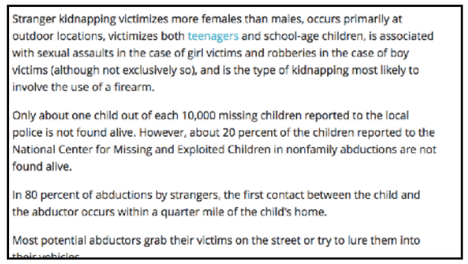
What is the problem?

After talking to a parent of a 3 year old child, she raised a concern that her child runs away every few minutes and has to run after him to make sure they do not go too far, this is tiring and challenging for the parent. It becomes really hard for her whenever she is outside for example: malls, crowded MRT stations. The parent is also becoming worried about losing the child to kidnappers, even though Singapore is very safe, their are still the stories of men in white vans.


Stranger kidnapping victimizes more females than males, occurs primarily at outdoor locations, victimizes both teenagers and school-age children, is associated with sexual assaults in the case of girl victims and robberies in the case of boy victims (although not exclusively so), and is the type of kidnapping most likely to involve the use of a firearm.

Only about one child out of each 10,000 missing children reported to the local police is not found alive. However, about 20 percent of the children reported to the National Center for Missing and Exploited Children in nonfamily abductions are not found alive.

In 80 percent of abductions by strangers, the first contact between the child and the abductor occurs within a quarter mile of the child's home.

Most potential abductors grab their victims on the street or try to lure them into

Statistics of Child Kidnapping

News Report on Missing Child

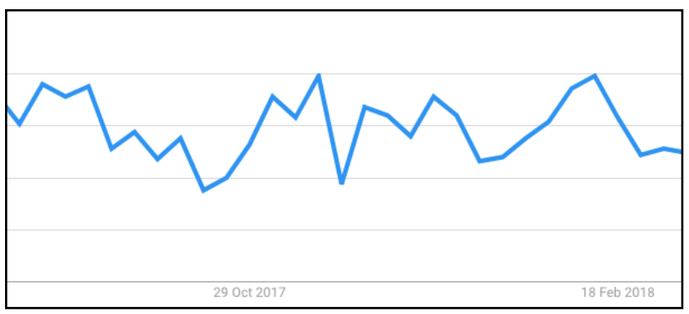
Child Running Away

By Taking on such a project, the following may apply:

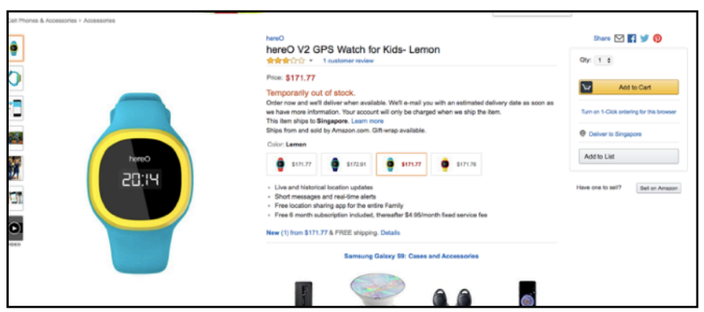
Pros
- An opportunity to use my electrical skills.
- Might help someone in need, has a realistic problem.
- It has a large market.
- It's new technology.
- It can be easily tested.

Cons
- It was end up very small.
- It is time absorbing.
- Since it's new technology, there are no kits.
- It's difficult to test on the field because it's a danger to the kid.
- Could be expensive as it is new technology.

1. The solution should be **small** and **compatible** as it may need be able to fit on the child.
2. It should be **durable**, able to sustain the child's falls.
3. Small and **lightweight**, not bulky
4. **Affordable**
5. **Wearable**
6. Not interfere with the child's comfort



Interest of Child Trackers (Google Trends)



Existing Product (Amazon)

C1 C2 C3 C4 C5 C6 C7

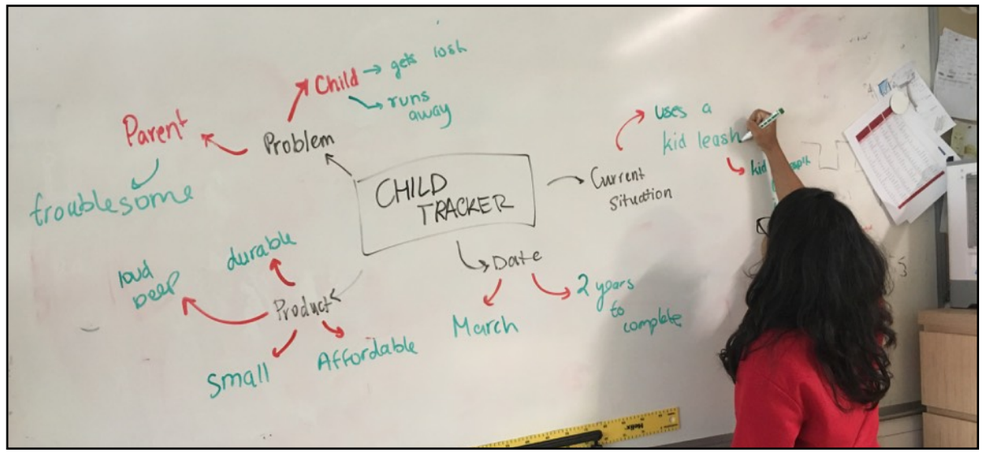
Hope to achieve

By designing a successful product, I hope to achieve the number of children kidnapping to decrease, as well as more child safety in Singapore. I hope that by designing this product, the children will not get lost in small places such as malls and shopping centres as well, especially when it's crowded. This will decrease the parents anxiousness about their children as well and increase family happiness.

Clients and Users

The client will the be parents, while the users are the children. The client wants the beep to be **loud** enough to be heard In a large crowd. While the user does not want this as it can scare them. The user wants the product to be a **bright colour** so that it's attracting to them. The client also wants it to be **waterproof** and **not too small**, so it can withstand the rain and the child should not swallow it. The user does not want the product to come in their way while playing and moving around.

Brainstorm and Brainstorm Summary



I did this brainstorm to From the brainstorm, I have come to the conclusion that my product should solve the product of the **child getting lost in crowds and running away**. The product should **not be too troublesome** for the parent either. What currently happens is that the parent uses a **kid leash**, but the kid does not like these constraints and usually **cries** until he's out, this is troublesome for the parent as well as the child. The product should be **durable**, to be able to contain the falls of the child, **affordable**, in the price limit, small enough to be **wearable** and should have a **loud beep**, so it's easier to find the child. The product should also be finished by the end of the two years, in **March 2019**, before IGCSE, therefore giving me time to test my product as well.

What does the client want?

C1 C2 C3 C4 C5 C6 C7

Transcript of Interview

Me: The product is a child tracker, there are two circuits, the transmitter will produce a frequency and when the receiver stops receiving the frequency, the receiver will start beeping.
Me: What are some specifications that this products should have?
Client: Specification such as if the child is far away, the beep should be **loud** enough to be heard in a crowded place. It should also be **small, lightweight and durable**. I would like it to be easy to wear, for example it can be attached to my shirt, or as a watch on my wrist.
Me: For the child, would you rather have it on his shirt or on his wrist?
Client: I think it would be better **as a watch** as it may fall off his shirt.
Me: What are some aspects or specifications that would stop you from buying this product?
Client: If it was too expensive I wouldn't buy it as there are **cheap**er products in the store. **Simple to use**, everything should already be set up.
Me: Some previous products you use?
Client: I have tried using the kid leash.
Me: What are some problems of these products?
Client: The child wants to come out of it as it restricts his movements and freedom. It becomes too troublesome for me.
Me: Do you have some budget range in mind?
Client: Within $100.
Me: What do you think about the product?
Client: This is a useful product because when the child gets lost in a large crowd, it would be easier to find them.

The Interview

Current Situation

The current situation of the client is that they use a **Kid Leash** for their child. The problem that they face with this product is that the child does not like being leashed and therefore cries until he's out. This creates a problem for both, the child and the parent. The parent has to take the child out and therefore the leash is useless. They still need to chase after the kid and make sure that he doesn't get lost. Furthermore, there is a risk of the child getting hurt by the leash. **So the problem is not solved.**

Problems of chasing after kids

Current Situation - Kid Leash

Kid getting lost in crowd

Crying he doesn't want to stay in Kid Leash

Needs and Wants of the client:

Needs

- Small
- Durable
- Loud beep
- Within $50
- needs to be useful for large crowds
- Gives the child freedom and not feel like he's suffocated
- Child would not resist wearing it.

Wants

- Simple looking
- 100 meters range
- Wearable for the parent (on the shirt)
- Wearable for the child (on the wrist)
- Lightweight - not too bulky
- Preferable in his favourite colour: Blue

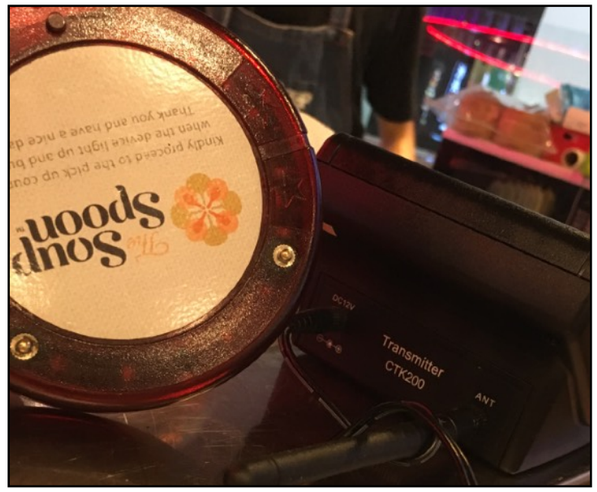
Design Brief

I am going to design and make a **Child Tracker**. This product is going to be used by parents in order to **help them not to lose their child in crowed places, playgrounds and more** and that will prevent the children from **being kidnapped or going missing.** My client is **a parent of a two year old child** and represents the market of concerned parents. My client only spends around SDG$100 on this sort of thing so I should try to keep the cost **below SDG$50.** I will have hopefully completed the product by **early December 2019** which should give my client enough time to test it and I should have it fully completed by March 2019.

What's already in store? - Products

C1 C2 C3 C4 C5 C6 C7

These are existing products of **transmitters and receivers**. These products are useful as my final product is going to have two components: transmitter and receiver. I use these existing products to see what kind of shape would be best for the users to use and what should be on the **interface**.



Restaurant Pager

Aesthetics
Round and lights up when the transmitter transmits a frequency.
Cost
US$14 for each pager per day
US$30 for each transmitter per day
Customer
Customer: Restaurants
User: Customers of the restaurants
Environment
Usually cold, aircon, food and liquids may be dropped on them.
Safety
Lightweight, thick insulation and can't be opened easily
Size
Easy to store, receiver is small enough to hold comfortably - 9.5cm in diameter
Function
To let the customer know when their order is ready
Material
Both, the receiver and transmitter are made of plastic

Child Tracker (Oval-Shaped)

Aesthetics
Oval shape, making it easy to grip. Has a button on the interface.
Cost
For the product - US$5
Device works with a phone (required)
Customer
Customer: Parents, amusement parks
Primary User: Parent(s)
Secondary User: Child(ren)
Environment
Different environments: Public places, will experience different seasonal changes as it's portable
Safety
Lightweight, can be used as a badge and attached on the child
Size
Easy to store, receiver is small enough to fit in child's hand or bag. - 1.2 x 2 x 0.4 inches
Function
To find when the child is out of a range and use an alarm to find them.
Material
It is made out of plastic

Child Tracker [Square]

Aesthetics
All edges are curved, there is an on/off button on the interface as well as a small hole for light. The top is removable, but not easily.
Cost
For the product - US$3
You need to have a phone (as the device works with the phone)
Customer
Customer: Parents, governments, amusement parks
Primary User: Parent(s)
Secondary User: Child(ren)
Environment
Different environments such as wet environments, seasonal changes and public places.
Safety
Lightweight, but it can be opened easily, causing chances of electrocution.
Size
Small and can be stored anywhere. - 4cm*4cm*0.5cm
Function
To find when the child is out of a range and use an alarm to find them.
Material
It Is made out of black

PROS

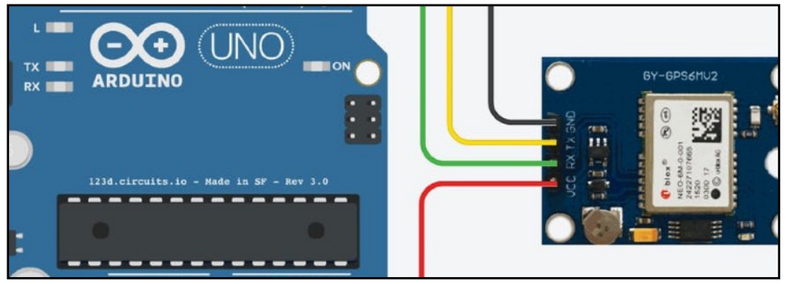
- **Restaurant Pager:**
  Lights and buzzes when alarmed
- **Child Tracker [Square]:**
  Small and compatible
- **Child Tracker (Oval-shaped):**
  Can be attached easily

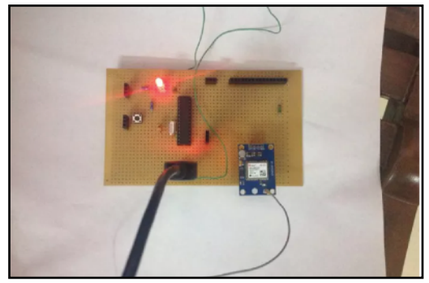
CONS

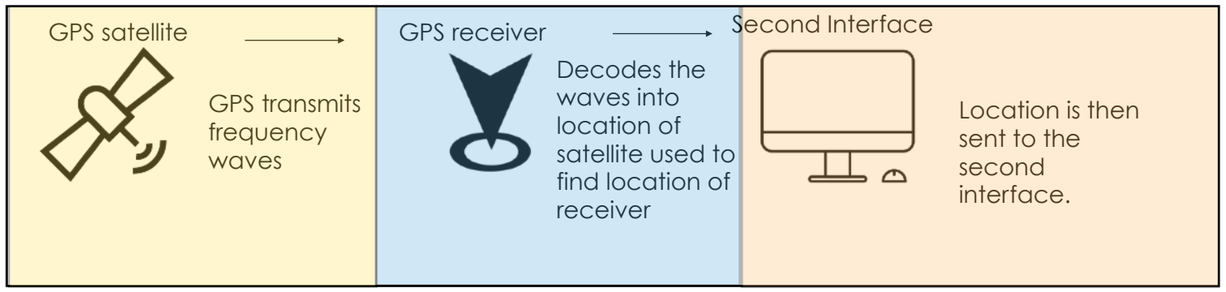
- **Restaurant Pager:**
  Bulky, can not fit everywhere.
- **Child Tracker [Square]:**
  Could fall out of child's bag.
- **Child Tracker (Oval-shaped):**
  Chid can on/off the tracker

What's already in store? - Circuits

GPS Arduino Circuit

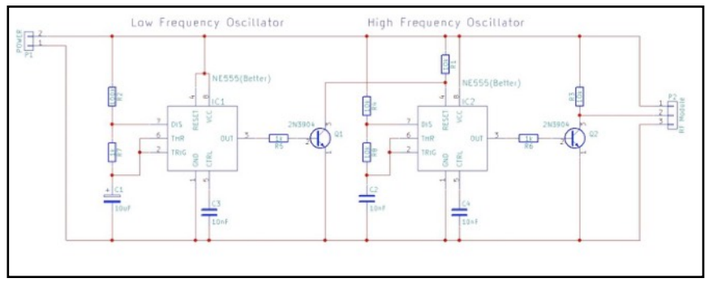


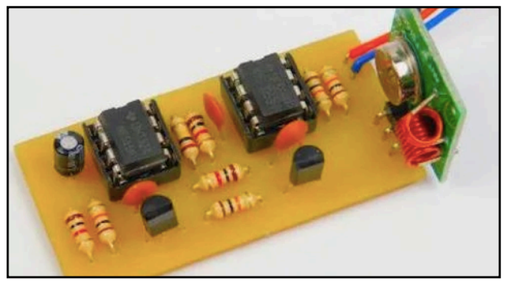


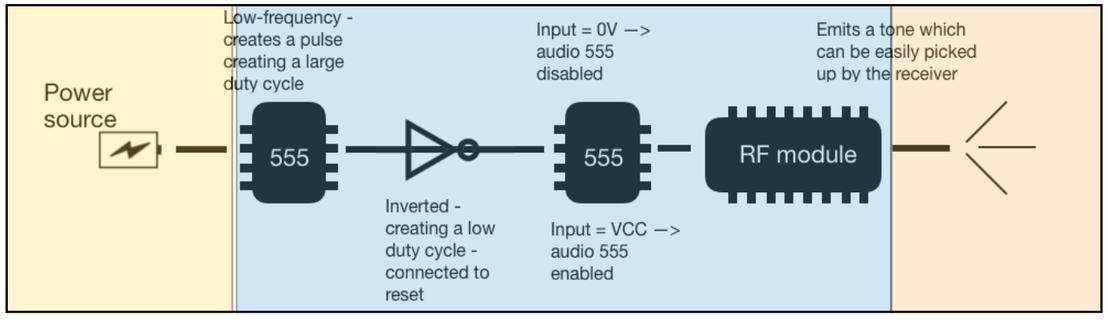


INPUT	PROCESS	OUTPUT

RF Beacon Transmitter



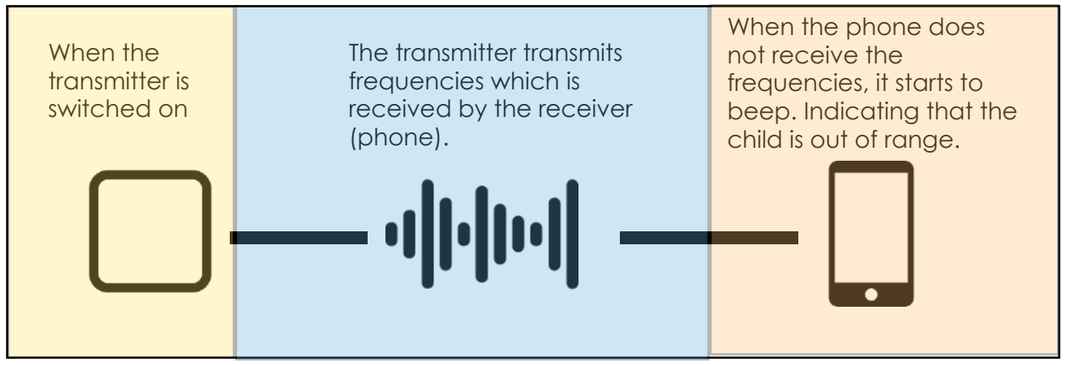




INPUT	PROCESS	OUTPUT

These are circuits used for **tracking**. There are two types of circuits: Receiver and Transmitter. Gaining knowledge of the **range** of existing circuits will help me to gain inspiration for the circuit that I am going to make for my final product.

Child Tracker Circuit

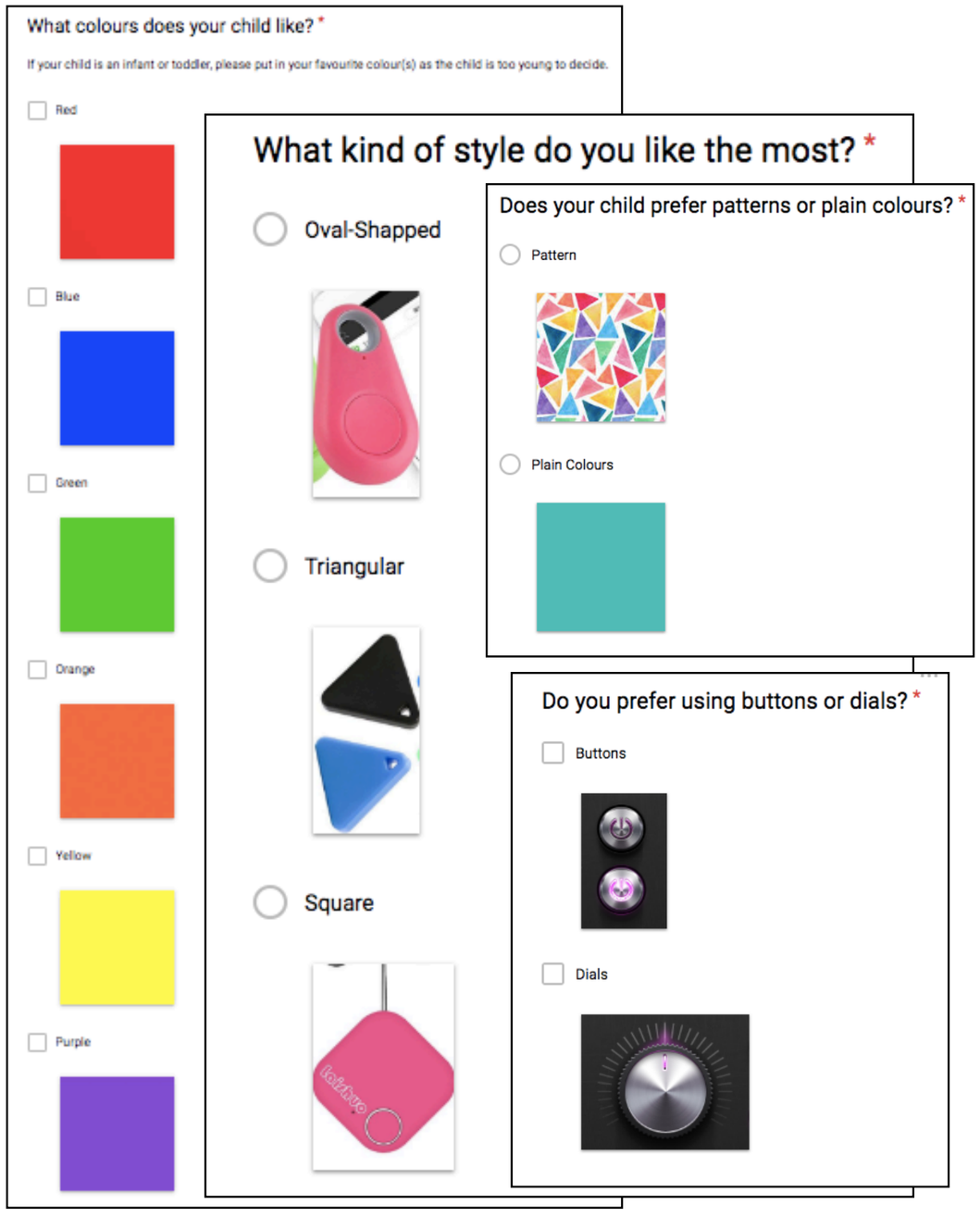


INPUT	PROCESS	OUTPUT

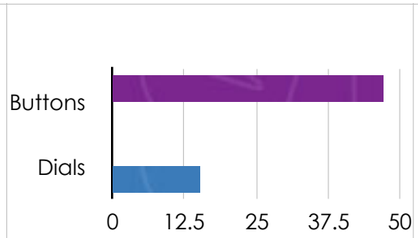
PROS	CONS
- **GPS Arduino Circuit:** I have the skills to make this circuit - **RF Beacon Transmitter** Has been used in past trackers - **Child Tracker Circuit** It works as I have tested it out.	- **GPS Arduino Circuit:** The second interface is digital. - **RF Beacon Transmitter** Receiver needs to be specific. - **Child Tracker Circuit** Will take time to make.

What do other people like?

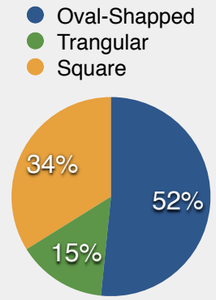
I conducted a survey on my product for parents to take. This is for me to see the specification of what I should place on the interface (aesthetics) as well as to recognise (if there are) any pattern between boys and girls, or the number of children. For example if parents with one child usually spend less on such products than parents with two children.



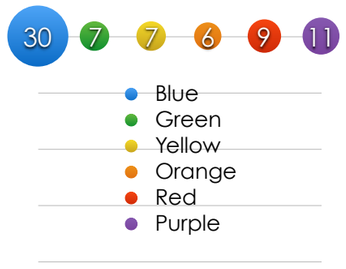
My final product will contain **buttons** rather than dials.
Therefore I will have to research what kind of buttons to put, and how and where to put them on my final product's interface.

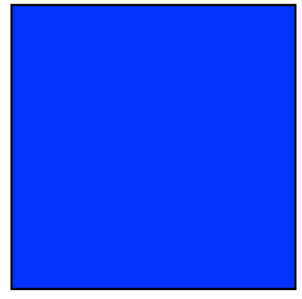


My final product will be **oval-snapped**, similar to the product shown.
Therefore I will research how to make my product oval shaped and what material can be made into such a shape, without having any sharp edges as well as how to put a hole in it.

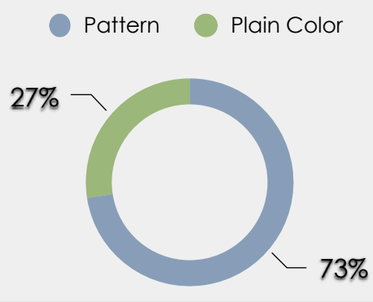


My final product will be **blue** in colour.
Therefore I will need to research where to buy blue material from or how to make the material I am using into blue so that the colour does not come out due to water.





My final product will have **patterns** on it.
To do this I need to research what patterns are most effective for children and how to add the pattern onto my final product's material so that it does not come out due to water.



- From my survey, I have found out that **33.5%** of the responses had at least one child from age 1-5, showing that my product is in demand.
- **52%** of the responses chose the oval-snapped, most of them said that this was because it was easy to grip and carry, that my product should be as well.
- **54.8%** had two children, therefore the tracker can be used for the elder child as well: Making them a secondary user

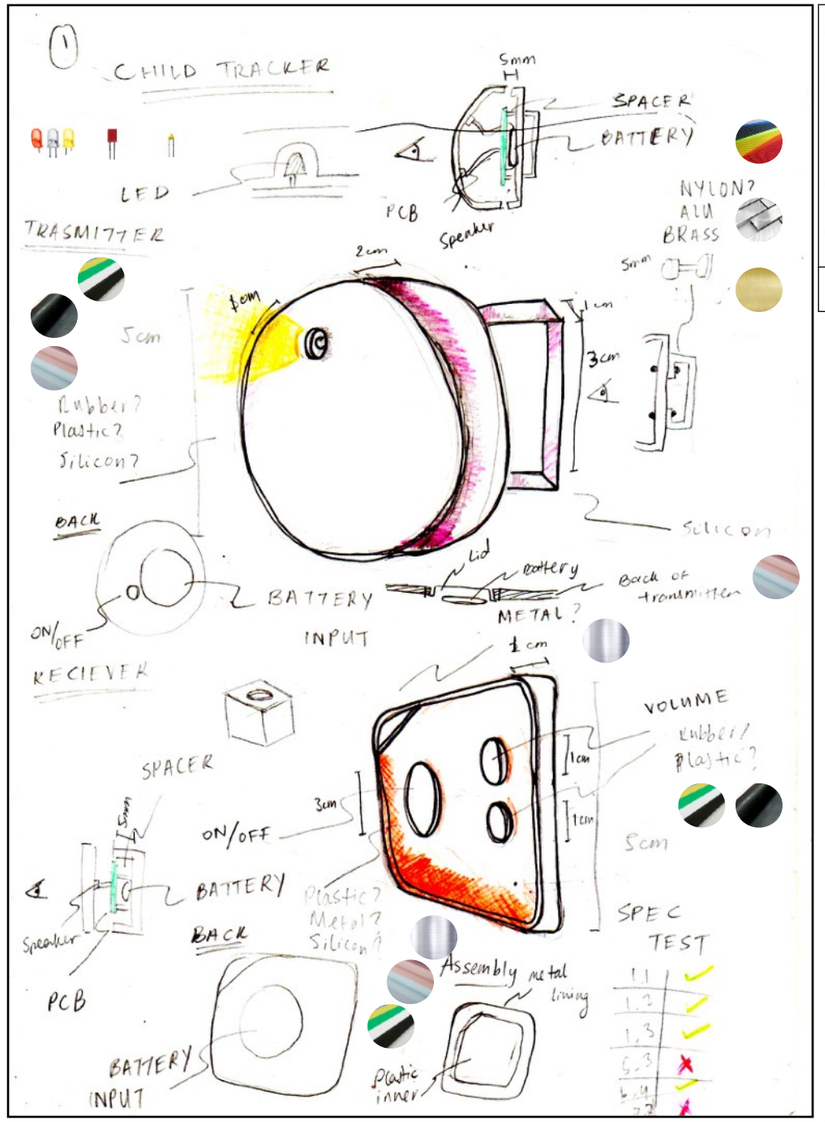
What is my product going to have? - Specifications

C1 C2 C3 C4 C5 C6 C7

1.0	**Aesthetics**	
1.1	The transmitter will be **wearable**	It needs to be able to stay on the child and not come off and my client wants it to be a watch.
1.2	The product should be split into two parts: **receiver and transmitter**	The transmitter is for the child and the receiver is for the parent
1.3	The receiver will have an **interface**, the transmitter will not.	The child should not be able to switch the product on and off, while the parent should.
2.0	**Client**	
2.1	The primary user is the **child**	The child will be the one using the transmitter
2.2	The secondary user, and the consumer is the **parent**	The parent will have the choice to buy this product, and they will be using the receiver
2.3	The client could be the **government, amusement parks, etc.**	They can sell the item to the parents, as it would be beneficial for their economy and security.
3.0	**Cost**	
3.1	The total cost of the project should not exceed **$200**	Including the research and prototype, which would take extra money that may be used.
3.2	The total cost of the product should not exceed **$100**	The high cost is due to the value the parents see for this product - **I will keep the receipts of the components**
4.0	**Environment**	
4.1	The product will be used in a **wet** environment, such as a swimming pool.	The product may be used in rain and swimming pools. - **I will use the final product in a wet environment**
4.2	The product will be used in a **hot** environment.	The product will be used outdoor, it may be sunny, hot and humid.
4.3	The product will be used in a outdoor, **harmful** environment	The child may fall over, the product should be able to sustain the falls.
5.0	**Safety**	
5.1	There will be **double insulation**	The child or parent should not be electrocuted.
5.2	The weight of the transmitter will not exceed **250g**	The product should not be too heavy for the child - **I will weigh the final transmitter using a balance.**
5.3	The transmitter will **not** be **openable**.	The child should not be able to tramper with the circuit in the transmitter.
6.0	**Size**	
6.1	The transmitter must not occupy a volume more than **2.5cm X 2.5cm X 1cm.**	It should be small enough to fit on the child's wrist.
6.2	The receiver must not occupy a volume more than **5cm X 5cm X 2cm**	It should be small enough to fit in handbags. - **I will measure the final receiver using a ruler**
6.3	The weight of the **receiver** should not exceed **250g**	It should be comfortable for the parent to carry
6.4	Should be a **portable** size	It will be taken around, not just used in houses. But not too small that the child can swallow it.
7.0	**Function**	
7.1	It will be able to tell when a child **exceeds an area limit**	The transmitter should let the parent know when the child has exceeded the area range.
7.2	It will be **appealing** for the child	The child should not resist wearing the transmitter.
7.3	It will be **safe** and **portable**	It should be safe and comfortable for the child and portable to carry around.
8.0	**Materials**	
8.1	It should be **durable**	It should not break if the child's falls
8.2	It should be **waterproof** to one meter	It should be able to be operated in a swimming pool and waterpark
8.3	It should be **lightweight**	The child and parent should be able to carry the product, my client wants it to be lightweight.

What can the product look like?

- Asthetics
- Saftey
- Size
- Function
- Material



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S	✗	✓	✗
S	✗	✓	✓
F	✓	✓	✓
M	✓	✗	✓

9/16

A	✗	✓	✓
S	✗	✓	✗
S	✗	✓	✓
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M	✓	✓	✓

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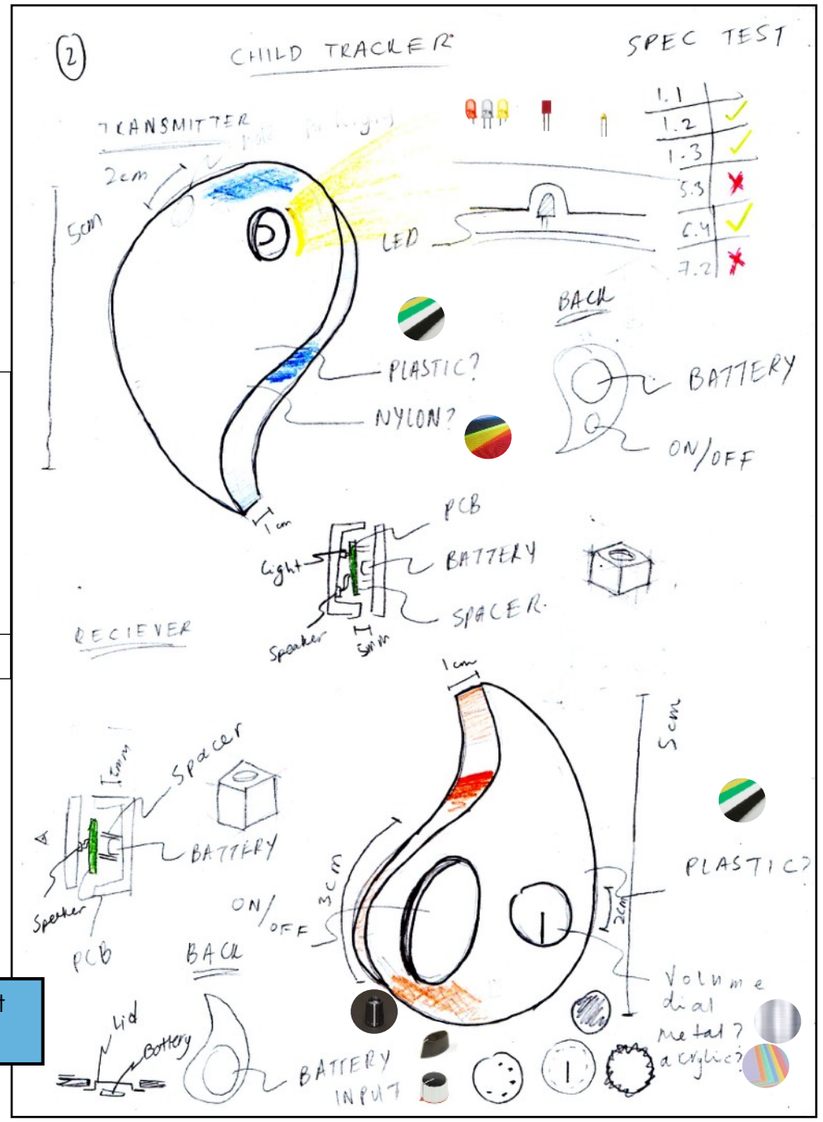


What I think

What my client thinks

Idea #1

This product fits most of my specifications, however it is not appealing for the child, which can be done easily by adding patterned material. It is also relatively easy to make, yet it does contain a number of materials.

👎

👎

Child friendly design. Can be made attractive by adding pictures and attractive colours. Should be sturdy and not made of material which is easy to break because children are not careful.

Idea #2

As these two pieces fit together like a ying-yang, it will be appealing for the child as well as being made of a colour that is most children's favourite according to my survey. However making it to fit would be hard and time consuming.

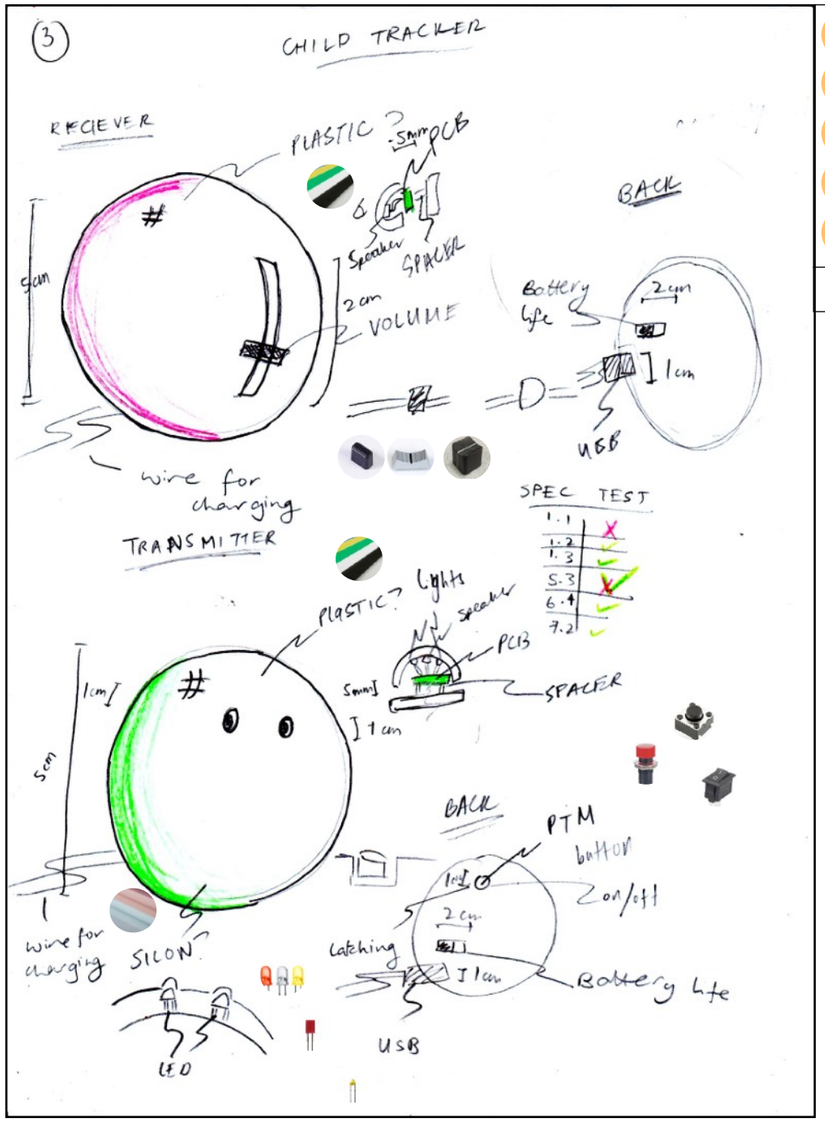
👍

👍

The product is battery operated so there is no worry to charge it but battery should last at least a couple of months to make it useful. Also, it can be easily lost as it can only be carried in child's clothes pockets or a bag may be.

C1 C2 C3 C4 C5 C6 C7

What can the product look like?



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A	✓	✓	✓
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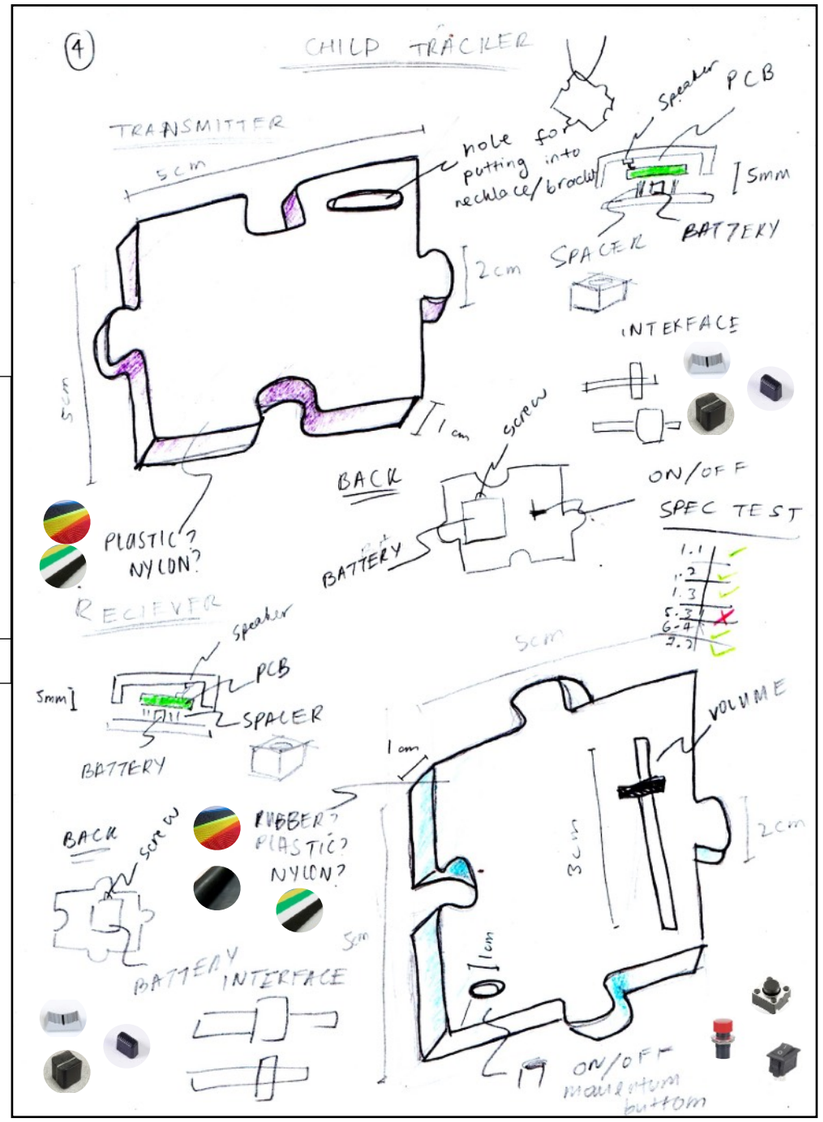


Idea #3

This product will be harder than most to make as it is circular. Moreover, it would be difficult to make usb cable charger. It fits almost all the specifications except being wearable, however it can be hot glued onto hair clips making it wearable

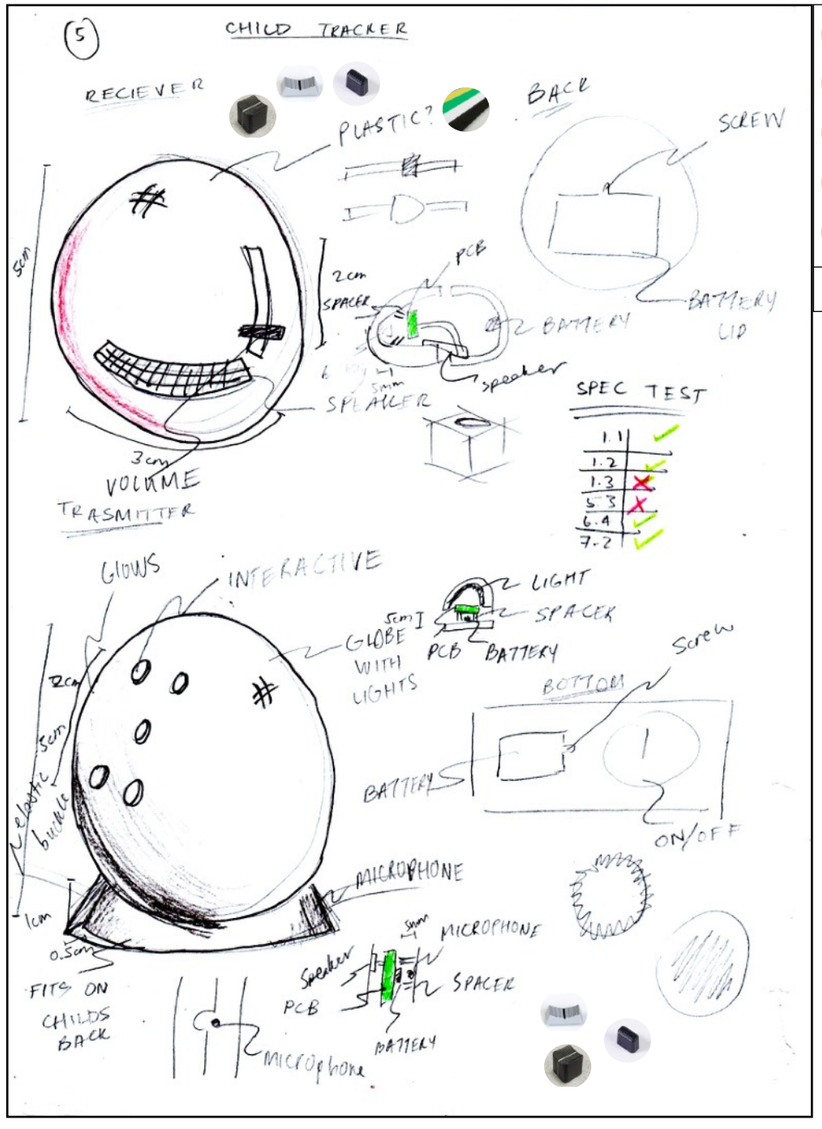
You will have to remember to carry the charger if you intend to carry it for a holiday. It can depict the battery life which is a useful feature. It has to be made with non-toxic plastic material if child can put it in mouth accidentally.

Idea #4

In this product, the two pieces fit together like a jigsaw piece making it appealing for the child and the parent. Although it would be a little hard to shape the material into the shape. It is openable, but it needs a screwdriver.

It could be made of silicon or soft plastic so that it can't hurt the child as necklace when the child is playing. It could be a inconvenience to find a screwdriver to open it to change batteries, but there is less risk of electrocution.

What can the product look like?



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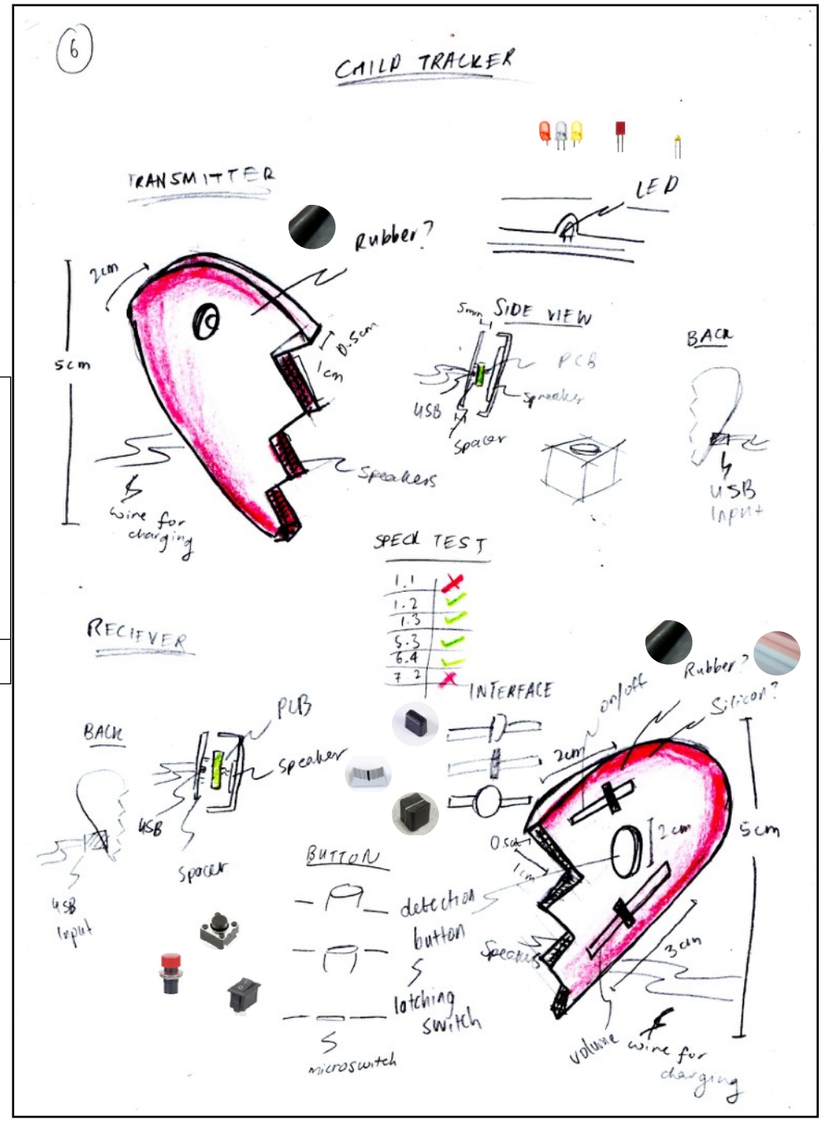
S	✗	✓	✓	✓
F	✓	✓	✓	
M	✗	✓	✓	

8/16

A	✗	✓	✓	
S	✗	✓	✓	
S	✗	✓	✓	✓
F	✓	✗	✗	
M	✓	✓	✓	

8/16



Idea #5

This idea is hard to make and requires a relatively high amount of time and electric PCBs. It fits most of the specifications although the transmitter does have an interface that can be distractive for the child to tamper with the product.

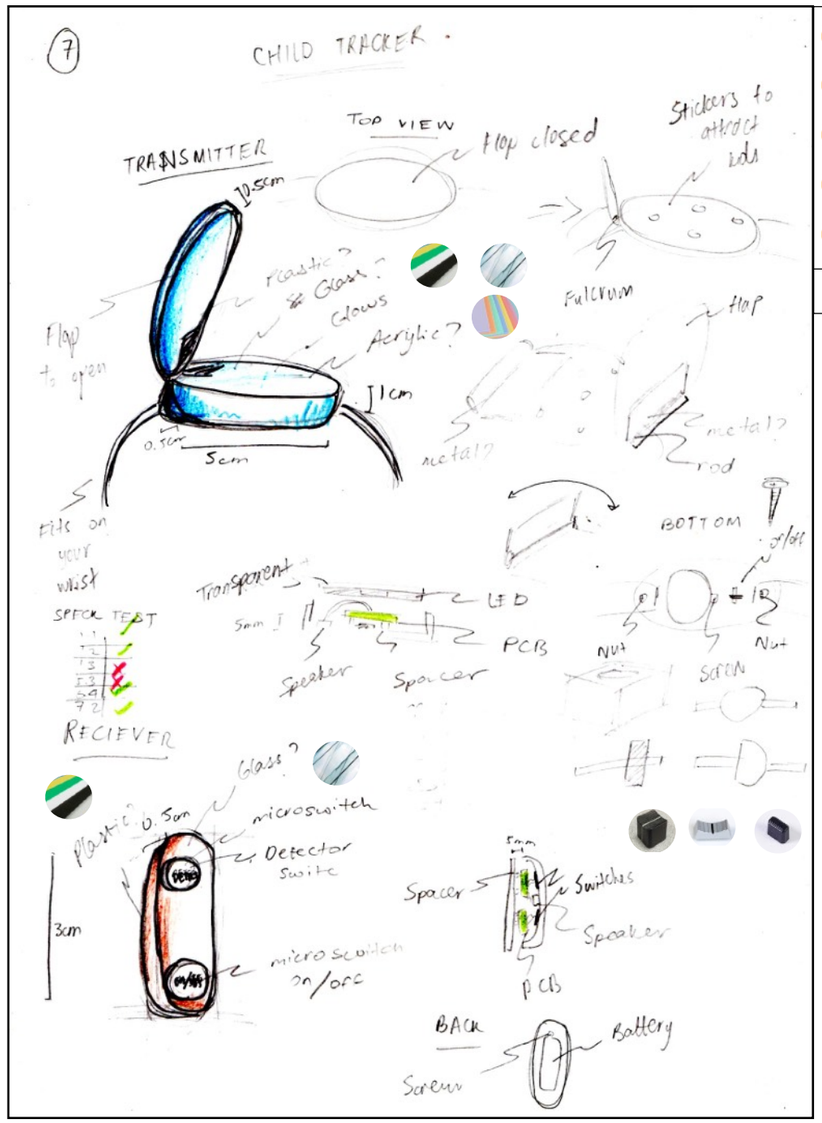
I like how this product has a microphone for the parent to hear the child, and that there is interactive activity for the child. But, I do not believe that the idea of the tracker on the back of the child is a good idea.

Idea #6

This would be really hard to make and make the two half-hearts fit, as it needs to be precise. Moreover using the USB charging would be difficult as it is another circuit. It can also be made more appealing for the child by adding stickers.

Very nice how the two pieces will fit together. Looks very fragile, easily broken. Can be made more appealing for the child. Should be make to be carried by the child because can get lost easily.

What can the product look like?

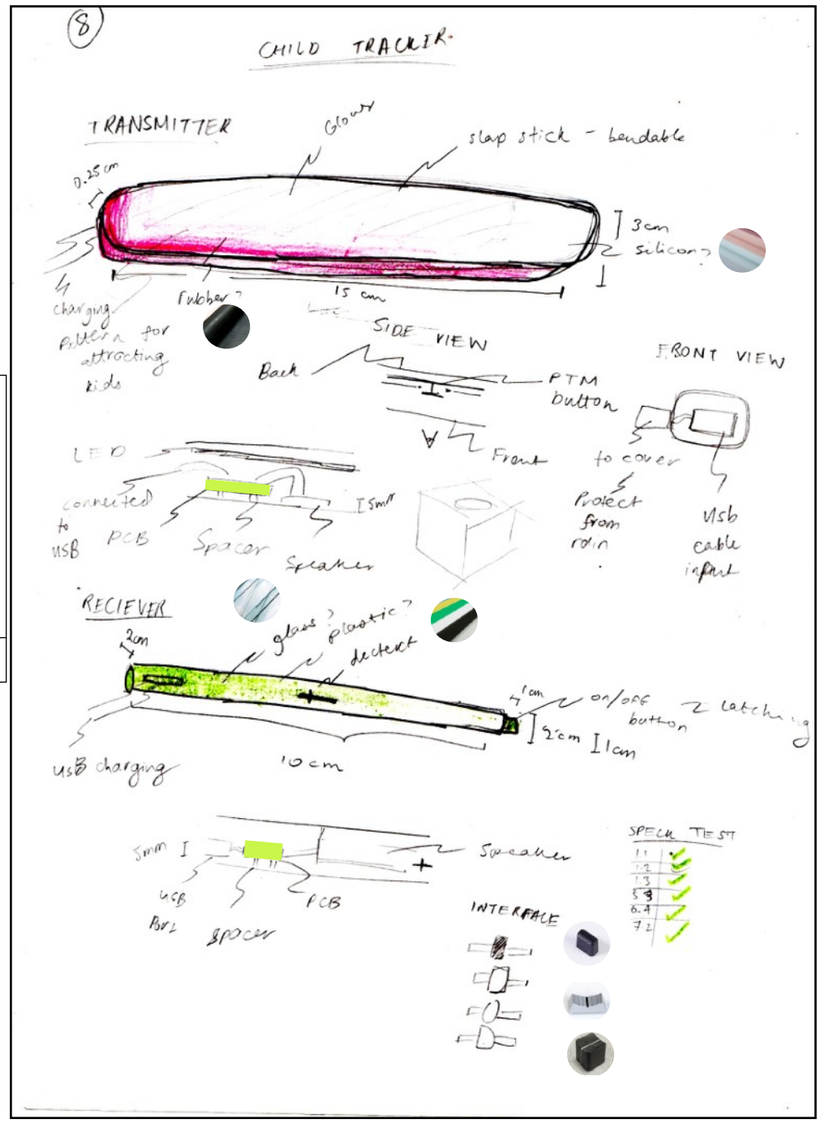


A	✓	✓	✗
S	✓	✓	✗
S	✗	✓	✓
F	✓	✓	✗
M	✓	✓	✓

8/16

A	✓	✓	✓
S	✓	✓	✓
S	✗	✓	✓
F	✓	✓	✓
M	✓	✓	✗

11/16



Idea #7

Both of these are designs that are fairly complicated, therefore making them hard to make. However, it fits almost all of the specifications making it good for its function.

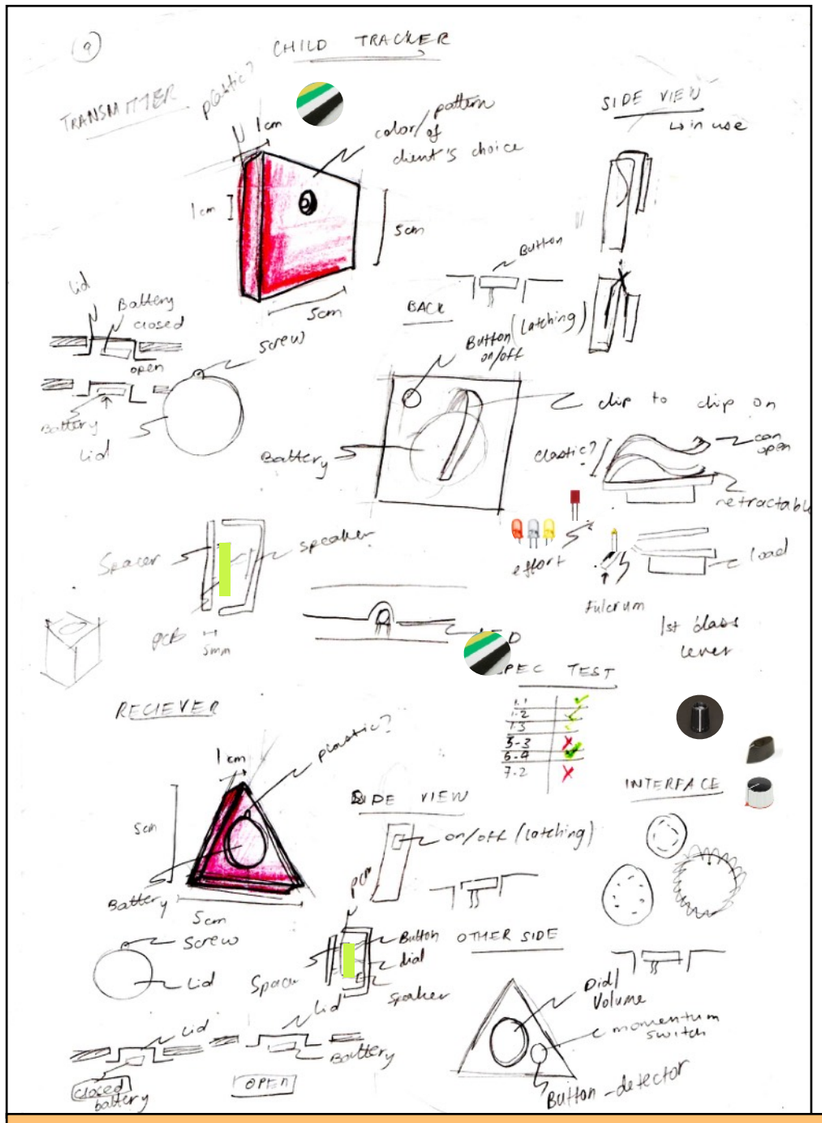
Like the fact that the child's part is openable, think that is very nice for attracting my child. I like the technology in the parents part, it is very nice and I like the shape of it.

Idea #8

The design is great and fits all of the specification, but this idea is also very hard to build as it contains using bendable material that will retract as well as thin circuits to fit inside.

I like the slap band idea as that would make the tracker for the child almost impossible to lose or break. The pen is good too, easy to fit inside handbags and carry to places.

What can the product look like?



A	✓	✓	✓
S	✗	✓	✗
S	✗	✓	✓
F	✓	✗	✓
M	✓	✓	✓

9/16

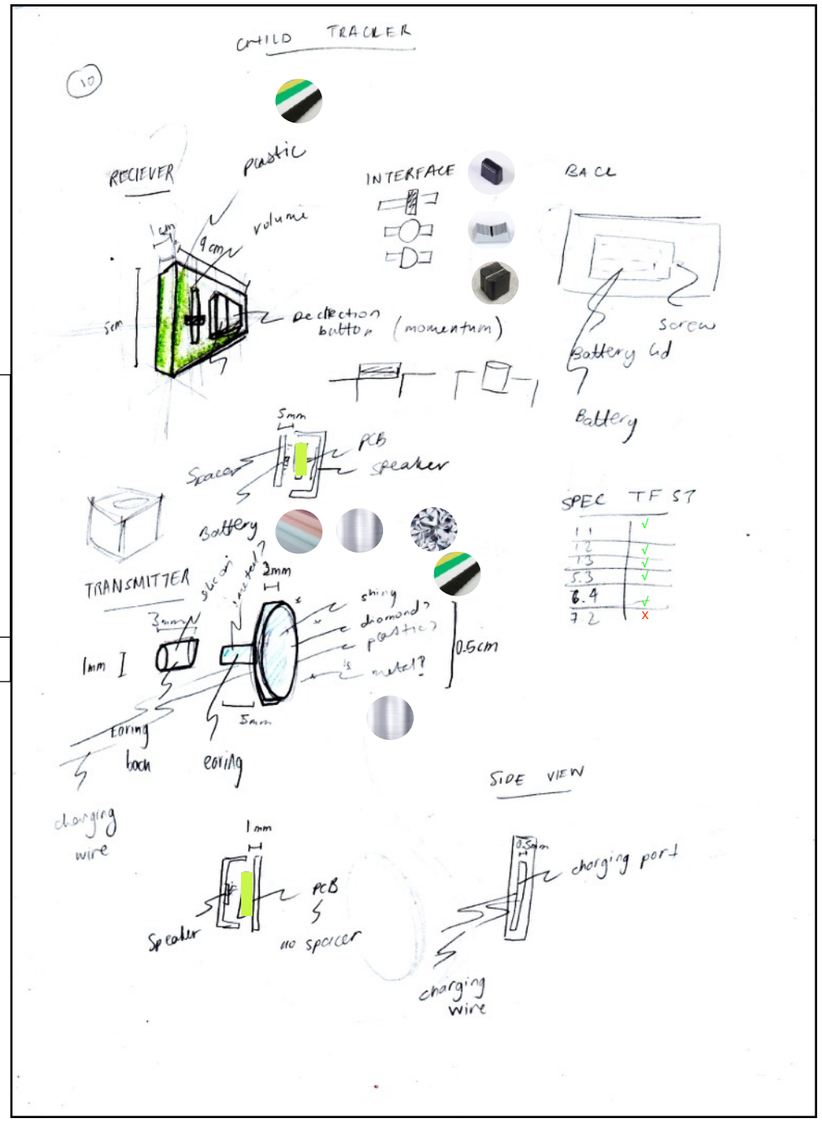
Idea #9

This product will be easy to make as it is made by simple shapes and it fulfils most of the specifications. It can also be made attractive easily by simply adding pattern.

Very simplistic. I like the triangle shape, very small and easy to carry. Sharp edges can hurt the child. Can get lost easily. Not sure if clip is safe enough and able to endue falls from child as he is very active.

A	✓	✓	✓
S	✗	✓	✓
S	✓	✓	✓
F	✓	✗	✗
M	✗	✓	✓

9/16



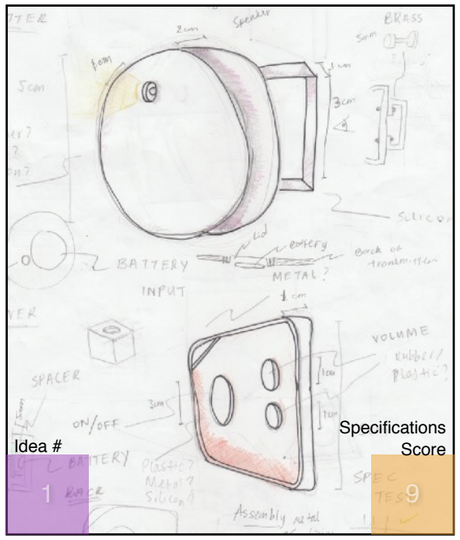
Idea #10

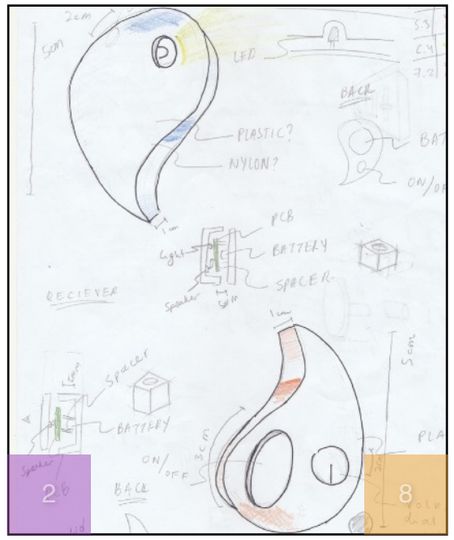
This is not a realistic idea as the transmitter is very small and that makes it hard to fit the PCB in. It can also get lost very easily and does not fit the child unless they have a piercing.

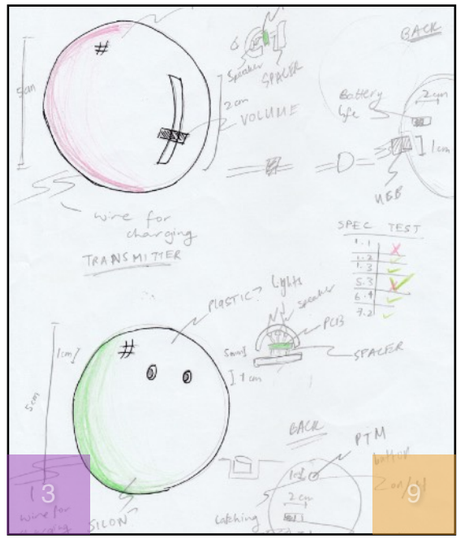
Not good for child, could cause infections as not sterilised and clean for child's ear. Easy to get lost and not safe, could get stuck or fall out easily. I like how the parents part is slim and can fit like a phone.

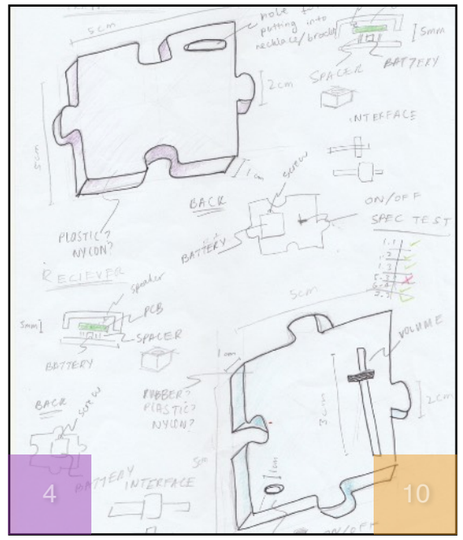
C1 C2 C3 C4 C5 C6 C7

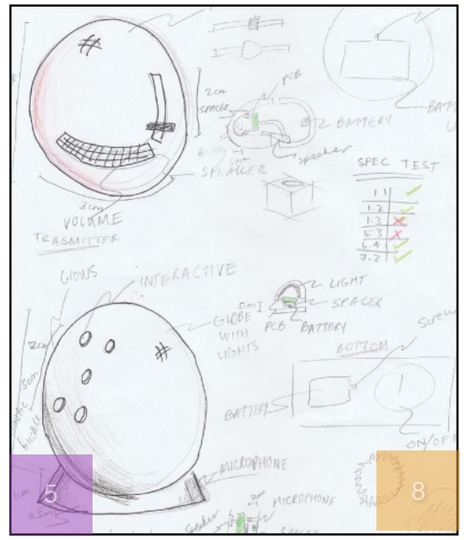
Which idea am I choosing? - Idea 9

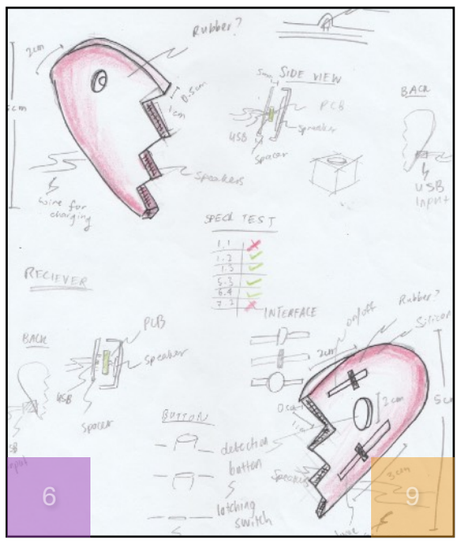


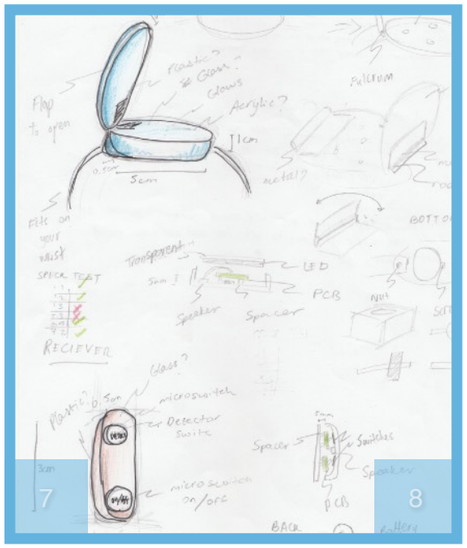


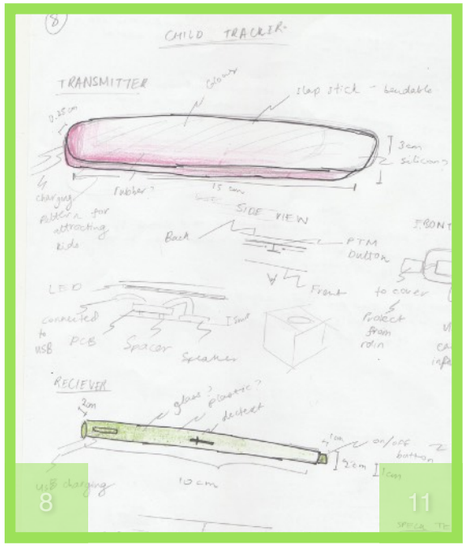


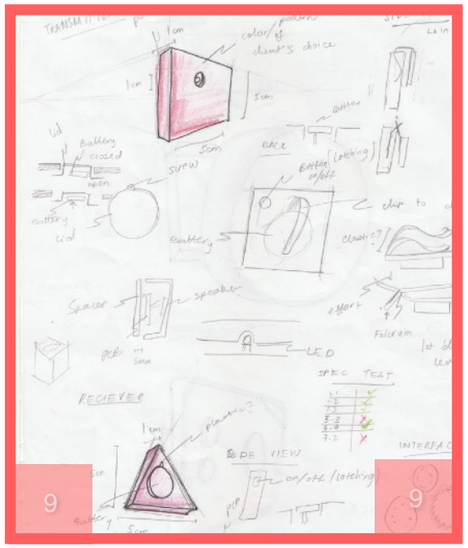


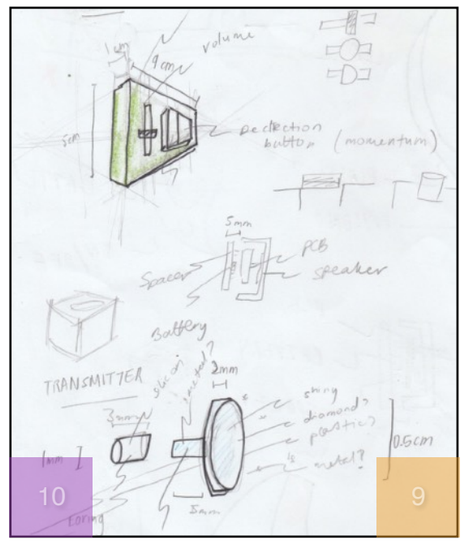












The client likes idea 7 this is because the child's part is very engaging for the child. The parent's part has a detect button which is very useful to find the child when needed. It has light and sound, compared to some earlier designs with just light, this helps to detect the child in a loud place, as well as sunny place. The shape of the child's part does not have any corners, making it safer for the child, in addition to being wearable, therefore it does not fall off the child easily and it is hard for the child to remove it themselves.

I like idea 9, this is due to its simplicity. Idea 9 is easy to build as it contains easy shapes and material and can be finished in a quick amount of time. Both parts of the product are small and portable making them easy to carry around. The transmitter is wearable it has a clip, making it harder to fall off the child while they are playing or running around. It does not contain many buttons and dials, making it easy to figure out how to use as well as use it. It also contains a battery, making it less of a hassle then charging the product every night. However, the use of a battery, creates a high risk of electrocution and the child tampering with the circuit. The transmitter can easily be made attractive for the child by adding a pattern that the child's likes or make it out of their favourite colour. Moreover, the sharp edges. Can be easily curved by sanding them making them less of a hazard to the child. The material for the product will make to be durable, water proof, etc as the child will be working in my different environments.

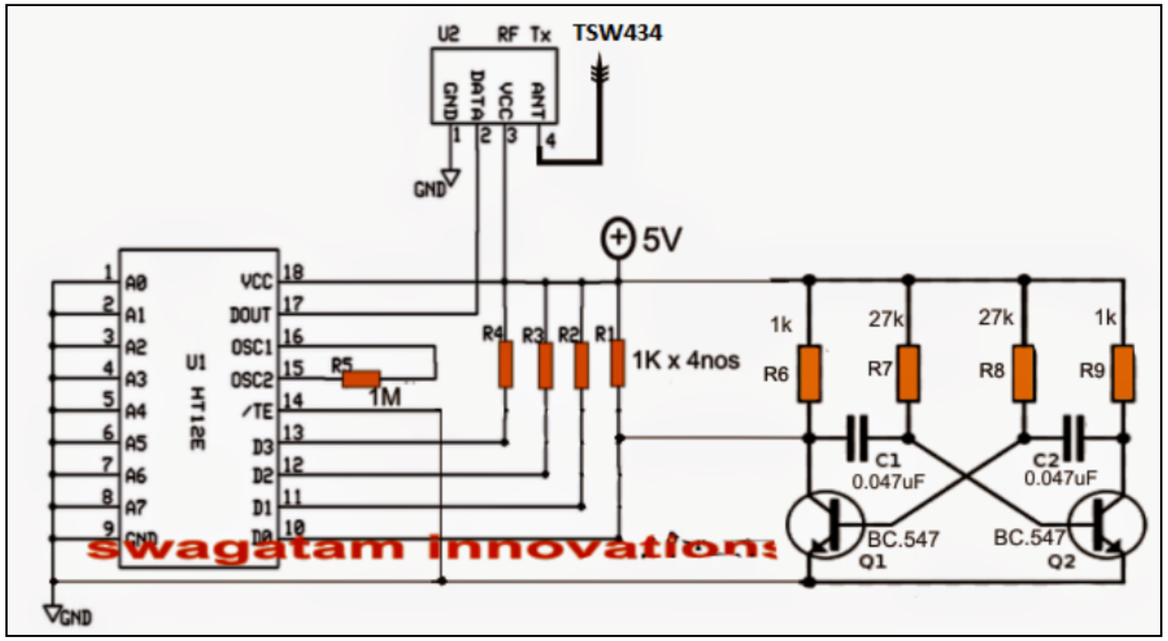
Therefore, I have chosen idea 9

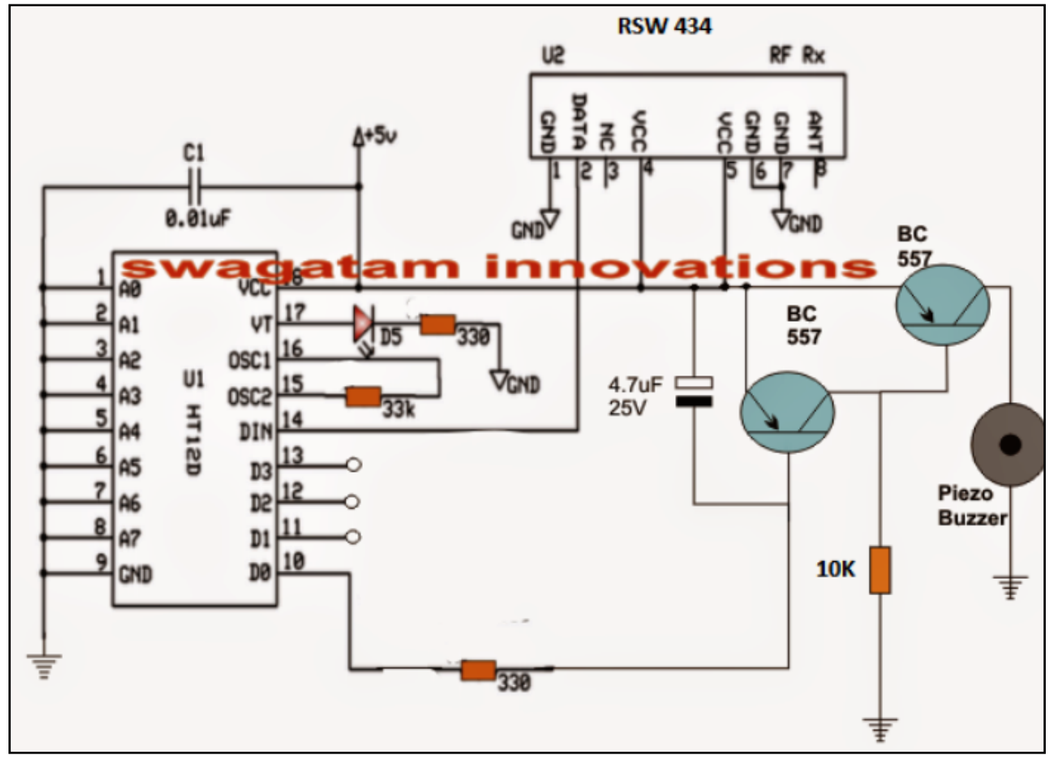
Idea depending on the most number of specifications fulfilled. Specifications are on each of the ideas separately.

C1 C2 C3 C4 C5 C6 C7

Development of Circuit

Circuit 1

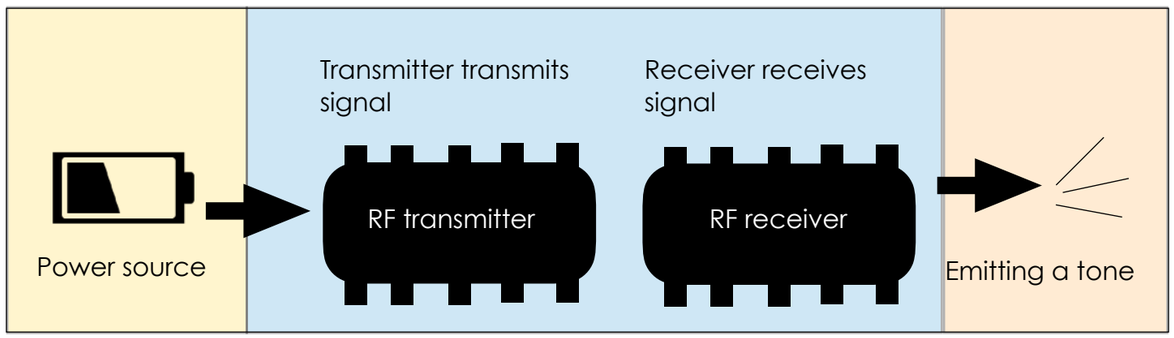


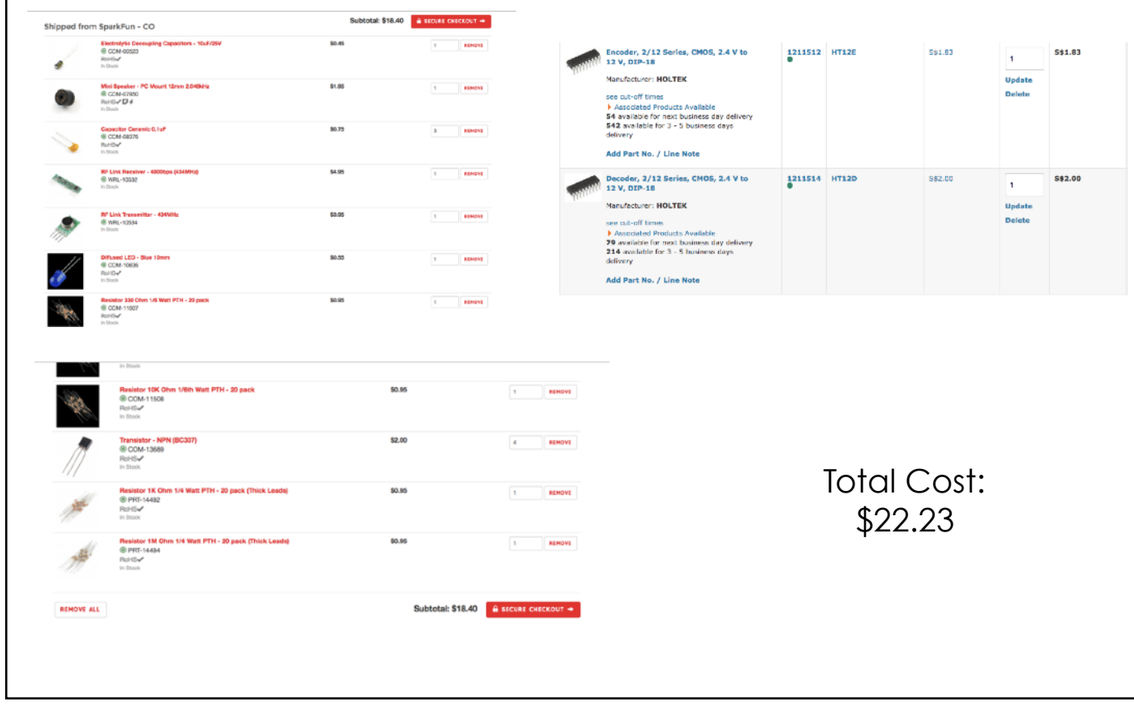


CONS

- I tried to simulate this circuit, however, the circuit was **too complicated** to simulate . Therefore I have chosen not to make this circuit.

- Moreover, the materials needed to build this circuit are **very expensive** and would therefore increases the cost of the product which my client does not want. So she would prefer not to use this circuit,

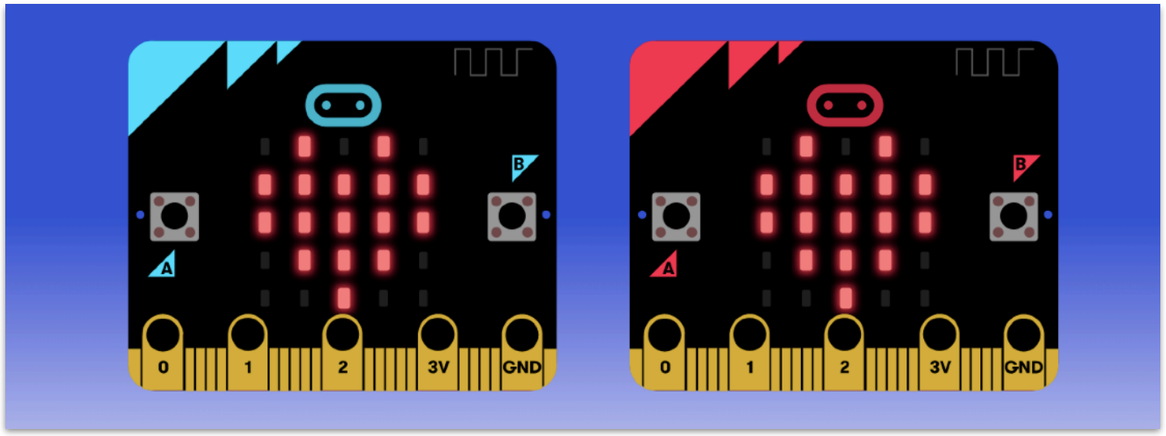


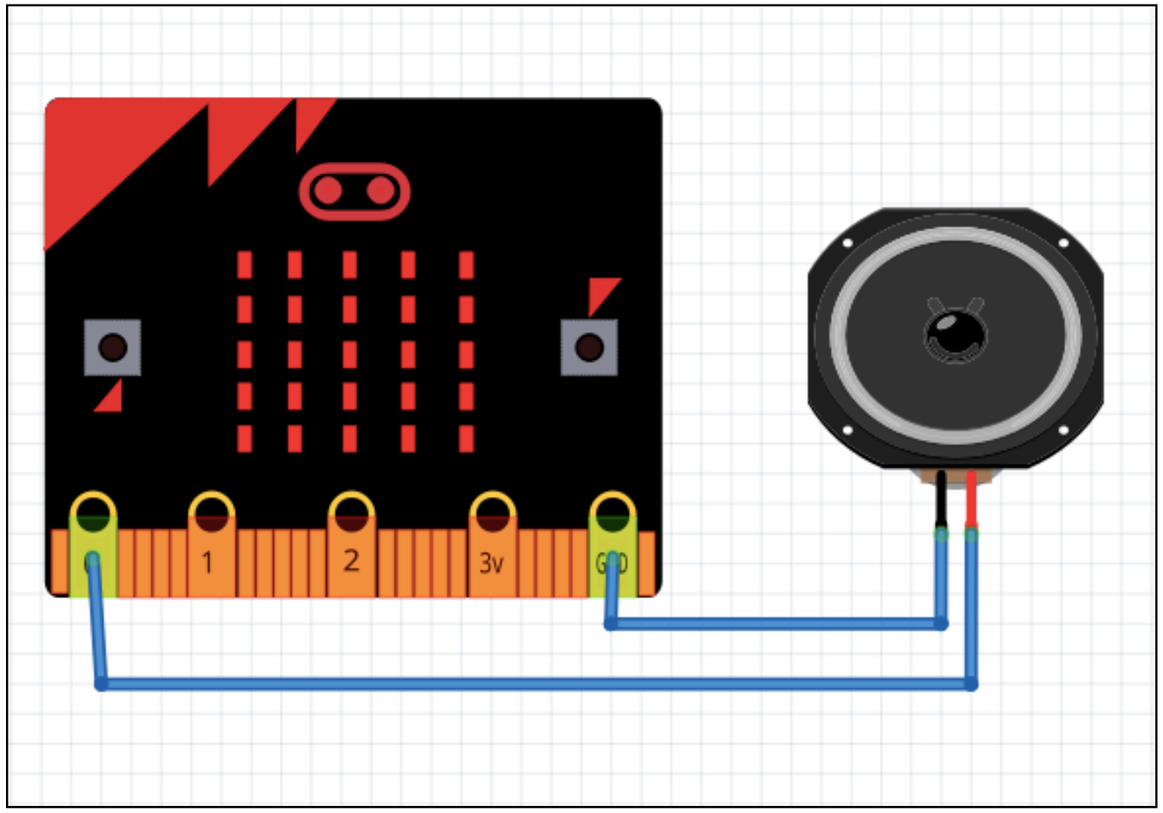


Total Cost:
$22.23

Development of Circuit

Circuit 2

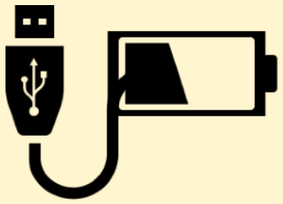




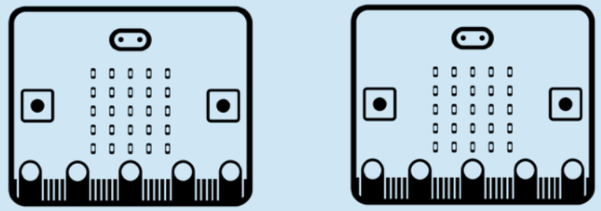
PROS

- This is a **very simple** circuit to make and can be easily simulated.
- There is a 9x9 LED display on the microbic which can display icons.

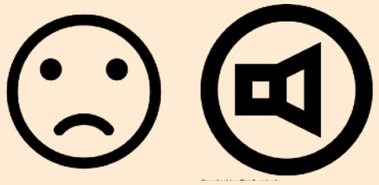
- There was a faire near my house where they were giving away micro bits, therefore both the micro bits were **free** for me.
- Its **small and concise**, making it easier to be carried around.



Power source - the device is shareable by Usb which will be connected to a rechargeable battery which is connected to the micro bit.



The micro bits are set in the same radio group. The transmitter sends out a radio signal which the other one receives. The signal becomes weaker and stronger depending on how far the micro bits are from each other.



If the signal is weak, the micro bits are far from each other, a cross or sad face appears on the receiver as well as a beep on the transmitter.

The speaker can emit **different types** of sound perhaps when the child is far away and when the parent is trying to locate the child.

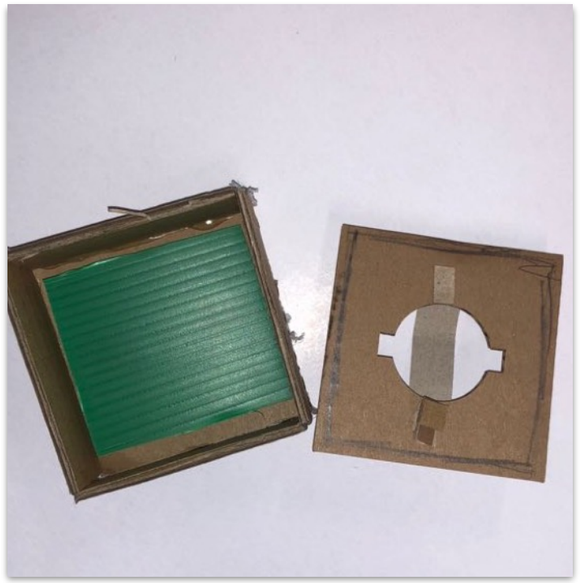
The buzzer on the other hand, can only emit one kind of sound moreover, it required a DC circuit.

INPUT | PROCESS | OUTPUT

Development of Product

C1 C2 C3 C4 C5 C6 C7

Transmitter



Front part

Back part

PCB placement

Hinge

Magnetic

Screw

PCB accessibility

Screw

Twist

Battery accessibility

Side-view

Front-view

Overall look

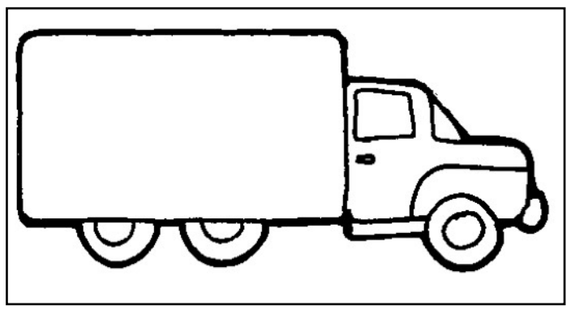
Development of Form

Transmitter

C1 C2 C3 C4 C5 C6 C7

Development

Final Design



What changed?

- I have made the box **bigger**
  - This is because making it bigger is easier.
- I added a **rectangular hole** for the LED
  - This is because the circuit has a square LED

- I added an **USB** instead of a battery
  - This is because it is easier to connect it to a charger back rather than changing the battery.

What changed?

- I have changed the shape to make it into a **bus**
  - This is because having a bus shape is more attractive for the child and will also look better while the child uses it.

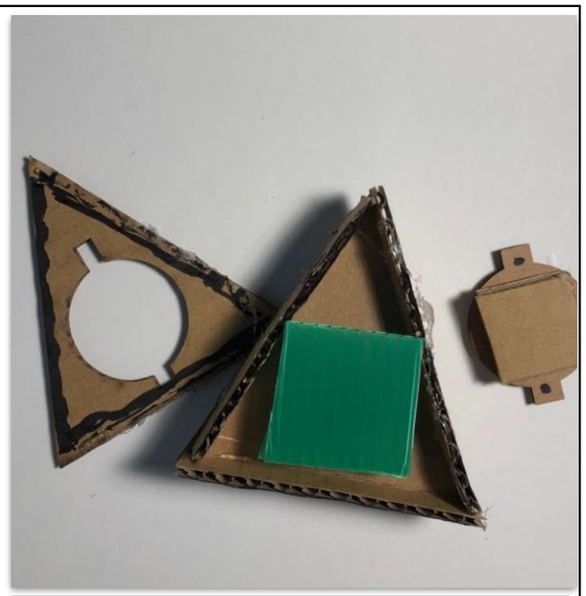
- I added a **battery** as well as a USB
  - Now this device can be charged by connecting USB charger which will charge the battery and therefore make the PCB work.

Development of Product

C1 C2 C3 C4 C5 C6 C7

Receiver

Front part



Back part

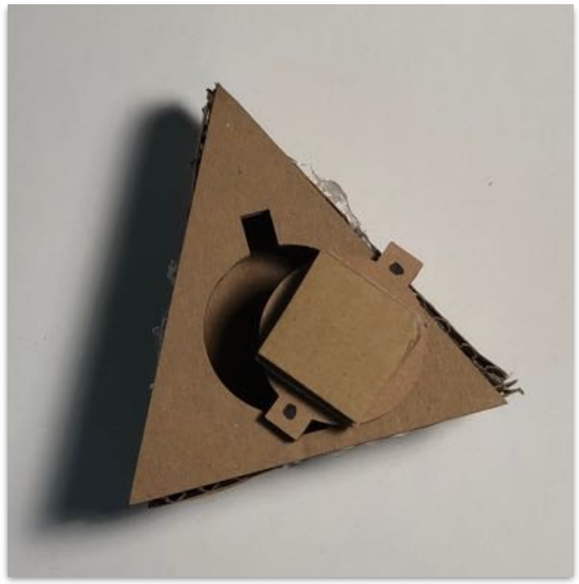
PCB placement

Hinge

Magnetic

Screw

PCB accessibility



Screw

Twist

Battery accessibility

Isometric-view

Front-view

Overall look

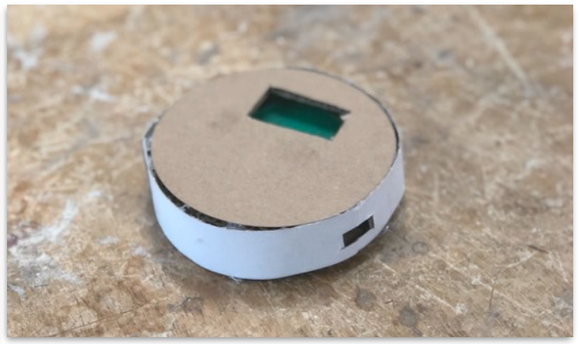
Development of Form

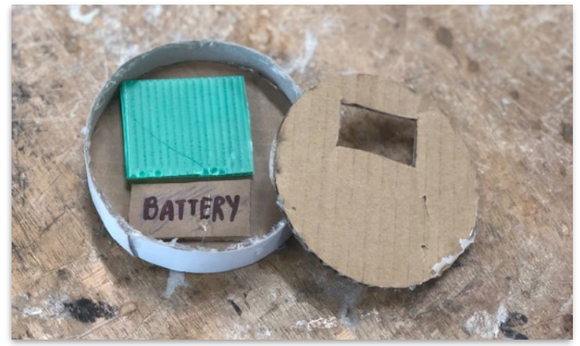
C1 C2 C3 C4 C5 C6 C7

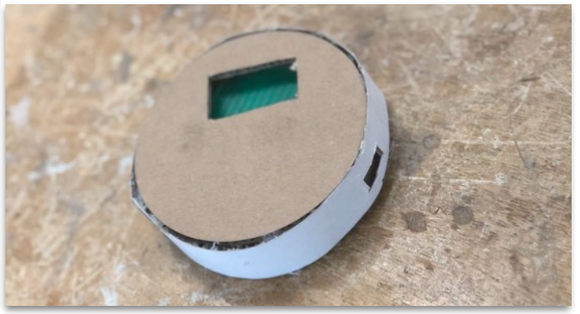
Receiver

Development

Final Design







What changed?

- I have turned the triangle into a **box**
  - This is because making the box is easier.
- I added a **square hole** for the LED
  - This is because the circuit has a square LED, not a circle.

- I added an **USB** instead of a battery
  - This is because it is easier to connect it to a charger back rather than changing the battery.

What changed?

-I have turned it into a **circle**
  - This is because then its safer for the child as there are no sharp corners as well as more attractive to wear for the adult.

- I have used a **screw opening** instead of a hinge opening
  - This is because I realised that the device should not be openable easily as that could lead to temperament.

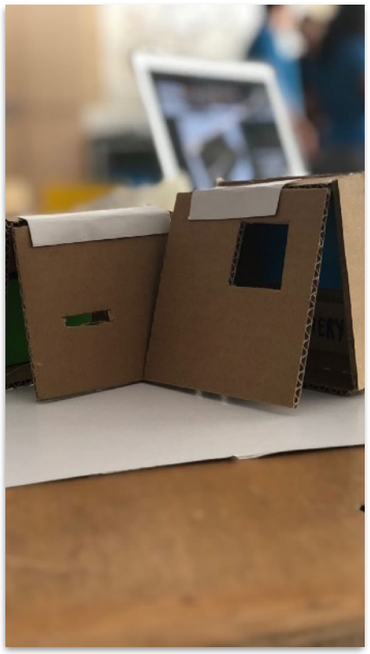
Development of Form

Receiver and Transmitter

C1 C2 C3 C4 C5 C6 C7

Orignal

Development



Final

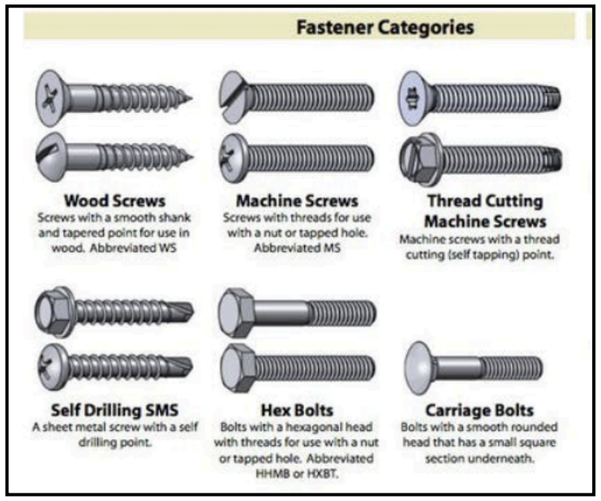
Development of Interface

C1 C2 C3 C4 C5 C6 C7

Everything is connected as it is all 3D printed

Because it is going to 3D printed as it is easier and 3D printing will make the design waterproof and more detailed

The PCB has holes on the bottom which will be used to screw the PCB to the spacers, Therefore making the **PCB stay mounted**. I have used this instead of sticking the PCB to the mounts as that would be weaker and last for a shorter amount of time



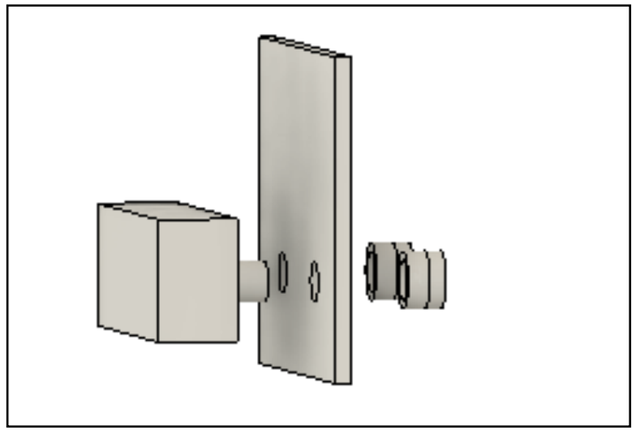
I chose this crew as it is inaccessible without the correct tool and the child should not be able to open. This screw can not be opened without the alloy key

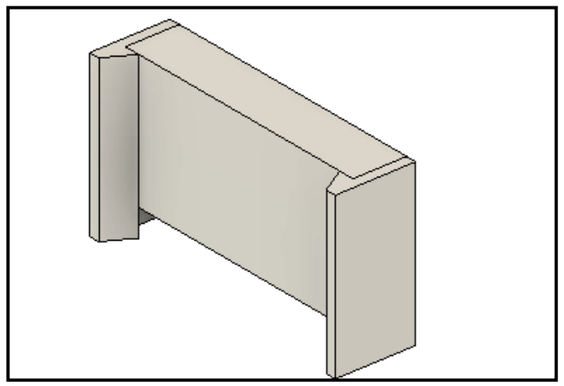
Nylon

+ Can be 3D printed
+ Strong
- Not durable

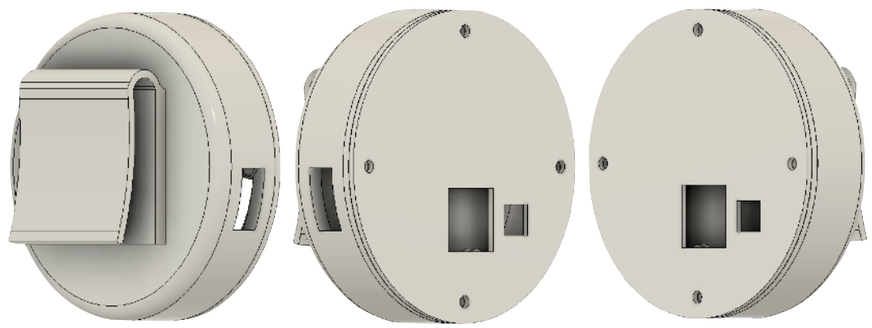
Polylactic Acid

+ 3D printable
+ Biodegradable
+ Detailed
- May deform in heat





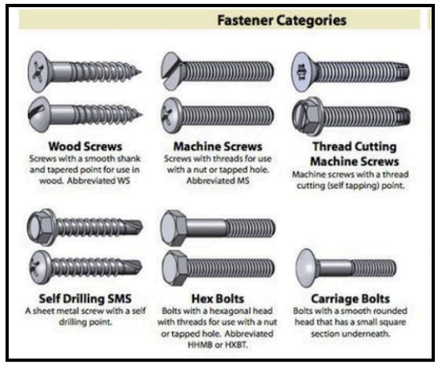
This mechanism will be used to **keep the battery** in the tracker, this design also makes sure that the battery holder can come out and therefore the batteries can be replaced in case spoiled by leakage, etc. I have used this instead of using Blue tack or tape as they are weaker and last for a short amount of time.



Detect	DETECT	Detect	Detect	*Detect*

I chose to write detect to make it clear to the parent what the button is for. I have decided to write it in the third font as it looks aesthetically nice as well as being easy to read.

Development of Interface



I chose this crew as it is inaccessible without the correct tool and the child should not be able to open. This screw can not be opened without the alloy key

Acrylic (Front and Back)

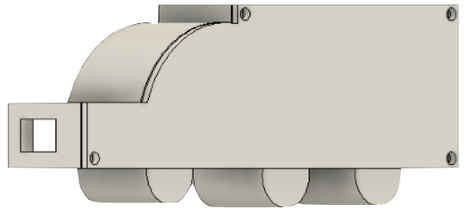
+ Strong and durable
+ Transparent
- Can not stand high temperatures

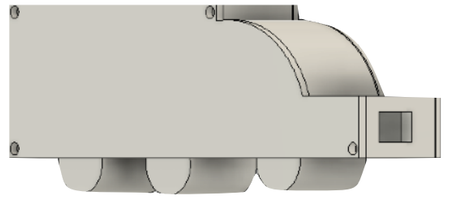
Rubber

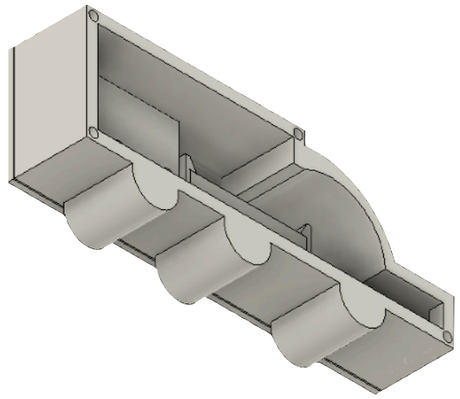
+ Flexible
+ Cheap
- Limited strength

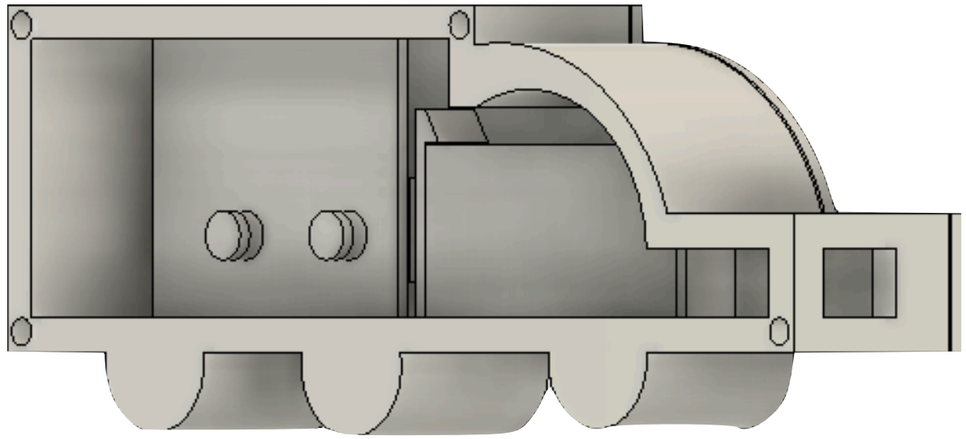
High Density Polymer

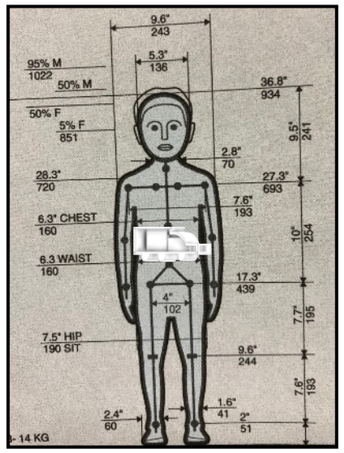
+ Child Friends - BPA free
+ Lightweight
+ Cheap
- Not biodegradable



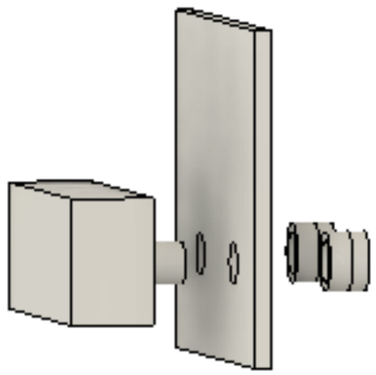




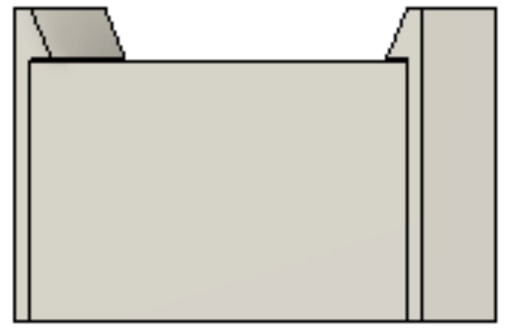




This pictures shoes the actual size of the bus in **comparison** with an average 3-year old child. (The user is a 3-year old child)



The PCB has holes on the bottom which will be used to attach it to the PCB spacer, Therefore making the **PCB stay mounted**. I have used this instead of sticking the PCB to the mounts as that would be weaker and last for a shorter amount of time



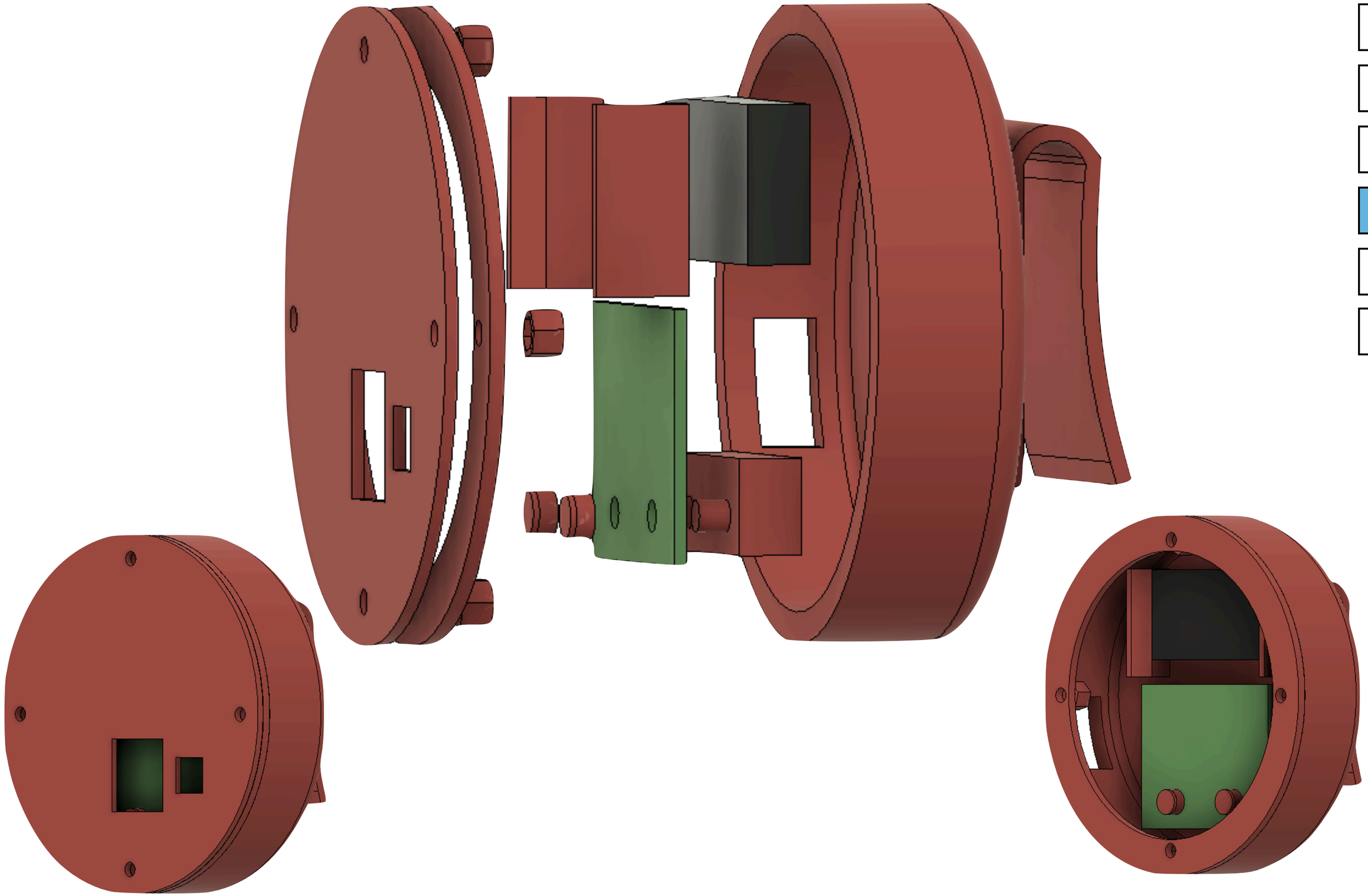
This mechanism will be used to **keep the battery** in the tracker, this design also makes sure that the battery holder can come out and therefore the batteries can be replaced in case spoiled by leakage, etc. I have used this instead of using Blue tack or tape as they are weaker and last for a short amount of time.

Specifications

1.0	**Aesthetics**			
1.1	The transmitter will be **wearable**	It needs to be able to stay on the child and not come off and my client wants it to be a watch.	X	**It's harder to make and wear a watch, so I made it as a belt accessory. It is still wearable.**
1.2	The product should be split into two parts: **receiver and transmitter**	The transmitter is for the child and the receiver is for the parent	√	
1.3	The receiver will have an **interface**, the transmitter will not.	The child should not be able to switch the product on and off, while the parent should.	√	
2.0	**Client**			
2.1	The primary user is the **child**	The child will be the one using the transmitter	√	
2.2	The secondary user, and the consumer is the **parent**	The parent will have the choice to buy this product, and they will be using the receiver	√	
2.3	The client could be the **government, amusement parks, etc.**	They can sell the item to the parents, as it would be beneficial for their economy and security.	√	
3.0	**Cost**			
3.1	The total cost of the project should not exceed **$200**	Including the research and prototype, which would take extra money that may be used.	√	
3.2	The total cost of the product should not exceed **$100**	The high cost is due to the value the parents see for this product - **I will keep the receipts of the components**	√	
4.0	**Environment**			
4.1	The product will be used in a **wet** environment, such as a swimming pool.	The product may be used in rain and swimming pools. - **I will use the final product in a wet environment**	√	**The product may not be able to sustain hard falls.** **The product may be used in a somewhat harmful enviorment**
4.2	The product will be used in a **hot** environment.	The product will be used outdoor, it may be sunny, hot and humid.	√	
4.3	The product will be used in a outdoor, **harmful** environment	The child may fall over, the product should be able to sustain the falls.	X	
5.0	**Safety**			
5.1	There will be **double insulation**	The child or parent should not be electrocuted.	X	**Since it's a low voltage circuit, it does not need double insulation.**
5.2	The weight of the transmitter will not exceed **250g**	The product should not be too heavy for the child - **I will weigh the final transmitter using a balance.**	√	
5.3	The transmitter will **not** be **openable**.	The child should not be able to tramper with the circuit in the transmitter.	X	**The transmitter will be openable to be accessible**
6.0	**Size**			
6.1	The transmitter must not occupy a volume more than **2.5cm X 2.5cm X 1cm.**	It should be small enough to fit on the child's wrist.	X	**The transmitter is hard to make small.** **The product will occupy 16X3.8X5 cm**
6.2	The receiver must not occupy a volume more than **5cm X 5cm X 2cm**	It should be small enough to fit in handbags. - **I will measure the final receiver using a ruler**	X	**The transmitter is hard to make small.** **The product will occupy 10X5.5X5.5cm**
6.3	The weight of the **receiver** should not exceed **250g**	It should be comfortable for the parent to carry	√	
6.4	Should be a **portable** size	It will be taken around, not just used in houses. But not too small that the child can swallow it.	√	
7.0	**Function**			
7.1	It will be able to tell when a child **exceeds an area limit**	The transmitter should let the parent know when the child has exceeded the area range.	√	
7.2	It will be **appealing** for the child	The child should not resist wearing the transmitter.	√	
7.3	It will be **safe** and **portable**	It should be safe and comfortable for the child and portable to carry around.	√	
8.0	**Materials**			**The material is not as strong to break a fall, but it is strong.** **It should be strong**
8.1	It should be **durable**	It should not break if the child's falls	X	
8.2	It should be **waterproof** to one meter	It should be able to be operated in a swimming pool and waterpark	X	**The material is not waterproof but it is water resistant** **It should be water resistant**
8.3	It should be **lightweight**	The child and parent should be able to carry the product, my client wants it to be lightweight.	√	

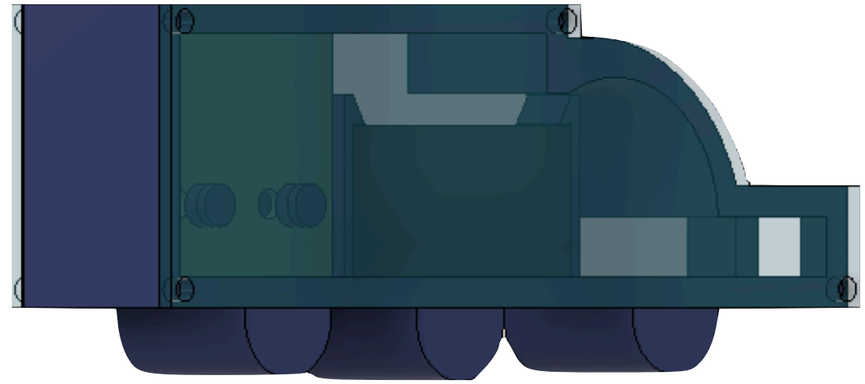
C1 C2 C3 C4 C5 C6 C7

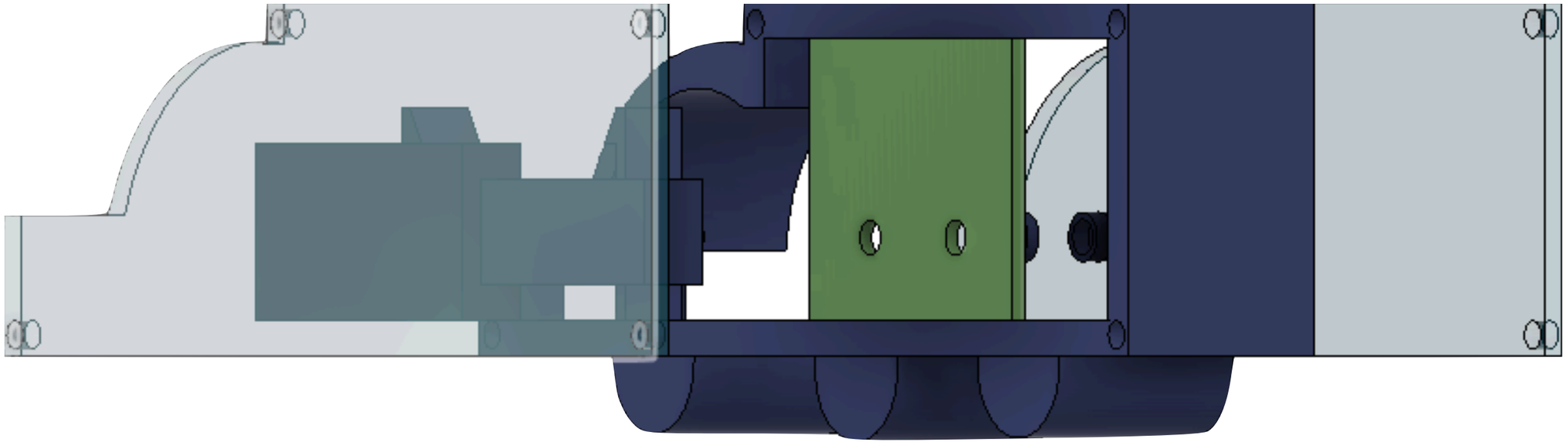
Development of Interface

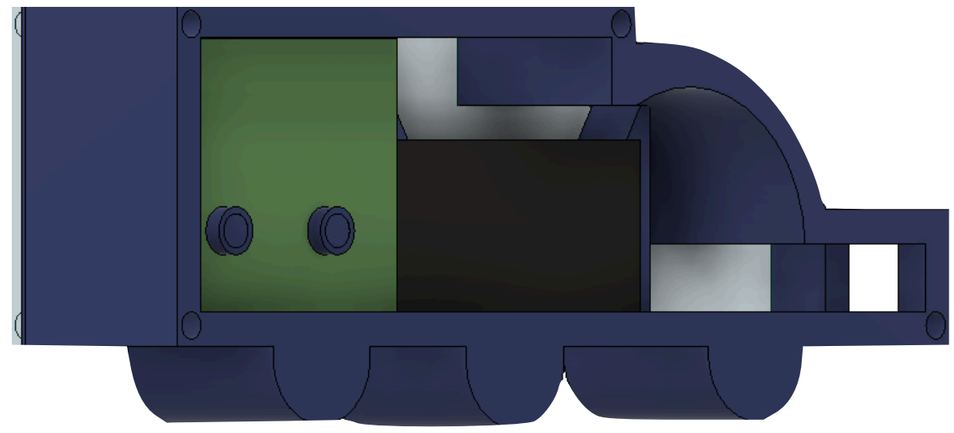


C1
C2
C3
C4
C5
C6
C7

Development of Interface

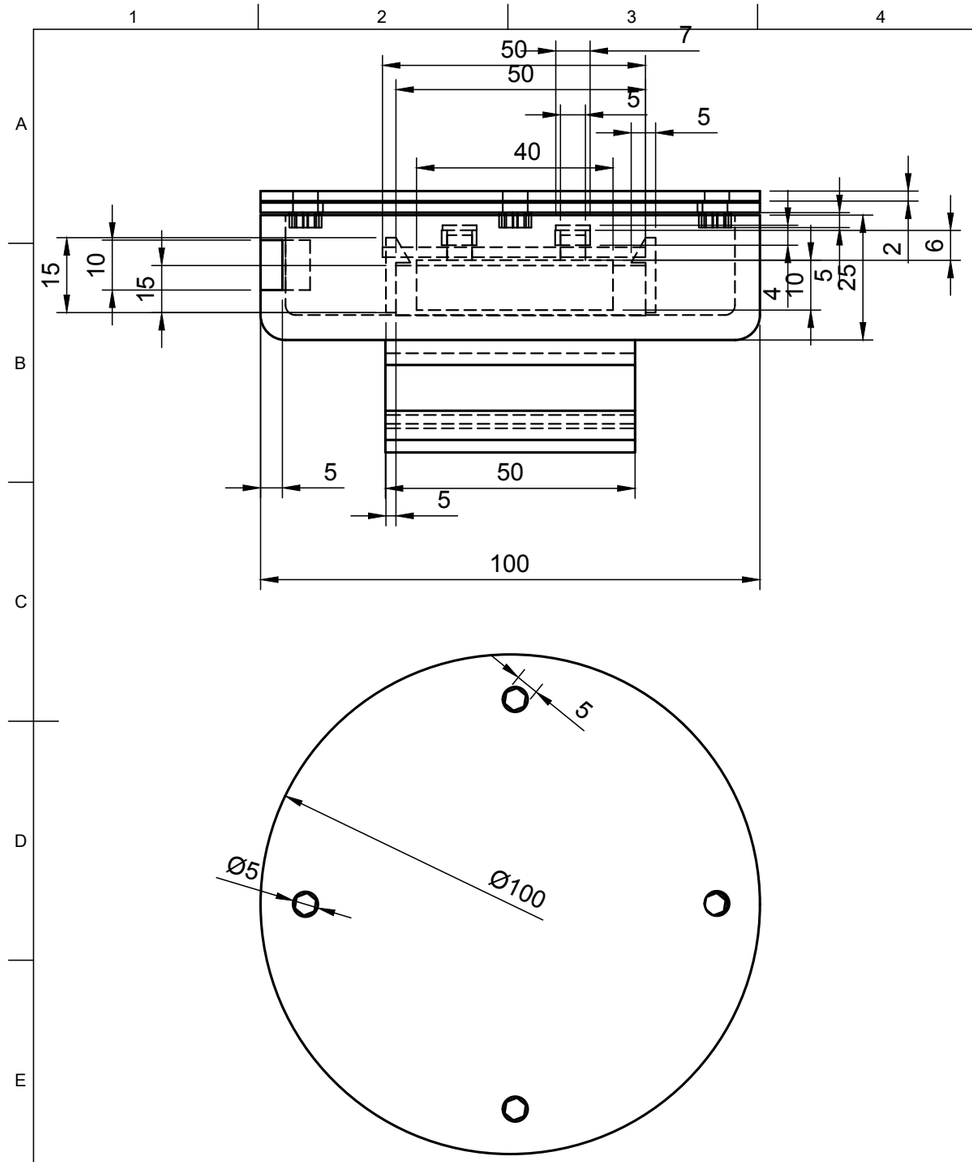


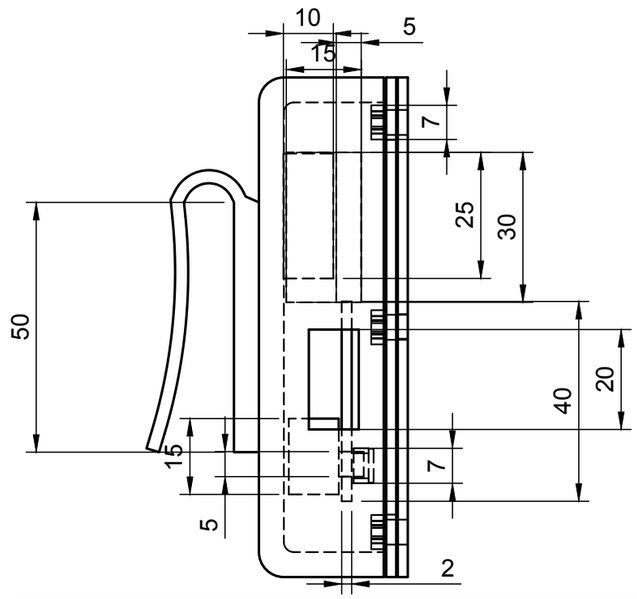




C1
C2
C3
C4
C5
C6
C7

Working Drawing - Receiver

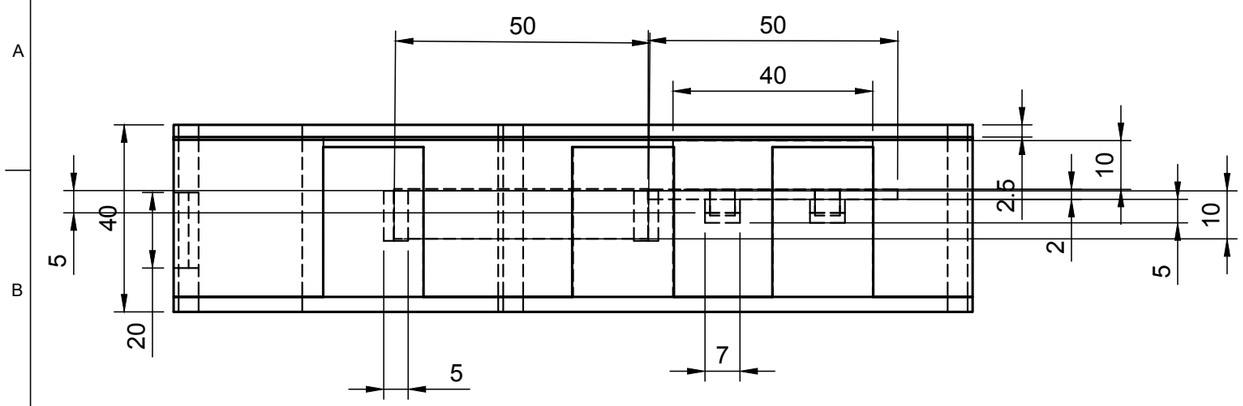


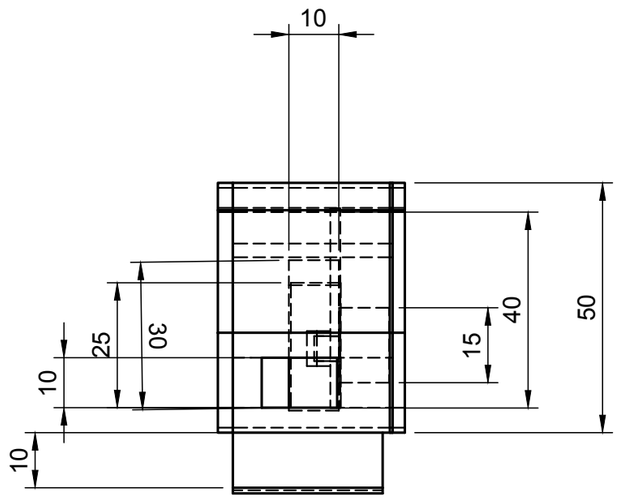


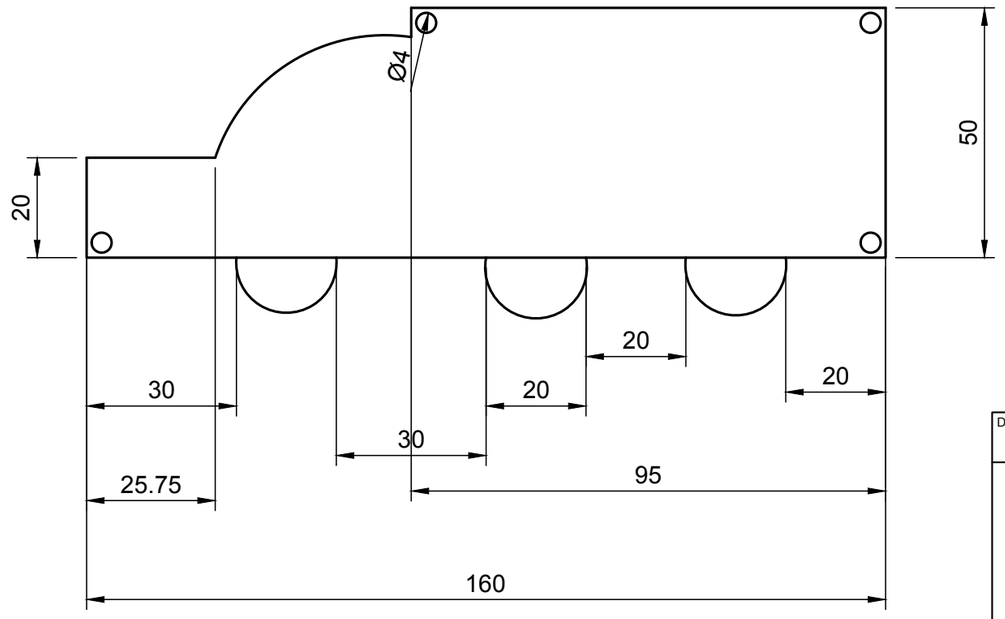
Dept.	Technical reference	Created by	Approved by
		Tanya Rustogi 22/10/18	
		Document type	Document status
		Title: Reciever	DWG No.
			Rev. / Date of issue / Sheet: 1/1

C1 C2 C3 C4 C5 C6 C7

Working Drawing - Transmitter







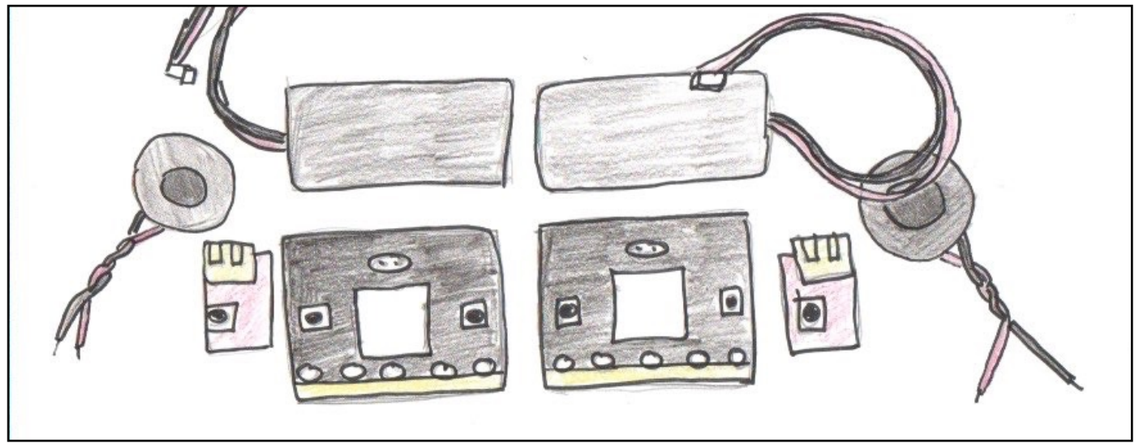
Dept.	Technical reference	Created by	Approved by
		Tanya Rustogi 22/10/18	
		Document type	Document status
		Title: Transmitter	DWG No.
			Rev. / Date of issue / Sheet: 1/1

C1 C2 C3 C4 C5 C6 C7

Planning and Manufacturing of PCBs

C1 C2 C3 C4 C5 C6 C7

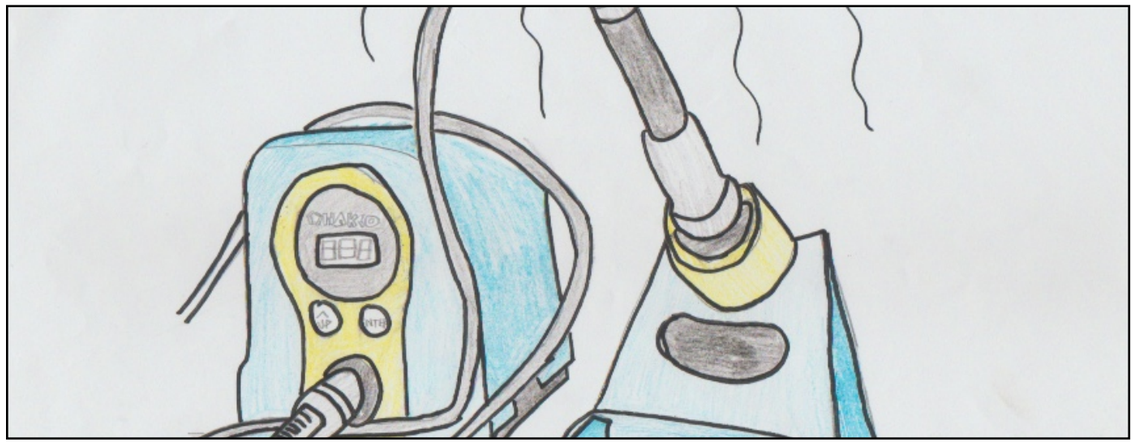
1.**Laying out** the material



: 2 Microbits, 2 speakers, 2 battery holders, 4 AA batteries, 2 USB ports

: Compare the materials so the BOM, to make sure I am not missing anything.

2. **Heating** the iron to 350°F

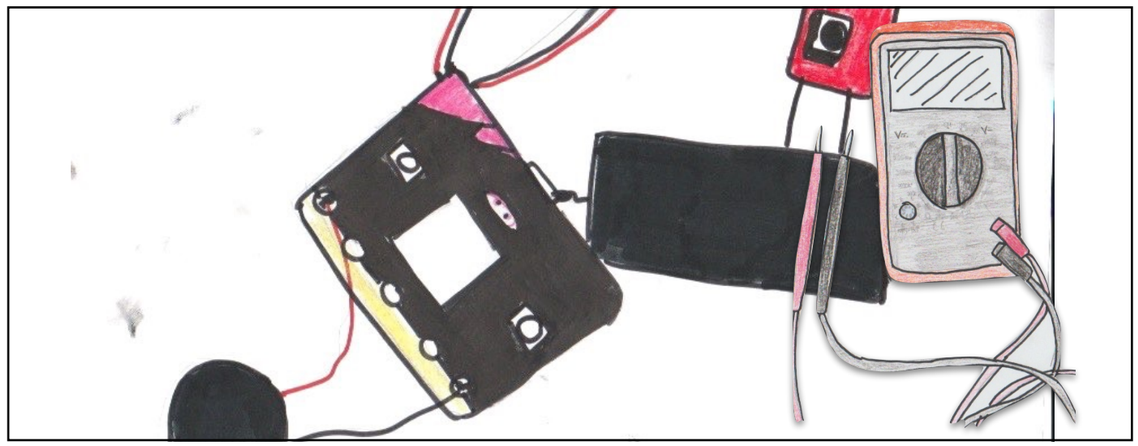


: Wet sponge, Solder, Flux

: Burns, Fumes, wear Safety Goggles

: 5 minutes for the solder to heat up

3. **Solder** the components



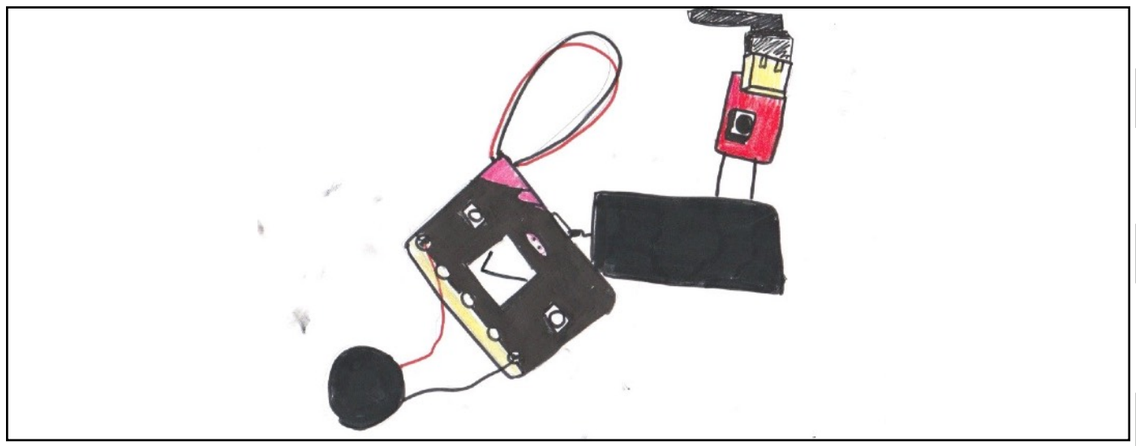
: Wet sponge, Solder, Flux, 2 Microbits, 2 speakers, 2 battery holder, 2 USB ports

: Check that the components are in the right place using the multimeter

: Burns, Fumes, wear Safety Goggles

: 30 minutes to solder everything

4. **Tests** the components



: PCBs, USB cables

Tools

Safety

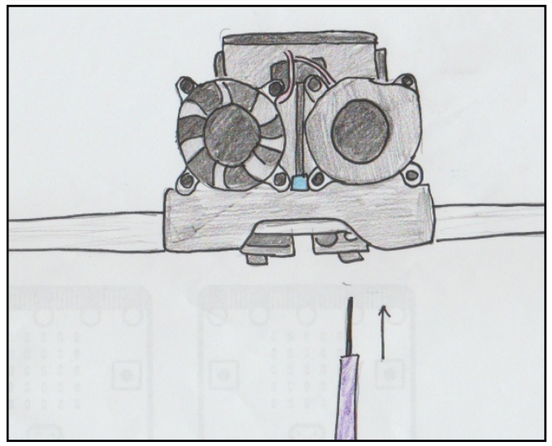
Time

Quality

Planning and Manufacturing of the Receiver and Transmitter

C1 C2 C3 C4 C5 C6 C7

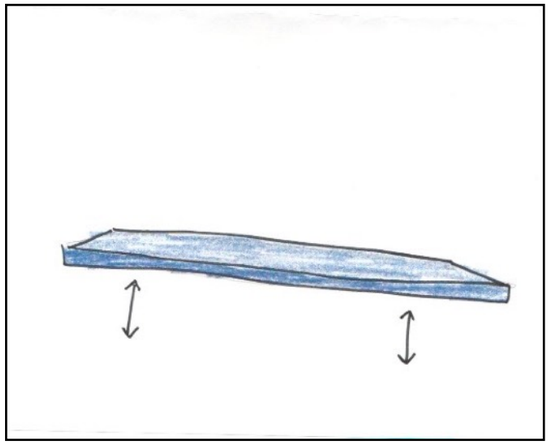
1. **Clear** the nozzle



: 3D printer, nozzle cleaner

: There should be nothing stuck inside the nozzle

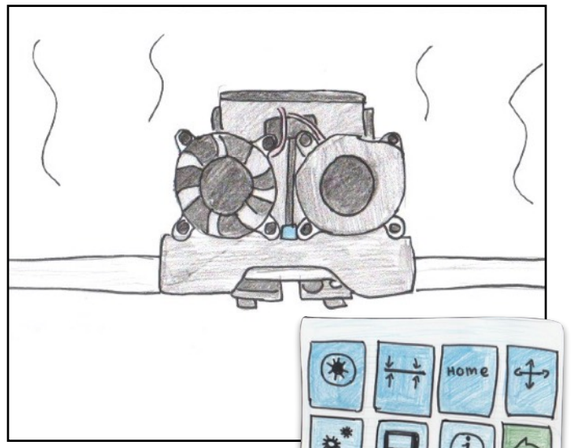
2. **Level** the bed



: 3D printer, levelling device(phone)

: Make sure that the bed is flat and accurate

3. **Preheat** nozzle to 210°C

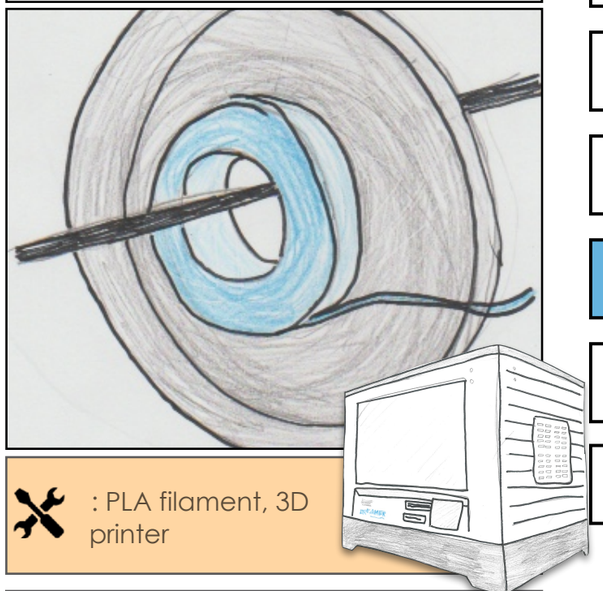


: 3D printer

: Hot, keep hands away

: 5 minutes to heat up

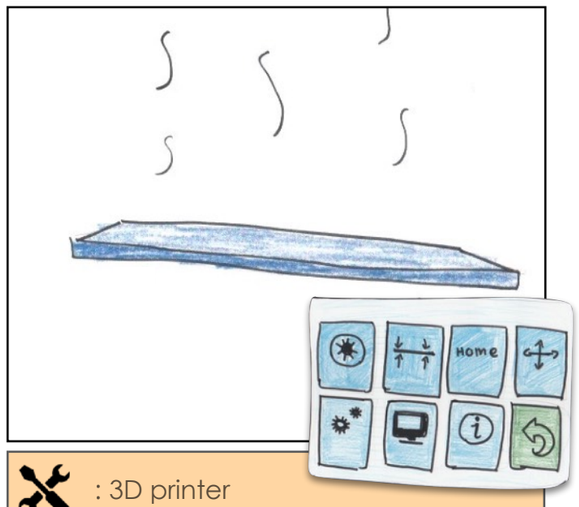
4. Feed the **filament**



: PLA filament, 3D printer

: Use fresh filament

5. **Preheat** the bed to 50°C

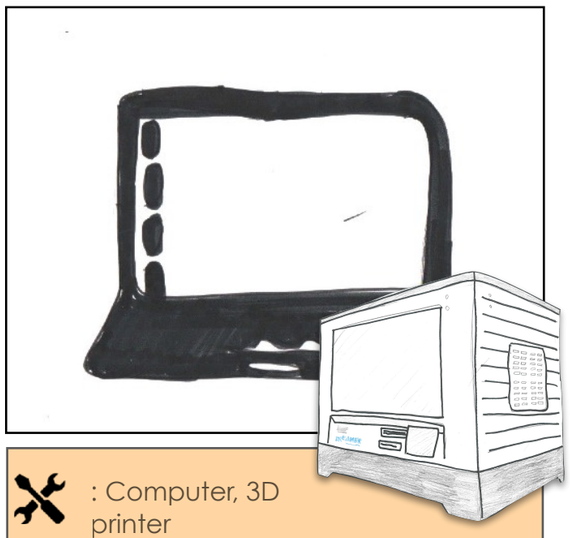


: 3D printer

: Hot, keep hands away

: 5 minutes to heat up

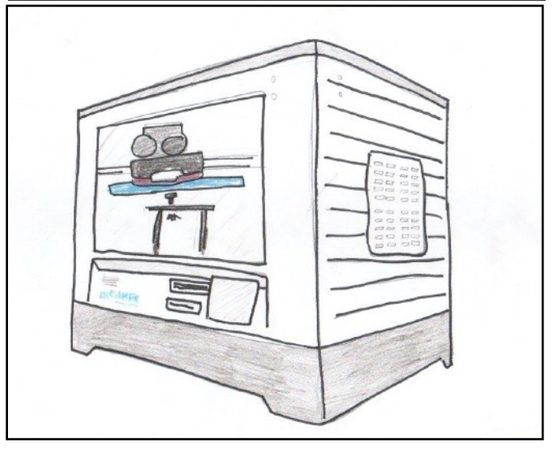
6. **Input** 3Gx file



: Computer, 3D printer

: Double check the measurements in the 3Gx file

7. **Print**



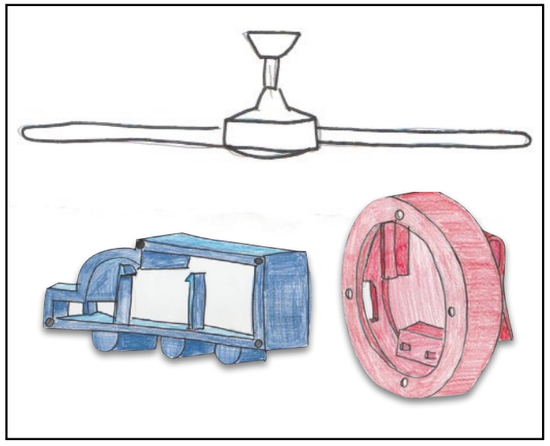
: 3D printer, filament

: Hot, keep hands away, fumes

: Double check the settings

: 2 days to print

8. **Extraction**



Bodies, extraction nozzle

: Fumes

: 10 minutes to extract

Tools

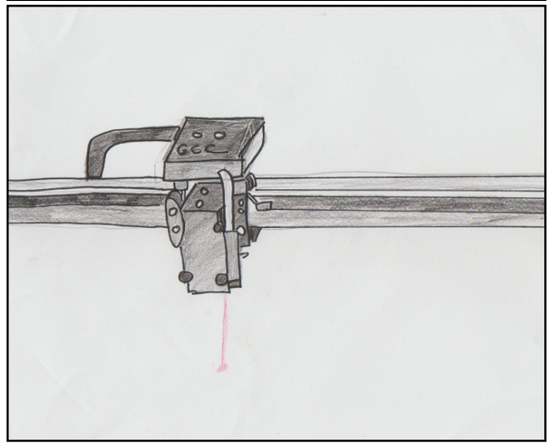
Safety

Time

Quality

Planning and Manufacturing of the Receiver and Transmitter

9. **Focus** the laser.

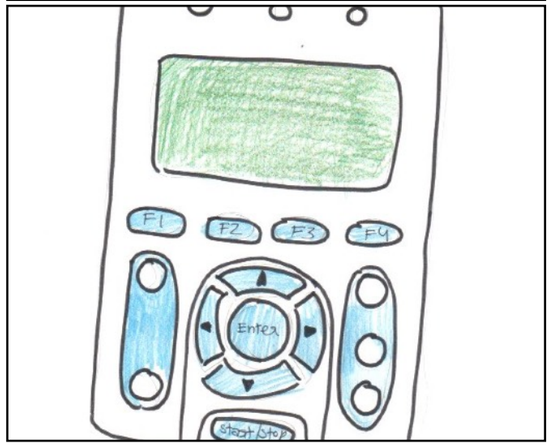


: Laser Cutter, Acrylic

: Do not touch laser

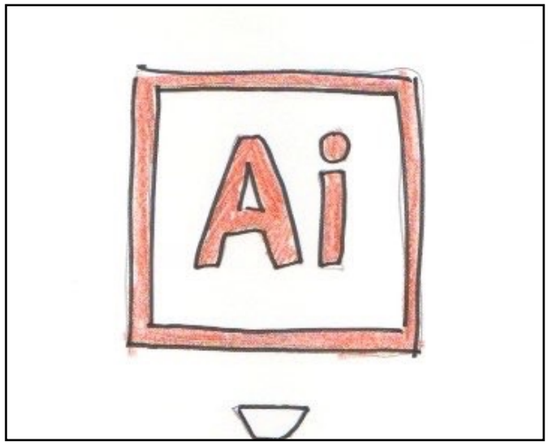
: The laser should not cross over

10.**Settings-**90% power and 0.8, 3%speed



: Laser Cutter

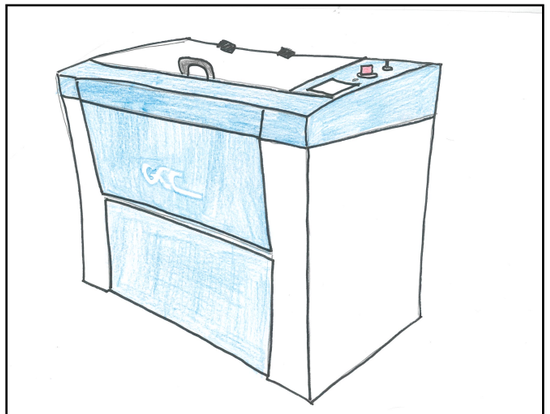
11. **Input** file



: Adobe Illustrator, Laser Cutter

: Double check the measurements in the Adobe file

12. **Print**



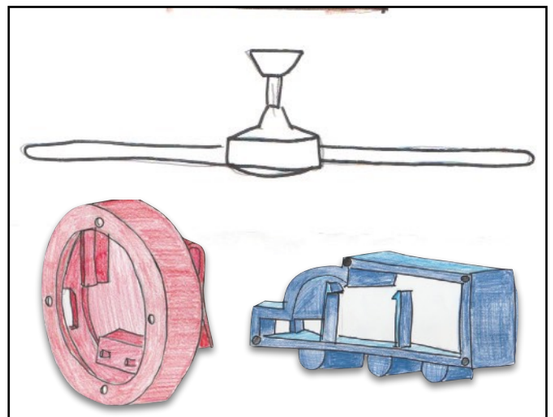
: Laser cutter, acrylic

: Do not look at laser, fumes

: Double check the settings

: 10 minutes to print

13. **Extraction**



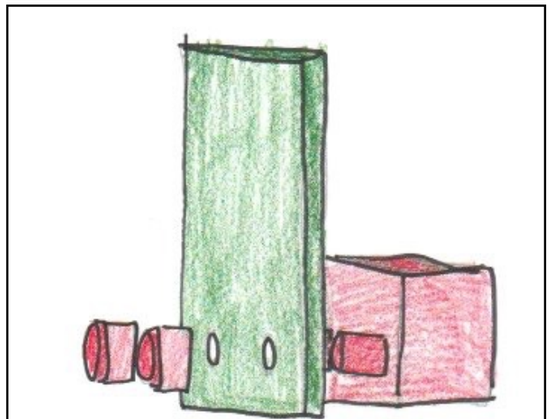
: Laser cut bodies,extraction nozzel

:Fumes

: Clean air given out by laser cutter

: 10 minutes to extract

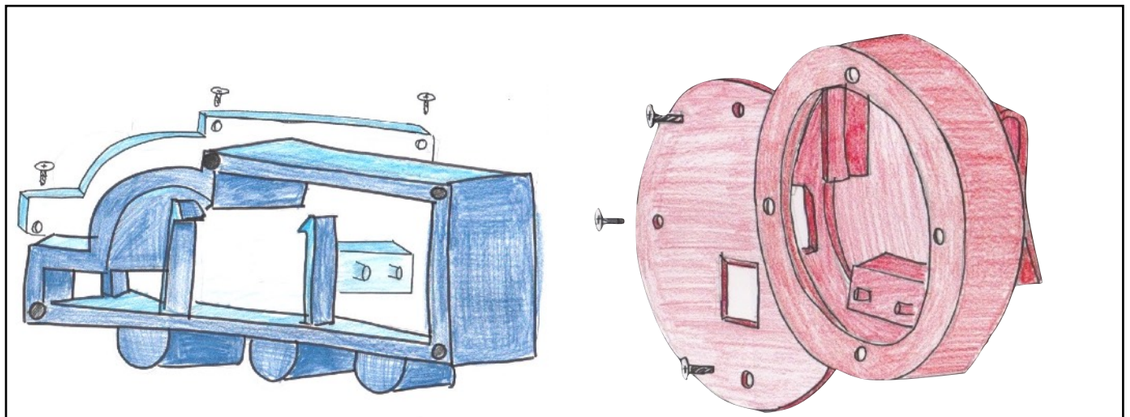
14. Attach **the components**



: Body, PCB, battery holder, USB, speaker

: Make sure the components can not fall out

7. **Screw** the lids on



: Body, lid, screwdriver, screw

: Make sure the screw is tight enough

C1
C2
C3
C4
C5
C6
C7

Tools

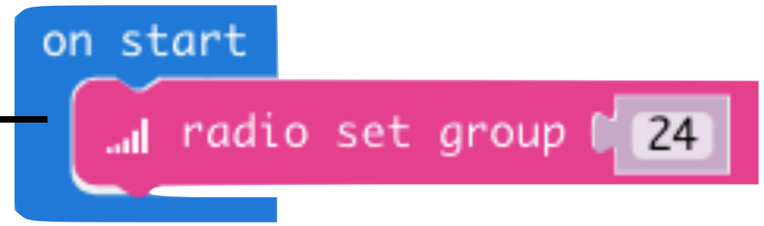
Safety

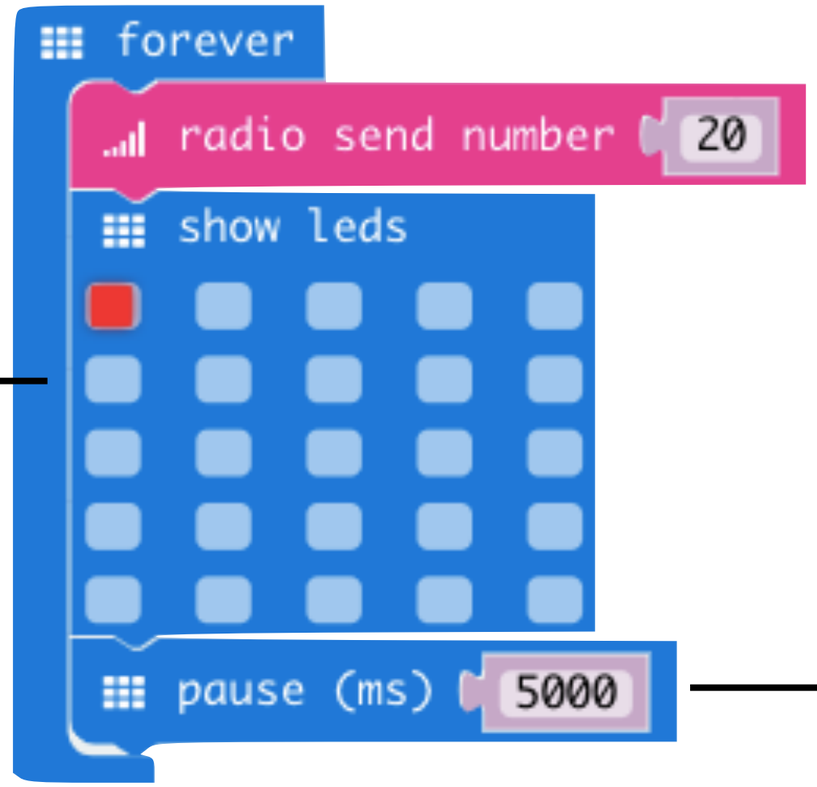
Time

Quality

Transmitter Program

In both the microbits, the radio set group has to be the same. If they are in different groups, they would be listening to other radio waves, not each other. This is in 'on start' as the group just needs to be set once.





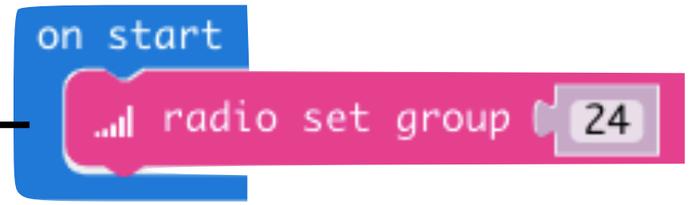
Here, the transmitter is sending the number '20' wave for the other microbit to receive. This is in forever because the transmitter has to keep emitting this wave

This LED is just there so that the user knows that the device is on.

There is a pause of 5 seconds between the radio signal emissions so that the battery does not get used up too fast.

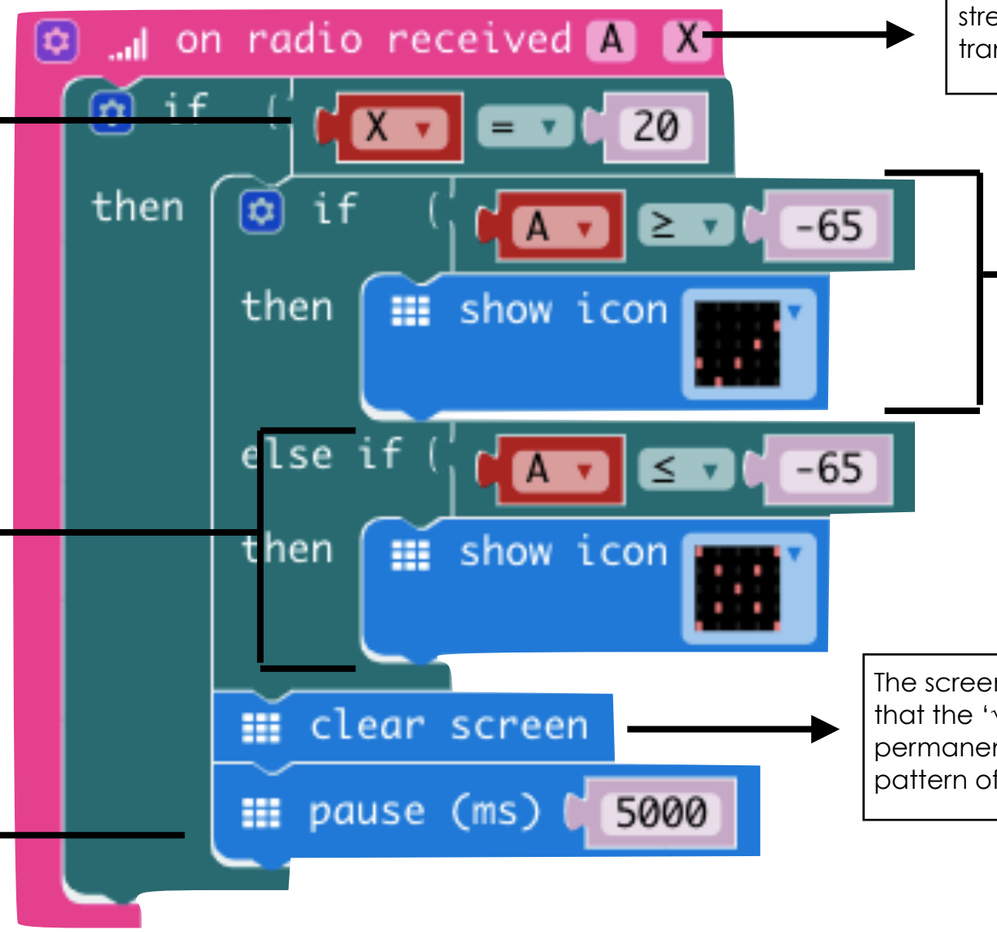
Transmitter Program

In both the microbits, the radio set group has to be the same.



This represents that when the microbit receives 'X' which is a number wave and 'A' which is the strength of the wave. The strength depends on proximity to the transmitter.

This shows that the following code will only take place if the number wave the radio waves is equal to 20 (the number wave sent from the transmitter is 20.



Now that the microbit has receiver the number 20 wave in set group 24 the transmitter sent, the strength, 'A', of the wave is measured. If the strength is more than -65, the higher the strength, the closer the transmitter and receiver, then a '√' will be displayed on the microbit. Indicating that the child is close to the parent.

If the strength is less than -65, the lower the strength, the further the transmitter and receiver, then a 'X' will be displayed on the microbit. Indicating that the child is far from the parent.

The screen is then cleared so that the '√' or 'X' does not stay permanently, disturbing the pattern of the display.

There is a pause before searching for the signal again as to save battery to create the microbits to be long-lasting.

Gantt chart - Estimated Time

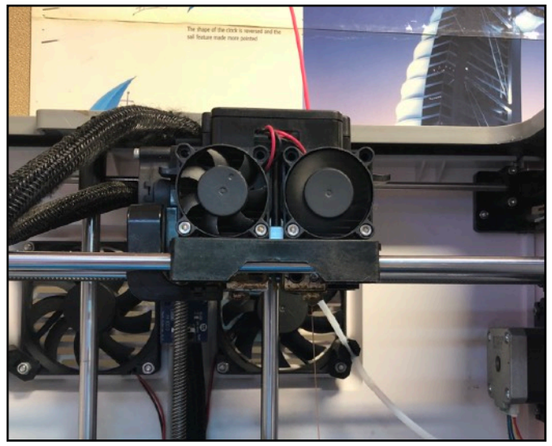
C1 C2 C3 C4 C5 C6 C7

Time in Weeks (Two Lessons per week) + 5th November (Full Day)									
		Start date	End date	Duration	Week 1	Week 2	Week 3	Week 4	Week 5
Process	Refine fusion and transfer the design to other file types as needed.	29th October 2018	5th November 2018	7 days					
	3D print both receiver and transmitter bodies	5th November 2018	8th November 2018	3 days					
	Laser cut transmitter sides	5th November 2018	8th November 2018	3 days					
	Manufacture the PCB	8th November 2018	15th November 2018	7 days					
	Put everything together and check whether changes need to be made	15th November 2018	22ndNovember 2018	4 days					
	Make small refinements and testing	22th November 2018	26th November 2018	3 days					
	Polishing everything up	26th November 2018	29th November 2018	4 days					

Manufacturing of the Receiver and Transmitter

C1 C2 C3 C4 C5 C6 C7

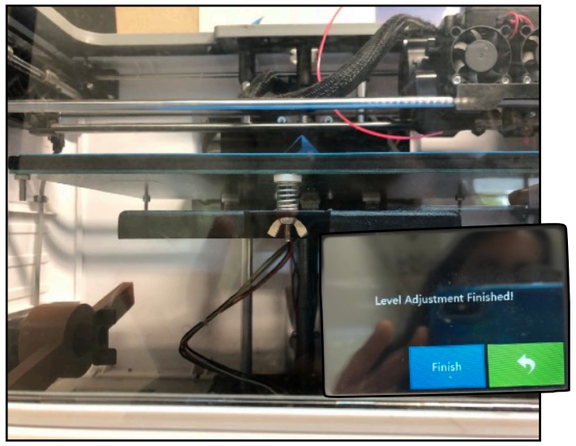
1. **Clear** the nozzle



: 3D printer
: Nothing stuck inside the nozzle
: The nozzle is hot, don't touch!
: 5 minutes

Heat the nozzle using keypad, it melts the old filament inside, removing it.

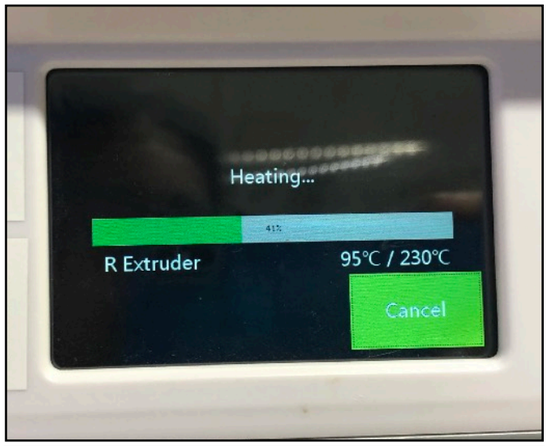
2. **Level** the bed



: 3D printer, leveller device
: Use leveller to check if levelled
: Moving parts, don't touch!
: 5 minutes

Using the keypad, level the bed to make sure the 3D print is levelled when made.

3. **Preheat** nozzle to 210°C



: 3D printer
: Do it twice to make sure
: The nozzle is hot, don't touch!
: 5 minutes

Using the keypad, heat the nozzle so that it can melt and mould the filament.

4. Feed the **filament**

: 3D printer, filament
: Test once- filament coming smooth
: The nozzle is hot, try not to touch
: 10 minutes

Insert the filament into the hot nozzle so that it can stay attached ready to mould

5. **Preheat** the bed to 50°C

: 3D printer, filament
: Do it twice to make sure
: The bed is hot, don't touch!
: 5 minutes

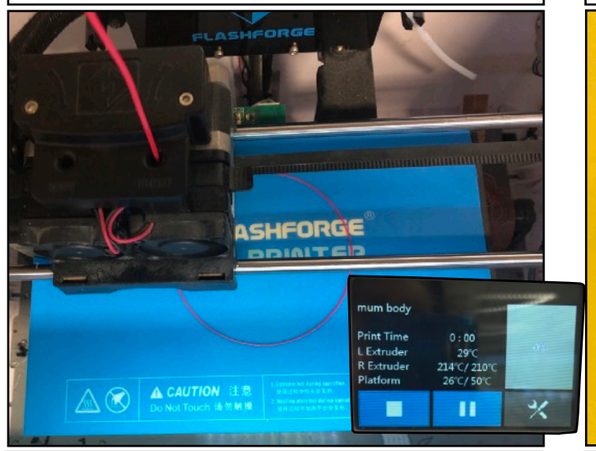
To make sure the filament sticks on the platform to prevent movement.

6. **Input** fusion file

: 3D printer, computer
: Double check the fusion before
: 3D printer may still be hot
: 5 minutes

Input the design that the filament needs to be moulded into on the 3D printer.

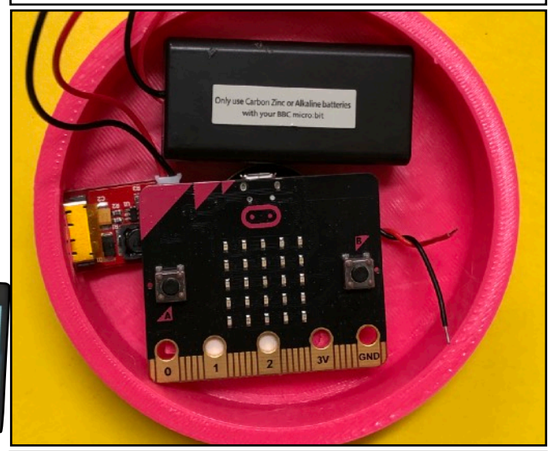
7. **Print**



: 3D printer, filament
: Double check the settings before
: 3D printer hot, fumes, don't touch!
: 2 days

The 3D printer will mould the filament into the shape of the bodies.

8. **Check** if everything fits



: Parent box, battery, microbit, USB
: Check that the box is big enough
: Be careful while taking out, still hot!
: 10 minutes

Take the box out of the 3D printer and make sure all the components fit inside.

Tools
Safety
Time
Quality

Manufacturing of the Receiver and Transmitter

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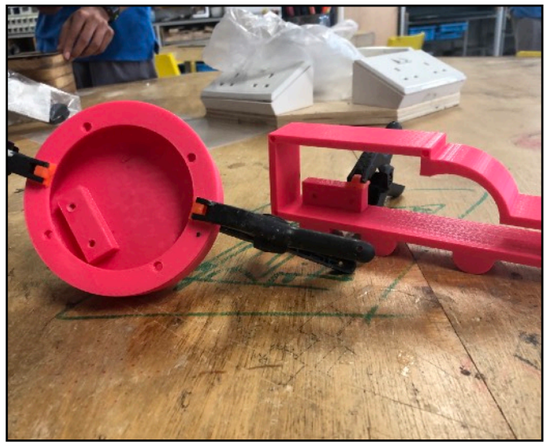
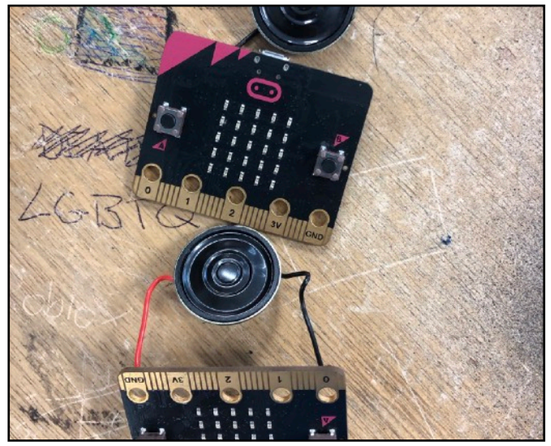
9. **Glue** the 3D printed products together



: 3D printed parts, glue
: Double check the measurements
: Be careful, don't stick your hands!
: 30 minutes

Different 3D printed part to be stuck together to form the whole product

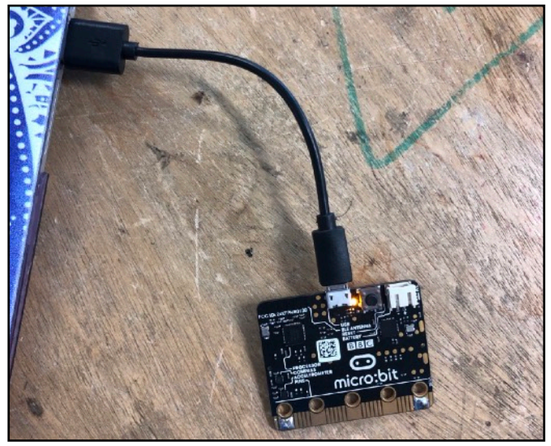
10. **Lay out** the components



: 2x speakers and 2x microbits
: Mapping out how to solder
: N/A
: 5 minutes

Lay out the components to make sure you have all of them.

11. **Transferring** the code



: Computer, 2x microbits, code
: Look into microbit file to make sure
: N/A
: 5 minutes

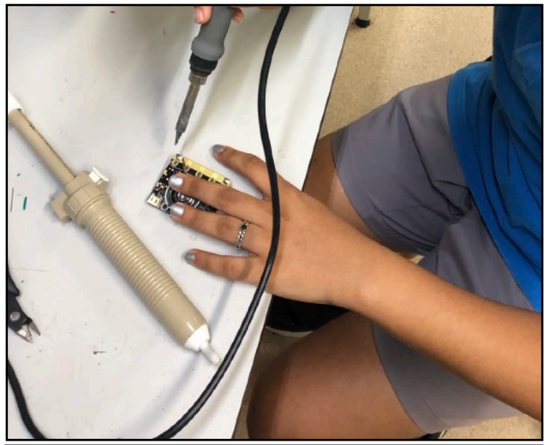
Transfer the code from C4 into the microbits to make them work.

12. **Heat** up the iron

: Soldering iron, power plug
: Remove old solder using flux
: Hot and fumes!
: 5 minutes

Heat up the soldering iron for soldering the components together.

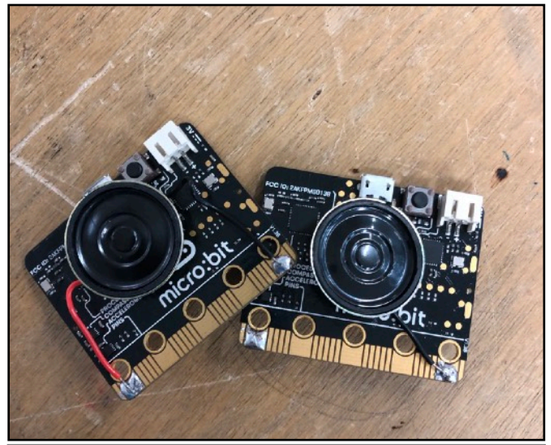
13. **Solder** the components



: Soldering iron, microbits, speakers
: Careful not to short circuit anything
: Hot,fumes and wear safety glasses!
: 1 hour

Solder the components together to make the circuit.

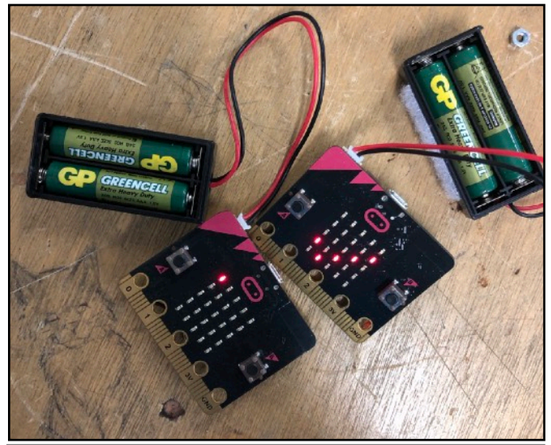
14. **Soldered** components



: 2x microbit+speaker
: Double check the soldering
: Some components may be hot
: 5 minutes

Lay out the soldered components before attaching them on.

15. **Test** the components



: Microbit circuits, batteries
: Try moving them away and test
: May short circuit, fire
: 15 minutes

Test out the circuits to see if they work before attaching them on

16. **Attach** velcro

: Glue, velcro, bodies
: Velcro is glued in the right place
: Don't stick your fingers!
: 15 minutes

Attach the velcro which will be used to attach the battering the bodies

Tools
Safety
Time
Quality

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17. **Drill** holes

: Drill, bodies
: Mark the hole before drilling it
: Be careful of your fingers!
: 30 minutes

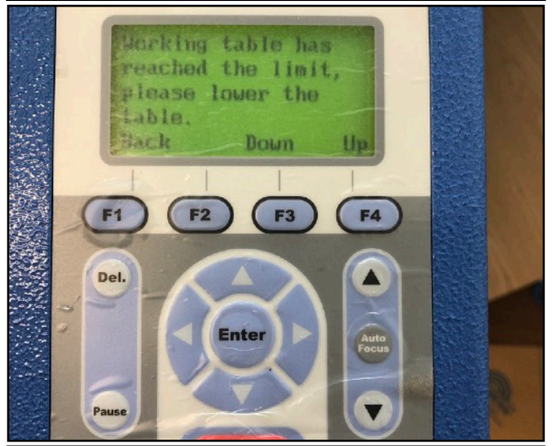
Drill the holes for the screws screwing the microbit to fit in.

18. **Focus** the laser.

: Laser printer, acrylic
: Automatic for accuracy
: Don't look at the laser!
: 5 minutes

Focus the laser before so that it's not too strong and it doesn't burn the acrylic.

19.**Settings-**90% power and 0.8, 3%speed



: Laser printer, acrylic
: Double check for the material
: If settings aren't right, acrylic burn
: 5 minutes

The settings change the laser's power and speed depending on the material.

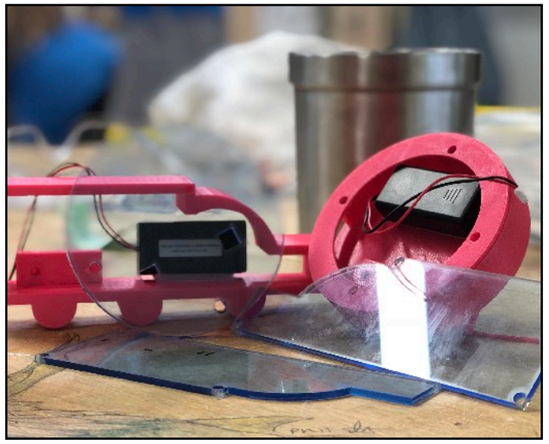
20. **Print**

: Laser printer, acrylic
: Check placing -material and laser
: Laser fumes and eyes!
: 15 minutes

The laser cuts the material into the shapes needed to make the lids.

Tools
Safety
Time
Quality

21. **Lay out** the 3D printed and laser cut



: Bodies, lids, batteries, microbes
: Check if the lids fit on the bodies
: N/A
: 5 minutes

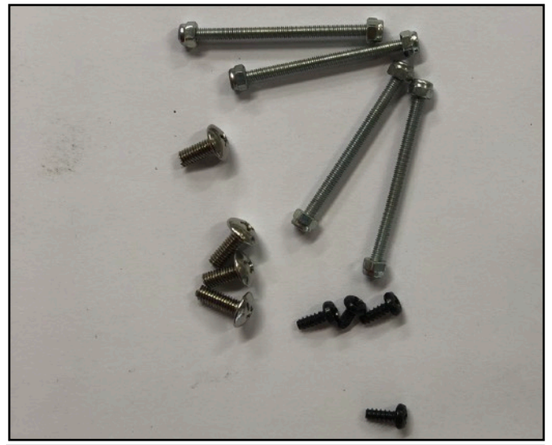
Lay out all the bodies and lids to make sure everything is there

22. **Cut** all the screws

: Hacksaw, screws
: Mark out where to cut before
: Be careful of your fingers!
: 1 hour

The screws are not all the right length, cut them to make them shorter.

23. **Lay** out the screws



: Srews, self locking screws
: Make sure they're the same size
: N/A
: 5 minutes

Lay out all the screws to make sure I have all of them.

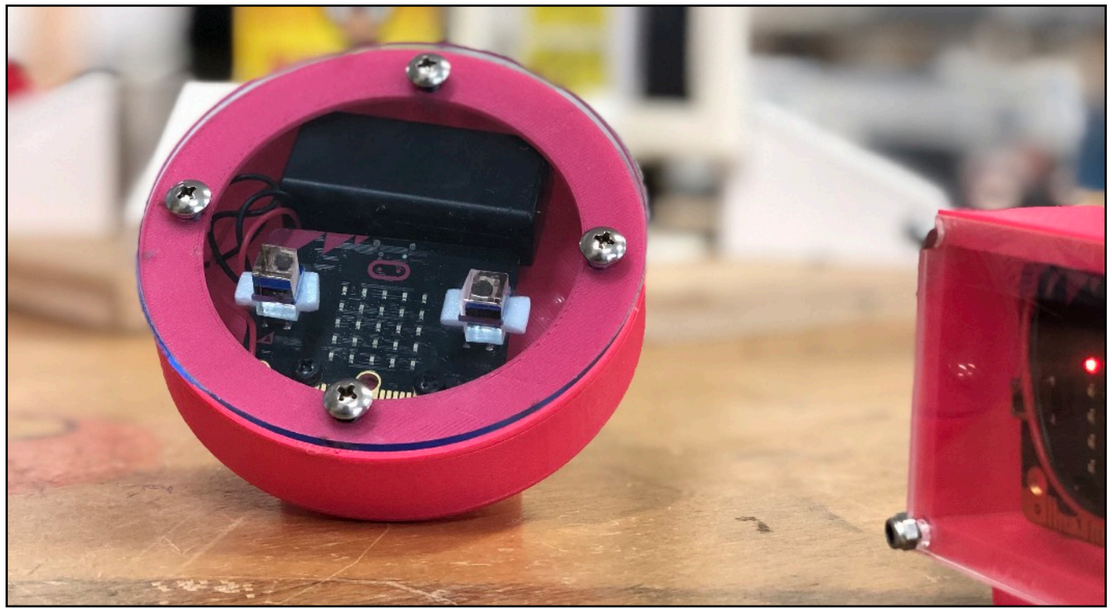
24. **Screwing** everything in

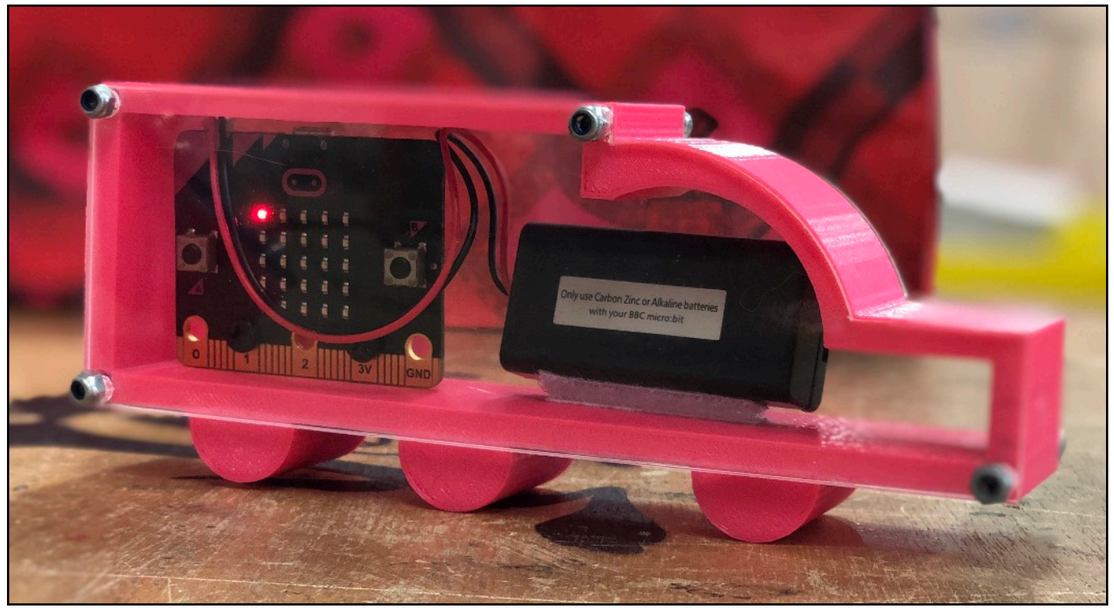
: Screwdriver, bodies, components
: Make sure everything fits before
: Don't get your finger stuck!
: 15 minutes

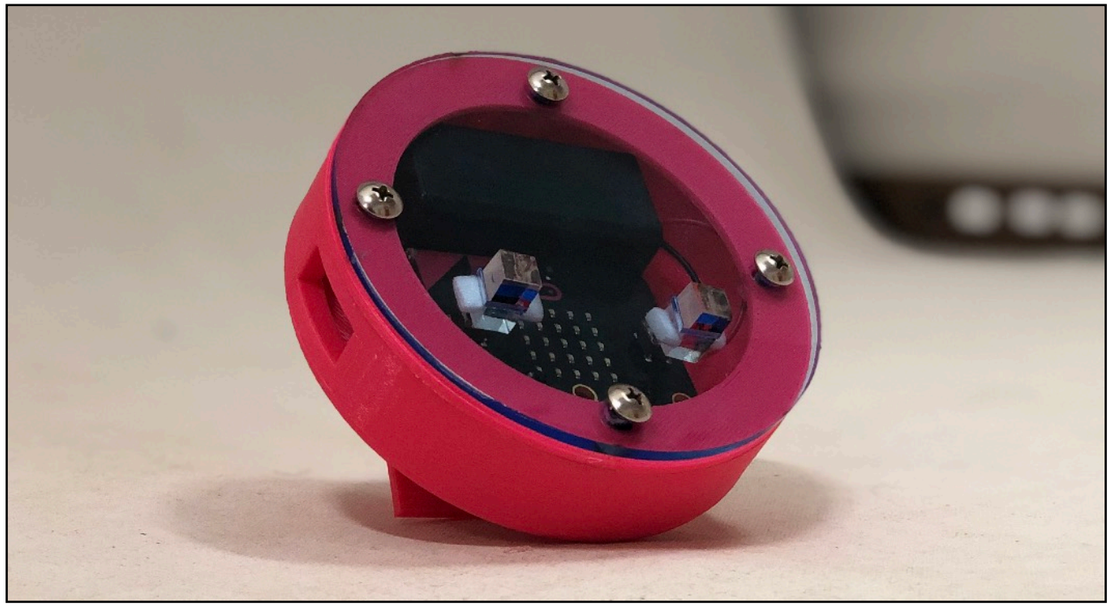
Screw the components together, finishing the product!

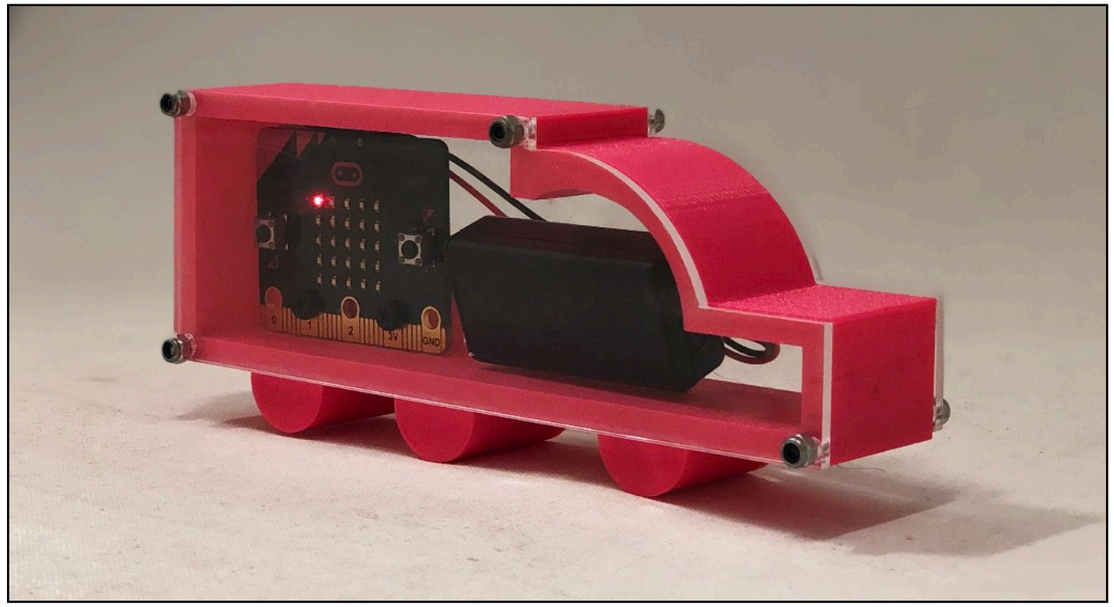
Manufacturing of the Receiver and Transmitter

25. **Attaching** everything in









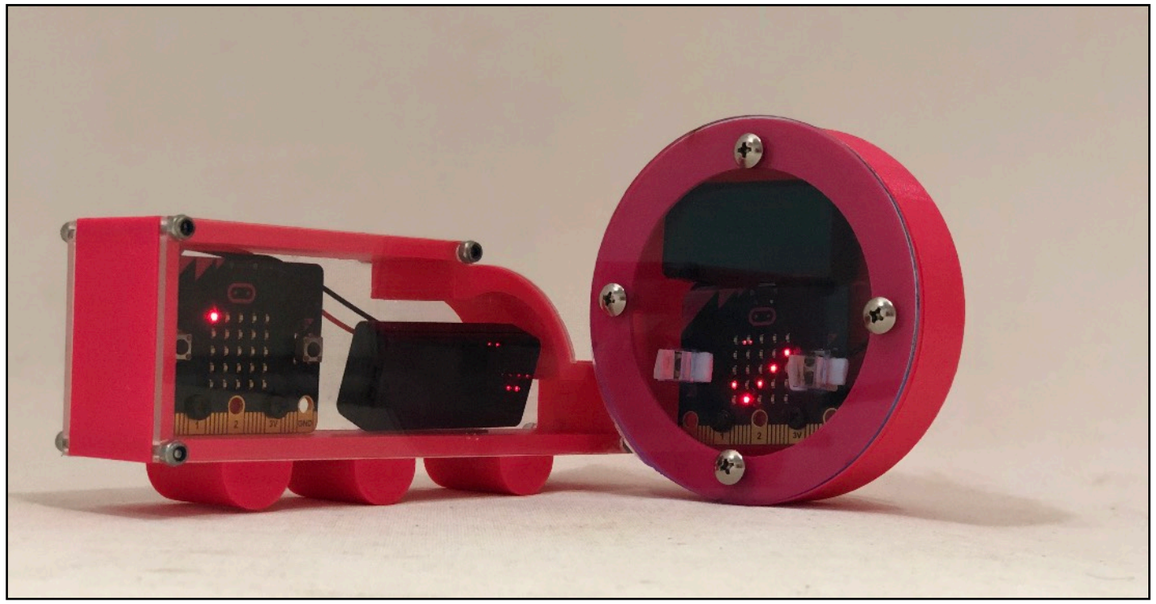
Attach everything and make sure that everything fits well, make the modifications needed to make everything fit and work. This is what the final product looks like. Test the product out.

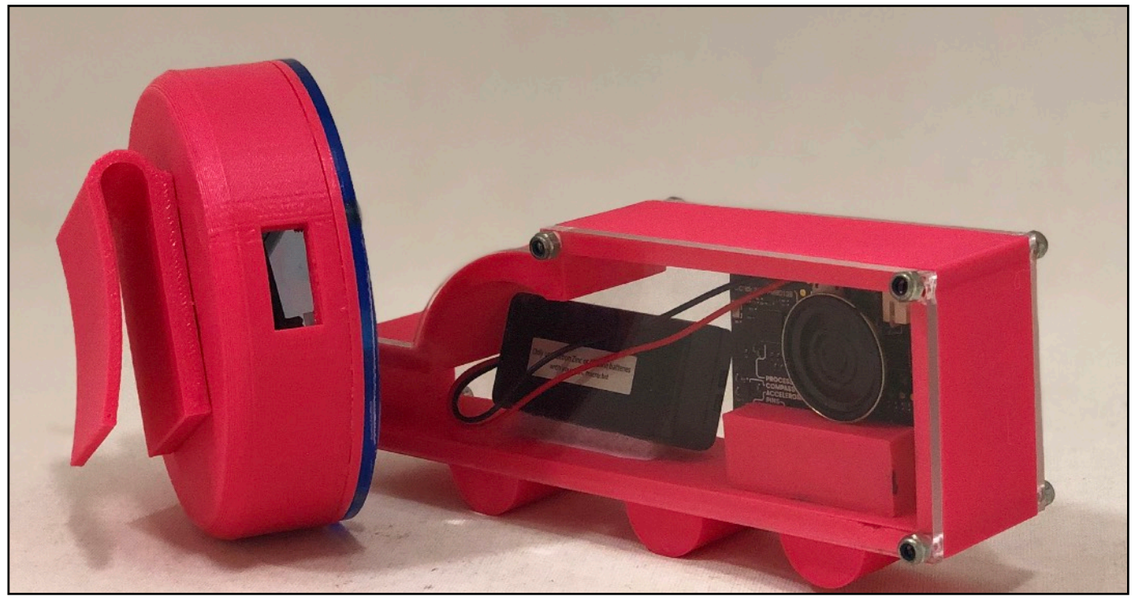
: Both the circuits, batteries and bodies(boxes)
: Test that the circuits work inside the bodies
: N/A
: 10 minutes

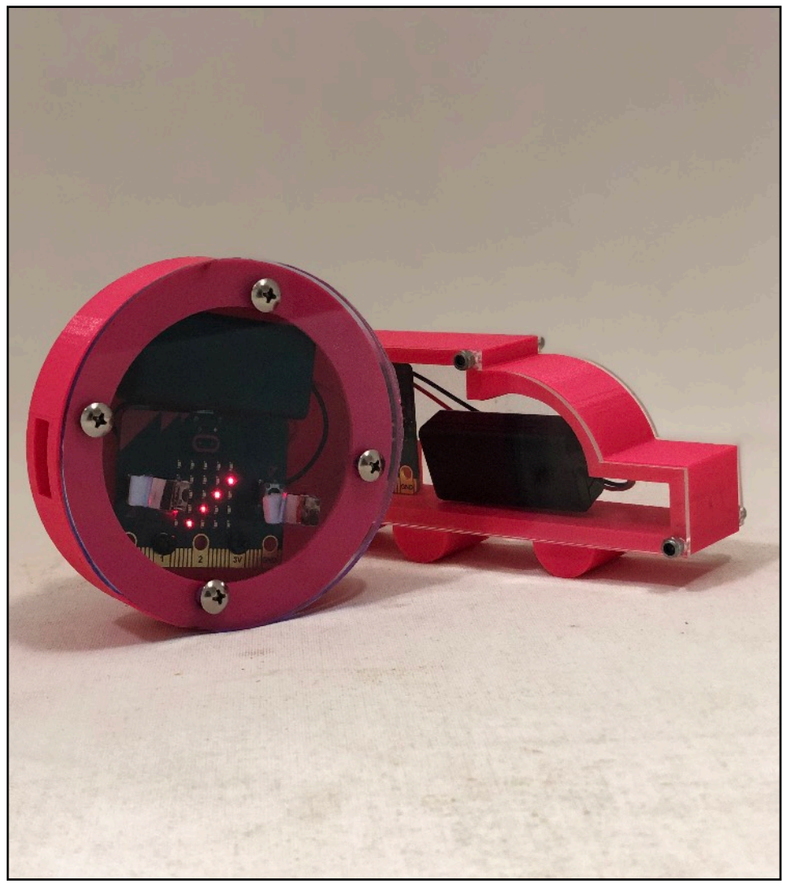
C1 C2 C3 C4 C5 C6 C7

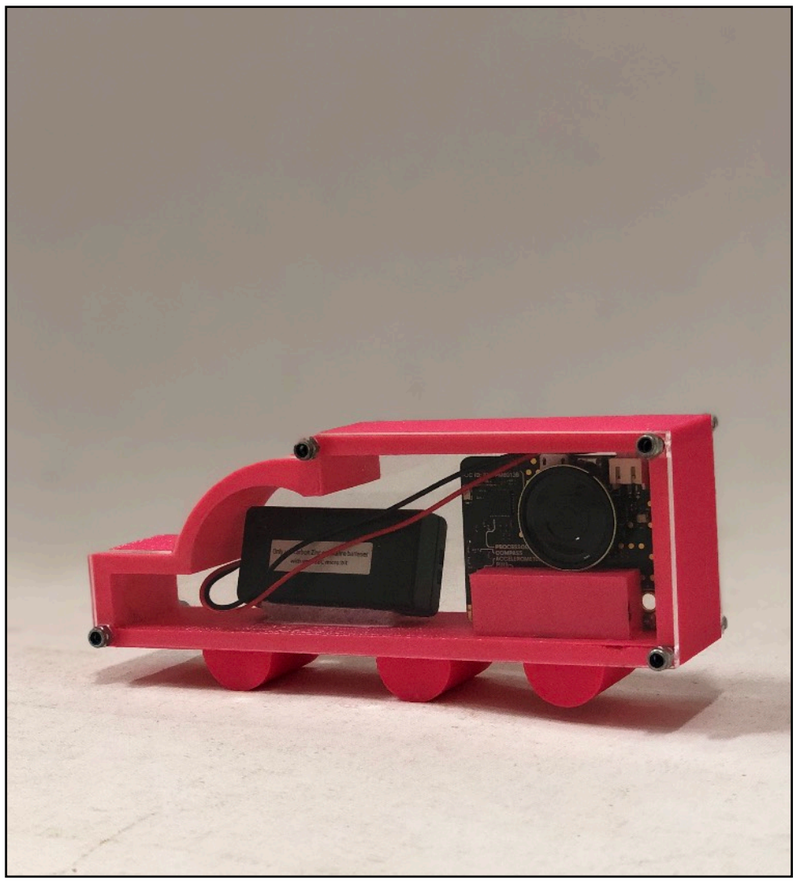
Tools
Safety
Time

Final Product!









C1

C2

C3

C4

C5

C6

C7

Gantt chart - Real Time

	Start date	End date	Time Taken	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12
Refine fusion and transfer the design to other file types as needed.	29th October 2018	5th November 2018	7 days												
3D print both receiver and transmitter bodies	5th November 2018	8th November 2018	3 days												
Soldering the PCB	8th November 2018	23th November 2018	15 days					Mock Exams							
Putting the velcro and drilling holes	10th December 2018	14th December 2018	4 days								December Break				
Laser cut the sides and buttons	7th January 2019	14th January 2019	7 days												
Make small refinements and testing	14th January 2019	16th January 2019	2 days												
Polishing everything up	16th January 2019	18th January 2019	2 days												

Predicted

Real

C1 C2 C3 C4 C5 C6 C7