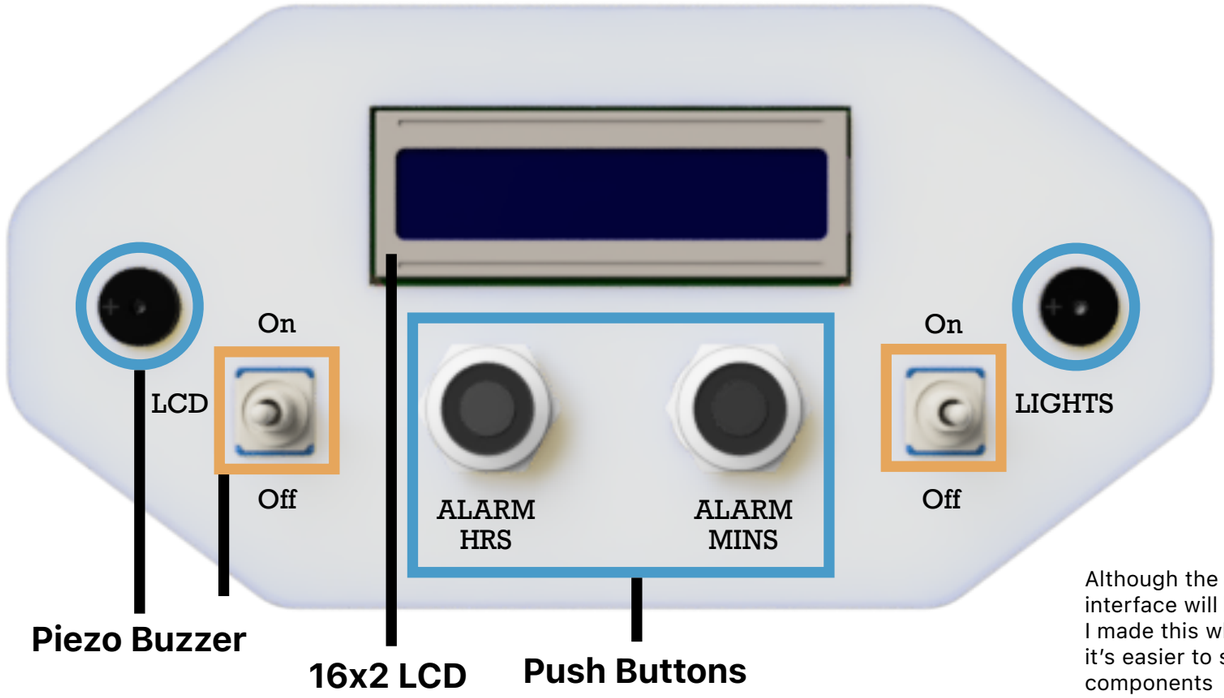
- Natural looking finish
- Less protection
- Has to be frequently reapplied

Furniture Wax

- Does not change the appearance of the wood
- Has to be frequently reapplied
- Protects the wood

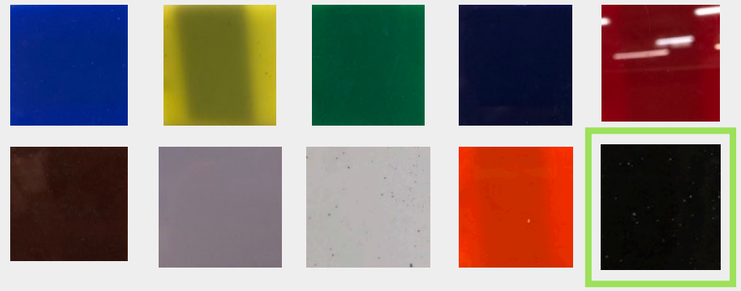
Development of User Interface

This page looks at the different choices in colors, switches and fonts for the user interface



Although the actual interface will be black, I made this white so it's easier to see the components

Acrylic Color Options



Push Button Color Options

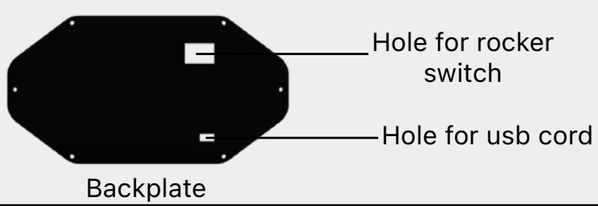
Push Switches Colors

LED Push Switches

Modifications

- Add an option to be energy efficient when using the device (charger off, lights off)

- The clock setting buttons are unlikely to be used often so they can be moved to the inside of the body



I can move the Time setting switches to the inside of the body as they are not often needed. In addition it makes space for other switches which can control the lighting, giving the user the option to save energy.

In addition there will be a rocker switch on the back plate that turns the charger on and off. The backplate will also match the user interface in color (black)

Font Options

Each of the four buttons will need to be labelled with their function. Two of them change the hours and minutes of the clock while the other two allow the user to set an alarm by controlling hours and minutes

Courier New - Alarm HRS Alarm MINS

SF Pro Display - Alarm HRS Alarm MINS

PHOSPHATE - ALARM HRS ALARM MINS

Rockwell - Alarm HRS Alarm MINS

Text Color

On

Off

HRS
MINS
LIGHTS
LCD

My final choice will be to go with the Rockwell Font. I feel that it would go well with the buttons

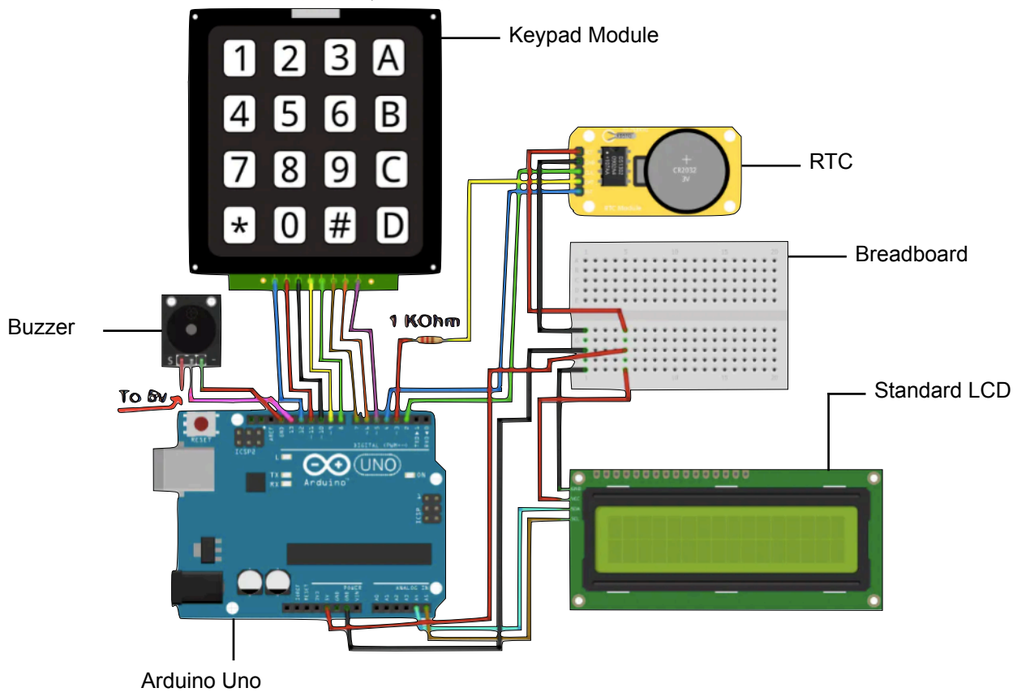
C1 C2 C3 C4 C5 C6 C7

Research: Circuit Analysis

In this page I will analyse two different potential circuits and weight out the unique opportunities each one offers while also looking at what they don't offer.

Arduino Alarm Clock

SurtrTech/simple-alarm-clock



Components

Arduino Uno, RTC (Real Time Clock) DS1302, Buzzer, Standard LCD, Breadboard, 4x4 Matrix Keypad Module.

Aspects To Consider

Some important factors to consider are size, efficiency and the clients needs.

Using an Arduino nano will allow me to reduce the size of housing needed	I can switch out the keypad for buttons that will take up less space as using an entire keypad is unnecessary. A problem would be that I will have to code the entire project from scratch.	The circuit will be made as user friendly as possible. It's quite easy to use as it only requires 5 volts and it should be easier to Link It to the apple watch

Input
- Any kind of switch
- Program (Code)
- 5 Volts

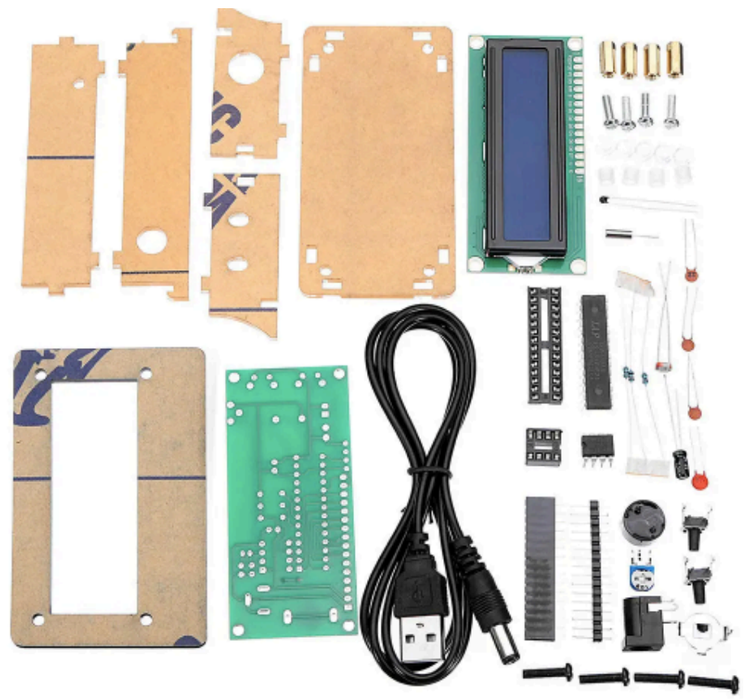
Output
- LCD
- Buzzer

Conclusion

In conclusion, while there is a lot of potential in this circuit, it will most definitely have to be modified to meet my clients specifications. In addition using an arduino increases the number of possible errors that may take place making it less reliable.

Alarm DIY Clock Kit

banggood.com



Components

Display: 1602 LCD , Power Supply: USB DC 5V; 1 * 3V CR1220 Button Battery(NOT included), Working Current: 20mA, USB Cable Length: 100cm / 39.4in, PCB Board Size: 78 * 35mm / 3.1 * 1.4in

Aspects To Consider

Some important factors to consider are size, efficiency and the clients needs.

It comes with a premade user interface that can be further customized to meet my clients needs. This means less work will need to be done on my part.	As this circuit needs a socket in which to connect, it is important to make sure the setting has the qualifications to meet the need of the circuit.	The process for setting an alarm may be beyond my clients technical expertise. It must be easy to use.

Input :
- 5 volts
- running clock time
- alarm time

Output :
-Alarm
-Display

Conclusion

In conclusion, this seems to be the easier circuit though there are a couple of minor issues including the cable, and overall quality. While the other may be harder to be put together, there is less information available about this one.

Circuit Components

This page looks at the connections in my final circuit and the reasons for my choice in components

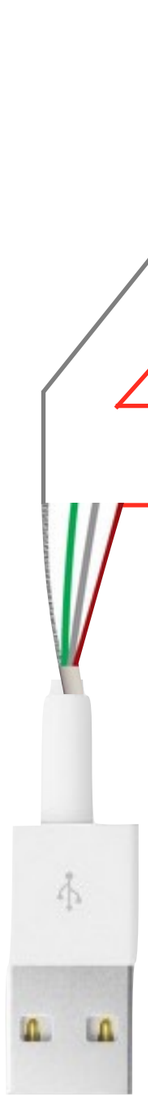
Apple Watch Charger

Sometimes leaving your device charging for to long can damage the battery, with this switch Priya can easily turn off the charger and use it as a stand for her watch

This switch allows Priya to save energy when she wishes while also allowing her to turn off the light when she sleeps as it may distract her

Attaches to the apple watch charger

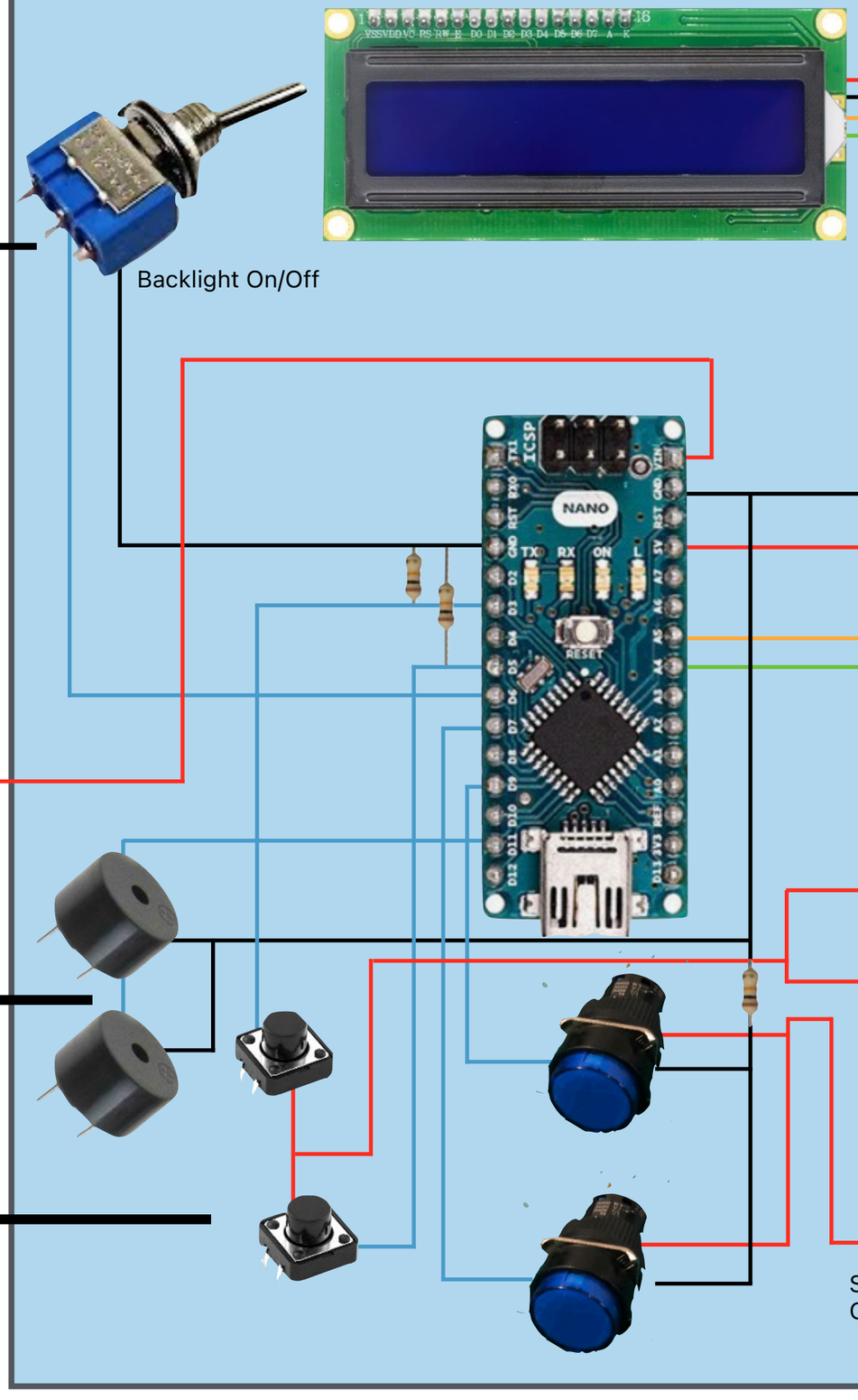
Charger - On/Off



I used two buzzers because I felt that one may not be enough to wake Priya up. Another reason was that I wanted a symmetrical interface for aesthetics.

To save money and be practical I moved the time setting buttons inside the body as they are only really used once. This meant I only had to buy two led buttons which are quite expensive ($12SGD)

Development of Arduino



C1 C2 C3 C4 C5 C6 C7

Plan of Manufacture

This page shows the plans for the manufacturing of the entire product, step by step.

Stage	Component	Process	Equipment	Estimated Time	Quality Control/Health and safety measures
1	Circuit	**Development and prototyping of the circuit** - Buy necessary components (1 x RGB LCD, 2 x LED pushbuttons, 1 x Arduino nano, Apple Watch charger) - Developing the code - Prototyping with breadboard - Testing apple watch charging circuit	- 1 x Breadboard - 1 x RGB LCD - 4 x pushbuttons - 1 x Arduino nano - 2 x Piezo buzzer - 18 x jumper wire - Soldering Iron	**18 Days** (Around 25hrs will be needed)	- Safety glasses - Heat protective mat - Turn circuit off when modifying to avoid shorts
2	Teak Body	**Cutting teak pieces** - Print dimensions for cutting on A3 paper - Use CNC machine to cut the pieces (3x 20mm thickness, 1 x 15mm thick with 5mm offset 3mm groove)	- CNC Machine - Teak wood - Printer	**1 Day** (Only 2 hours needed as the CAD is already designed)	- Using a CNC instead of doing it by hand as the CNC is much more accurate and less time consuming
3	Teak body	**Glue the three identical teak pieces** - Line the pieces up and glue with wood glue - Fix the pieces into a clamp to squeeze them - Wipe off excess glue and leave to dry - After it's dried sand off excess wood	- Wood glue - Clamp - 320 grit sand paper - Popsicle stick (to apply wood glue)	**2 Days** (30 Minutes for the gluing and then 12 hours for drying)	- Use clamp and tape to ensure glue dries properly without pieces shifting - Wiping off excess glue that emerges from the joint after pressing the pieces together - Sand in the direction of the grain and sand lightly to avoid scratching
4	Clock Circuit	**Soldering final clock circuit** - Plan out how to fit the circuit in housing - Cut perfboards to fit the housing - Solder all pertinent connections	- 3 x Perfboard - 1 x RGB LCD - 2 x pushbuttons - 1 x Arduino nano - 2 x Piezo buzzer - 22 x jumper wire - Soldering Iron - Saw	**7 Days** (Will require around 12 hours to solder the entire circuit and work around problems)	- Safety glasses - Heat protective mat - Use space efficiently when plotting circuit size
5	User interface and backplate	**Cutting the user interface and backplate** - Modify fusion sketches in adobe illustrator to add text, font, size - Laser cutting the user interface - Laser cutting backplate	- 1 x Matte black acrylic sheet - 1 x Laser cutter	**1 Day** 20 min - Add text 10 min - Cut both pieces in paper 30 min - Make changes 10 min - cut in acrylic	- Use space efficiently when plotting circuit size
6	User interface and backplate	**Touching up the user interface and backplate** - Checking to see if components fit - Coloring the text for easy visibility and aesthetics	- 1 x White marker - 1 x Green marker - 1 x Red marker	**1 Day** 20min (5min between each layer)	- Wait five minutes in between each layer of color to let it dry

C1 C2 C3 C4 C5 C6 C7

Plan of Manufacture

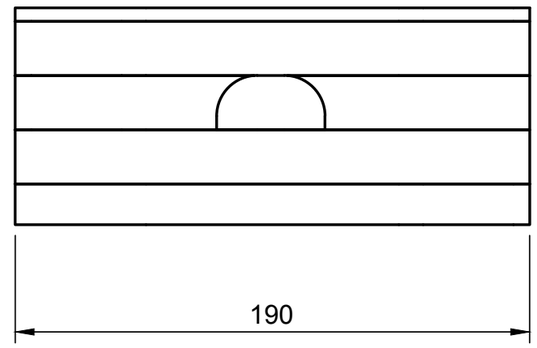
This page shows the plans for the manufacturing of the entire product, step by step.

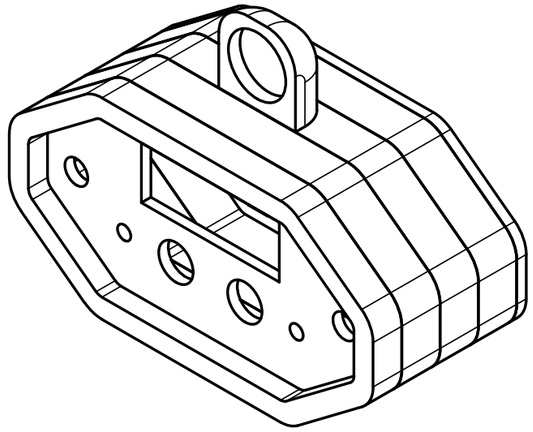
Stage	Component	Process	Equipment	Estimated Time	Quality Control/Health and safety measures
7	Apple watch charger	**3D print charger housing and prepare the main body** - Design and upload CAD model of housing to the 3D printer - Mark out the hole for the charger cable on the main body - Drill hole for the cable - File out the 1.5cm by 0.7cm hole for accuracy	- 3D printer - Black PLA - Ruler - Pencil - Hand drill - 8mm drill bit - Filing tools	**1 Day** 3 hrs for 3D Printing, 15 min to mark and drill hole. 5 min to file.	- Ruler to measure out the middle of the body and ensure a straight cut - Small files allow better accuracy
8	Apple watch charger + New body	**Installation of charger circuit** - Glue Apple Watch charger into it's housing with epoxy resin - Put the cable through it's hole and connect it to the circuit - Organize the cable using zip ties and hot glue - Glue the housing to the top of the new body with epoxy resin	- Epoxy resin - Cardboard bits (to mix the epoxy resin) - 2 x zip ties	**2 days** 15 min to glue. 10 hrs to dry each time.	- Cut off the unnecessary parts of the zip ties after the cable has been organized to safe space. - Use a clamp to keep the apple watch charger from moving while the glue dries
9	User interface + Circuit + Teak groove piece	**Installation of clock circuit** - Sand down the teak piece with the groove to perfectly fit the user interface - Fix 2 x toggle switches and 2 x led pushbuttons to interface using nuts - Hot glue 2 x piezo buzzers to the interface - Secure the LCD using hot glue as well - Cut and hot glue 6 x small pieces of balsa in the teak body to prepare the body	- sand paper (320 grit) - 2 x toggle switch - 2 x led pushbutton - 2 x piezo buzzers - 1 x RGB LCD (16x2) - hot glue gun - 4 x hex nuts - 1 x hex spanner - 30cm of balsa wood - 1 x junior hacksaw	**1 Day** 20min to sand the teak wood. 30 min to attach user interface components. 20 min to cut and hot glue balsa wood.	- Use hot glue with moderation as to much could potentially damage one of the electrical components - Ensure the toggle switches are exactly upright before fixing them to the interface
10	Backplate	**Fixing the plate to the body** - Fit the rocker switch to the plate and let the usb cable pass through - Align the plate to the body and keep in place with masking tape - Use a hand drill to screw 6 counter sunk screws into the body through the holes in the back plate - Use a countersink bit to modify the previously cut holes in the backplate to allow the counter sunk screws to rest flatter	- 1 x hand drill - Screw driver - Countersink bit	**1 Day** 5 min to attach the rocker switch and let the cord through. 30min to drill holes.	- Using the hand drill to screw the wood screws allows for a faster more efficient process - Drilling the countersunk indents into the backplate allows for a Bette fit for the countersunk screws
11	User interface + Circuit + Teak groove piece + Teak body	**Installation of clock circuit** - Fit user interface into groove piece and use wood glue to attach it to the teak body - Clamp the body - Hot glue perf boards to the balsa pieces - Sand off excess wood from the groove piece	- 1 x hot glue gun - 1 x bottle of Gorilla wood glue - 1 x clamp	**2 days** 30min to glue the wood pieces and hot glue perfboards. 8 Hrs to dry. 20min to sand.	- Use a clamp to hold the balsa wood when cutting it with the hacksaw
12	Full body	**Final touch ups + finish** - Sand the body so that the back plate and wood pieces align - Apply teak oil to the wood portions of the body, use masking tape to prevent it from getting on the acrylic	- 1 x bottle of teak oil - 3 x Polishing cloth - 1 x Plastic glove	**1 Day** 1 hr to sand and apply teak oil and let it dry.	- Ensure teak oil does not touch the acrylic - Use gloves and polishing cloth

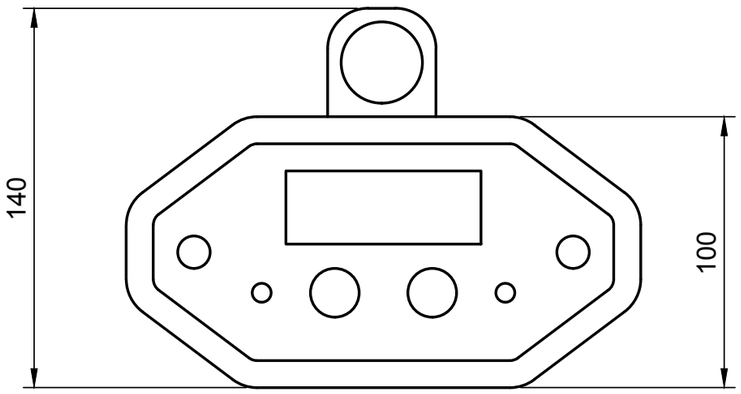
C1 C2 C3 C4 C5 C6 C7

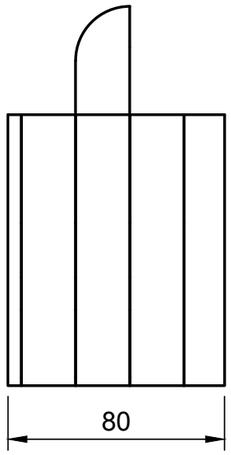
Orthographic

Orthographic of the final product with dimensions









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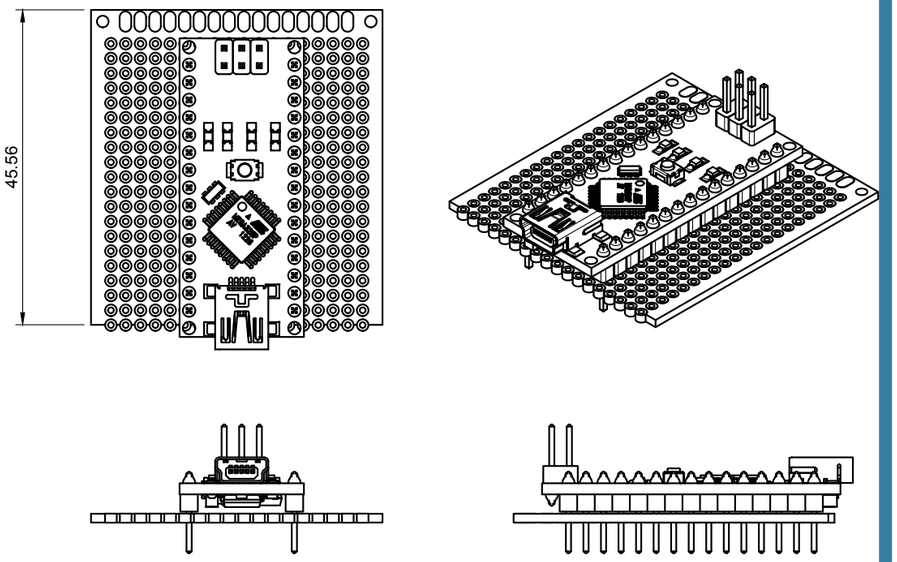
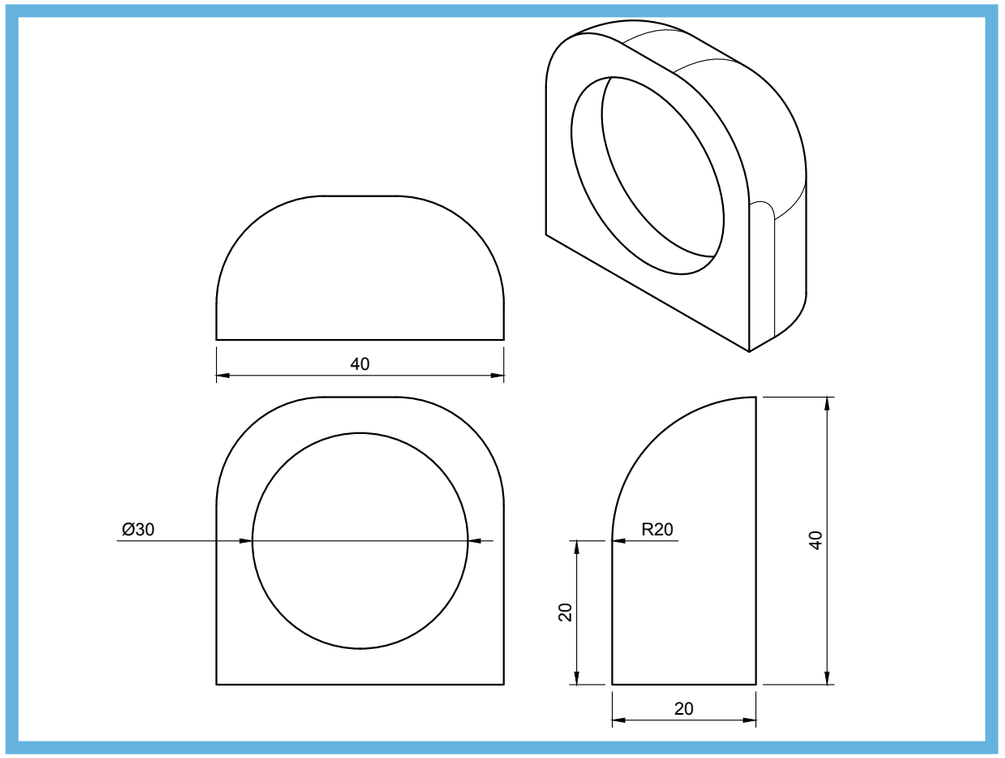
		Aayush Irani 2/15/21	
		Document type	Document status
		Title: Final	DWG No.
			Rev. / Date of issue / Sheet: 1/1

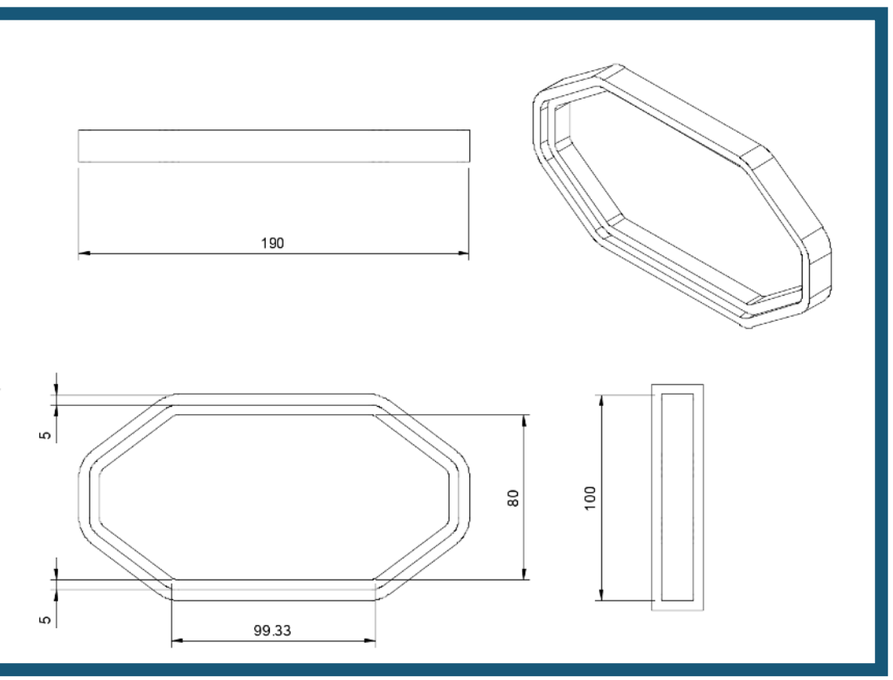
C1 C2 C3 C4 C5 C6 C7

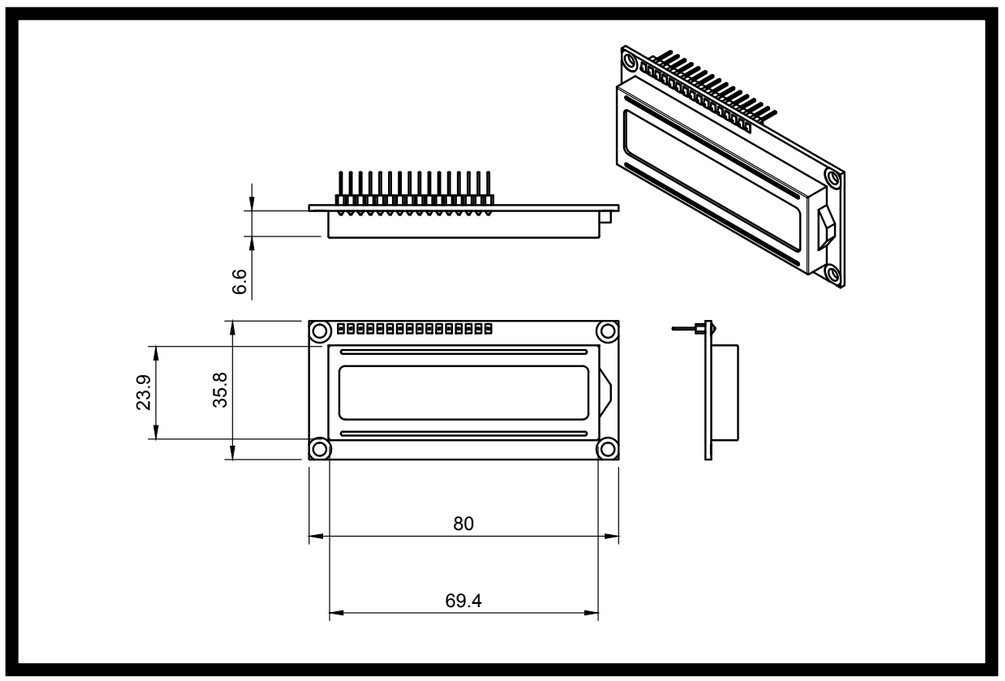
Orthographic

Orthographics of different components in the product









Watch housing

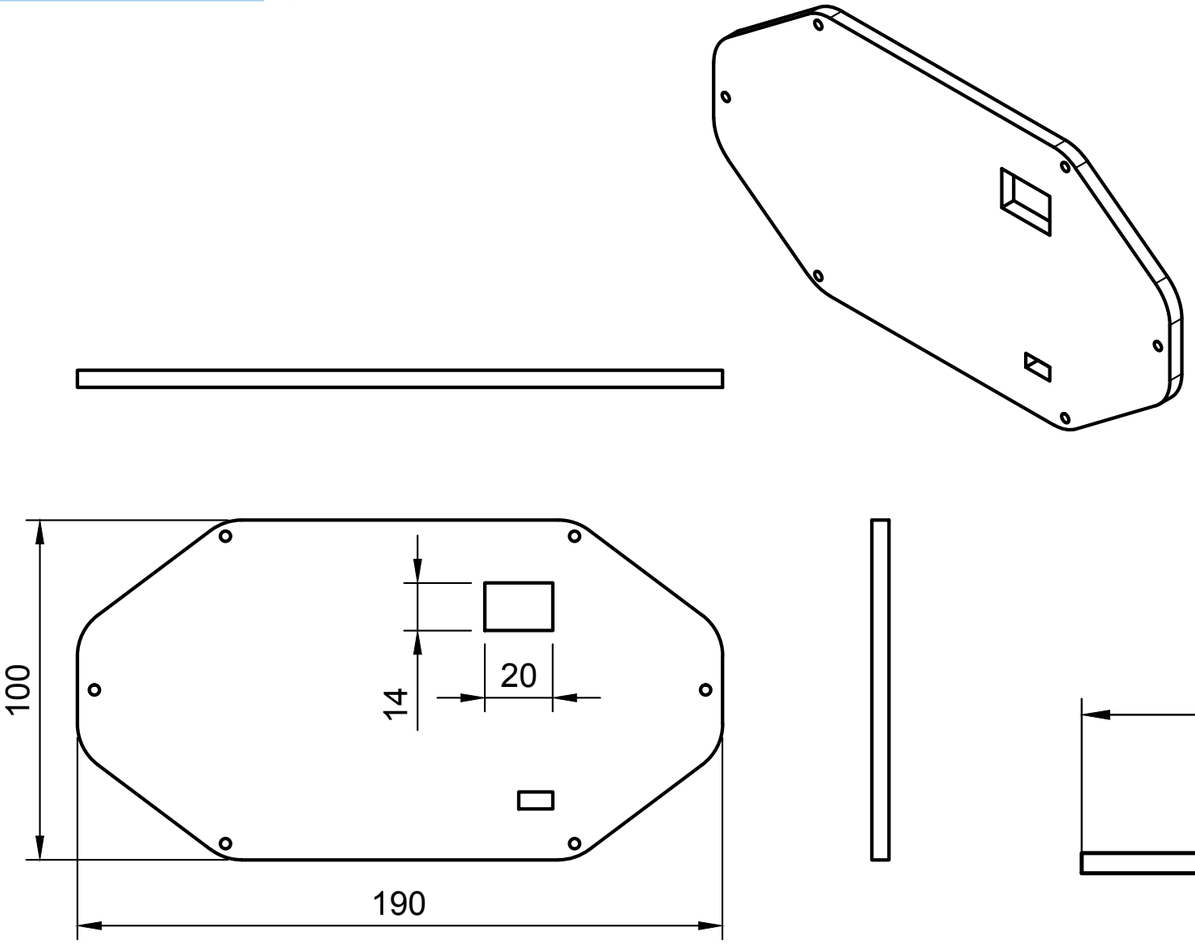
Arduino Nano

Front piece

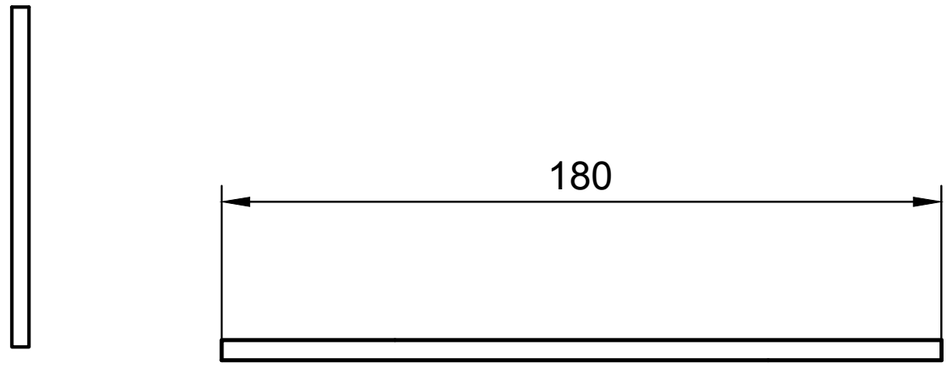
LCD

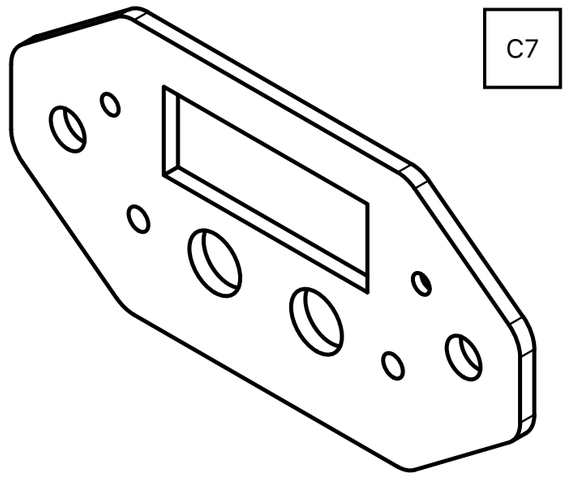
Orthographic

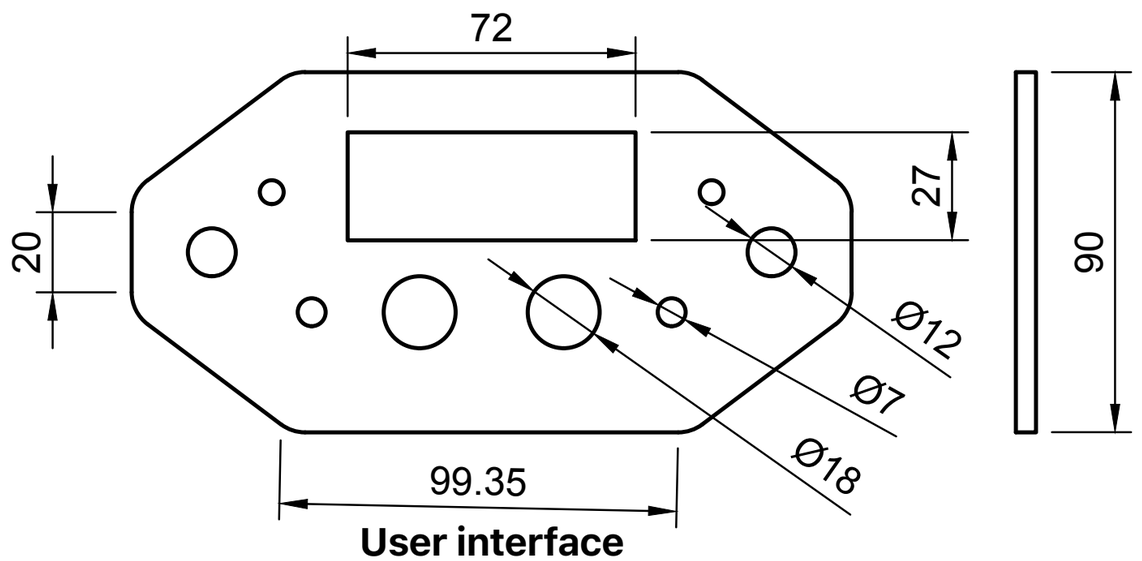
Orthographics of different components in the product



Backplate





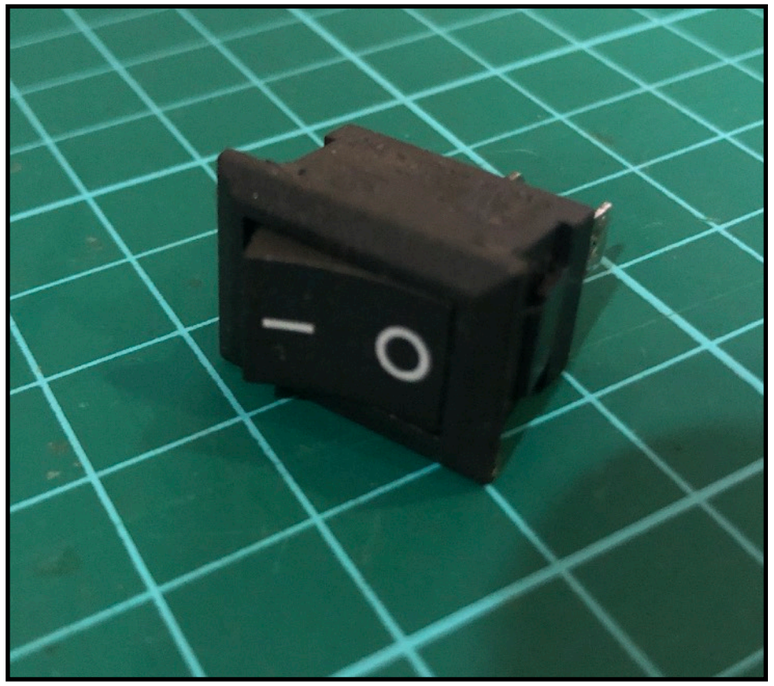


User interface

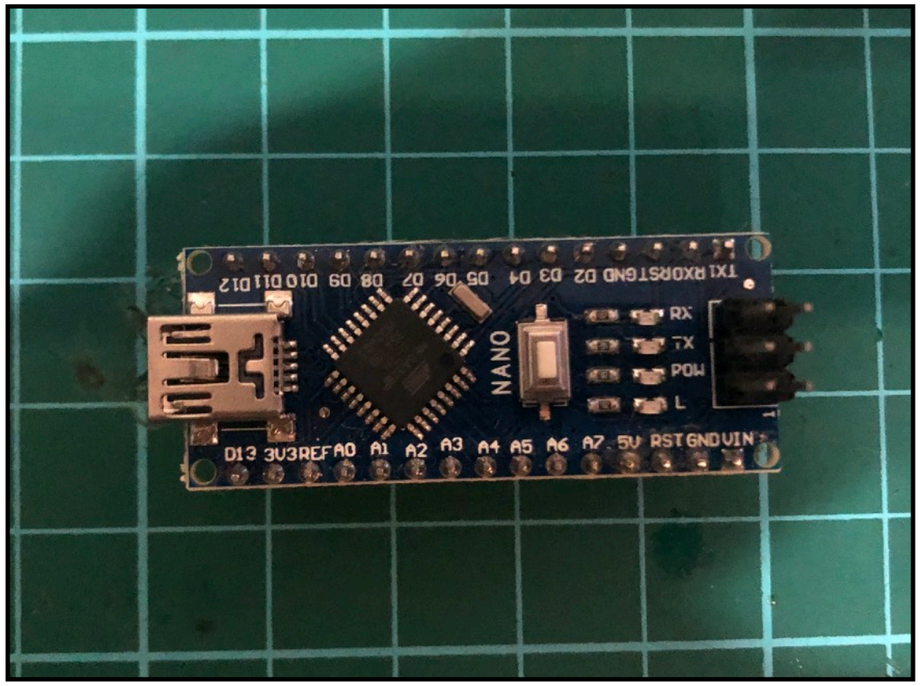
Additional Components

On this page we look at additional components in the product and their dimensions

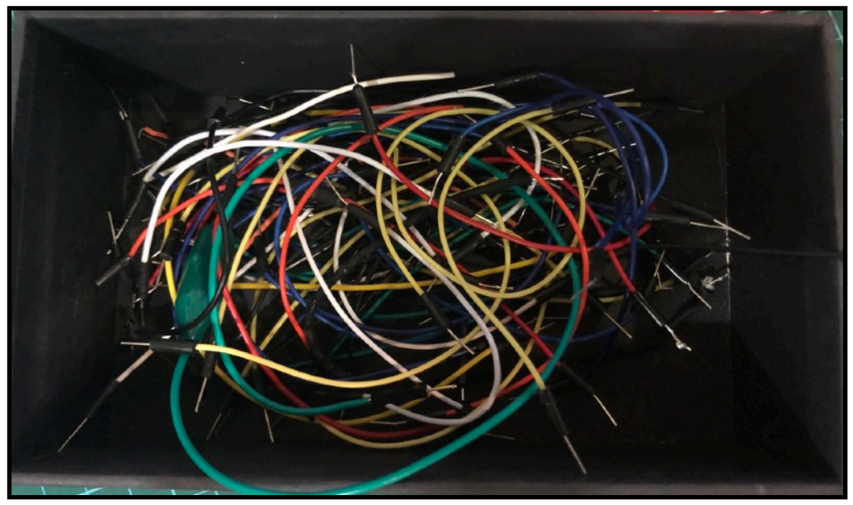
2 x Push buttons for setting the time
(10mm x 10mm)



1 x Rocker switch to turn on and off the watch charger
(20mm x 13mm)

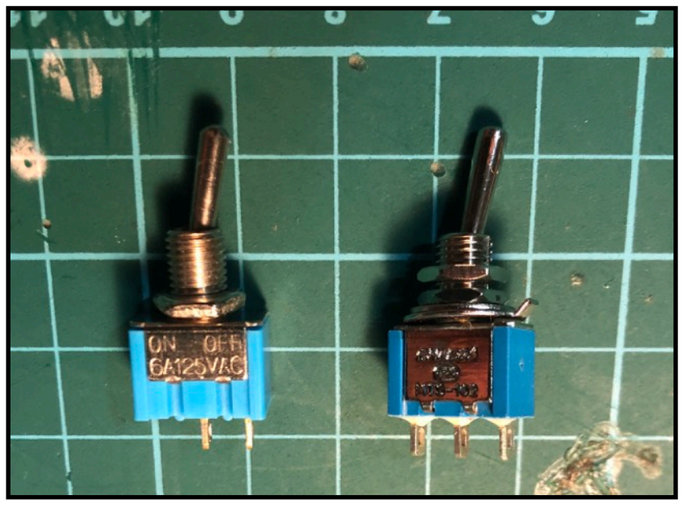


1 x Arduino Nano to control the circuit
(45mm x 15mm)



Jumper wires to connect components
(Varying lengths)

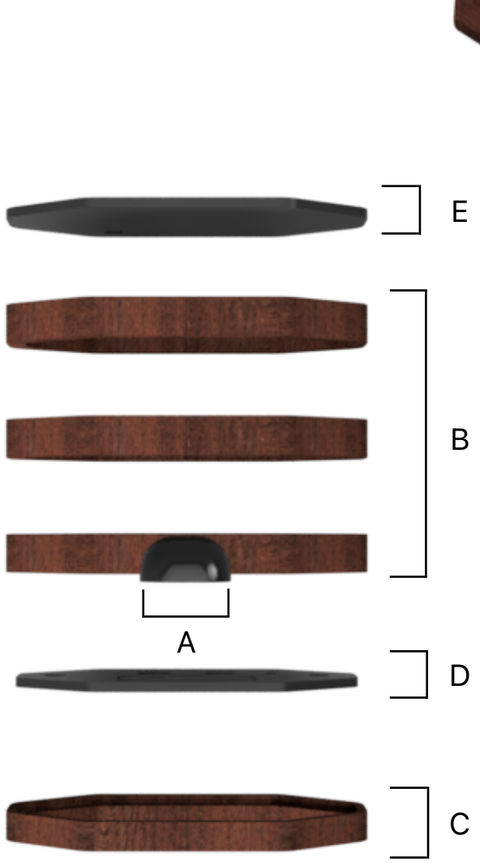
2 x LED Pushbuttons for setting the alarm
(10mm diameter, 40mm length)



2 x Toggle switches
(6mm diameter)

Rendered Exploded View and Cutting List

Exploded view of the render for the final product alongside a cutting list for each part



Cutting List

Component	Material Description	Dimensions	Finish	Section/ Colour	Quantity
A	- Holds the apple watch charger - Made of PLA (3D printed)	Height 40mm Length 40mm Width 20mm	Self finishing	PLA black	1
B	- Teak wood body piece - Total thickness = 60mm made of 3 x 20mm pieces	Height 100mm Length 190mm Width 20mm	Teak oil	Teak (dark brown)	3
C	- Similar dimensions to piece B except 15mm wide with a 3mm groove (offset of 5mm) to hold the interface	Height 100mm Length 190mm Width 20mm	Teak oil	Teak (dark brown)	1
D	- User interface (same 2d profile as B and C except it's Acrylic) - 3mm thickness with holes to fit the electronic components	Height 90mm Length 180mm Width 4mm	Self finishing	Matte black acrylic	1
E	- Back plate (same as user interface except it has one hole for a rocker switch, 6 holes for countersunk screws, and one for the usb cable) - Acrylic	Height 100mm Length 190mm Width 4mm	Self finishing	Matte black acrylic	1

Presentation Drawing

A final render from different angles of the planned product

C1

C2

C3

C4

C5

C6

C7

Production Process

In the first page of my production diary I explore the steps of developing my circuit which include buying the components, prototyping, developing the code, and modifying the circuit and solving problems.

Task 1

Supplier

In order to secure all the parts, I frequented a variety of stores in a building called **Sim lim tower.** It has a reputation as the go to destination for people looking for **electrical components** in Singapore.

Fig 1 - Sim lim Tower

Software

I chose to use **Arduino** due to my prior experience with it and the **versatility** that accompanies an Arduino nano. Arduino lets me make my own **custom circuit** specific to the way **my client would like**. For example through Arduino, I can control the **sound** of the buzzers and the **color** of the RGB LCD.

1 Buying the components

26/10/2020

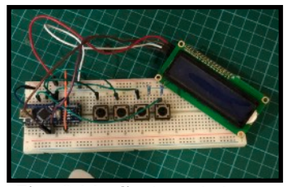


Fig. 2 My first prototype

The first step in the process of prototyping was to visit Sim lim tower and acquire the necessary parts for my circuit

- 1 x Arduino Nano
- 4 x Pushbuttons
- 26 x Jumper wires
- 1 x 16x2 LCD
- 2 x Piezo buzzer
- 1 x Breadboard

2 Prototyping the circuit

26/10 - 12/11

Fig. 3 This is the circuit station where I developed my circuit

Next I set up and wired a basic circuit to the Arduino nano with allowed to me to test my code as I developed it. Managing my wires was important, as was doing my best to **structure the circuit efficiently.**

Problem

One problem I encountered in the process was that as I was using the delay function in my Arduino for the clock there's was an additional, **uncontrollable delay** as the Arduino had to process the entire code. This resulted in a clock that was too slow and it prompted me to look for an alternative approach

3 Developing the code

28/10/2020

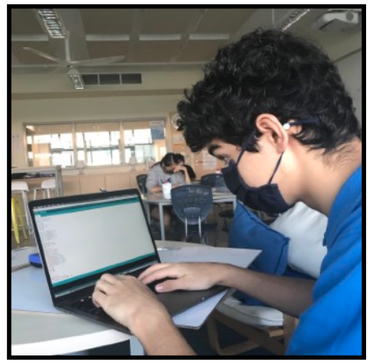


Fig. 4 Coding with Arduino

I spent a lot of time doing **research online** trying to figure out the most efficient way to code a clock on Arduino. This involved a lot of **trial and error** as I encountered several problems throughout the process.

4 Modifications

10/11/2020

After sorting out the basic code, I bought an **RGB LCD** and **2 Blue LED Push buttons** to **improve aesthetics** and give Priya the option to **see the device in the dark**. I also add two toggle switches to turn off the lights to save power, or if the light was distracting her.

Fig. 5 LED Pushbutton

Furthermore an essential part of any alarm clock is the alarm itself. No one likes to wake up to an annoying alarm. Though the piezo buzzers were limited in variety of sound, I could still control the tone and timing to some degree. After talking with Priya and getting her input we decided on a **basic alarm** sound that **suited her.**

5 Apple Watch charger

15/11/2020

Fig. 6 Apple Watch charger

Normally apple watch chargers can cost around **$45** in Singapore which is why I was lucky to have a spare one which I used in the circuit. After working around most of my problems I developed a circuit that would charge the watch and power the clock with one usb cable. However because of the problem I encountered I had to buy a new cable adding $45 to the cost

Problem

A problem I encountered with the apple watch charger was **apples ingenuity**. There are almost no alternatives to apple's charger for the apple watch because they are able to prevent other chargers from interacting with their watches. **After cutting an apple watch cord** and trying the circuit I realized the apple watch cable **wouldn't work** because of Apple's measures for privacy. As a result I had to acquire a **female usb piece** and **buy a new charger**. I devised a solution to fold up the apple watches cable to plug into the female usb receiver which was connected to another usb cable that powered both the charger and clock.

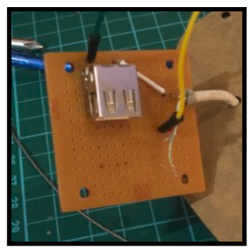


Fig 7 - A prototype of the watch charger circuit

Production Process

Going through the process of gluing the three main teak pieces

- **Picking the teak wood**
- **Using the CNC machine**
- **Gluing the pieces together**
- **Sanding the body**

Task 2 & 3

15/11 - 20/11

Fig 1 - Teak planks

1 The first step was to **pick out the piece of wood** for the body. Some features I was looking for:

- **No scratches/damage**
- **No stains**
- **Aesthetic grain**

Fig. 2 CNC Machine

2 After ensuring that all the **dimensions were accurate** from my CAD, I uploaded the sketch to the **CNC machine** and the pieces were **cut.**

Fig. 3 3 x teak body pieces

3 Step three involved ensuring the three main body pieces **lined up** and were the **right size.** An **important consideration** was the **arrangement of the pieces** so that the body looked the most **aesthetically pleasing**.

Fig. 4 Bottle of gorilla wood glue

4 I applied glue to the pieces and lined them up as best as I could. I used a **brush to spread the glue out evenly.** One of the difficulties in the process was being able to **evenly** spread out the glue. Too much and the glue would squeeze out of the cracks. Too little and the integrity of the body would be compromised.

Fig. 5 Tightening the clamp

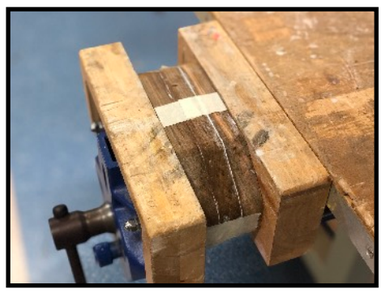


Fig 6. Bidy in the clamp

5 I first **taped the pieces together** with masking tape to keep them in alignment and then squeezed them with a **wood clamp** for a day. I used a tissue paper to clean up glue that emerged from the cracks under the pressure.

6 After a day of drying, I removed the tape and sanded down each side so it was **level** and **smooth** with 320 grit sandpaper. It was important to ensure that **I didn't sand too much on one side** otherwise it would result in the body becoming disfigured. I made to sand **in line with the grain** and to **sand lightly** as to not scratch the wood

C1 C2 C3 C4 C5 C6 C7

Production Process

Going through the process of soldering the final circuit

C1 C2 C3 C4 C5 C6 C7

1 The first step was to gather the additional materials and equipment which included

- **3 x Perfboards**
- **Soldering iron**
- **Cutter**
- **Multi meter**

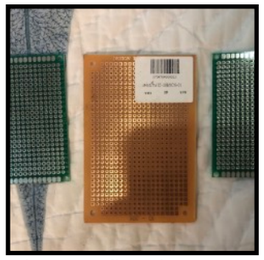


Fig. 1 - Perfboards

Fig. 2 - Multimeter

Fig. 3 - Soldering iron

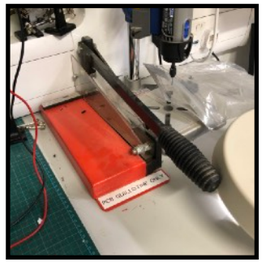


Fig. 4 - PCB Guillotine

2 The first step in the process was to cut the perfboards using a PCD Guillotine so they would fit exactly into the body. Width only a width of 60mm I was worried the body may not be able to contain the entire circuit. This is why efficient use of size was essential. I cut them to around 40mm.

Fig. 5 - Using the PCB Guillotine to cut the perfboards (make sure fingers are not near the blade)

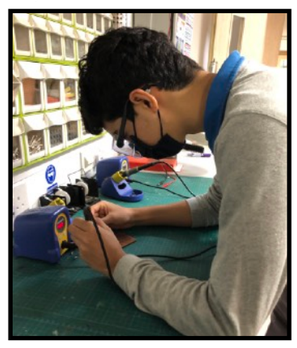


Fig. 6 - Using the soldering iron with safety glasses (for protection)

3 Next I began the process of soldering everything together while constantly testing the code to ensure everything worked. Soldering the entire circuit was a strenuous task filled with many mistakes. It was also important to ensure that I was soldering in a well ventilated area wearing the proper protection equipment (e.g safety glasses)

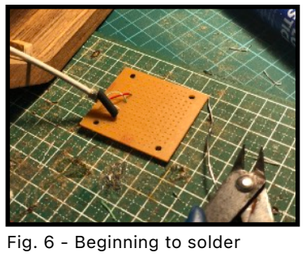


Fig. 6 - Beginning to solder

Task 4

21/11 - 28/11

- **Gathering components**
- **Cutting perfboards**
- **Soldering the circuit**
- **Planning for the circuit placement**

4 Once the circuit was completed I referred back to my cad of the device and used it as a basis for the placement of my new circuit. This allowed me to build from my previous ideas and develop a efficient method for keeping the circuit relatively organized while minimizing the space taken up.

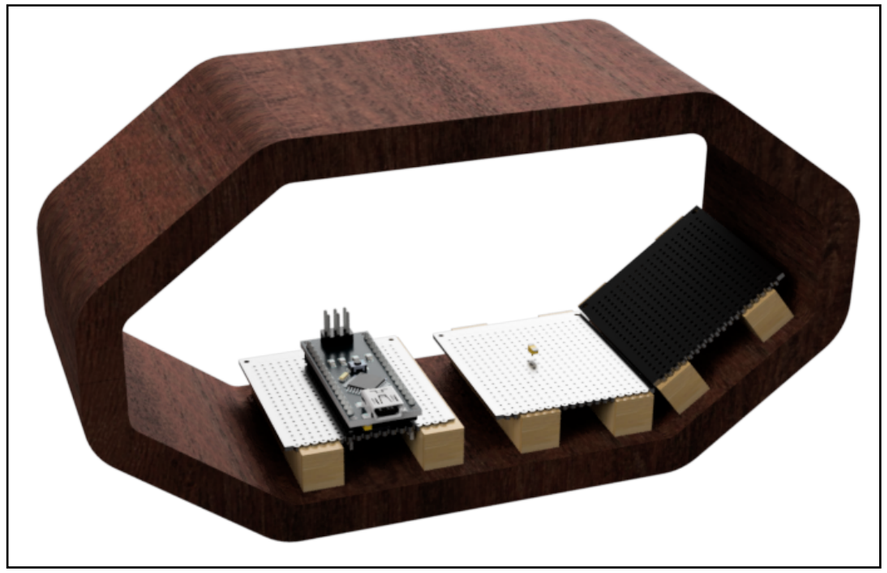


Fig. 1 - Rendered sketch of circuit placement

Problem

Several times throughout the process of soldering I found that my circuit would stop working. Through the use of a multimeter's continuity function I was able to identify where I had accidentally made a soldering error and fix it. Due to the many connections so close to each other, accuracy was imperative.

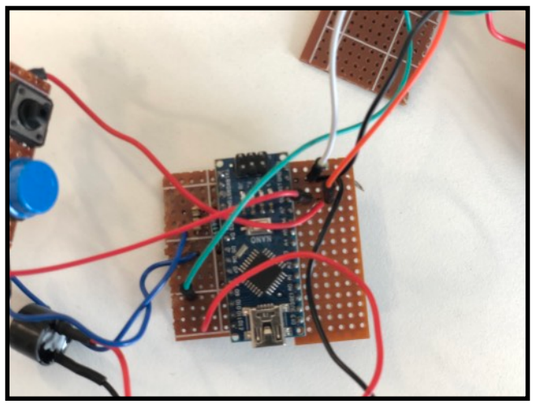


Fig. 3 - Final circuit

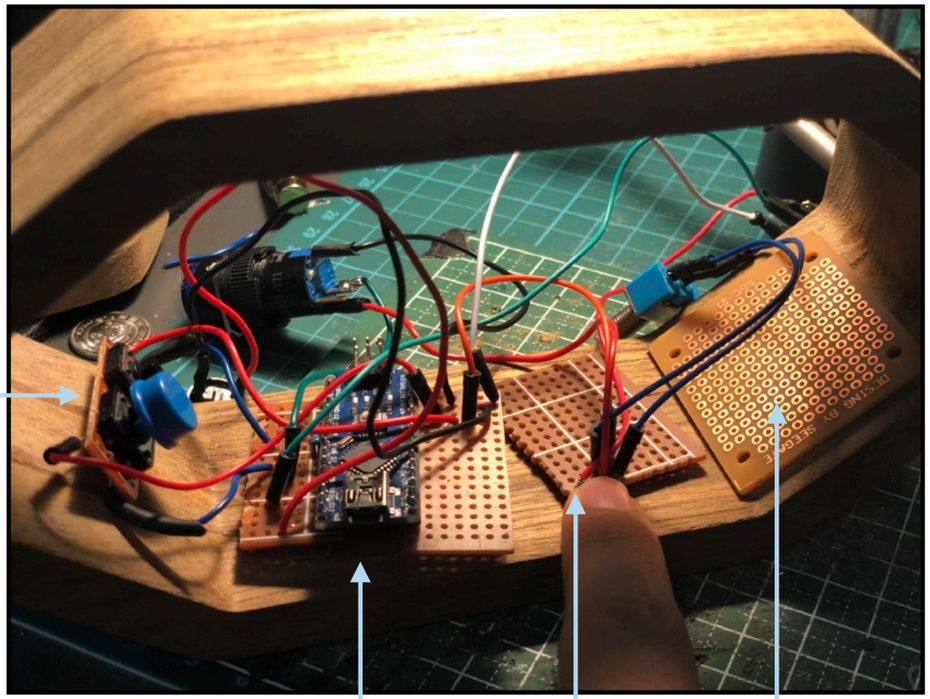


Fig. 2 - Testing to see if the final circuit fits in the housing

Production Process

Going through the process of producing the acrylic pieces and attaching the watch housing

Task 5 & 6 28/11 - 2/12

- Cutting the user interface and backplate in card
- Checking them to make sure components fit
- Cutting the final acrylic pieces
- Coloring in the text

1 My first step was to add the necessary text to the two pieces by using adobe illustrator. I then uploaded my sketch to the laser cutter.

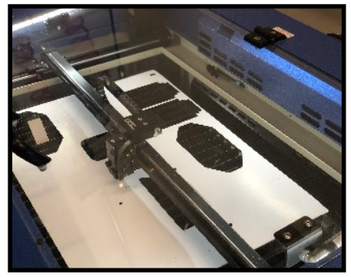


Fig. 1 - Laser cutter

2 I first cut the sketch out of card to make sure all the components fit, then I proceeded to cut the sketch in acrylic.

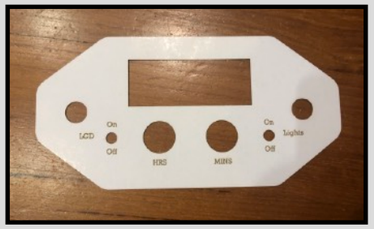


Fig 2. - Card prototype of user interface

3 One I ensured that everything fit in the user interface and backplate I began the process of coloring in the text. I mainly stuck with white except for the On and Off where I used green and red accordingly. I did three layers of color with an interval of 10 minutes to let the paint dry in order to maintain accuracy.

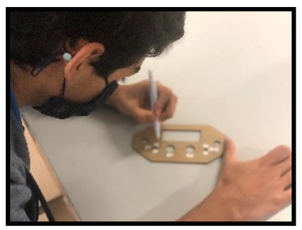


Fig 3 - Working on the interface

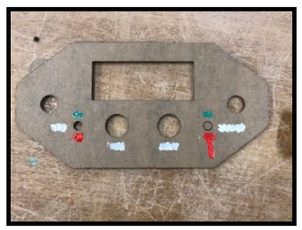


Fig 4 - Letting the final layer dry

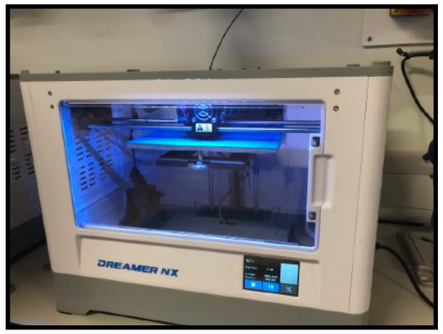


Fig. 1 - 3D Printer

1 After ensuring the CAD of the charger housing was scaled properly, I uploaded the file to the 3D printer. The process of printing took 3 hours. It's important to make sure that all the settings (e.g temperature and spacing are set properly.

Task 7 & 8 2/12 - 8/12

Fig. 2 - Printed Housing

Fig. 3 - Charger in housing

2 After certifying that the product had no scratches or deformations I quickly tested it for size as I fit the watch charger in it. It was thin enough to allow the charger to poke out to charge the watch while also having a big enough groove to fit the charger.

Fig. 4 - Drilling the hole

3 The first step was to sketch a roughly 1.5cm by 0.7cm rectangle on the center of the body using a ruler and pencil. This hole would be for my charger cable to pass through. I used a 8mm bit to drill the hole. To maintain quality and accuracy I ensure the bit was 90 degrees to the surface.

4 By using a flat and round micro file I was able to file out the rectangular shape for the charger that fit the cable through it. An important consideration was making the sure the hole was as small as possible. If the hole was too big then it would become obvious, even with the watch housing on top of it.

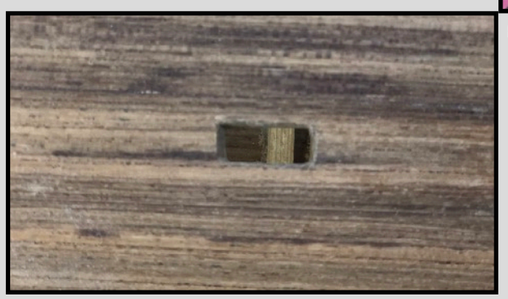


Fig. 5 - The hole after being filed

Fig. 6 - Micro file next to the hole for the cable

5 Once the housing was prepared for the two stages of gluing with epoxy resin. The first being gluing the apple watch charger to it's housing. One problem was that in the process, some epoxy got on the front of the charger and left a stain. Unfortunately trying to scrape it off and paint over it did not work well so I had to leave it as it was.

6 Next I used a ruler and pencil to mark out the exact placement for the apple watch charger in it's housing on top of the body. I then applied epoxy resin to the housing and clamped it to the teak body.

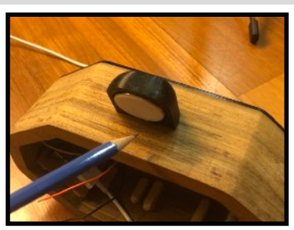


Fig. 7 - Marking out the placement for the charger

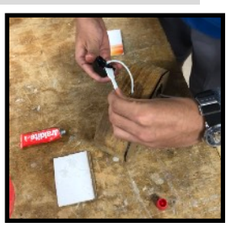


Fig. 8 - Applying epoxy resin to the charger housing

Fig. 9 - Clamping the charger to the main body and letting it dry

Fig. 7, 8. Making sure the charger fits and gluing it to it's housing

7 Cable management is an especially essential skill in my product due to the the small space available for the large circuit. As a result, since I was reusing an old long cable I had to fold and zip tie it to make it compact. I then used some hot glue to hold it in place to disrupt it from moving around.

Fig. 9 organizing the charger cord

C1 C2 C3 C4 C5 C6 C7

Production Process

A walk through of installing the circuit into the user interface and preparing the backplate

- **Testing user interface for fit**
- **Attaching components to the interface and back plate**
- **Hot gluing balsa wood to elevate the circuit**
- **Preparing backplate for the installation of the circuit**

Task 9 & 10

10/1 - 18/1

1 After peeling off the the paper from the acrylic pieces, I checked both the interface and back plate to make sure the text was intelligible.

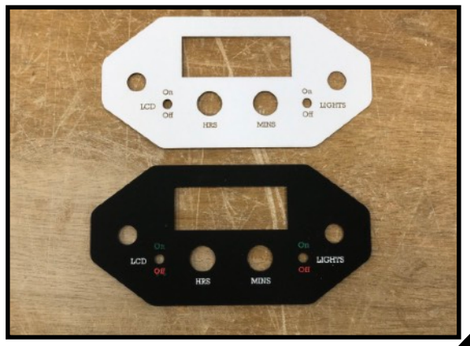


Fig. 1 - Comparison of acrylic piece and card piece (User interface)

2 I made sure that the groove on the front piece exactly fit the interface. When I first checked, the groove was a little too deep so I sanded down the front piece until they were a perfect fit which prevented the interface from shifting in it's position.

Fig. 2 - User interface in the front piece

3 Next, I began the process of fitting the circuit first into the user interface.

- The LCD was able to fit on it's own as it was a tight fit
- The Piezo buzzers were hot glued
- The latch switches were fastened with nuts
- The LED buttons came with their own fasteners but I had to remove them from the circuit and reattach them through the interface

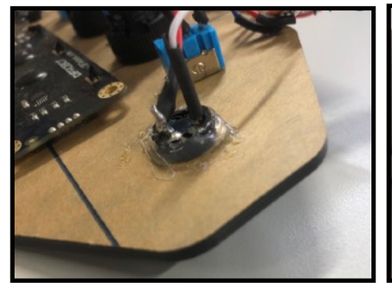


Fig. 3 - Piezo buzzer attached to interface with hot glue

Fig. 4 - Front of interface after all components have been attached

4 I then began to prepare the body for the circuit by hot gluing the pieces of balsa wood meant to hold up the perf boards into the circuit. I first cut different lengths of balsa ranging from 10mm to 40mm. I proceeded to glue to them according to the way I planned my circuit to be structured.

Fig. 8 - Cutting the balsa wood

Fig. 9 - Hot gluing the balsa wood into the body

5 Once the body was ready for the circuit I began to prepare the backplate. I first peeled off the paper and then lined it up with the body to screw the wood screws in. I held the screw drive at 90 degrees to ensure they went into straight. When the holes were made in the teak body I removed the screws and used a counter sink drill bit to drill a groove in the holes of the backplate that allowed the screws the rest flat against the surface

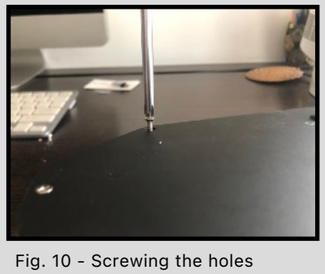


Fig. 10 - Screwing the holes

Fig. 11 - Counter sunk drill bit

Fig. 12 - Drilling the grooves

Fig. 13 - View of the backplate

Fig. 5 - Interface when the circuit is on

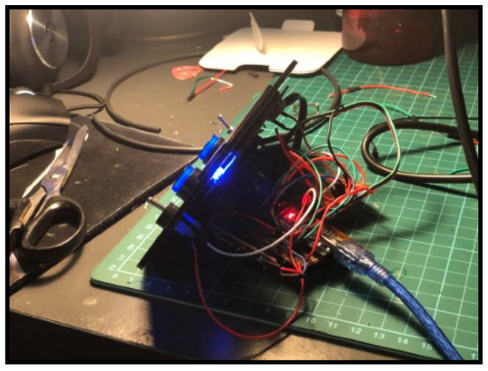


Fig. 6 - Side view

I then hot glued the perf-board holding the USB female piece that connected to the main USB cable to it's assigned place in the body. This allowed me to pass the cable out of the backplate and insert to rocker switch which turned the charger on an off

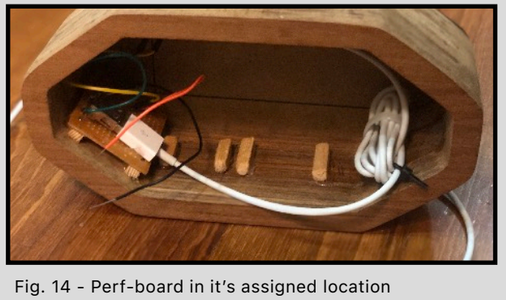


Fig. 14 - Perf-board in it's assigned location

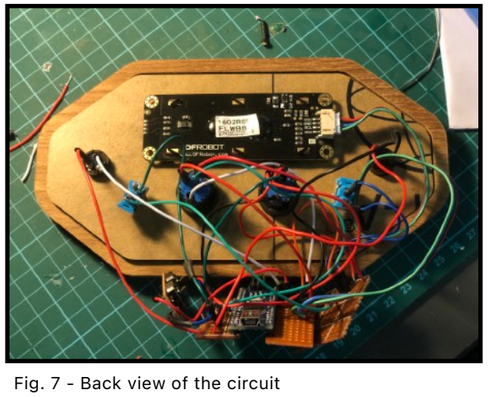


Fig. 7 - Back view of the circuit

C1 C2 C3 C4 C5 C6 C7

Production Process

Task 11 & 12 20/1- 28/1

- **Soldering the power jumpers to usb connector perf-board**
- **Gluing the front piece to the main body**
- **Hot gluing perfboards to the balsa stands**
- **Sand down the front piece**
- **Apply teak oil**

Fig. 1 Preparing to glue the new acrylic piece

Problem

During stage 6, it came to my attention that the area around the apple watch charger was quite stained with glue which had dried. After an attempt to sand it down did not work I decided to laser cut a small platform that would cover the stains. One potential problem was that it may have interfered with the watches leveling. To make sure I didn't I tested the circuit with the platform and it worked.


Fig. 2 Clamping the acrylic piece as it dries

1 When I first glued in the USB connecter perf-board I soldered two open wires to the 5 volt and ground connections so that when I was going to attach the rest of the circuit I could easily solder those open wires to the Arduino nano. The first step was completing this task.

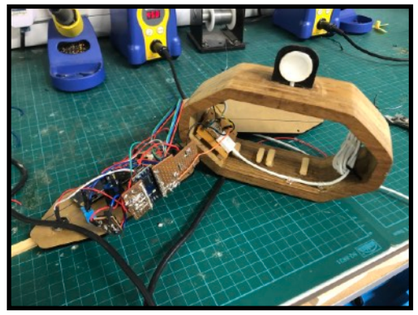


Fig. 4 Connecting the circuit before gluing the front piece

3 Once the front piece was fixed to the body I immediately turned my attention to the circuit. The first step was to arrange the perfboards to their places and then hot glue them to the balsa wood.


Fig. 3 Hot gluing the circuit to the balsa pieces

5 Since the teak body had undergone vigorous sanding in past stages of production it was expected that the front piece was slightly larger. This was easily fixed by sanding the front piece down to be level with the rest of the body.


Fig. 7 Front piece before sanding

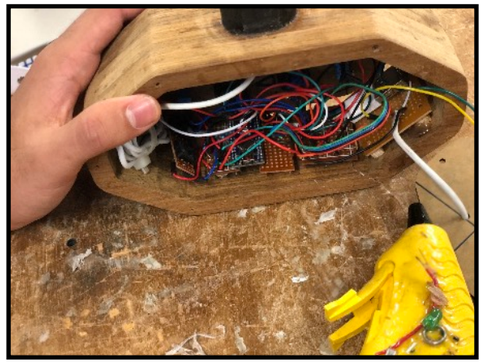


Fig. 5 Hot gluing the circuit to the balsa pieces

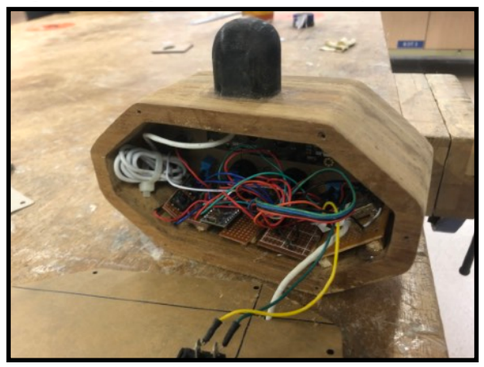


Fig. 6 Circuit installed

6 Once the body was ready, I began the process of applying teak oil to the body. I wore gloves and used a polishing cloth to prevent the oil from getting on me. I applied in three layers and made sure to the tape the acrylic near the surface of the body to prevent any teak oil from getting on it.

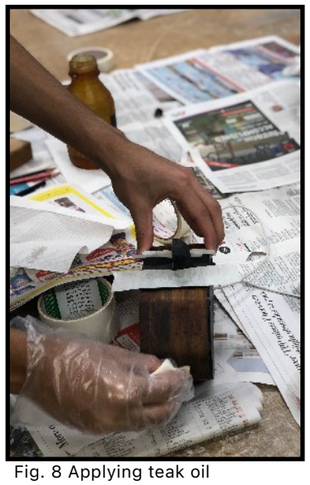


Fig. 8 Applying teak oil

2 Next I temporarily pushed the circuit into the housing and after fitting the interface into the front piece, I glued the front piece to the main body using wood glue. I then clamped it and left it to dry for a day.

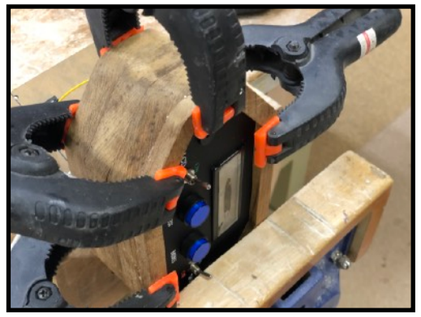


Fig. 9 Clamping the body to let the glue dry

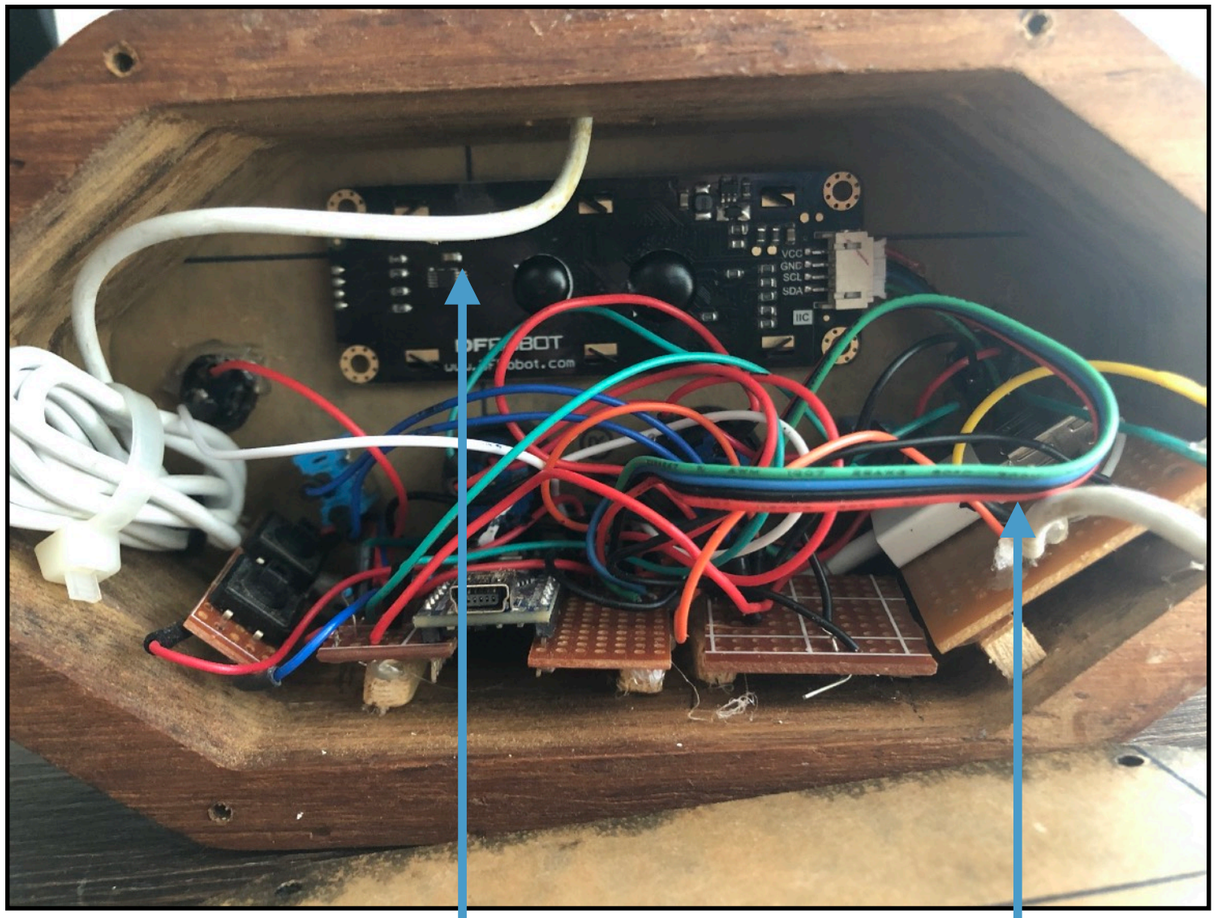
4 Before proceeding I made sure to test the circuit in order to ensure that everything worked as it should.

Fig. 10 Testing the circuit

C1 C2 C3 C4 C5 C6 C7

Justification of modifications

List of modifications and supportive reasoning. Reflection on the design and production process.



C1 C2 C3 C4 C5 C6 C7

Modification 4

I decided to change the back light color to blue so that it matched the push buttons making the product more aesthetic

Modification 3

Since my original plan for the apple watch charger circuit didn't work I had to add a female usb piece

Modification 2

I decided to change from a glossy black acrylic plate to a matte black plate as it doesn't reflect as much light making it easier read

Modification 1

I added a acrylic plate under the apple watch charger to raise the the level of the watch when charging and to also cover up stains that resulted of my gluing of the charger housing to the body

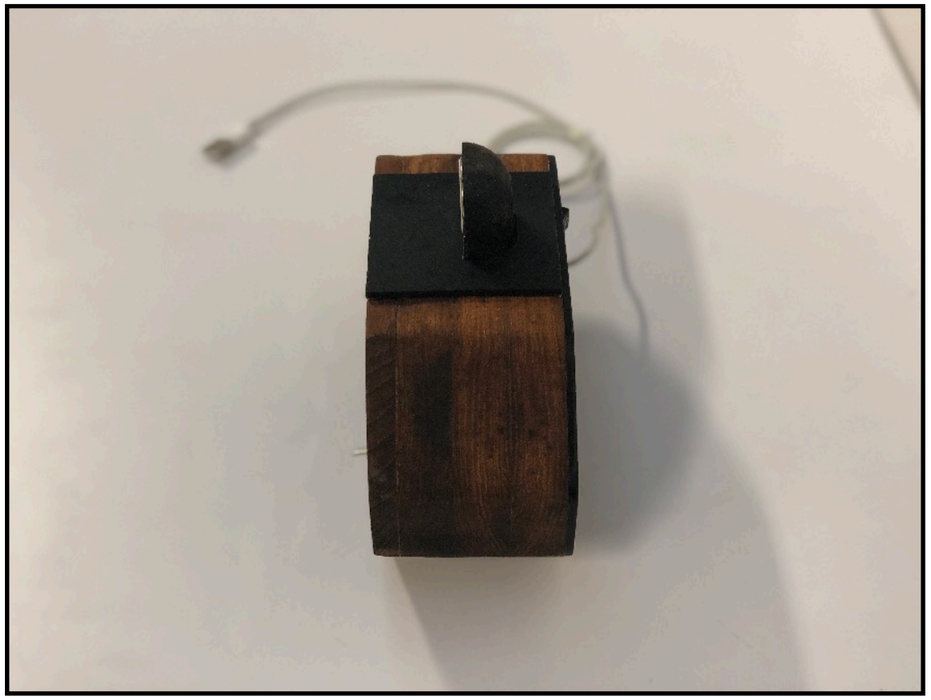
Conclusion

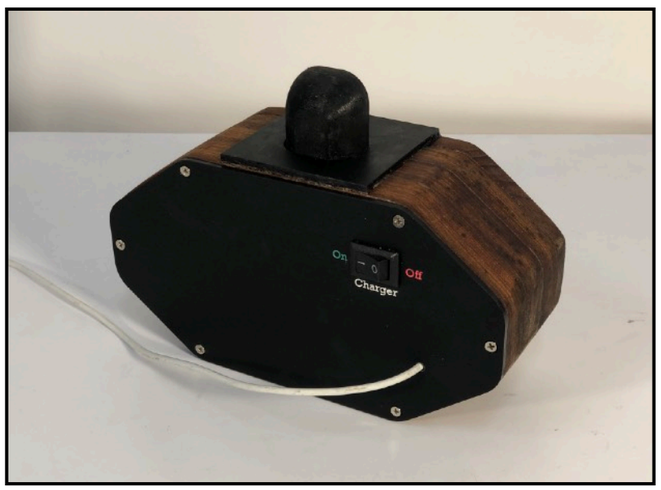
In the end most of the changes were quite minor with the exception of the additional acrylic plate for the charger. I think this was due to a **great deal of planning** on my part. I did my best to a**ccount for most of the problems** I though I might encounter when planning the product. I think for the most part throughout the production process **I worked with a lot of accuracy** however there were some moments when **I rushed ahead or made impulsive choices** that impacted the **quality of the product**. For example I glued the apple watch charger to it's housing to quickly and this resulted in some stains that were extremely tough to remove. Furthermore my eagerness to cut the apple watch cable possibly resulted in a waste of$45 as I had to buy a new one once I realized the circuit didn't work. In conclusion some improvements could be **working through the process slowly and confidently.**

Product Realisation

High quality presentation images of the final product

C1 C2 C3 C4 C5 C6 C7

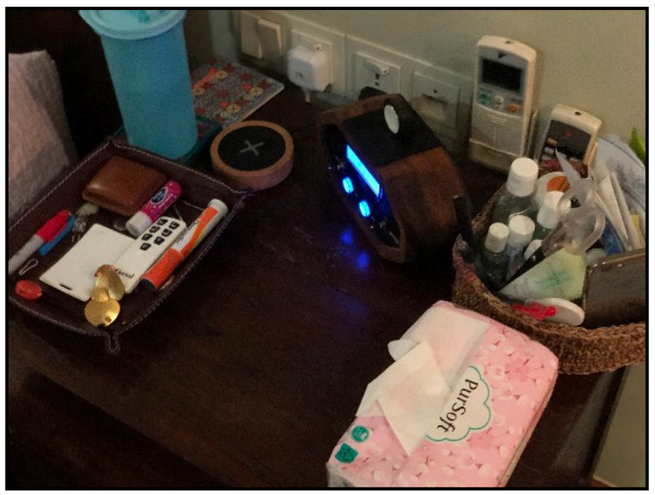




Product in the intended environment

Pictures of the product on Priya's bedside table

C1 C2 C3 C4 C5 C6 C7



Testing and Evaluation in the Intended Environment

Priya using the product in the environment. Analyzing how it fits does and doesn't fit into the environment.

Specification

The product had to fit in with the environment, and compliment it aesthetically.

Positive

The product does seem to match the color of the table quite well and doesn't compliment it. The client seems to enjoy how it looks.

Negative

The client did identify several stains and scratches in the product as a result of the gluing and sanding. Although it is barely visible, it does not add to the aesthetic.

Conclusion

Overall, I think that the product fulfills the expectations of the client although there are a few minor issues regarding the aesthetics (e.g small stains)

Specification

The client wanted a product that could withstand the conditions of the environment.

Positive

Although it isn't a particularly harsh environment, I did make sure to incorporate materials that were water resistant due to the chance of the water bottle next to the product spilling.

Negative

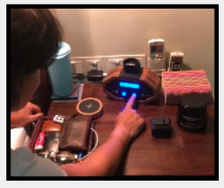
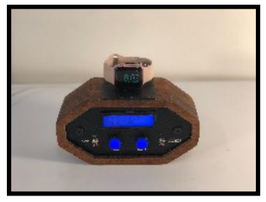
I was not able to make the product entirely stain resistant and while it is resistant to water, I could have maybe raised it off the table slightly to prevent any leaking water from damaging the circuit.

Conclusion

Given that the environment is not demanding, the product meets criteria.

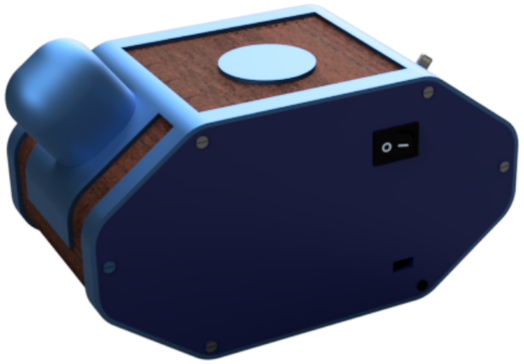
Testing and Evaluation against the Specifications

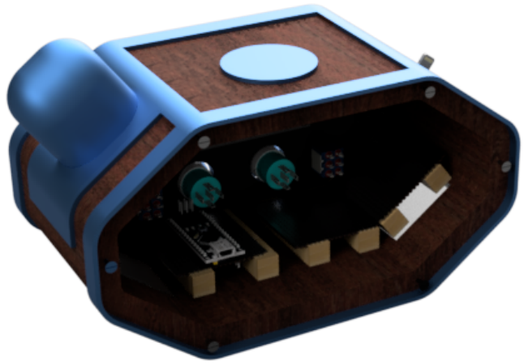
Analysis of the design specifications alongside client feedback

Specification	How was this tested?	Self Evaluation	Score (Out of 3)	Client Evaluation	Score (Out of 3)
• The product must somewhat **match the colour scheme** of the table/bedroom • **Easily be installed** into the environment.	The product was placed in the environment and observed by the client and my self. We also went through the process of installing it.	In my opinion although the table wood is darker than the teak, the product fits in well and it is easy to install as you only have to plug it into a socket.	**2/3**	"I like the way it looks, it was easy to put in but there are some stains on the apple watch charger and it does stand out a bit on my table.	**1/3**
• The client has said that she would like the product to be great quality, but she doesn't want something extremely pricey or over the top. She is willing to pay **$75**	After compiling a list of all the components I went to my client to get her opinion on whether it was too much or too little	Since I broke when apple watch charger when testing the circuit and I had to buy another, it cost quite a bit. The final cost was roughly **SGD $110**	**1/3**	"Although I understand why it costs more than I had planned, I would have preferred if it had been within the planned budget"	**1/3**
• It must also give her the option to be somewhat **environmentally conscious** (minimizing the energy expenditure of the product)	I talked with my client about the different capabilities the product had and showed her how it allows her to save energy when she wants.	I think I definitely achieved this specification as a lot of thought went into giving her the option to switch off the lights for her own comfort and also for the environment.	**3/3**	"I really like the option to turn off the lights and charger whenever I want, it's useful at night and I get to feel good, saving energy"	**3/3**
• In terms of function it must have some sort of alarm that can be **customized** by the client. • It also must have a **functioning clock**	I showed the client the functioning clock and how to set and alarm. I opened the back of the product and showed her how to change the time. 	One of the reasons I made the circuit from scratch was so that I could customize it to my client making it easier fore her to operate the device.	**3/3**	"It's really easy to use, all I have to do is press one button to change the hours on the alarm, and another to change the minutes."	**3/3**
• It also must have a solution to **organising her apple watch more effectively**	Tested the clients apple watch with the device and showed her the results. We also talked about whether the method suited her needs for her apple watch. 	I went one step beyond allowing her to organize her apple watch. I created a platform where she could charge the apple watch saving space on her bedside table as she no longer needed a separate charger.	**3/3**	"The apple watch charger is one of my favorite features! It looks nice on top of the clock and I get to save space."	**3/3**

Proposals for Further Developments

In this page I will explore a possible future development to my product. It includes improvements to both the circuit and body, building upon the aesthetics in the previous product.



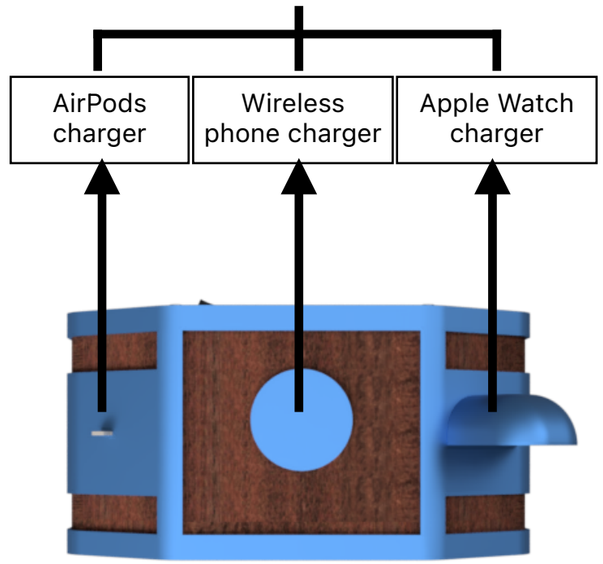


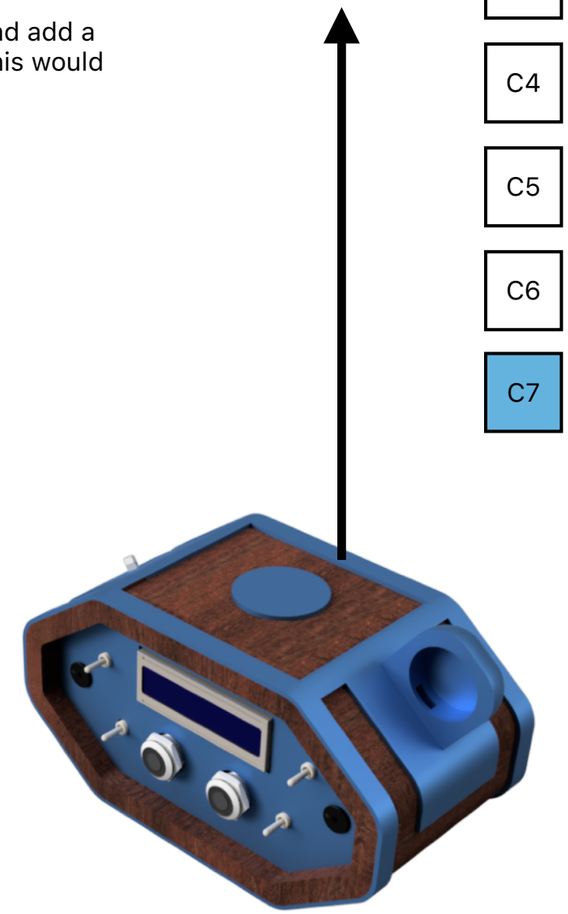
To improve the security and resist dents and scratches, I designed several aluminum pieces (10mm in diameter) that wrap around the body protecting the edges. I also gave the apple watch charger and AirPods charger their own bottom plates made out of folded aluminum. Aluminum being malleable and lightweight made it perfect for the job

The aluminum edge cover on the back will be positioned so that it ends with the acrylic backplate creating a aesthetic back of the device

I decided to move the apple watch charger to the side and add a wireless phone charger alongside an AirPods charger. This would allow the client to charge three products at once.

The rocker switch on the back will turn off and on all three chargers





Colour

As a part of improving the product I chose to change the color scheme. Instead of keeping the black acrylic and PLA, I switched to a blue. However, given that my product will have aluminum, PLA, and Acrylic that all need to be blue. It's improbable I will be able to obtain the exact same shade.

Circuit

One problem is that I doubt the same Arduino nano will be able to manage the RGB LEDs, I may need another. There is also the danger of powering too many devices with the one usb cord. I'll have to be careful to do a lot more research in that if I decide to go forward with the development.

These two squares of frosted acrylic will have RGB squares behind them combined by an Arduino.

With the addition of the RGB LED's, I decided to add two switches to control theme. One toggle switch will turn the LEDs on and off, the other will switch between two color modes, Rainbow and Ocean.

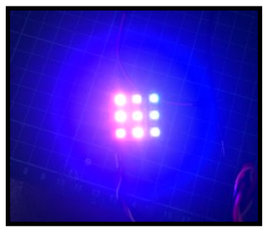


Fig. 1 LED Square when it's on

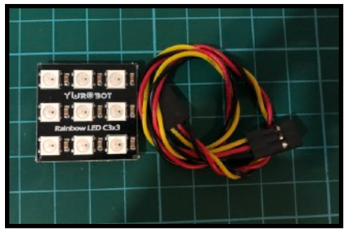
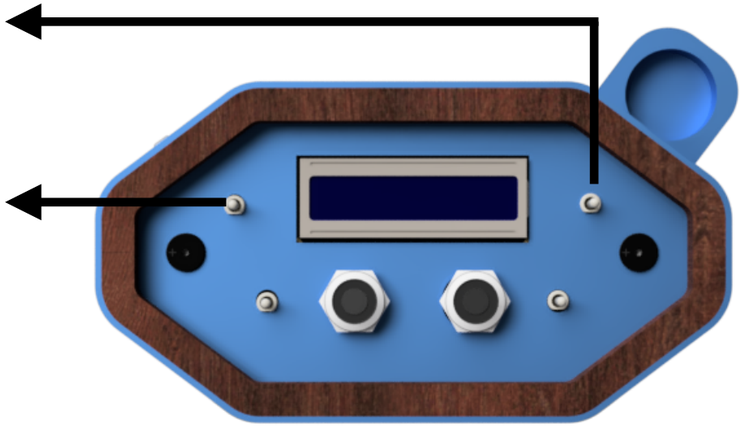


Fig. 2 LED Square (3x3)



This is the code used for my product


```
#include <Wire.h>
#include "DFRobot_LCD.h"
DFRobot_LCD lcd(16,2);
int r,g,b;
long Time;
long Alarm = 0;
int colour = 0;
long adj;

const int LCDswitch = 8;
const int buttonone = 9;
const int buttontwo = 7;
const int buttonthree = 5;
const int buttonfour = 3;
const int buzzer = 12;

void setup() {
  Serial.begin(9600);
  adj = 50;

  lcd.init();
  lcd.setCursor(0,0);
  lcd.print("Time:");
  lcd.setCursor(0,1);
  lcd.print("Alarm:");
  pinMode(buzzer,OUTPUT);
  pinMode(buttonone, INPUT);
  pinMode(buttontwo, INPUT);
  pinMode(buttonthree, INPUT);
  pinMode(buttonfour, INPUT);
  pinMode(LCDswitch, INPUT);
 r = 10;
 g = 10;
 b = 200;
}


 void loop() {
//Serial.println(colour);
  long Time = millis()/1000 + adj;
  render(Time, 6, 0);

  // render(alarm, 7, 1);
  int b1 = digitalRead(buttonone);
  int b2 = digitalRead(buttontwo);
  int b3 = digitalRead(buttonthree);
  int b4 = digitalRead(buttonfour);

  if (digitalRead(LCDswitch) == HIGH){
     lcd.setRGB(0, 0, 0);
}

else {
  lcd.setRGB (r,g,b);
}


  if(b1 == HIGH){
    Alarm += 300;
  }

  if(b2 == HIGH){
    Alarm += 3600;
  }
    if(b3 == HIGH){
    adj += 60;
  }

  if(b4 == HIGH){
    adj += 3600;
  }

render(Alarm, 6, 1);
    if ( Alarm == Time ){
lcd.setRGB (200,10,10);
tone(buzzer,5000);
delay(500);
noTone(buzzer);
delay(500);
  lcd.setRGB (10,200,10);
tone(buzzer,5000);
delay(500);
noTone(buzzer);
delay(500);
  lcd.setRGB (10,200,10);
tone(buzzer,5000);
delay(500);
noTone(buzzer);
delay(500);
  lcd.setRGB (200,100,10);
tone(buzzer,5000);
delay(500);
noTone(buzzer);
lcd.setRGB (r,g,b);
  }

void render(long Time, int x, int y) {
  int second = Time%60;
  int minute = ((Time-second)%3600)/60;
  int hour = ((Time-second-
minute*60)%86400)/3600;
  lcd.setCursor(x, y);


  if(second%2 == 0) {
    lcd.println(String(hour) + ":"  +
String(minute) + ":" + String(second) + "
");

  } else {
    lcd.println(String(hour) + " " +
String(minute) + " " + String(second) + "
");
  }


}
```

Defines the variables

Prints on the LCD
Alarm:
Time:

More Variables