Junior Certificate Technology

Design Task 2018

Examination number: 18828

Contents

Briefs

A. Design and make an electro-mechanically adjustable LED study lamp.
B. Design and make a working model of a remotely controlled vehicle capable of traversing soft ground and small obstacles. Note: Wireless remote control is not required.
C. Mice can be seen as unwanted visitors to homes and businesses. Design and make a mouse trap to capture a mouse without injury. The trap should signal electronically when a mouse has been trapped.
D. The ability to rotate a locomotive offers a great degree of convenience to railway operators. Design and make a working model of an electro-mechanically controlled locomotive turntable. Limit/proximity switches should be incorporated as part of the control system.
E. Design and make a stand for a small tablet computer. The design should include tilt and turn functionality with at least one of these movements being electro-mechanically controlled.
F. Design and make a working model of a shutter for the window of a house. The shutter should open automatically in daylight and close automatically at night.

Analysis of Brief

A;

Electro-Mechanically: The mechanism is controlled by an electrical component (such as an electrical motor), which may be controlled by another mechanism

Adjustable: The lamp can be moved (e.g. Up, down, left, or right) without having to move the base or legs of the lamp

LED: Uses Light Emitting Diodes rather than a traditional bulb

Study Lamp: A lamp that is small enough to stand on a desk and doesn't look out of place

To summarise, brief A, is asking me to create a lamb that can sit on a desk, which can be moved is some way using an electrical component, and emits light using LEDs (not a light bulb).

B;

Vehicle: Something that can move without being directly pushed (e.g. a car)

Remotely Controlled: Receives commands to move and turn from another device, that does not have to be wireless

Capable of Traversing: Can move across

Soft Ground: This could refer to a surface like sand

Small Objects: This could be something as simple as a pen or a Lego piece

To summarise, brief B, is asking me to create a model of a vehicle, that can move across a surface such as sand and across objects such as Lego with ease, at the command of a remote control.

C;

Mouse Trap: A device which lures and captures mice

Without Injury: The device should not harm the mouse in any way

Signal Electronically: There should be a mechanism in place that will send an electrical current to an electrical component which will alert someone

To summarise, brief C, is asking me to create an object that will lure and capture mice without harming them in any way, and that will

alert someone, using an electrical component, that a mouse has been captured.

D;

Locomotive: A train

Electro-Mechanically Controlled: The mechanism is controlled by an electrical component (such as an electrical motor), which may be controlled by another mechanism

Turntable: A mechanical structure which rotates trains to move them from one track to another

Limit/Proximity Switches: A type of switch which is activated through closeness with another object such as a reed switch

Control System: A system that is used to activate the turntable and decide the destination

To summarise, brief D, is asking me to create a model turntable which is controlled by an electrical component, and which incorporates limit/proximity switches in to the control system.

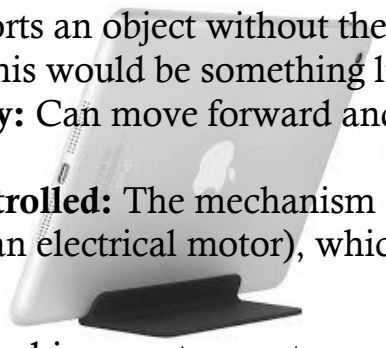
E;

Stand: An object that supports an object without the need to be held

Small Tablet Computer: This would be something like an iPad Mini

Tilt and Turn Functionality: Can move forward and backwards and can move left and right

Electro-Mechanically Controlled: The mechanism is controlled by an electrical component (such as an electrical motor), which may be controlled by another mechanism



To summarise, brief E, is asking me to create an iPad (or similar) stand which can turn in different directions in one case electronically.

F;

Shutter: An object that blocks light from entering

Automatically: Should change state without the need for human input

Open Automatically in Daylight and Close Automatically at Night: Should have the ability to sense light levels

To summarise, brief F, is asking me to create a window shutter which opens when light is detected and closes when light is no longer detected, without the need for human input.

Analysis of Chosen Brief

I have chosen to attempt brief C

> Mice can be seen as unwanted visitors to homes and businesses. Design and make a mouse trap to capture a mouse without injury. The trap should signal electronically when a mouse has been trapped.

To be successful in this I will need to;

- Design and make a mouse trap
- The trap must not harm the mouse
- The capture of a mouse should trigger an electrical component that will alert someone
- I must use materials that are strong and durable against damage from mice
- The trap should be able to be left outdoors
- The trap should incorporate a lure
- The model must be realistically sized
- I must complete this task by Friday 27th April 2018

Research

As part of researching my project I visited Homebase and documented the products they were selling that related to my project. I also interviewed Philip, the other technology teacher in the school (metalwork too), who Michael told me had made multiple humane capture mouse traps in the past.
I also found more information online at;

- http://how-to-get-rid-of-mice.com/mouse-trap-bait/
- http://how-to-get-rid-of-mice.com/humane-mouse-traps/
- https://www.apartmenttherapy.com/best-mouse-traps-humane-annual-guide-216570
- http://www.conserveireland.com/mammals/wood_mouse.php
- https://www.rentokil.ie/mice/species/
- https://www.rentokil.com/rodents/rodent-borne-diseases/
- http://animals.mom.me/wild-mice-need-eat-11634.html

Analysis of Research

Inhumane;

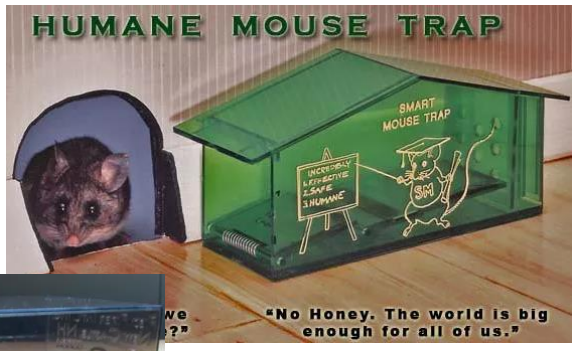
Most for the traps for sale in Homebase were kill on capture traps, examples of these can be found on this page.

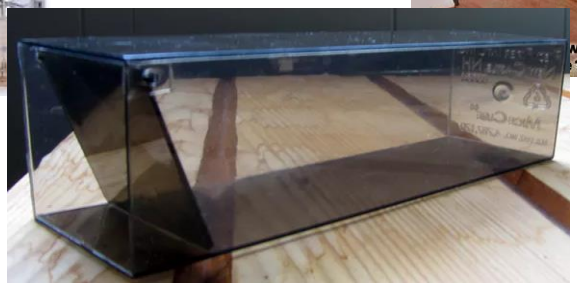
Live Capture;

Homebase had a very small stock of live capture traps, these can be seen below.

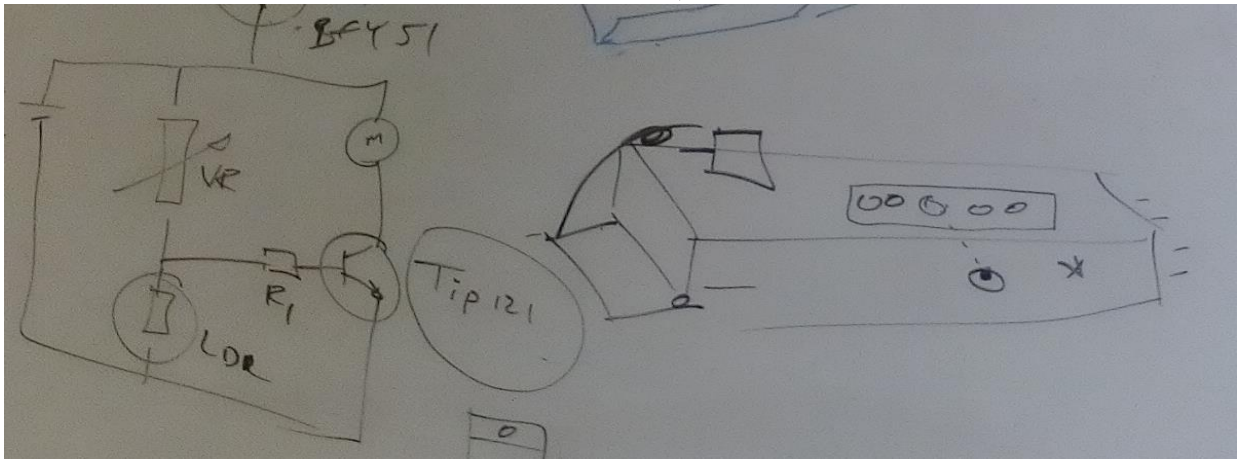
Online I had better luck finding more live capture traps, the below pictures are from;

- http://how-to-get-rid-of-mice.com/humane-mouse-traps/
- https://www.apartmenttherapy.com/best-mouse-traps-humane-annual-guide-216570





Interview of Phillip;



Phillip recommended that I make the trap long, so the mouse's tail does not get caught when the door closes. He also recommended that I create holes at the end of the trap, which the mouse can't get through, as the mouse will be more likely to enter the trap if it thinks there is another way out at the other end. As an activation method he recommended the use of a LDR on one side and a series of small holes on the other, this would activate a motor when the light was obstructed, this would also allow for easy cleaning as all electronics would be external. Finally, I should not make the trap too wide, so the mouse cannot easily turn around, which would remove the risk of the mouse forcing its way out of the closed trap (I also see this as a good way to reduce the risk of bites)

Investigation of Research

Market

Who would buy this product?

- Understandably, a product like this product could be sold to people who don't want to kill animals but have a problem with (or worry about) mice at home or run a large area like a farm or a factory or a restaurant and must keep rodent numbers down

What price do similar products sell for?

- Based on my research at Homebase, traps can range anywhere from €4.75 to €18.74

Types of Traps and Mechanisms used?

- Spring loaded kill traps, which, when set, are kept under torsion which is released when a pressure pad is activated by a mouse, this comes in a wooden version which is disposable and a plastic version which is reusable

- Capture and dispose of traps, which seal shut when a mouse enters them and are then thrown away, starving the mouse to death, I believe this trap to be incredibly inhumane and wasteful

- Live Capture, through the use of a leaver action, which is interestingly simplistic, however I believe this trap could fail in many areas such as its lack of air flow and nothing stopping the mouse from pushing its way out of it

- Spring loaded, live capture cages which when activated closes the entrench to a cage trapping the mouse inside, I like this trap because it has plenty of air flow and is not escapable

- Live Capture, using a beautifully simplistic design, using a one-way door, I like this product because it uses a simplistic design but has the potential to be improve easily

Safety

What harm could the trap cause to the mouse?

- The mouse could receive a slight electronic shock if any wiring is exposed
- The mouse could cut its self on sharp edges
- The mouse could accidentally get caught in a spring-loaded mechanism
- The mouse could suffocate in an enclosed space (http://how-to-get-rid-of-mice.com/humane-mouse-traps/)

How can this be prevented?

- Electrocution can be prevented by keeping wires external and by using non-conductive materials
- Cuts can be prevented by correctly finishing and smoothing all edges
- Damage from spring loaded mechanisms can be prevented by making the trap long enough for the mouse to be out of danger before anything activates
- Suffocation can be prevented by adding some small holes to the trap

What harm could the mouse cause to the trap?

- The mouse could chew through soft material and electronics
- Urine could damage electronics

How can this be prevented?

- Using though materials and concealing electronics would prevent the mouse from chewing through anything
- The placement of electronics up high or externally would prevent this

What harm could the trap or the mouse (after being caught) cause to humans?

- The mouse could bite the person who is releasing it
- Sharp edges could cut the person who is handling the trap
- If the trap is spring loaded, it could slam shut on the person setting it

How can this be prevented?

- A second exit which can be easily opened and closed would greatly reduce the likelihood of this happening
- Cuts can be prevented by correctly finishing and smoothing all edges
- There is no way to stop this ever happening, but if the spring is not too tight and the person can easily free themselves, it should be no more than a mild annoyance

Environmental Impacts

What damage could the mouse cause to the environment, once caught?

- Mice carry many diseases which can easily spread to humans, through urine and faeces which could be left in the trap (https://www.rentokil.com/rodents/rodent-borne-diseases/)

How can this be prevented?

- If there are no internal electronics, the opening to the trap could be held under a tap and the waste could flow out of holes at the other end, this would allow for easy removal of waste products from the trap

Design

Does this product need to look attractive?

- Based on what I observed in my research looks are not a priority, however certain design choices such as making the product transparent can add to the appeal and its functionality

How should this product be finished?

- The product should have no sharp edges to reduce damage to both mice and humans

What shape would work best?

- The clear majority of traps I have come across in my research are square, this is most likely because this shape is better suited to this task, as it is easy to make and does not contain any complicated angles

Sizing

How long do mice get on average?

- Based on what I have researched the most common mice in Ireland and their lengths are;

  - Field Mice: 150mm-190mm (tale included)
  - House Mice: 140mm-180mm (tale included)
  - Yellow Necked Field Mice: 170mm-230mm (tale included)
  - Wood Mouse: Up to 190mm (tale included)

(http://www.conserveireland.com/mammals/wood_mouse.php and https://www.rentokil.ie/mice/species/)

To prevent damage to the mouse how long will it have to be?

- Seen as the longest mouse can reach 230 mm in length the trap should probably be at least 270mm long to be safe

Maintenance

How could it be cleaned?

- If there are no internal electronics, the opening to the trap could be held under a tap and the waste could flow out of holes at the other end

How could the batteries be changed?

- If the batteries are left open on enclosed in an area which can easily be opened there would be no trouble changing the batteries

Method to Sense a Caught Mouse

Push to Activate Switch?

Pros;

- Simple to setup
- Could be connected to an Arduino

Cons;

- Must be on the ground
- Can't place anything on it

Infra-Red Motion Sensor or Range Sensor?

Pros;

- Could be connected to an Arduino
- Could be off the ground or external

Cons;

- May not activate through clear certain materials (but this could be fixed by cutting a small hole and placing clear (and thin) piece of over it

LDR;

Pros;

- Can be connected to an Arduino
- Can be placed externally

Cons;

- Would require being paced in a bright place or would need another light source
- High potential to activate prematurely or fail if the light source drops or if the LDR is still receiving light from a hole at the bottom when the mouse passes the desired activation point

Materials

(Information in this section is based primarily on what we were taught in class)

Wood?

Pros;

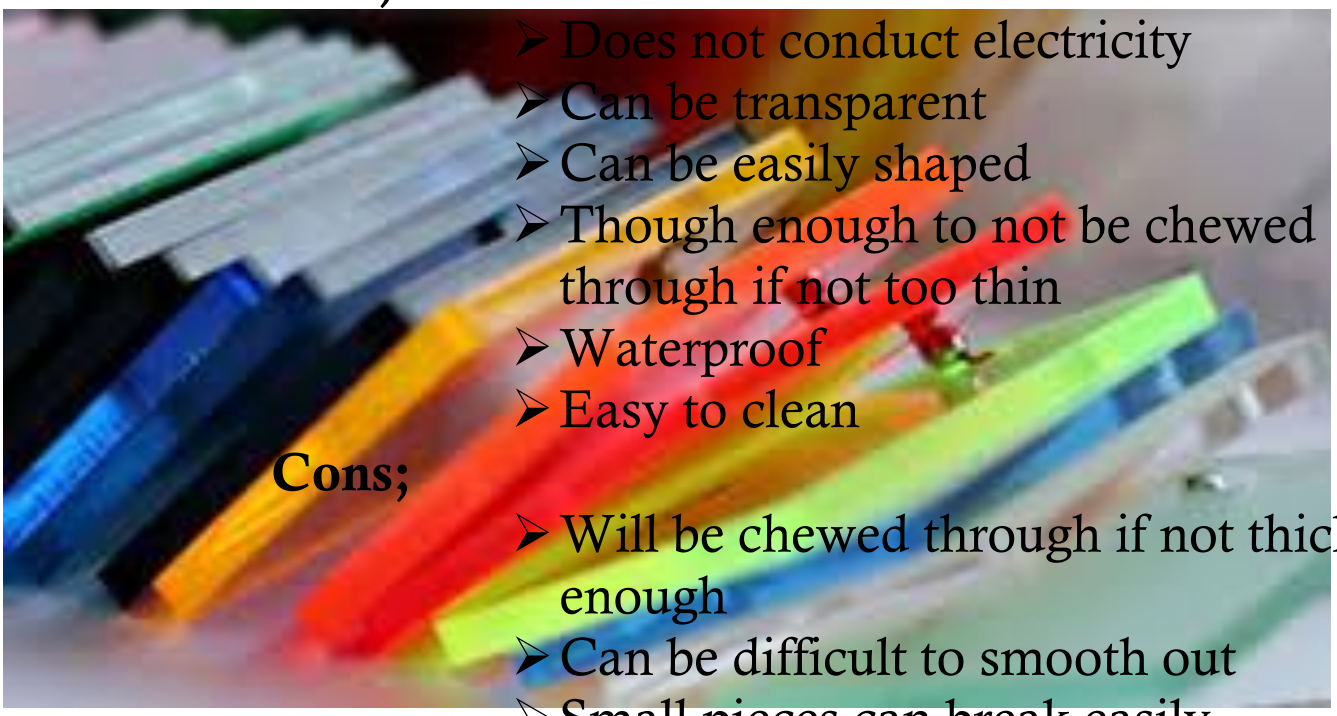
- Easy to work with
- Does not conduct electricity

Cons;

- The mouse could chew through it
- Does not hold liquids well
- Difficult to clean

Plastic?

Pros;



- Does not conduct electricity
- Can be transparent
- Can be easily shaped
- Though enough to not be chewed through if not too thin
- Waterproof
- Easy to clean

Cons;

- Will be chewed through if not thick enough
- Can be difficult to smooth out
- Small pieces can break easily

Metal?

Pros;

- Strong
- Waterproof
- Will not be chewed through
- Easy to clean

Cons;

- Difficult to work with
- Conducts Electricity
- Can rust

Method of Electronically Signalling a Caught Mouse

LED?

Pros;

- Will not stress a captured mouse
- Will not annoy anyone if left outside

Cons;

- Will not get anyone's attention unless checked

Buzzer?

Pros;

- Is much more likely to alert someone of a capture

Cons;

- Could stress a mouse
- If left outside, it could annoy neighbours

Arduino to Phone SMS?

Pros;

- Would not require anyone to be nearby
- Would not cause any annoyance or discomfort to the mouse or other people
- Would save people time as there would be no reason to constantly check the trap(s)

Cons;

- Would be more complicated and expensive than other options

- The more successful the trap the more money would be spent on sending SMS's

(https://www.youtube.com/watch?v=JRWOt-H7ZMI **and** https://www.youtube.com/watch?v=CU26W8CXpeE**)**

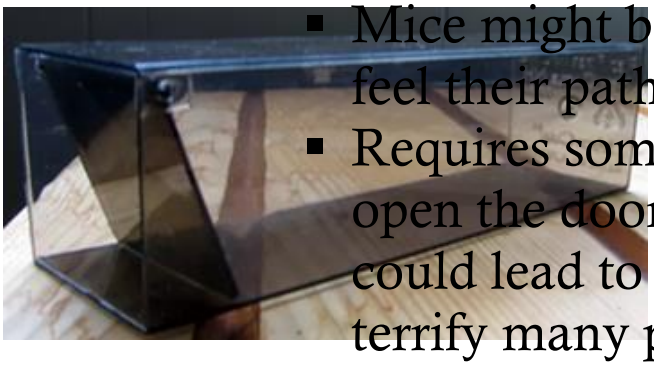
Method of Capturing the Mouse Once Inside

Simple One-Way Door;

Pros;

- Easy to set up
- No potential to cause damage to mouse
- Has the potential to catch multiple mice

Cons;



- Mice might be discouraged to enter if they feel their path is blocked
- Requires someone to reach into the trap to open the door and let the mouse out, which could lead to bites, is unhygienic, and would terrify many people

Spring Loaded Door;

Pros;

- Unescapable
- Fast

Cons;

- Potential to cause harm
- Difficult to set
- Many smaller parts

Motorized Door;

Pros;

- Can be fast
- Less potential to cause harm
- Can be connected to the signaling system

Cons;

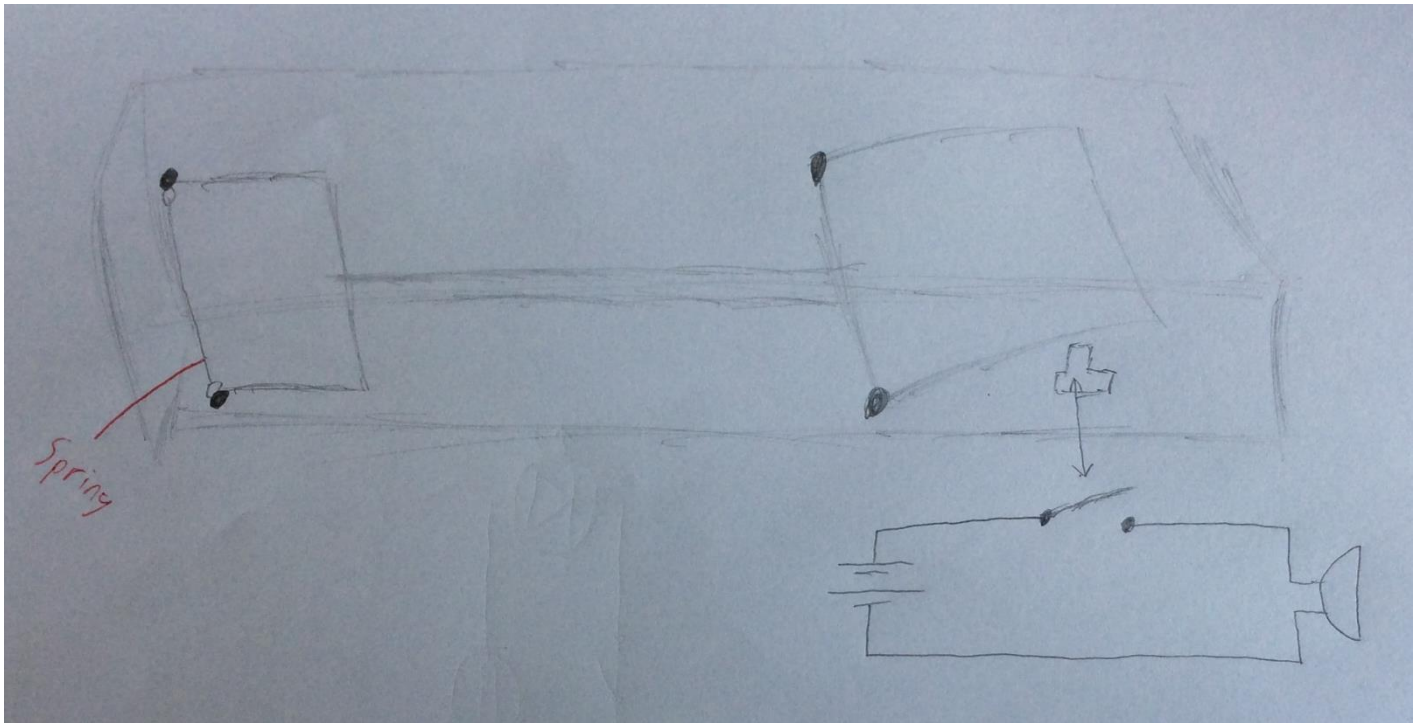
- The motor will take up more room
- Would be easier to force open than a spring-loaded door

Overall

What should the main design and -functions of my product be based on my research?

- Should be square in shape
- Should be at least 270mm long inside
- Should be cleanable
- Should not causes any harm to the mouse or humans
- Should contain a method of electronically signalling a caught mouse
- If possible, I should us a transparent substance
- If possible, I should try to not go too far over €18.74 or the product could be overlooked, on shelves, as too expensive

Development of Design Ideas
Possible Solution 1



About: This possible solution works off the design of spring loaded traps that I have previously talked about and would alert someone to the capture using a buzzer activated by a push to activate switch inside the trap.

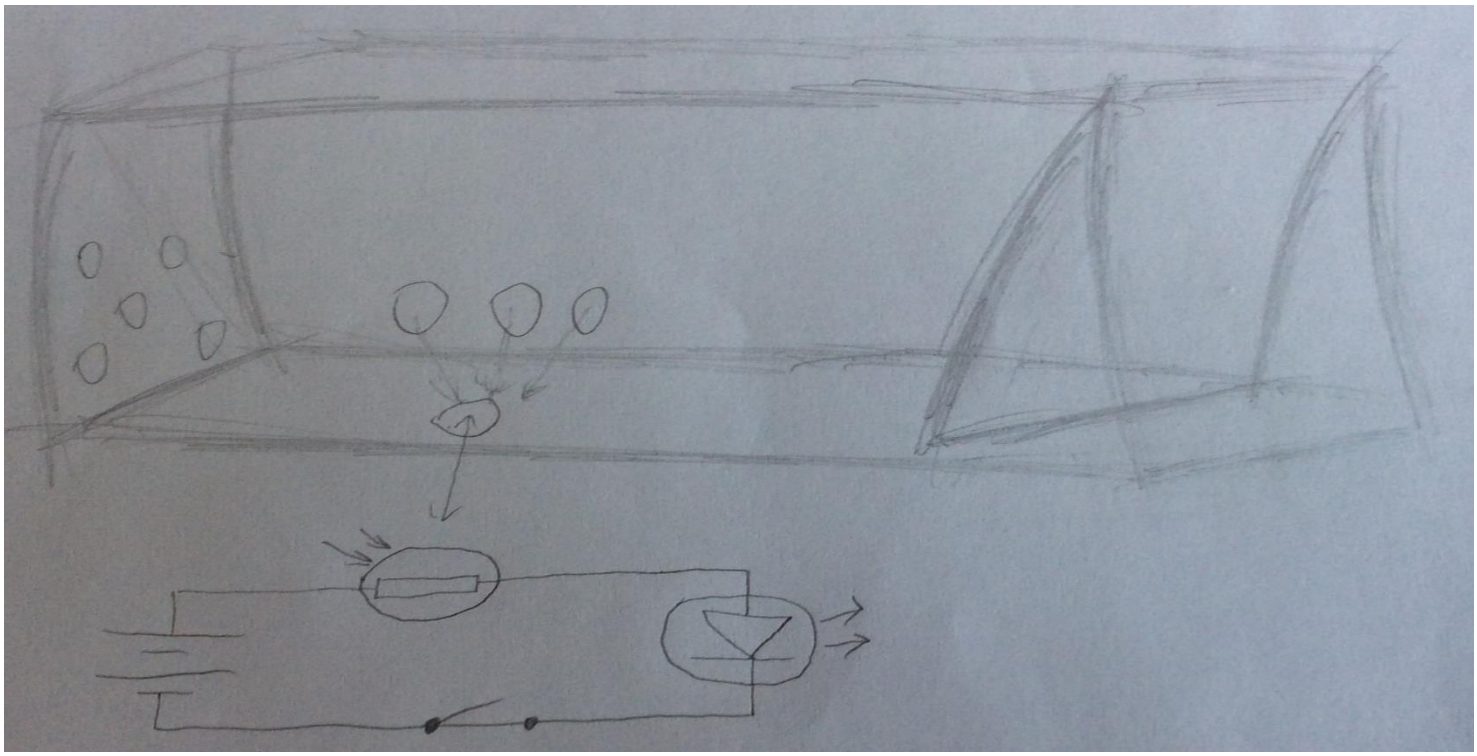
Pros;

- No chance of escape
- A good buzzer could be heard from a far distance
- Low power draw

Cons;

- Potential to cause injury
- If the mouse moves off the switch the buzzer will turn off
- The buzzer could be a stressor for the mouse
- Would be almost impossible to clean as it would contain many small spaces and internal electronics

Possible Solution 2



About: This possible solution contains some ideas that Philip gave me, such as holes at the other end and activation using a LDR. This also uses a one-way door and would signal someone using a LED.

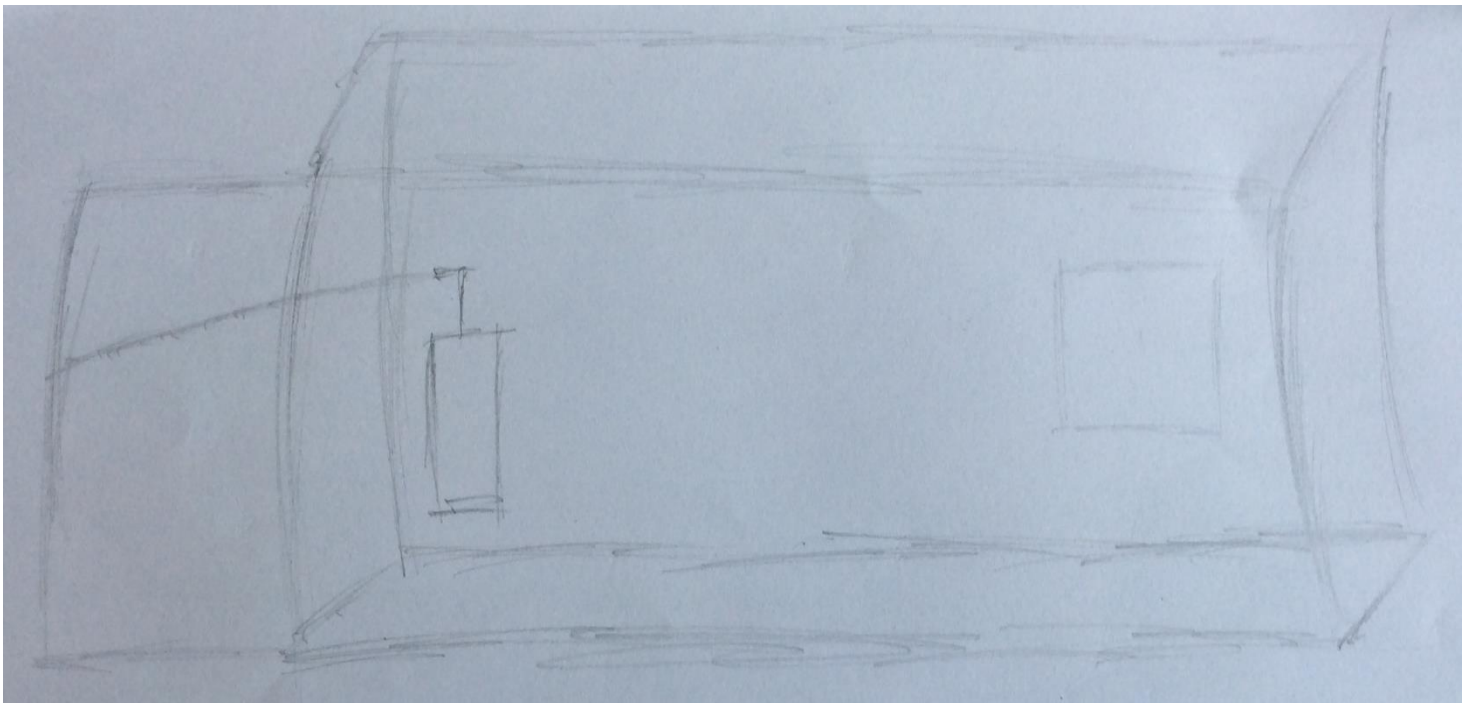
Pros;

- Easy to clean as there are no internal electronics
- No potential to cause damage to the mouse
- A LED would not stress a mouse
- The ability to see light at the other end may entice the mouse
- Could catch multiple mice
- Low power draw

Cons;

- The LED may not catch anyone's attention
- The door being closed may discourage the mouse and could defeat the point in having holes at the other end
- The person releasing the mouse must reach into the trap
- Slight possibility the LDR switch could fail

Possible Solution 3



About: This trap would be activated using an infra-red sensor which would run to an Arduino, which would send a message over the internet to a personal device and would quickly activate a motor which would pull the door shut using a string and pullies.

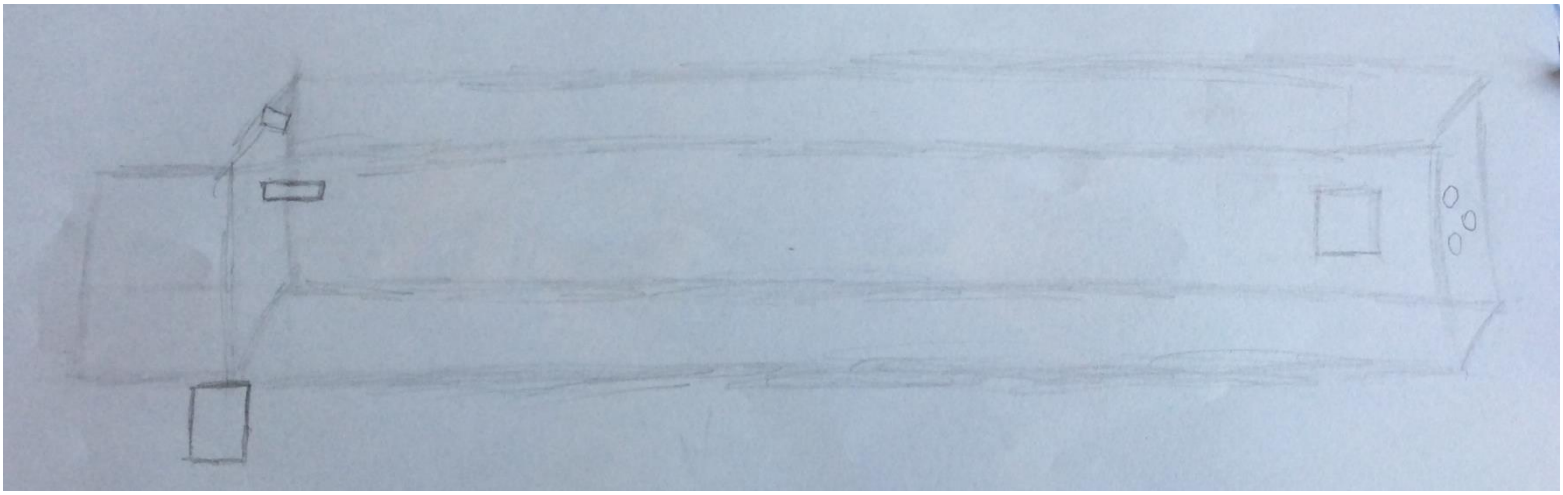
Pros;

- Can be easily cleaned and there are no internal electronics or small parts
- Can be opened without any danger to the human or mouse
- Very little potential to cause harm to the captured mouse

Cons;

- If the string snaps the mouse could escape, and it would be a pain to repair
- The trap is wide which could lead to the mouse moving outside the sensors area
- No holes to allow air flow and to entice the mouse
- Possibly high-power draw
- The use of an Arduino will greatly increase the price

Possible Solution 4



About: This possible solution is a long trap which works a lot like the previously mentioned solution, *Possible Solution 3,* but has be improved by making it longer (and thinner), adding small holes, and changing the motor so it will control the door directly (without using any string).

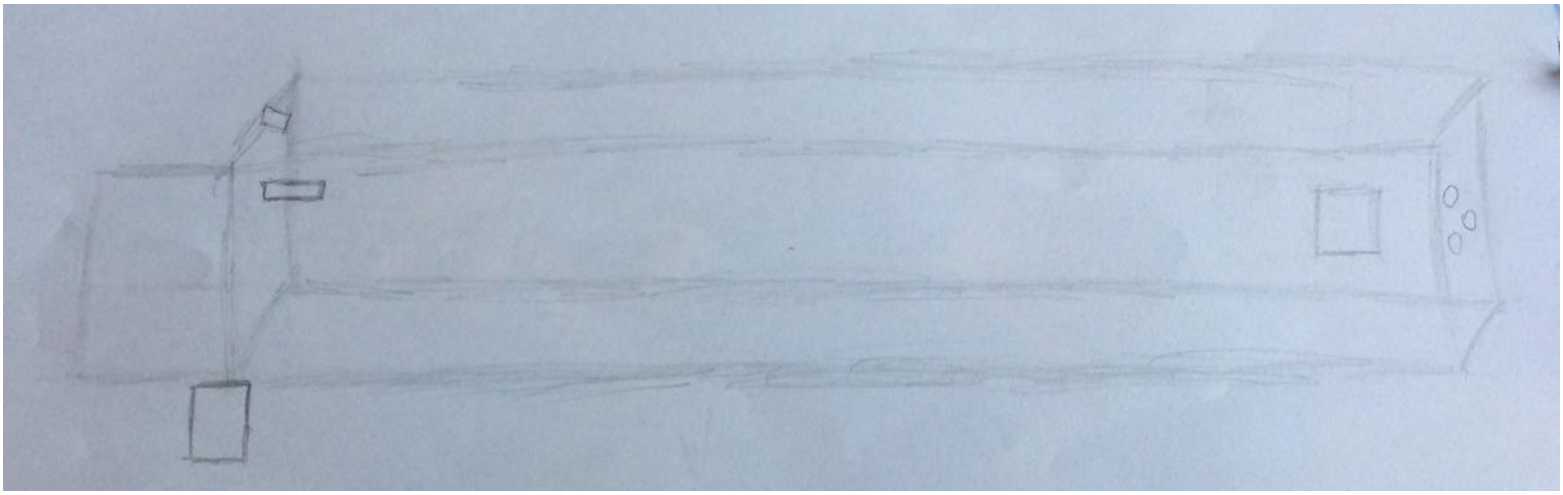
Pros;

- Can be easily cleaned and there are no internal electronics or small parts
- Can be opened without any danger to the human or mouse
- Very little potential to cause harm to the captured mouse, now even less as it is much longer
- Almost completely unescapable
- No way the mouse can avoid the sensor
- Contains holes

Cons;

- Having the motor on the ground puts it and some wires in more danger of being chewed by mice
- Possible high-power draw
- The restriction of movement may stress the mouse
- The use of an Arduino will greatly increase the price

Final Solution



As my final solution, I chose *Possible Solution 4.* This solution is rectangular and long (270mm as previously decided). The width and height of the design are yet to be finalised but will be relatively small, as to prevent the ability of the mouse to turn with ease. At the end of the trap, and possibly at the top, there will be some small holes, which would allow for the flow of air, and would make the mouse more likely to enter the trap as it would believe there is a way out at the other side.

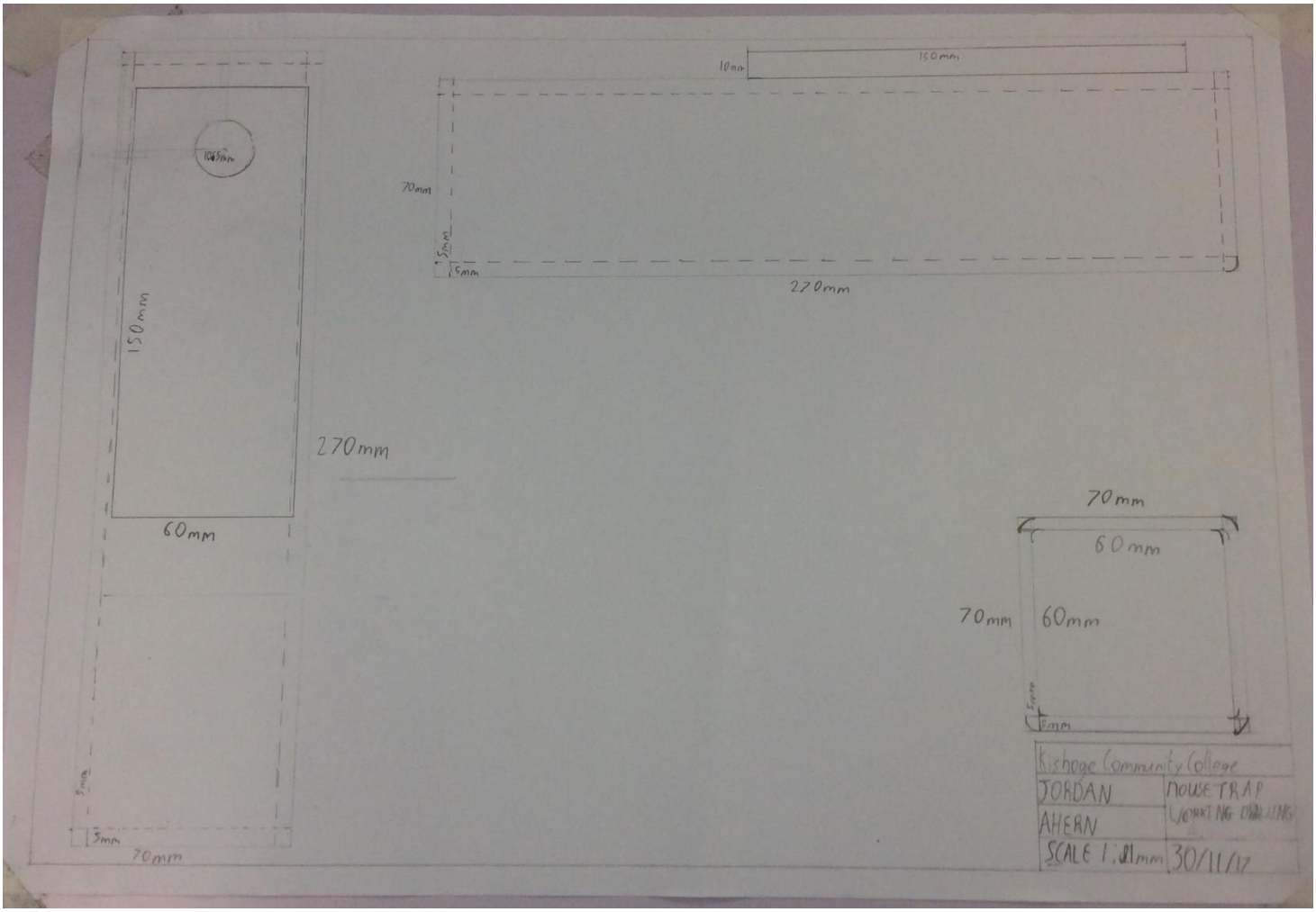
The trap will be activated and send a capture signal electronically. This will be activated using an Infra-Red sensor at the far end of the trap. This will send a signal to an Arduino which will activate a motor which will quickly close the door on the trap, and will send a signal, in the form of an SMS or Email, to the owner of the trap.

This design has almost no possibility to harm the captured mouse as it is long enough to accommodate for even the longest of mice in Ireland, has no internal electronics or small parts, and has air holes to prevent suffocation.

This solution ticks all requirements in the brief and is the most effective of all solutions I suggested, as it is one of, if not, the most difficult trap to escape from, it uses a singling method which is most likely to grab someone's attention fast while causing the mouse the least discomfort, and it ticks boxes which were not even included in the brief, but realistically are very important, such as being easy to clean and allowing for safe release.

Working Drawing

(Full-size drawing available in booklet)



Circuit Diagram

(Full-size drawing available in booklet)

Materials

In my investigation of research, I talked about three possible materials, wood, metal, and plastic, and their pros and cons.
From the outset, it was obvious that wood, would be completely ineffective. For reasons such as, but not limited to, being susceptible to damage from liquids and the likelihood that a mouse could, given time, burrow out of the trap.

From then on, I had to decide between metal and plastic.
The main advantage to metal is that it would guarantee captured mice would remain captured. But metal is more difficult to work with than plastic and can rust.
The main advantage of plastic is that it is relatively easy to work with and can fulfill the advantages of metal without the danger of rusting. But I order to be as secure as metal the plastic will have to be thicker.

In the end, I have decided to work with plastic.
I have chosen to work with plastic, primarily acrylic, for the reasons previously discussed and as a personal preference, as it is the material I have the most experience working with.

Will I use clear acrylic?
Earlier, in my investigation of research, I talked about potentially using a clear material. This would allow the user to easily seen if a mouse is inside the trap. However, I believe this may make the use of holes at the opposite end to entice the mouse, less useful and may not do the same. Even more concerning, however, is the possibility that the Infra-Red sensor could be rendered useless against and transparent (or even translucent) surface. These concerns, coupled with the greatly reduced likelihood of false-positives using my design, as opposed to traps on the market, such as spring-loaded traps, has led me to decide to use opaque acrylic.

Electronics

Components

Raspberry Pi;

- Originally, I have referred to using an Arduino, but I have decided to instead use a Raspberry Pi, mainly because it comes with built-in Wi-Fi capabilities, which will make sending Emails much more convenient, while still completing the same functions that an Arduino could.
- This will be the main control center of my electronics.
- Its main function(s) will be to; activate the trap when it receives a signal and to send a signal to the owner of the device (in the form of an Email or SMS).

PIR Sensor;

- The function of this will be to detect a mouse inside the trap.

Torque Motor;

- The function of this will be to quickly close the door and keep it closed.
- I chose this type of motor as it is very quick and versatile, though it will increase the price.

Limit Switch;

- The function of this will be to stop the motor when the door has closed.
- Additionally, if the mouse is strong enough to begin opening the door, the powerful torque motor will quickly halt the mouse, as it will activate as soon as the pressure on the limit switch is eased.

Toggle Switch;

- The main function of this will be to stop power from flowing to the motor

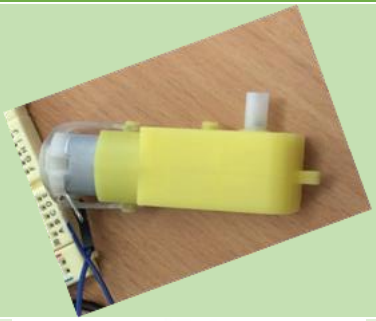
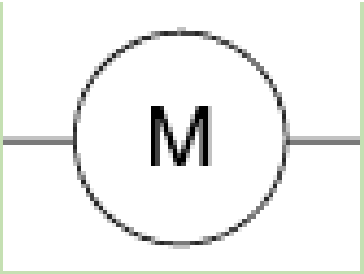
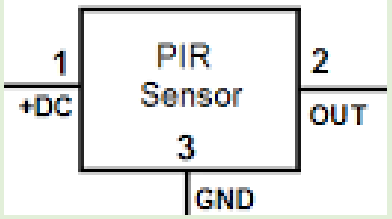
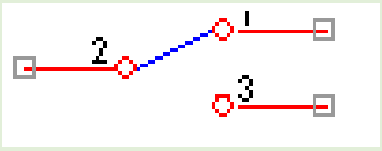
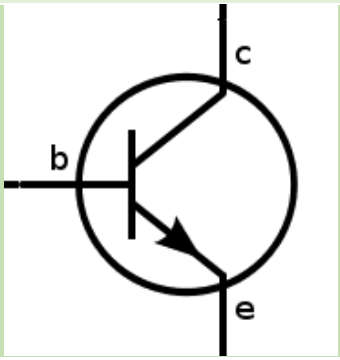
Electronics Research Links

- https://www.allaboutcircuits.com/projects/build-a-raspberry-pi-pushbutton-switch/
- https://diyhacking.com/raspberry-pi-gpio-control/
- https://pinout.xyz/
- https://maker.pro/raspberry-pi/tutorial/how-to-interface-a-pir-motion-sensor-with-raspberry-pi-gpio
- http://naelshiab.com/tutorial-send-email-python/

Cutting List

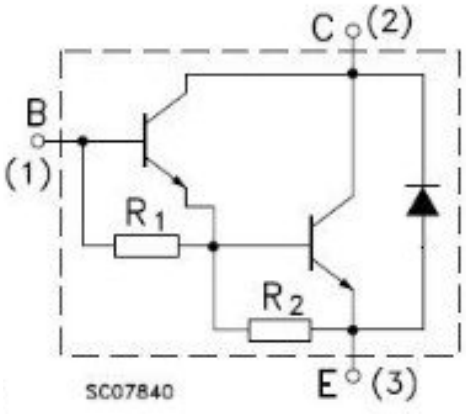
Name	Material	Colour	Width	Length	Thickness	Quantity
Body	Acrylic	Black	130mm	300mm	4mm	2
Ends	Acrylic	Black	65mm	70mm	4mm	2
Base	Wood	N/a	200mm	455mm	15mm	1
Frame	Wood	N/a	40mm	150mm	15mm	1
Frame	Wood	N/a	45mm	185mm	15mm	1
Frame	Wood	N/a	45mm	290mm	15mm	1
Columns	Wood	N/a	35mm	140mm	15mm	2

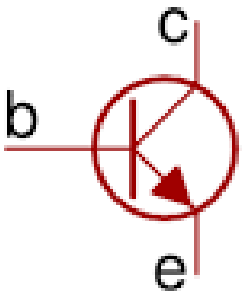
Electrical Components List

Name	Picture	Circuit Diagram
Torque Motor		
PIR Sensor		
SPST Toggle Switch		
SPDT Limit Switch		
TIP 121 Transistor		

A Quick Note on Transistors

I used a TIP121 transistor in my circuit over a transistor such as a BC108 deliberately. This was not a difficult choice as the TIP121 has many benefits over other options. One notable example of this is that the TIP121 is a Darlington Pair transistor. The internal circuit of a TIP121 is seen on the right compared to the circuit of a BC108 on the left.





In general, transistors can be quick triggering but can burnout easily or able to take more voltage and be slow to trigger. With the TIP121 I get the best of both worlds as the first transistor triggers fast and the second transistor transports most of the power. The Tip121 is also very well designed with some other notable benefits such as the inclusion of a heatsink at the back, to spread out and transport the heat created when electricity is flowing which reduces the risk of the transistor being damaged by heat and requiring replacing.

Manufacture

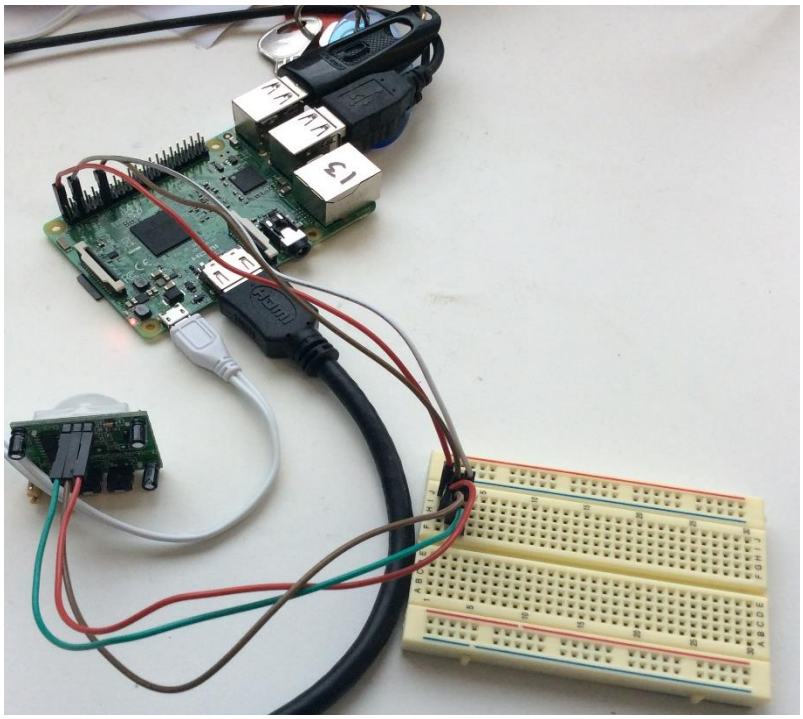
Sequence

1. Test out electronic components to ensure everything works with the Pi
2. Create some code that will bring the electronics together
3. Cut out materials in accordance to the cutting list
4. Mark out each part using the measurements in the working drawings
5. Use a coping saw to cut this section into a square and use a file to smooth down the edges
6. Drill four 4mm holes, in a square shape, near the back end of the trap
7. Use the strip heater to bend the main sections of the trap and acrylic cement to stick them together
8. Drill four 4mm holes, in a square shape, in the back cover of the trap
9. Use a coping saw to cut this section into a square and use a file to smooth down the edges
10. Stick the back cover on to the back end of the trap
11. Use the belt sander to file this cover down till it is flush with the body of the trap
12. Create a hold for the trap but surrounding it by three pieces of wood and sticking them to one large piece of wood with wood glue
13. Create the door mechanism by sticking the door cover to a 4mm metal rod with a small gear
14. Cut a 4mm hole in two pieces of wood and place the metal rod through them, stick these pieces, with wood glue, just close enough to the trap so the door will be flush with the trap when it closes
15. Varnish the wood
16. Bolt the motor to the top of the trap and glue a limit switch to the bottom of the door
17. Solder the electronics to a copper strip board

Processes

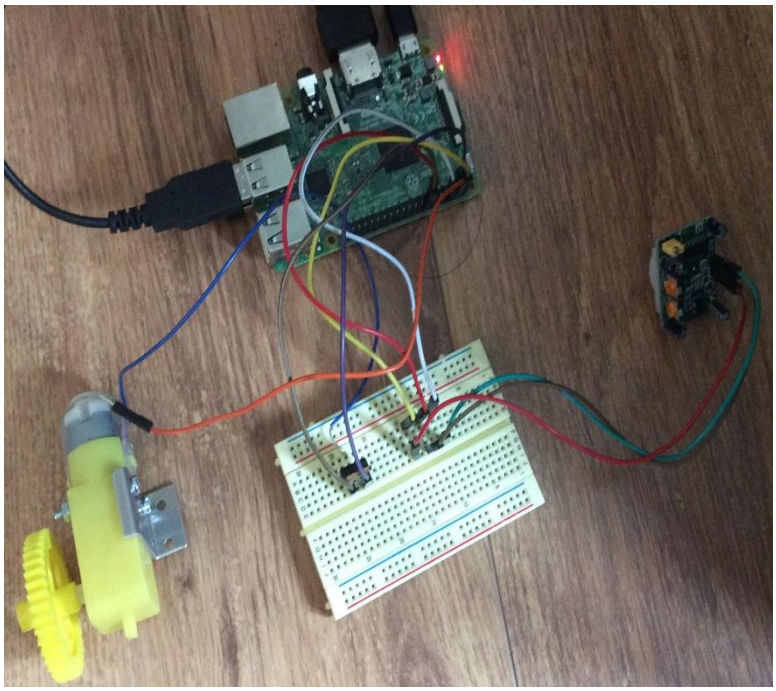
Electronics;

Testing Separately;



I began by testing each of my electrical components individually. The PIR motion sensor can be seen on the right this will sense when the mouse has entered the trap. I ran into trouble when testing the motor as the voltage appeared to be skipping the transistor. This problem heled me up for a while until I noticed I was looking in the wrong place. It turned out that when you turn a pin off on the Pi it must be told to turn back off even if the code that turned it on has ended. With this knowledge I was able to progress onto the next stage.

Testing Together;



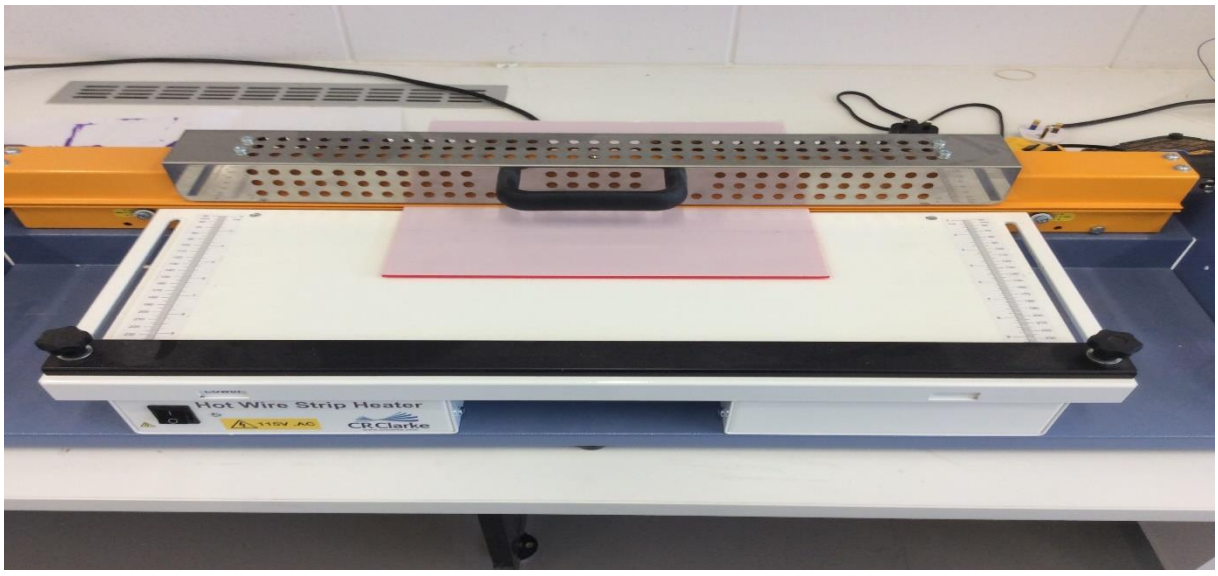
I then brought all my main components together for testing in an arrangement that can be seen on the right. At this point the transistor I was using stopped working for reasons I cannot explain, but this was solved by replacing it with a different transistor.

The Code;

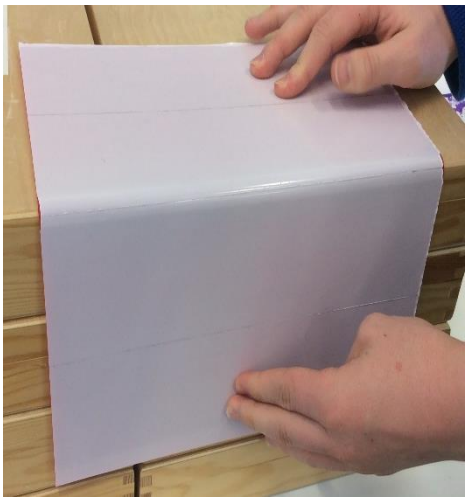
```
#This allows use to read the sensor
import RPi.GPIO as GPIO
#This gives python an understanding of time
import time
#This imports tools which will allow us to send an email from this code
import smtplib

#This will connect our program to gmail
server = smtplib.SMTP("smtp.gmail.com", 587)
#This will begin the program's search for our gmail account
server.starttls()
#This will tell the program which gmail account to connect to
server.login("jccodingtest@gmail.com", "jccoding")

#This section defines what each pin used will do
GPIO.setwarnings(False)
GPIO.setmode(GPIO.BOARD)
#This tells python that it should treet pin 11 as an input
GPIO.setup(11, GPIO.IN)
#This tells python that it should treet pin 3 an an output
GPIO.setup(3 ,GPIO.OUT)

#This resets the motor
GPIO.output(3, False)

#This creates a variable "trap"
trap = 1

#This while loop will run constantly
while True:
    #This while loop will run untill a mouse enters the trap
    while trap < 3:
        #This will read the sensor
        i = GPIO.input(11)
        #This will keep runnunig untill a mouse is sensed
        if i==0:
            #This allows me to see the output in the console for debugging
            print ("false",i)
            #This resets the couter to avoid errors
            trap = 0
            #This will restart the loop
            time.sleep(0.3)
        #This will run once a mouse is sensed
        elif i==1:
            #This allows me to see the output in the console for debugging
            print ("true",i , trap)
            #This will count up when the sensor is triggered to avoid false readings
            trap = trap + 1
            #This will restart the loop
            time.sleep(0.3)

    #This while loop will close the door when a mouse enters the trap
    while trap == 3:
        #This turns the motor on
        GPIO.output(3, True)
        #This allows me to see the output in the console for debugging
        print ("Capture")
        #This will tell the program where to send the email and what to say
        server.sendmail("jcccodingtest@gmail.com", "jordanahern12@gmail.com", "Capture")
        #This will exit email
        server.quit
        #This will end the program
        quit()

```

My final code (Pictured Above) was written in Python, which I learned in coding class, and is commented (anything after a #) to make for easy editing. My code controls almost everything that happens in my project, it detects when the sensor has been tripped and in turn turns on the motor and sends an email to tell me a mouse has been captured. Originally, I set the code to activate the motor as soon as it returns a true reading, but in testing I found this could cause false positives. I believe this was caused by sudden surges of voltage which may have jumped the PIR sensor's circuit. I solved this issue by only allowing the motor to trigger after a true reading has been returned three times in a row.

Strip Heater;

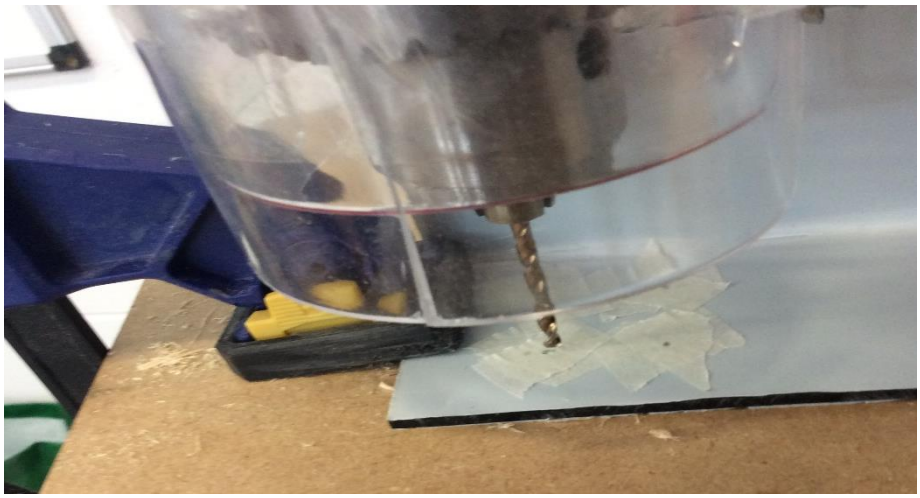


I made a series miscalculation on my first attempt to bend the trap. I attempted to bend it all as one. I quickly realise that this wouldn't work as I would have to make a near impossible bend. Instead I cut two pieces at half the size and bent them and stuck them together.



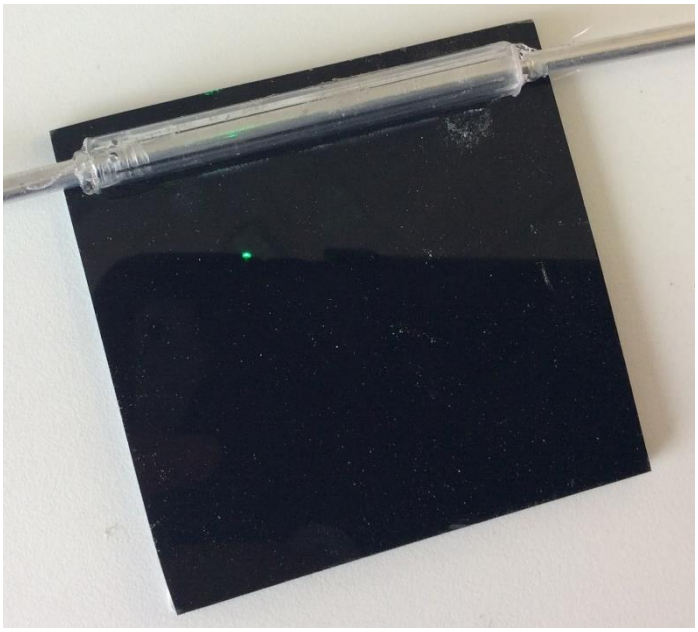
Drilling and Cutting;

(In the picture to the left, I was forced to use a hand drill as the piece blocked the pillar drill from reaching the bottom of the piece)



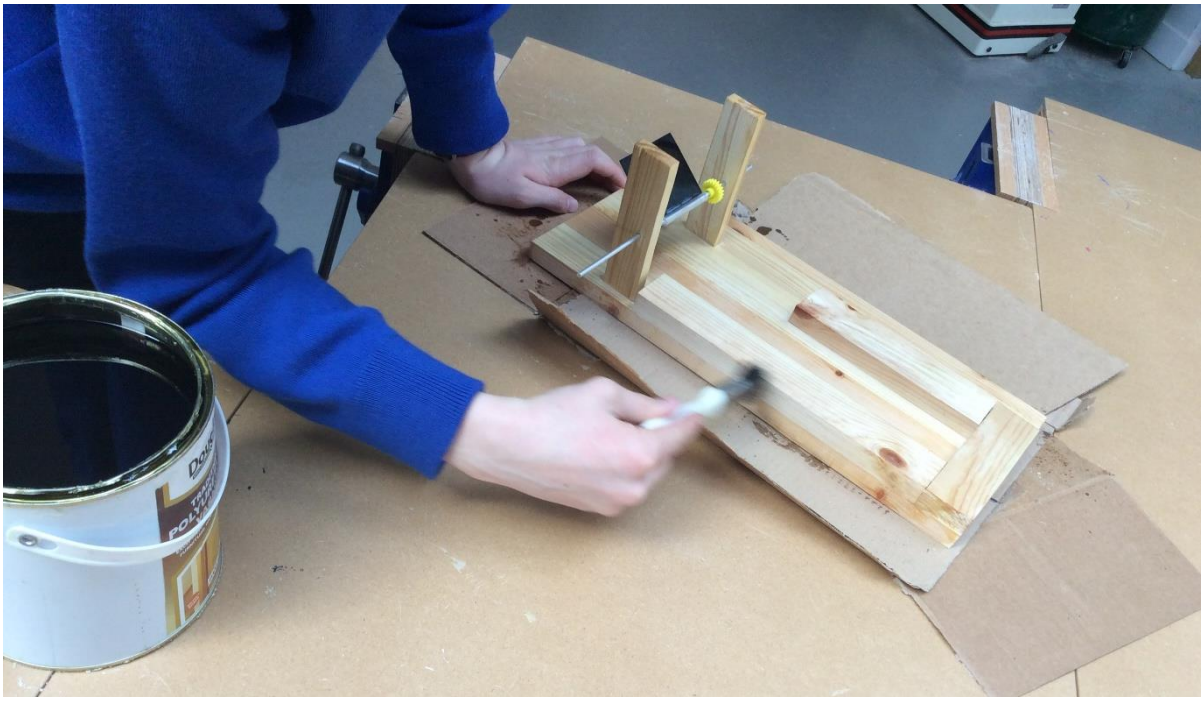
Wood Joining;

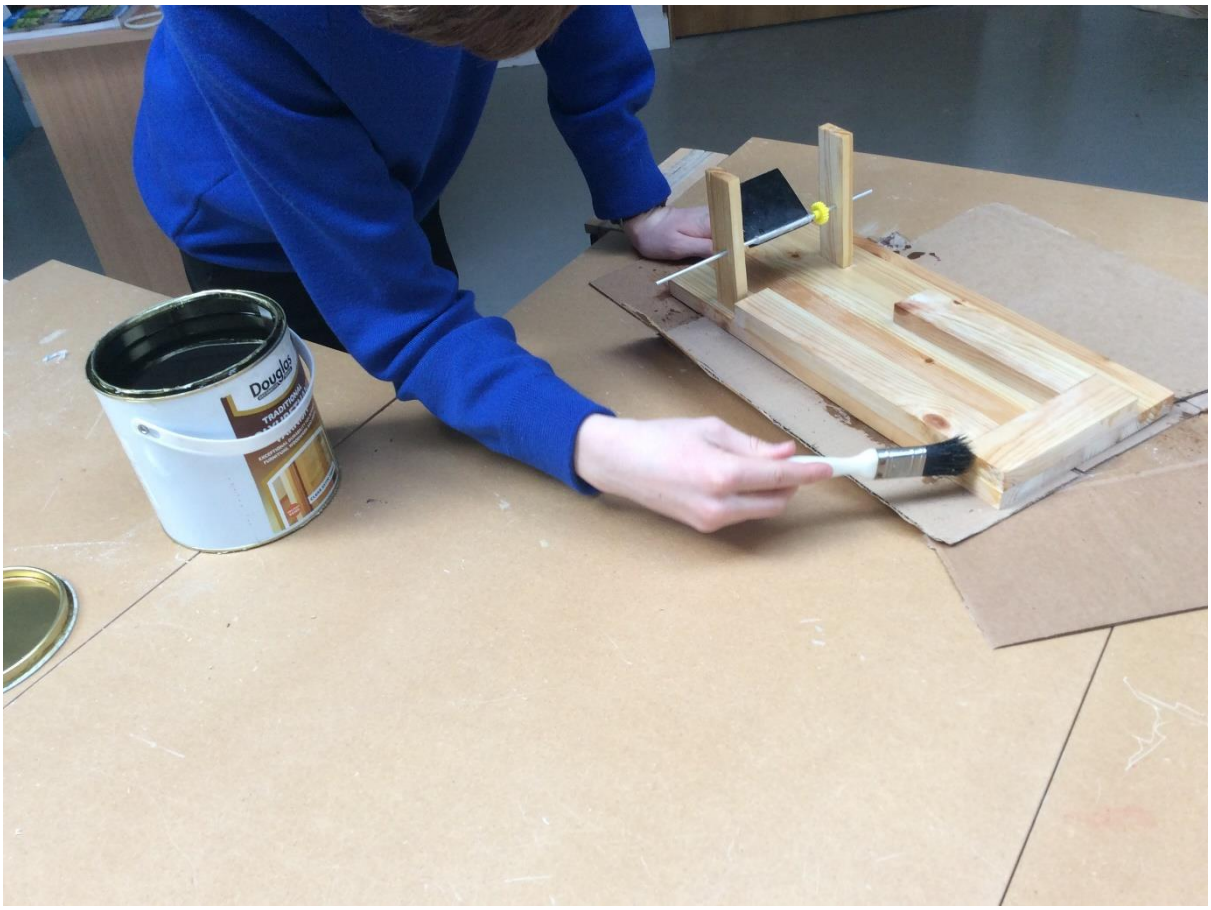
Gluing (Hot Glue Gun and Industrial Glue);



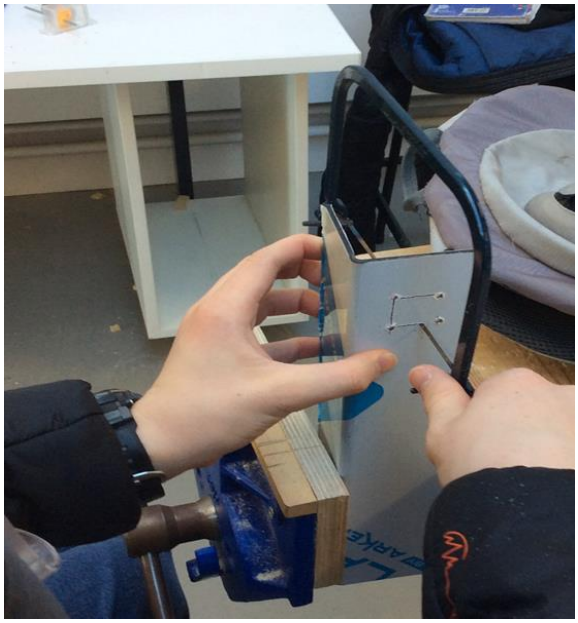
Wire Stripping;

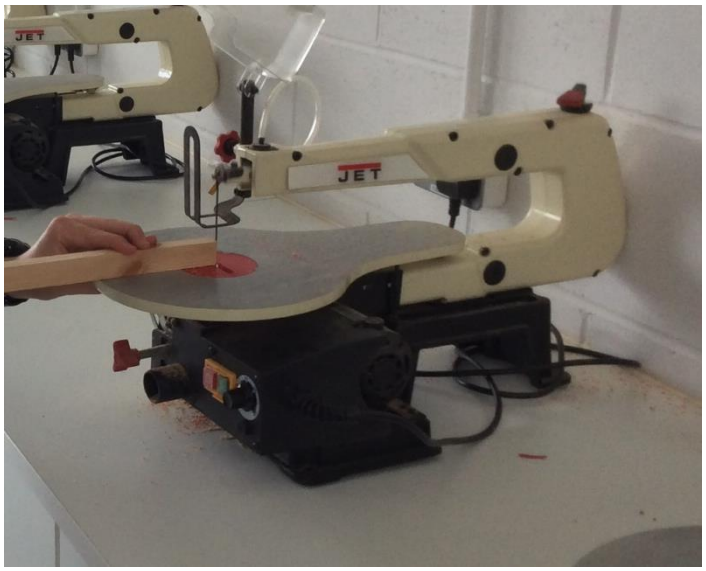
Varnishing;





Cutting;





Sanding;

Repair;

When attaching my two main pieces together one snapped through a week spot created where I drilled a hole. I quickly reattached this piece together with industrial glue.