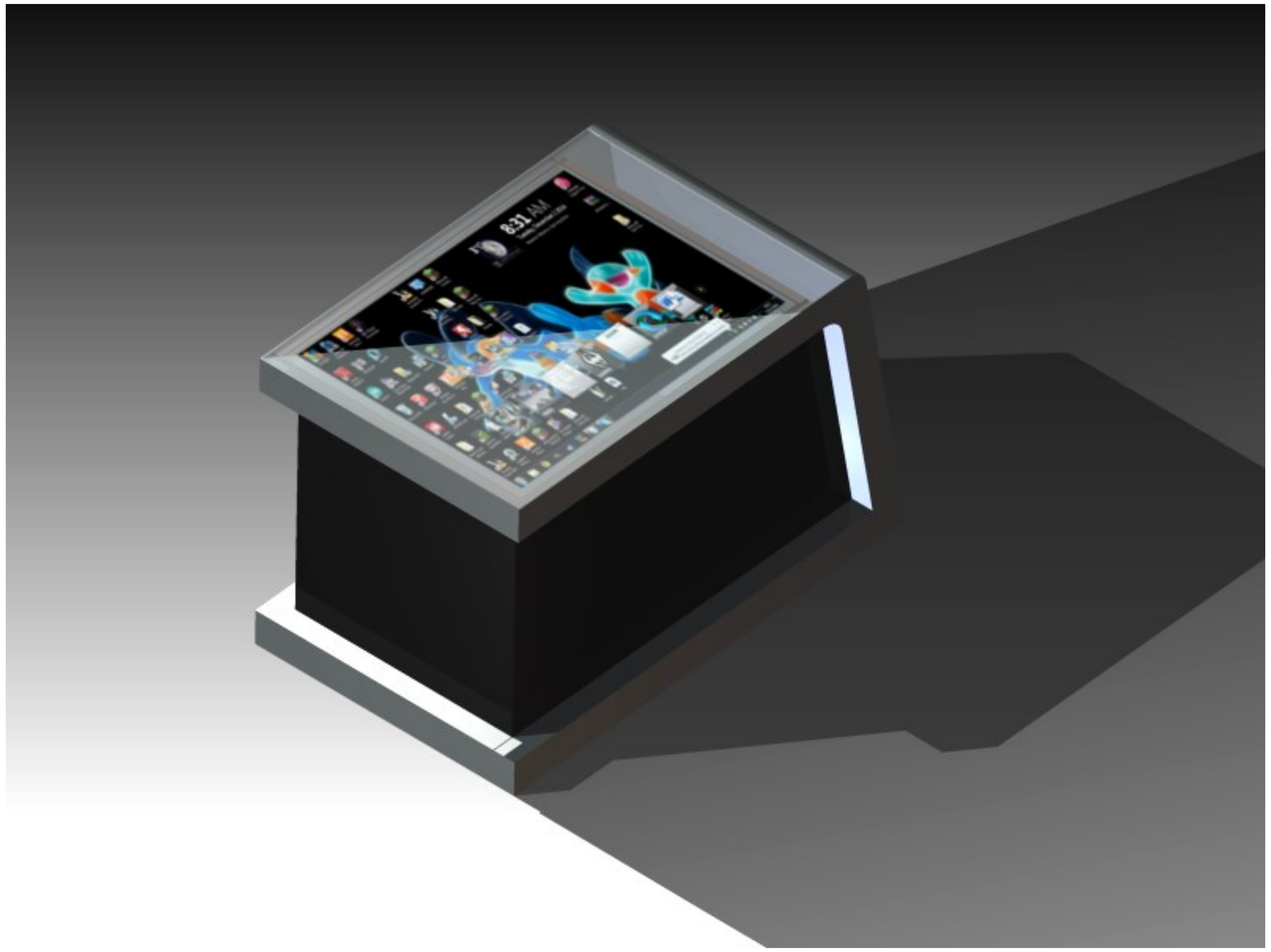
Multi-touch User Interface Table



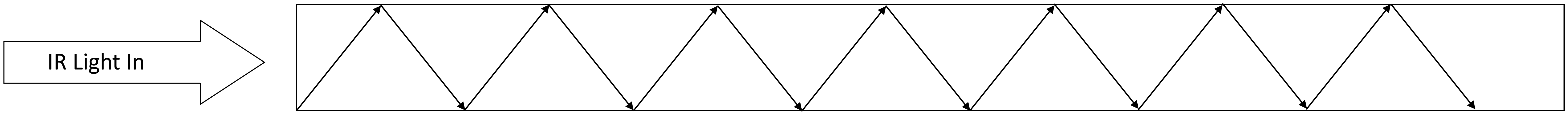
Context:

Roughly Two years ago from now I was in Intermediate Two level subjects approaching the end of the year. As a result I was still relatively new to engineering in Product Design but had gained a vested interest, studying new technologies and processes in my own time. While doing this research I came across a program called 'Community Core Vision' which can be used to track basic shapes and objects, I found people who had used this software to create simple, cost effective touch sensors using infra red light and decided to attempt to make my own version of this for computer interfacing. The design would be relatively simple due to the nature of the technology that I have available but would require a technical capability which was, at the time, beyond my capability. In this document I have shown the development work I had and details about how I intend to pick this project up now, roughly two years on.

It should be noted that much of the work shown here was completed to in Intermediate Two level so will be noticeably less detailed than more recent work however due to the fact that this project was completed and could hypothetically be manufactured I have decided to still include it in my portfolio.

The theory behind the design

The CCV software is essentially an object tracking software, when activated, it will take a snapshot of the feed from a connected webcam or other camera and compare any changes in the feed it receives in order to track new objects. In this way it can be used as a touch sensor, the user need only be able to trigger a visible point difference for the software to detect, in short, make the software notice the points of your fingertips. Shown here is a diagram of how this can be achieved with infra-red light.

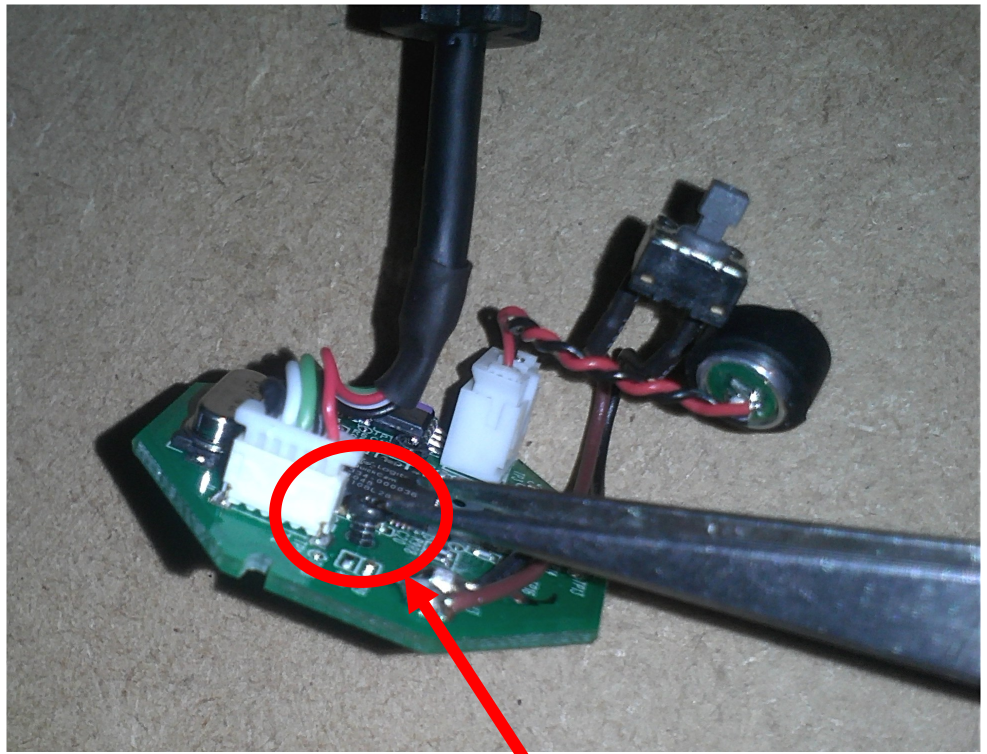


Infra-red light is shown into live-edge acrylic and, as indicated by the arrows, will cause the effect of total internal reflection. All the IR camera will see in optimal conditions is a sheet of white.

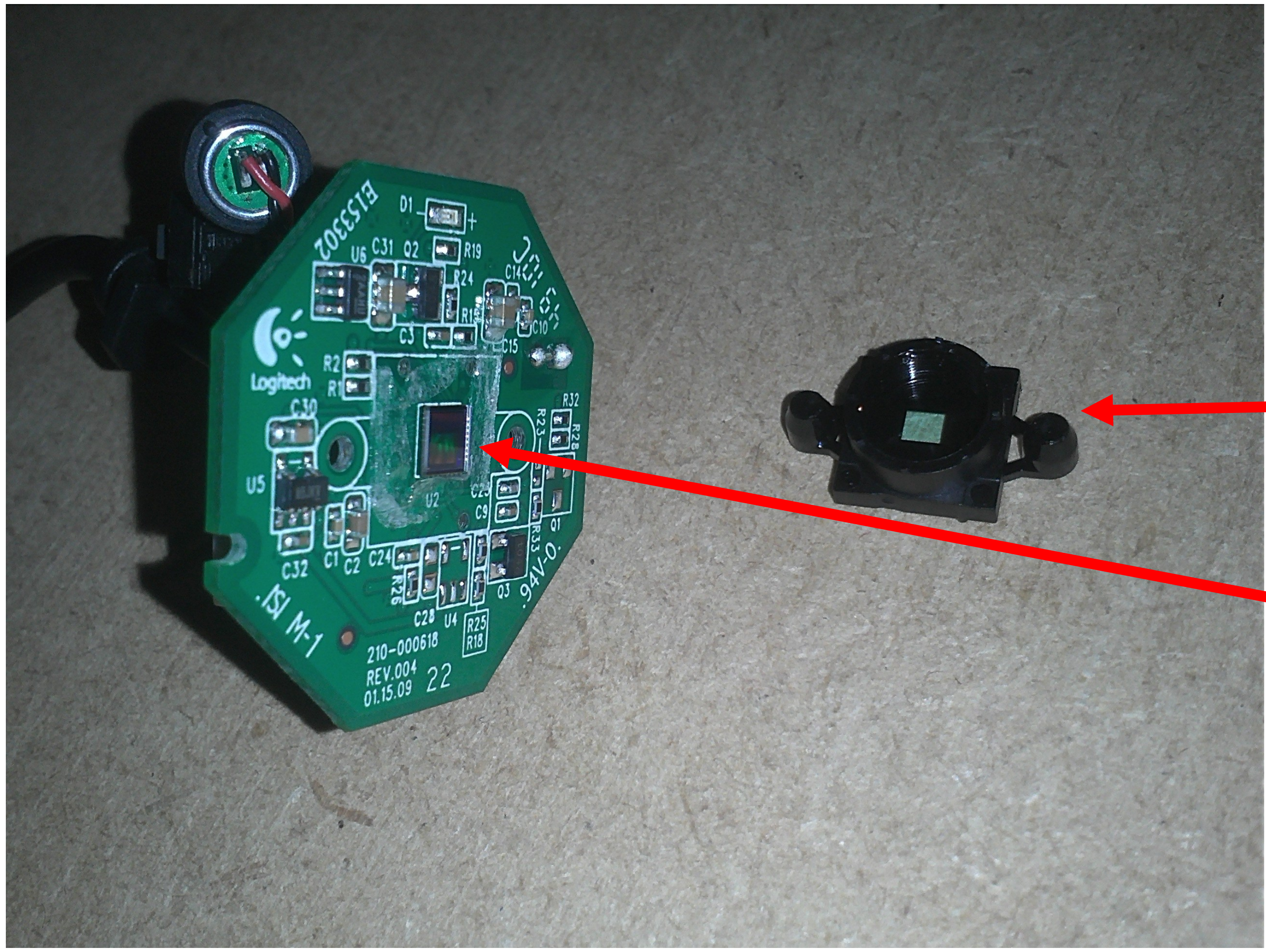
When a user places their finger, or any object on the acrylic, they will create a shadow which will appear to the software as a dark patch which it will then track as an entity. This not only allows for calibration for a range of environments and situations but, because the software can track an indefinite number of entities, allows for multi touch interfaces. Shown here is a screenshot of the software demonstrating this effect. You can likely make out the hand on the first image, the feed from the camera, the shadows are present because at the time I was relying on ambient IR radiation which is easier to block.

To create an IR camera I began with a simple 1.7 megapixel webcam

I removed the outer casing revealing the components attached to a central board.



I removed two screws, one of which is circled here to detach the lens assembly.

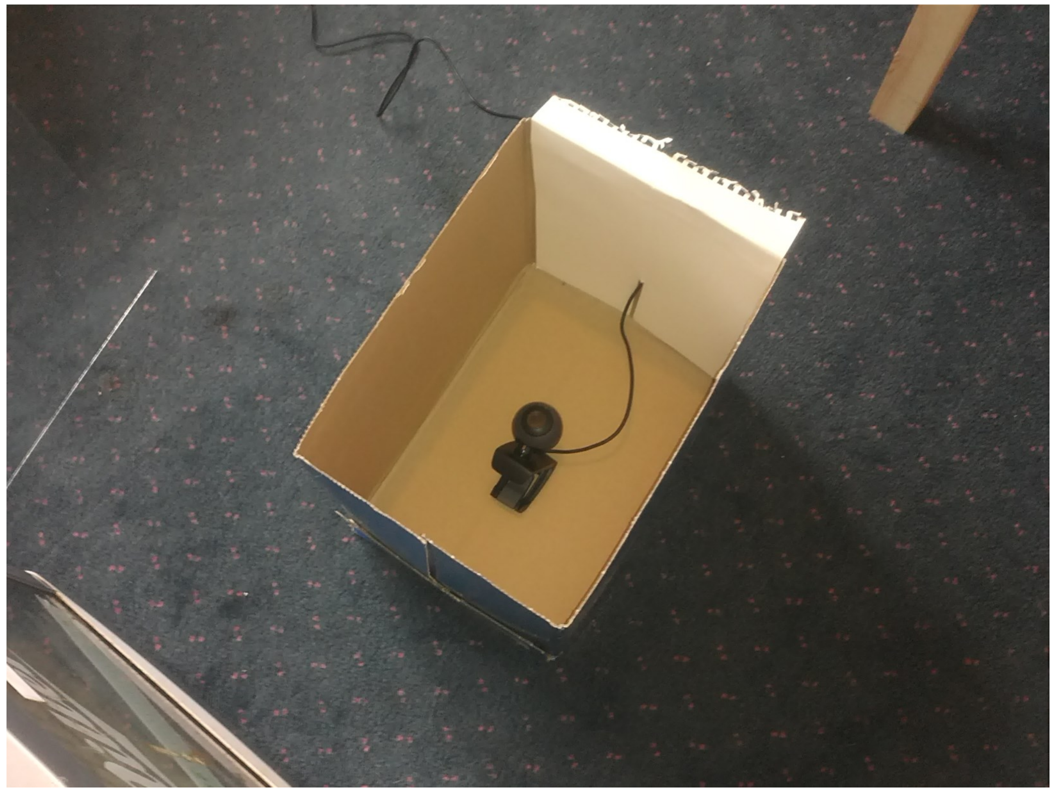


Once the assembly was removed, I located a filter designed to block IR light which I removed. I then cut a small section of black photographic film to block the visible spectrum wavelengths. The camera will now detect IR light and no longer detect visible light.

Lens assembly without IR filter

Photo receptor

The PCP was then re-assembled and placed back in the camera casing.



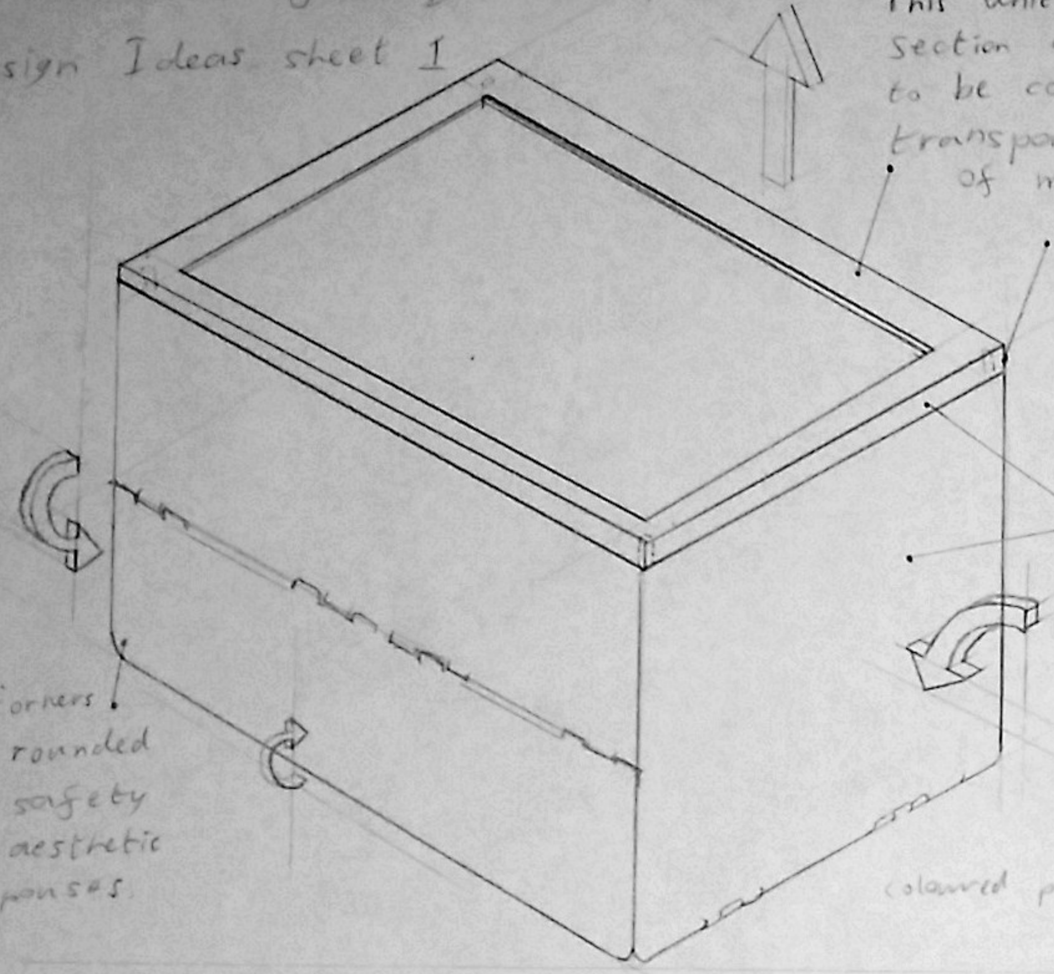
I created a simple test rig using the modified camera and a box with a sheet of standard acrylic I had to hand layered over the top. I then placed a piece of paper over the acrylic and used this to test the software.

A screenshot of the software is shown here. The left panel shows the camera input feed where you can likely make out the shadow of my hand. The software is detecting and tracking two of my fingers shown on the right screen meaning that I needed to adjust the settings and conduct more tests.

With other attempts I added additional light sources from above and bellow the acrylic and creating a larger detection area which gave me enough data to know that total internal reflection was the best method to use going forward.

MULTI TOUCH USER INTERFACE TABLE

Design Ideas sheet 1



This unit utilises a removeable top section and folding sides to allow it to be collapsed for storage and transportation. (Arrows show direction of movement)

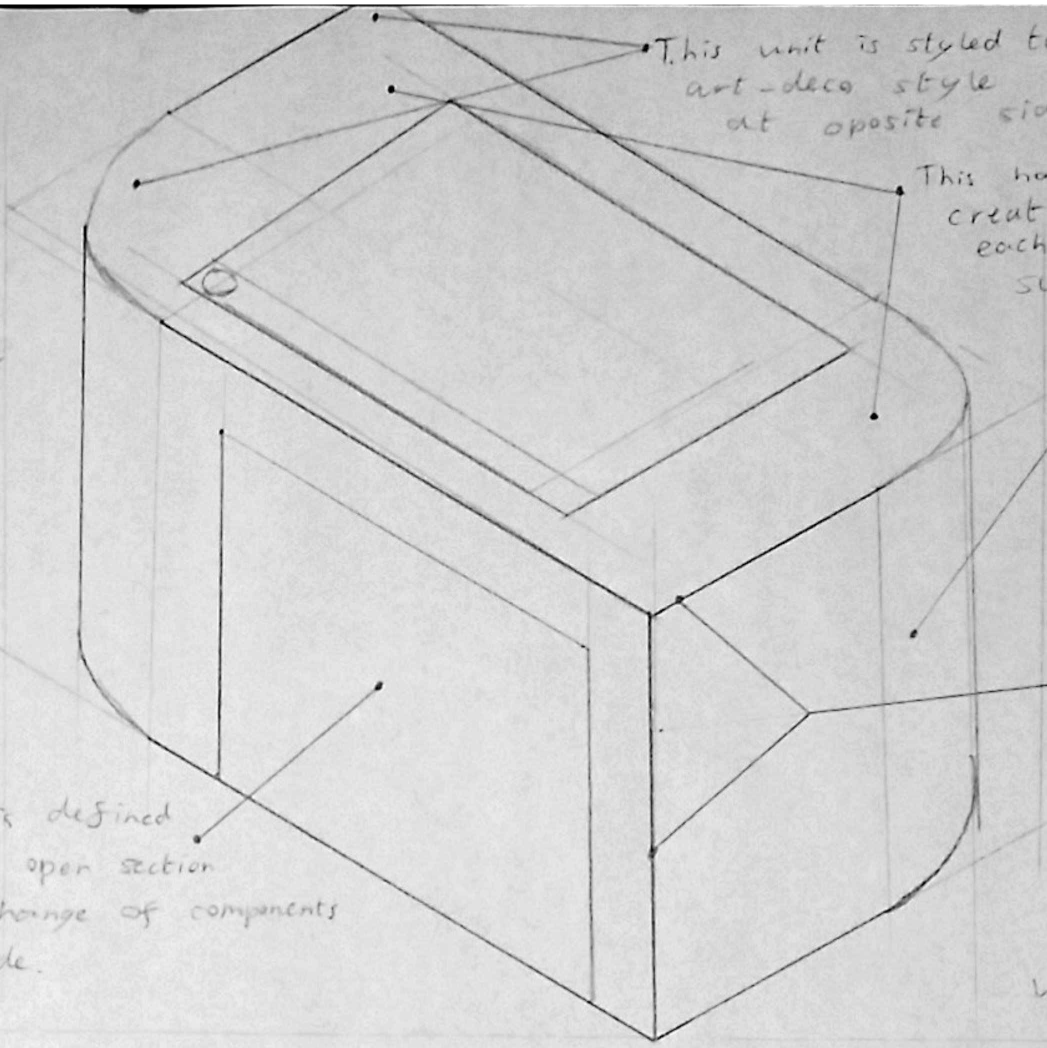
The ability to remove the top allows for later redesigns e.g. if I decide to convert the unit to FTIR technique rather than the currently used RDI.

The sides and top are made from a mixture of chipboard and MDF for a cost-effective easy to manufacture solution.

The corners are rounded for safety and aesthetic purposes.

coloured pencil

DESIGN ONE



This unit is styled to resemble a symplistic art-deco style with rounded corners at oposite sides.

This has the side affect of creating empty space on each side of the projection surface for alternate use.

The sides will be either painted or decorated based on later desicions.

All components are as seemless as possible for a refined look.

The front is defined by a drop open section for the change of components on the inside.

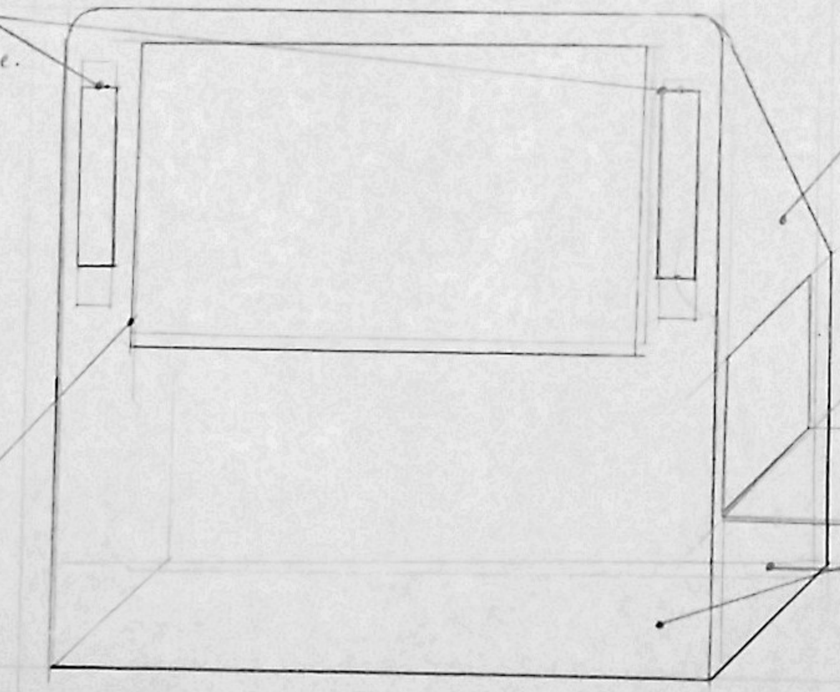
WC pencill

DESIGN TWO

This unit encorpirates two usb speakers for addes surround sound and user interface.

This and the overall shape give the unit a 'retro' look like an early CRT screen.

Unlike previous designs, this unit mounts the components vertically, the result of witch is a screen that faces the user like a monitor or Television.



DESIGN THREE

The unit is taller than nessecary so it is a suitable height for the user to interact with. This can be changed if neccessary.

A drop down pannel allows the user to station a laptop or compatible tablet for complete containment.

The large space on the front allows me to emblasen the unit with writing or a logo.

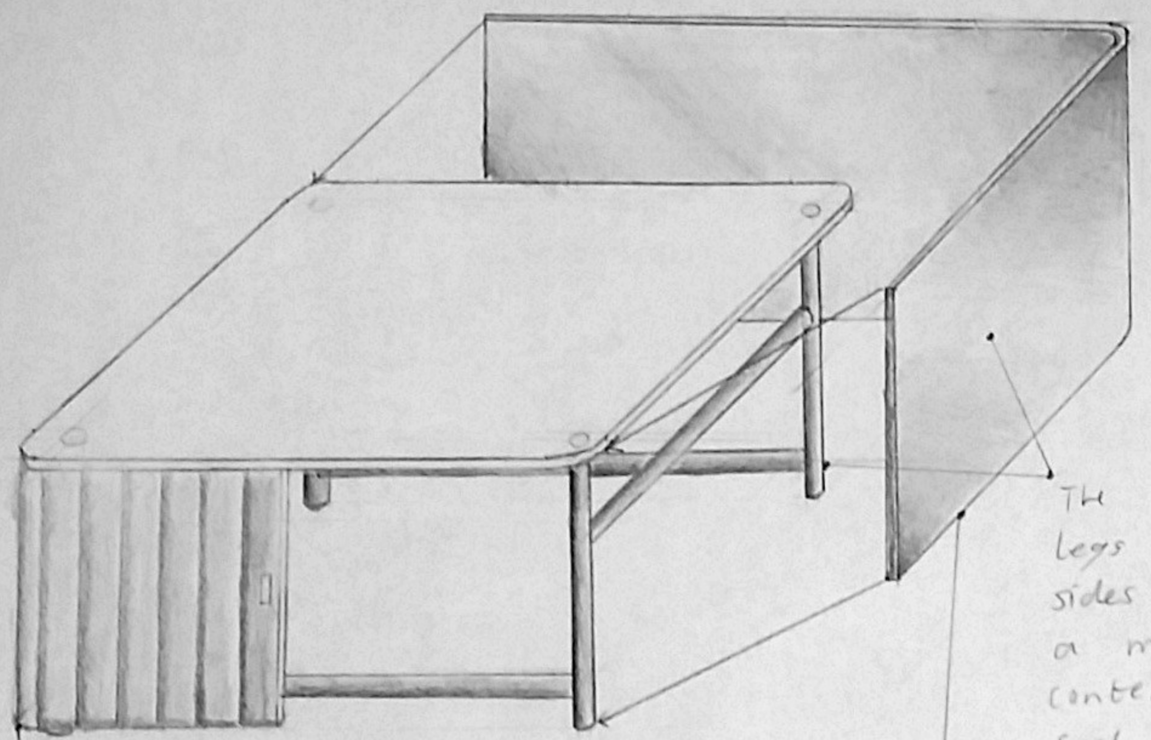
Again this unit would be made out of simple manufactured boards and painted depending on design.

Page 1: Initial Ideas

Multitouch User Interface Table

Design Ideas sheet 2

pencil.

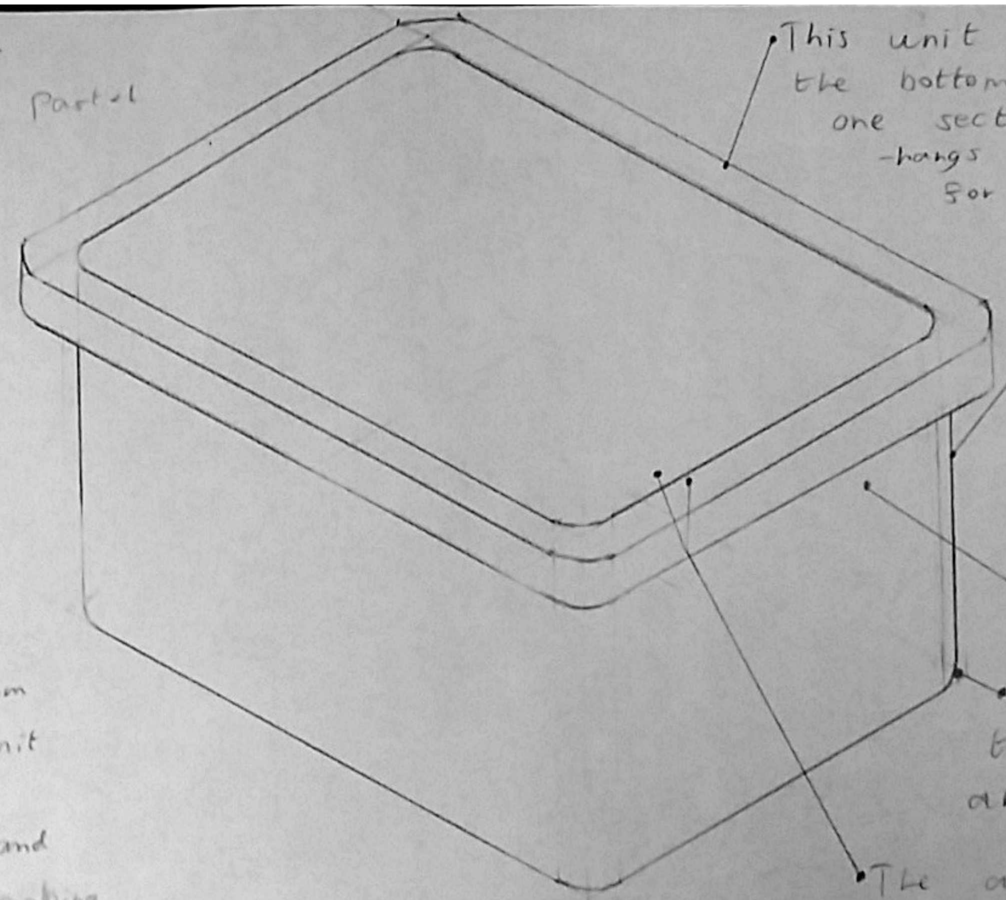


DESIGN FOUR

The tubular steel legs and aluminium sides give the unit a modern, clean, contemporary look and feel as well as making it very durable.

This design comprises of sheet acrylic with rounded edges mounted on tubular steel legs and covered on three sides by sheet alluminium. The front can be covered or opened by a sliding door that can be hidden to access the projector.

Pastel



DESIGN FIVE

This unit uses a symple design; the bottom section is made to be one section while the lid over-hangs and can be removed for setup.

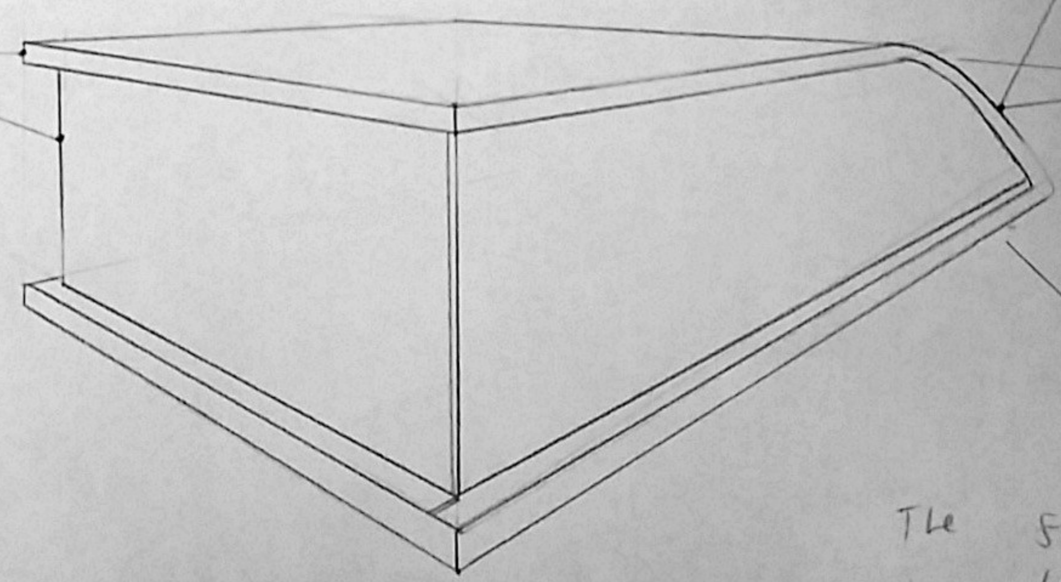
This overhang is for aesthetic and manufacturing purposes. An array of LED strips underneeth cast a luminecent glow down when on.

The rounded corners make the unit safe for users and it's environment.

The acrylic top is seemless with the wooden border witch is painted black to resemble a smartphone or tablet.

HB pencil

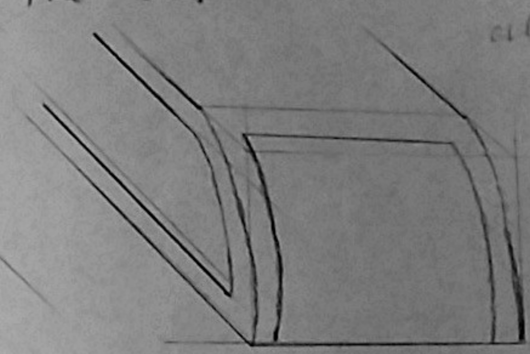
This design idea uses a more complex shape with a wooden or metal skeleton covered in opaque acrylic to give it an almost science-fiction look that is sleek, modern and contemporary.



DESIGN SIX

All the acrylic panpels are placed seemlessly to make them hard to differenciate. In addition, the connecting screws are very small.

The sloped back has a hinged lid to allow for storage of components and wires.



The front pannel slide out on grooves to allow for setup like all the other units.

Page 2: Initial Ideas

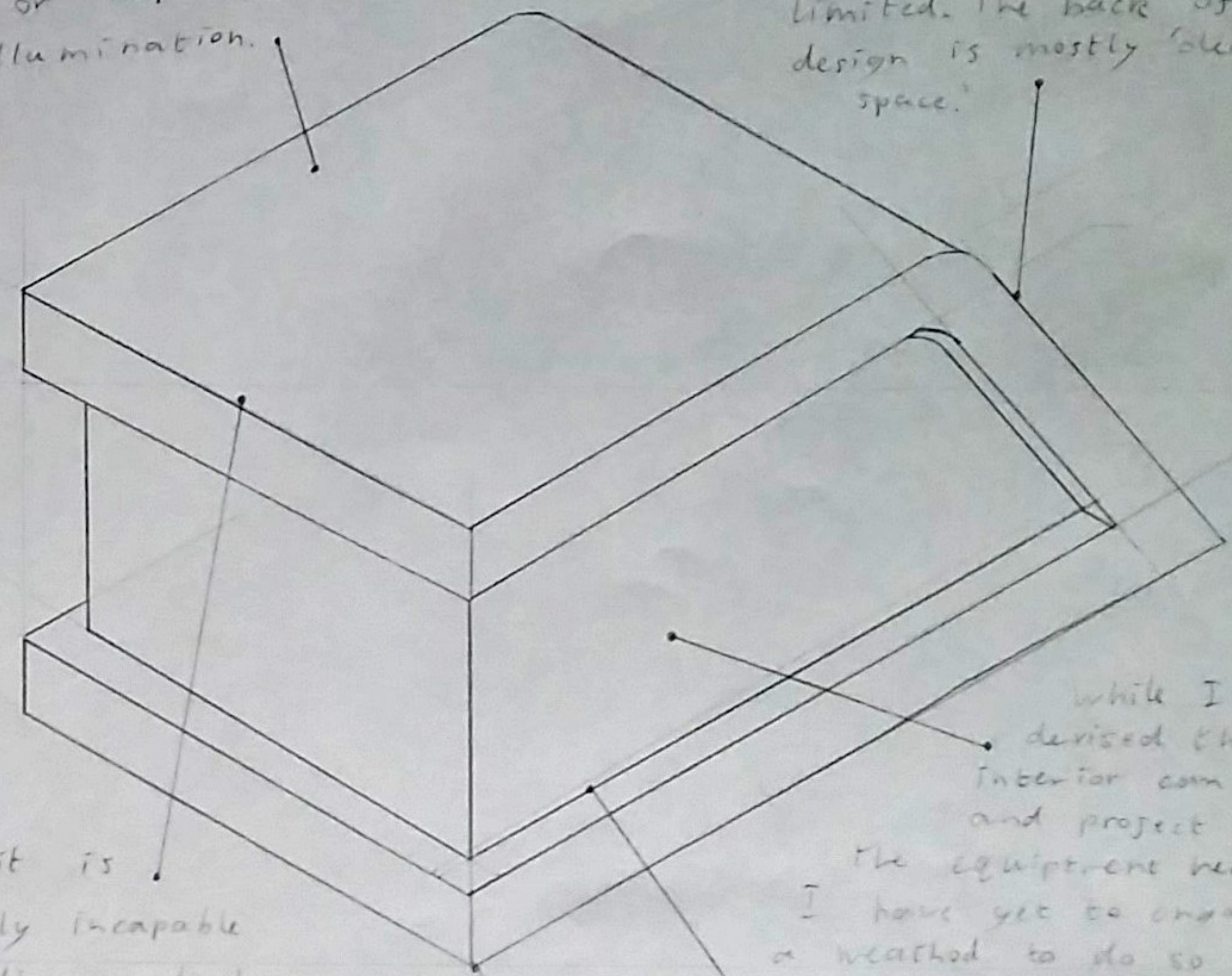
Convergance Matrix

	Design Idea One	Design Idea Two	Design Idea Three	Design Idea Four	Design Idea Five	Design Idea Six
Specification One	5	5	5	5	5	5
Specification Two	5	5	5	5	5	5
Specification Three	4	5	4	4	3	5
Specification Four	2	3	4	3	2	4
Specification Five	1	4	3	3	4	4
Specification Six	2	4	3	2	2	5
Specification Seven	4	3	2	3	2	3
Specification Eight	3	4	3	4	5	4
TOTAL /40	27	33	29	29	28	35
%	68	83	73	72	70	88

- Specification requirement One stated that the unit must display a computer desktop and allow user interaction through CCV. All designs are variants of the same basic principple so all scored 5 points.
- The same was true for specification Two witch required the unit to use the projector and modified IR camera I have witch all do.
- Specification three stated that the unit must be self contained. As all are indipendant, points were deducted for how easilly they could hold a laptop.
- The fourth specification required the unit to connect to and potentially hold a laptop of 95st percentile size. I deducted points for the way in witch said laptop could be contained. None scored 5.
- The units were to have mounted chasis that could hold and remove the components as specified by specification 5. I scored each based on the ease of witch such a bracket cold be connected. Only one could not do so and scored 1/5.
- The units had a range of imaginitive, contemporary designs as specification six required but some scored very low due to simplicity such as one, four and five.
- Specification seven stated that the unit should have the capacity for upgrade at a later point. One scored highly due to its folding abilitys, a case or box could have been created later. Six also features the ability to add an IR light but none scored very highly.
- The eith specification required the unit to be safe to use. Points were added and deducted based on the smoothness of corners and edges and the moving component involved.

The fixed top means there is little room for upgrade later by means of a more sophisticated camera or improved Infra red illumination.

At current the storage capacity and uses for the rear compartment are limited. The back of the design is mostly 'dead space.'



While I have devised that the interior can hold and project properly the equipment needed, I have yet to engineer a method to do so

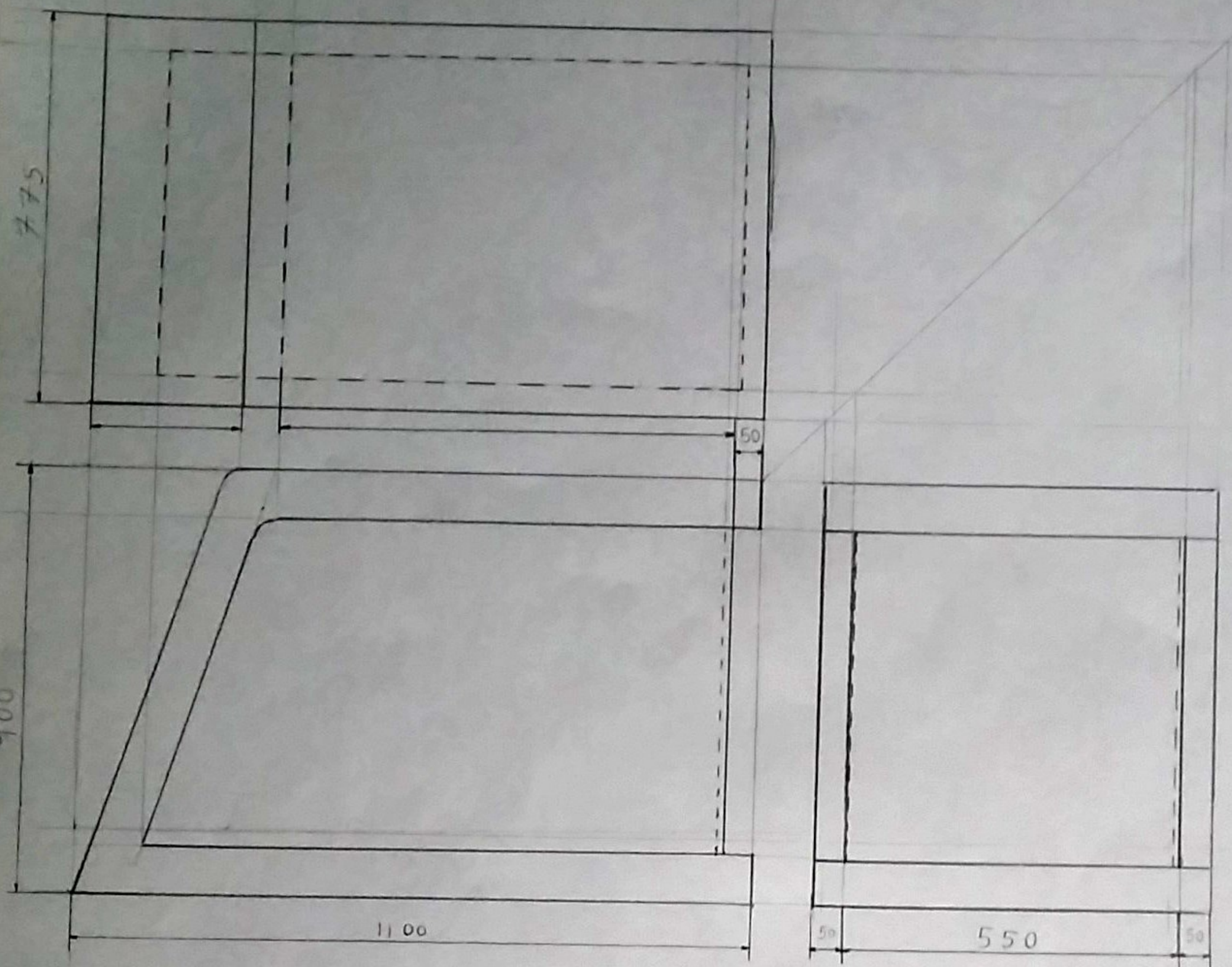
The unit is currently incapable of holding a laptop unless the user were to perch one porcariousely on the edge witch is not advised.

Some of the rough edges and corners will need to be changed as they may pose a health and safety hazzard.

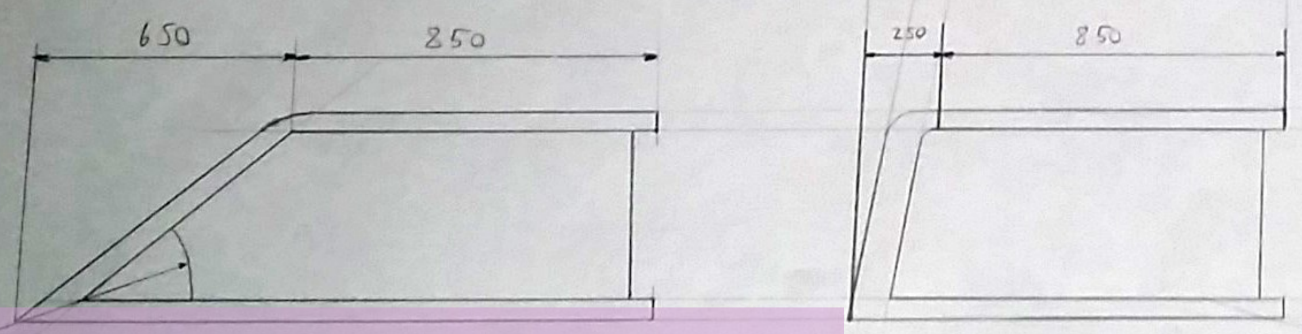
The dimensions of the unit are yet to be decided, in addition, how the unit is made will need to be meticulously thought through

Page 3: Analysis

Development Sheet One



The first requirement for development was dimensions as all further changes will be affected by the mature sizes and constraints of the unit. Once established, I decided to shorten the back end of the unit. This had the result of lessening the 'dead-space' and compacting the overall design while keeping the original aesthetic

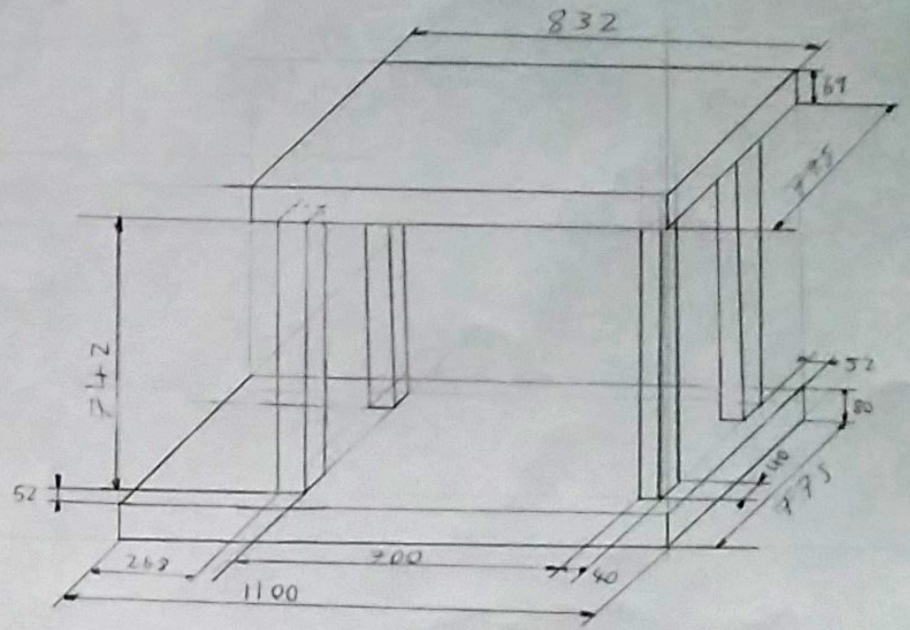


Original sketch

I then decided to change the outer material to an Opaque Polyamide to enhance the overall aesthetic and create an outer skin to build around.

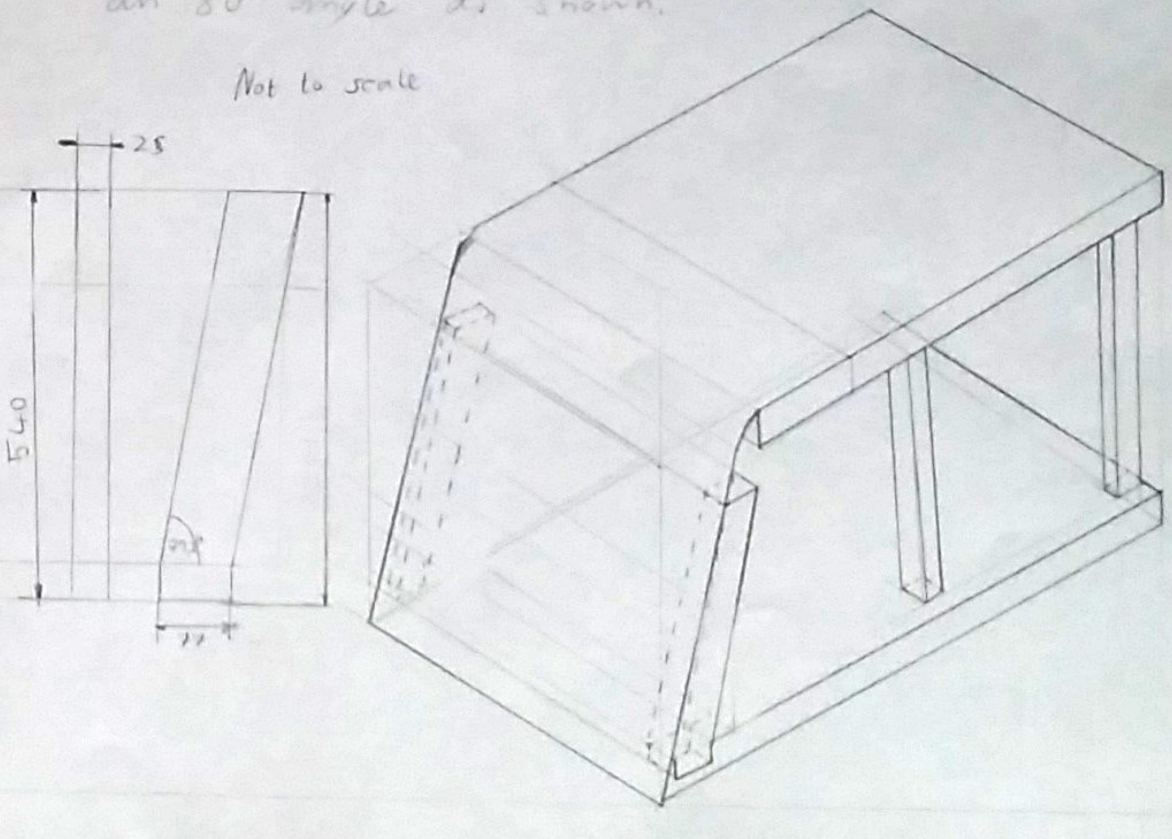
At this point I decided that the top and base of the frame should be a manufactured board supported by four legs to support the basic structure. This gave me the following wire frame to work around.

Not to scale



I then decided that the back should be one single polyamide sheet for consistancy, supported by two wooden beams at an 80° angle as shown:

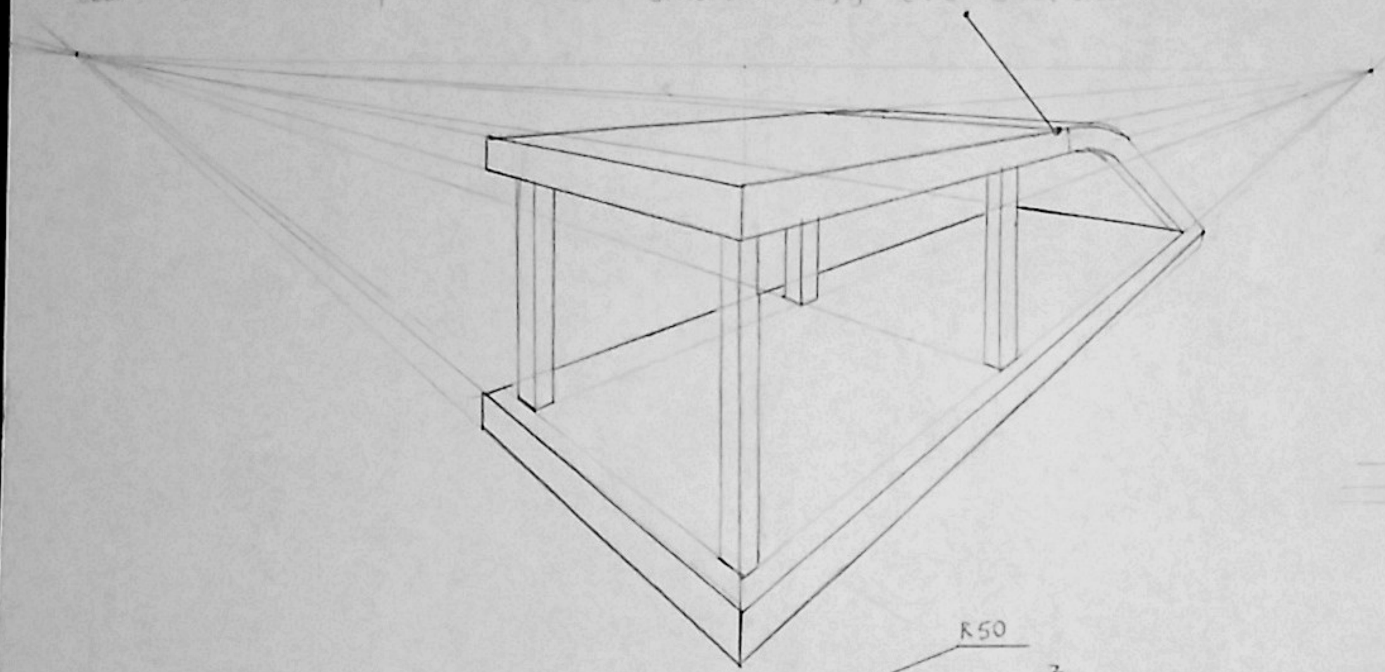
Not to scale

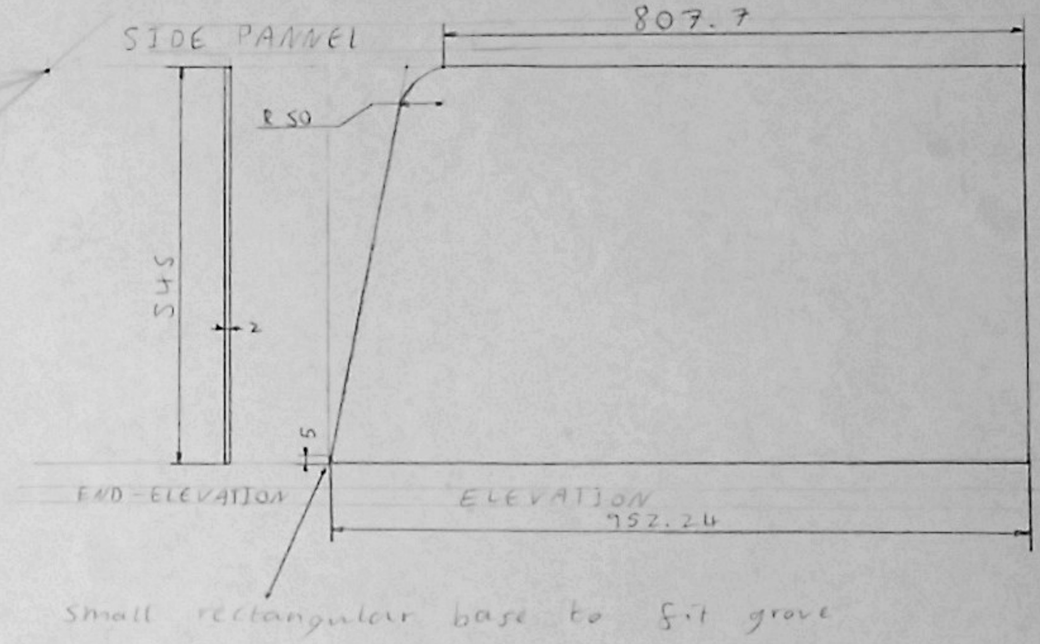


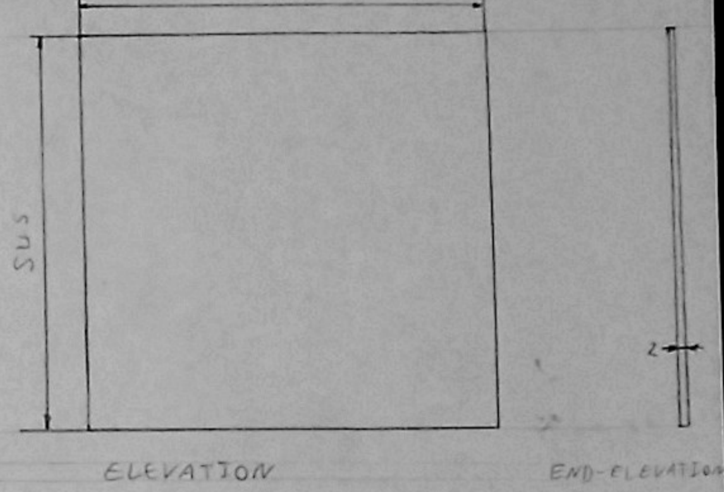
Development Sheet Two

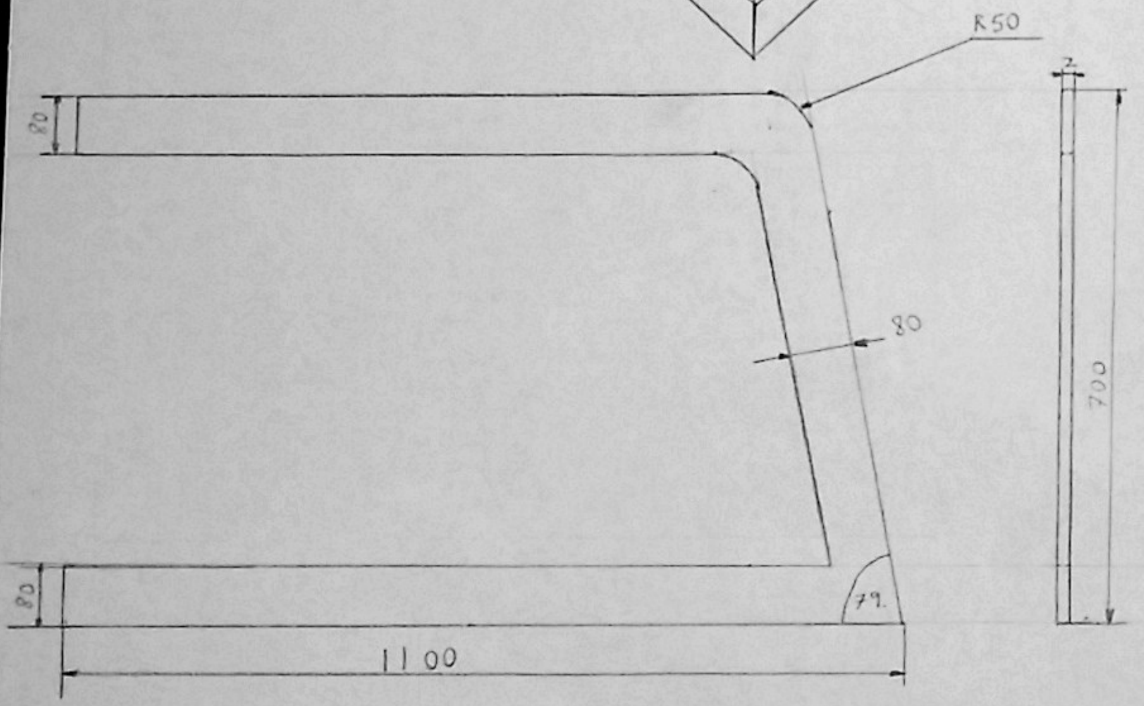
I decided to use a simillar sheet of plastic, possibly polyamide on the interior, connected to the back structural legs. This allowed me to add two side pannels to smooth off the outside.

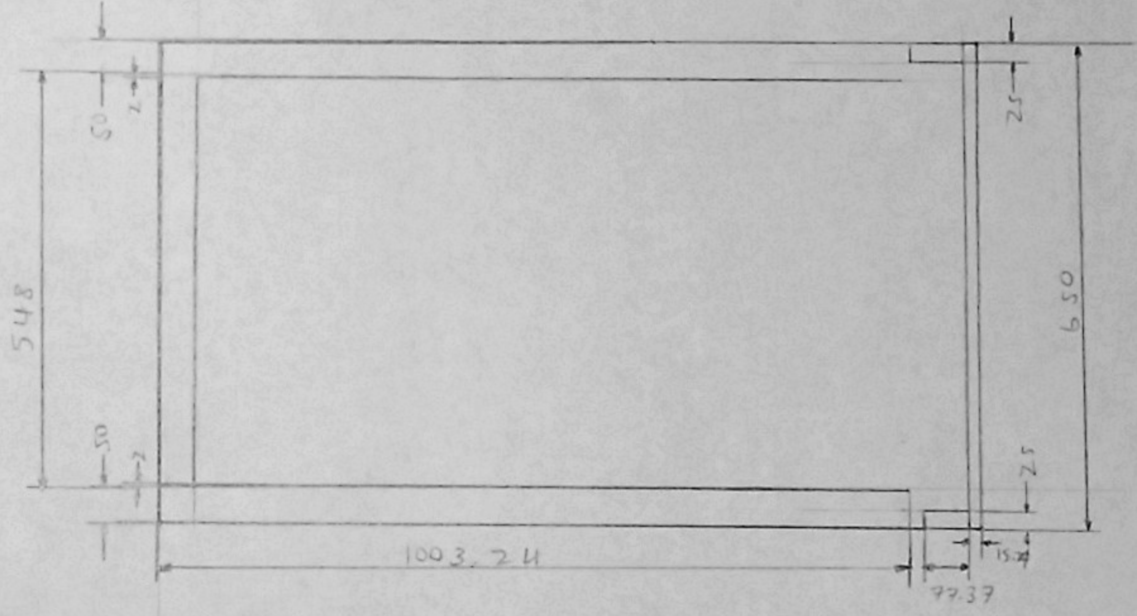
Next I gave consideration to the inner-section, deciding that a plastic similar to the side pannels could be used. The pannels would fit in groves cut in the base and top section with two screwed to the leg posts and one able to be slid out to access the interior.



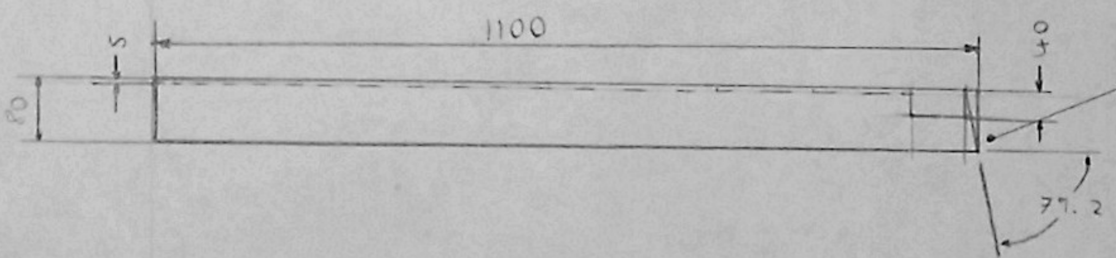








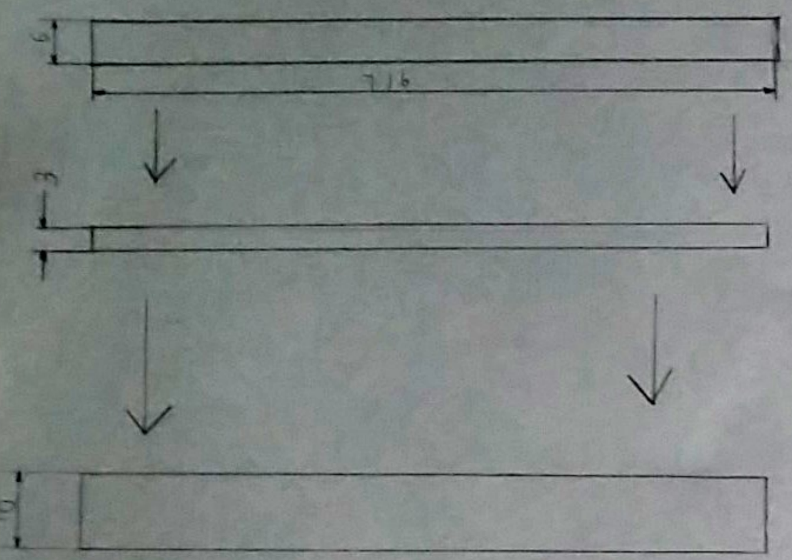
This gave me the basic outer shape I originally planned and structural suport neccisary.



The rear pannel will screw onto the back, flush with ground.

Page 5: Development 2

The next stage was to synthisise a method of projecting the display. Online, I had found advice that said to use three layers of poly-methacrylate



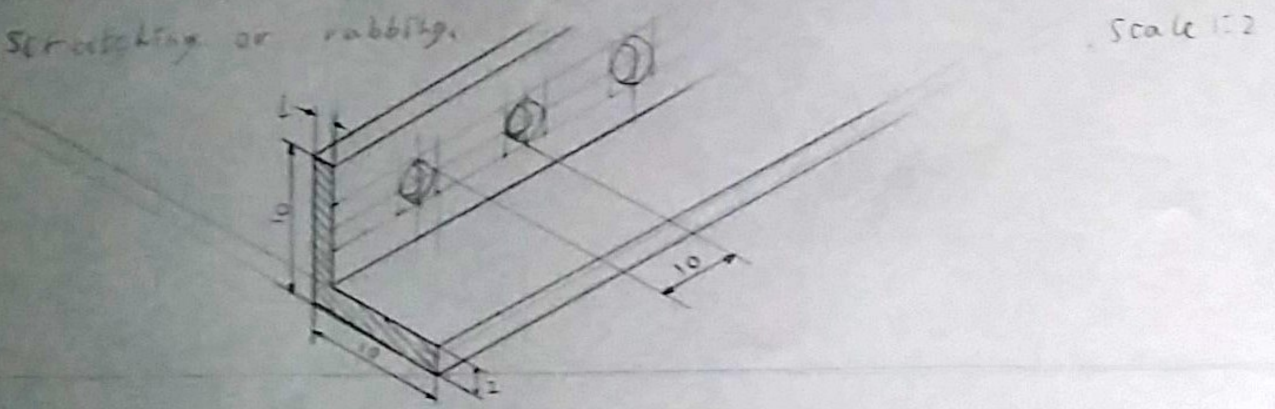
1) The top layer will be abrasive-resistant acrylic acting as a scratch protective surface.

2) The middle layer will be rear-projection acrylic and will display the image from the projector without need for paper.

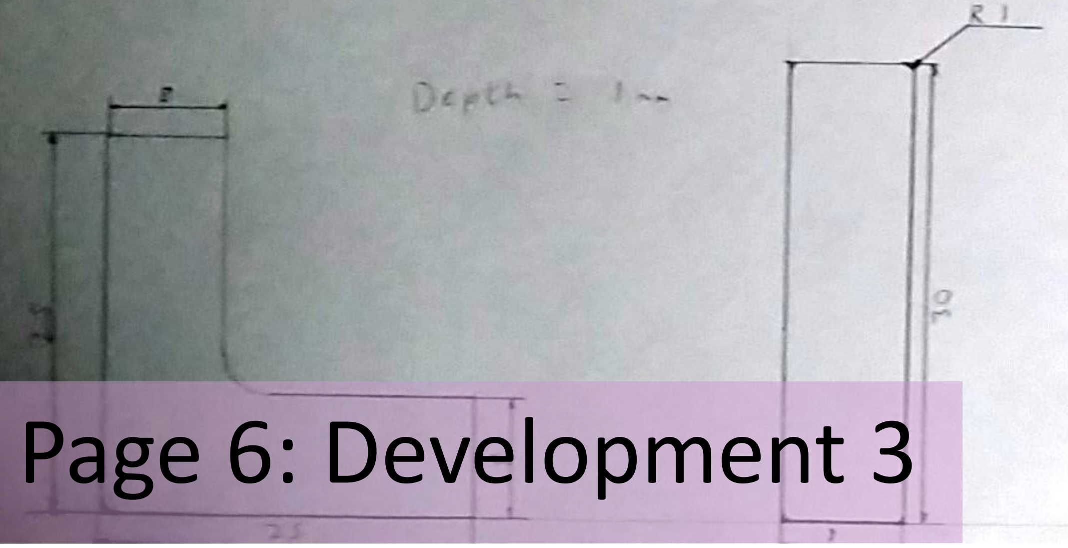
3) The bottom layer will be End Lighter Acrylic and will serve as the basis for FTIR for the screen's operation.

I decided, after further research that I would use 'L' shaped alluminium to create a frame to house an area of IR LEDs. Padding will also be used to stop scratching or rubbing.

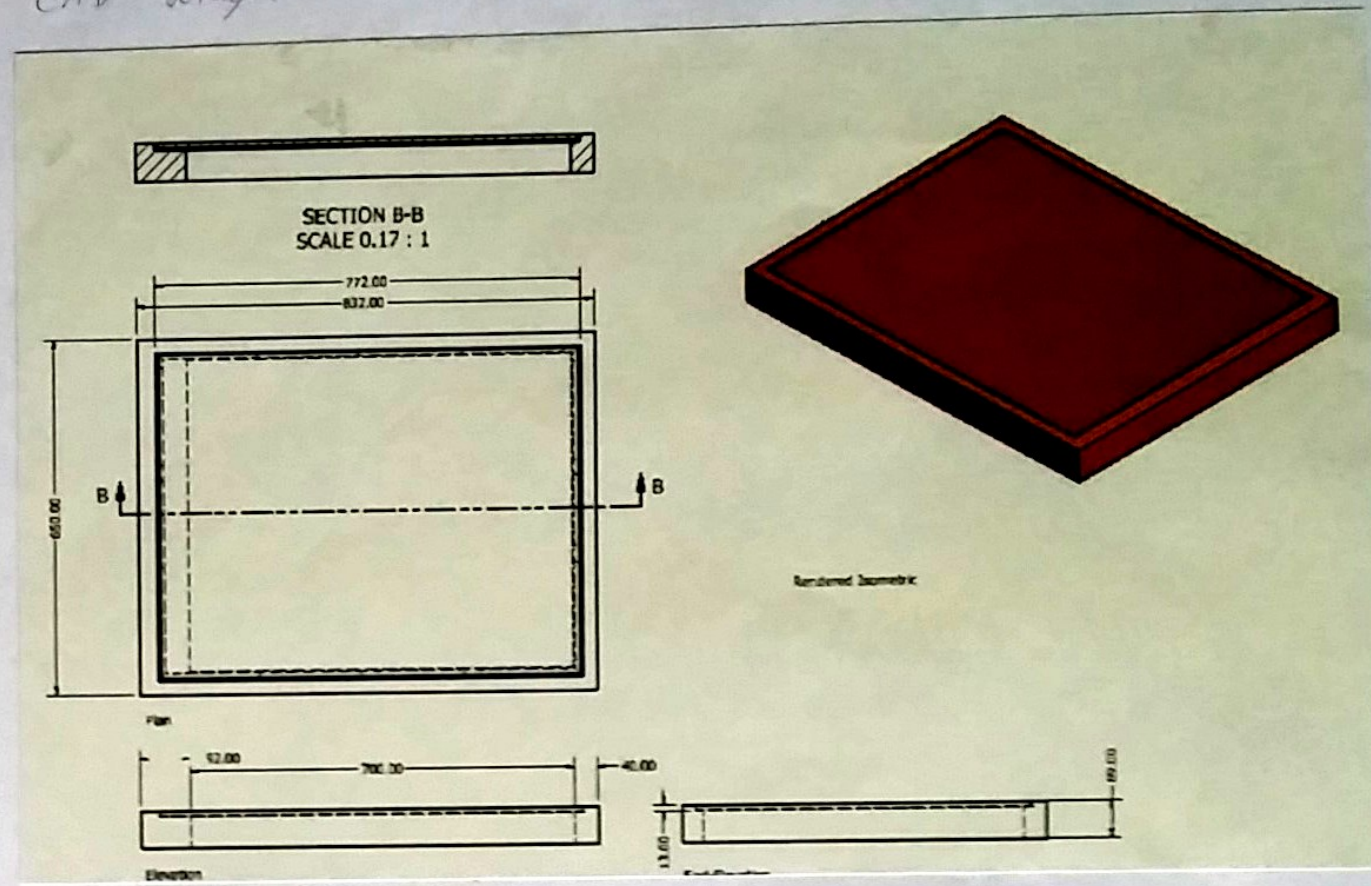
Scale 1:2



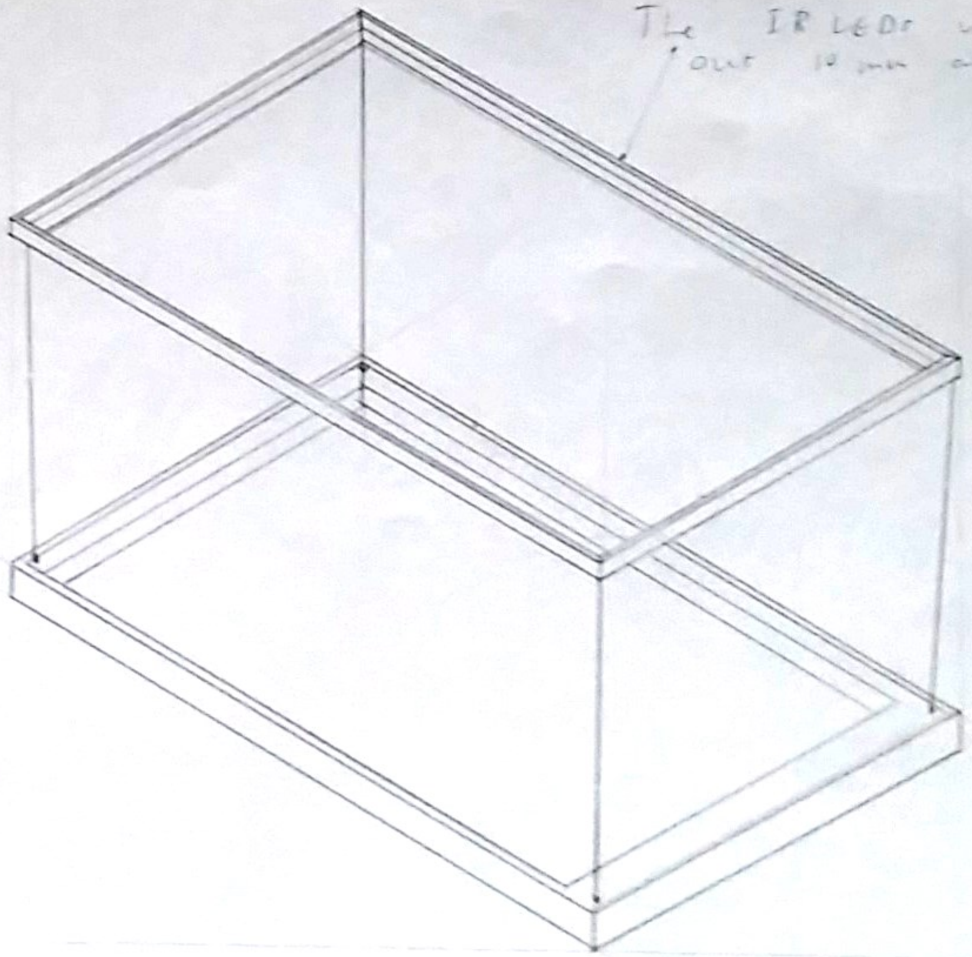
Depth = 1mm



I then decided ... shaft all through. The End Lighter acrylic and frame will rest on the grove and be screwed in while the other two sheets will be screwed onto the frame directly. A detailed CAD diagram and assembly drawing can be seen bellow

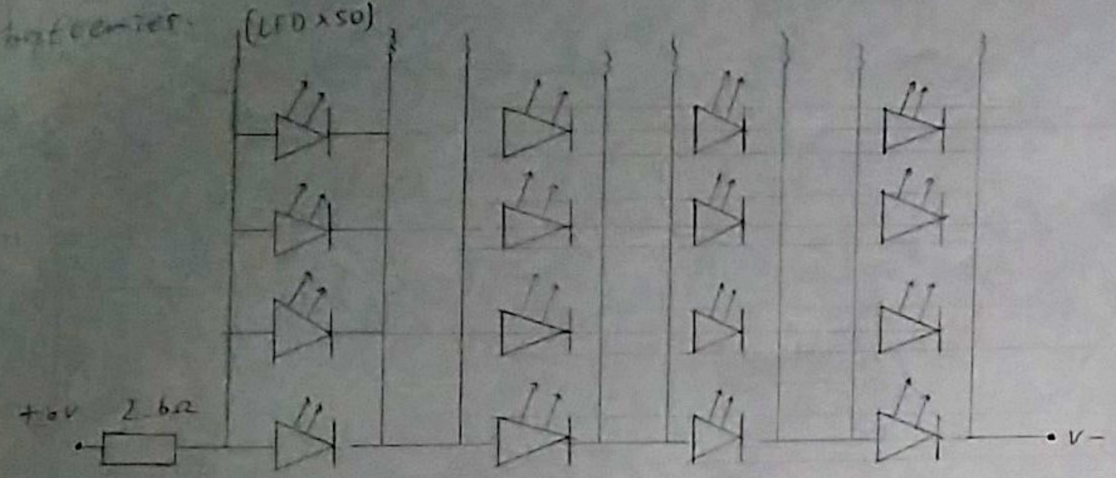


The IR LEDs would be spread out 10 mm apart



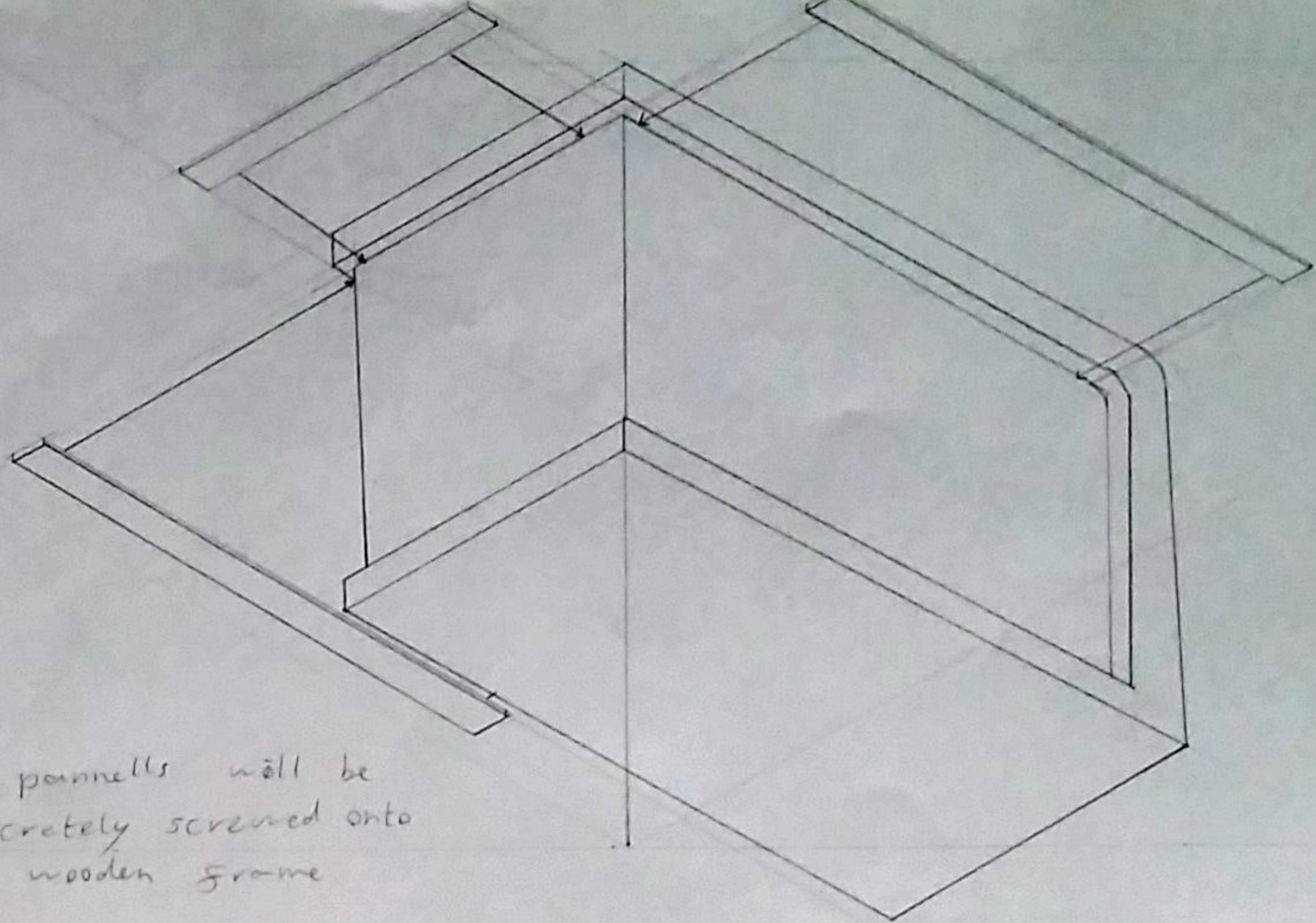
Development Sheet Four

I decided to wire the led's using a series of four parralell branches each with 50 Led's powered by four 1.5v 'D' batteries.

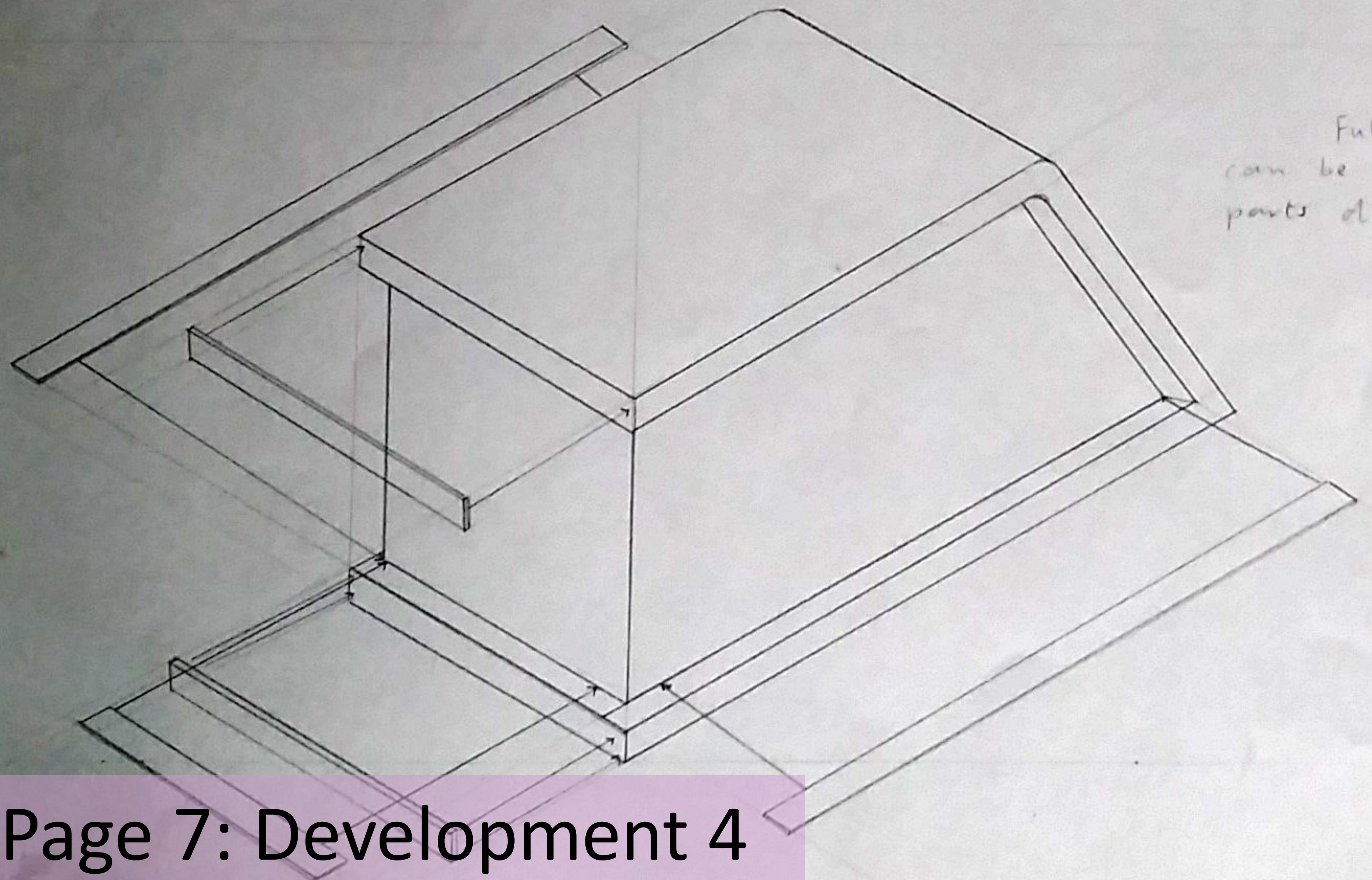


The circuit would wrap around the L-Bar frame with the LED's sticking through holes cut in it. They would be powered by a standard battery container for safety purpouses.

To complete the aesthetic of the table I added six pannels of polly-methacrylate coulored white.



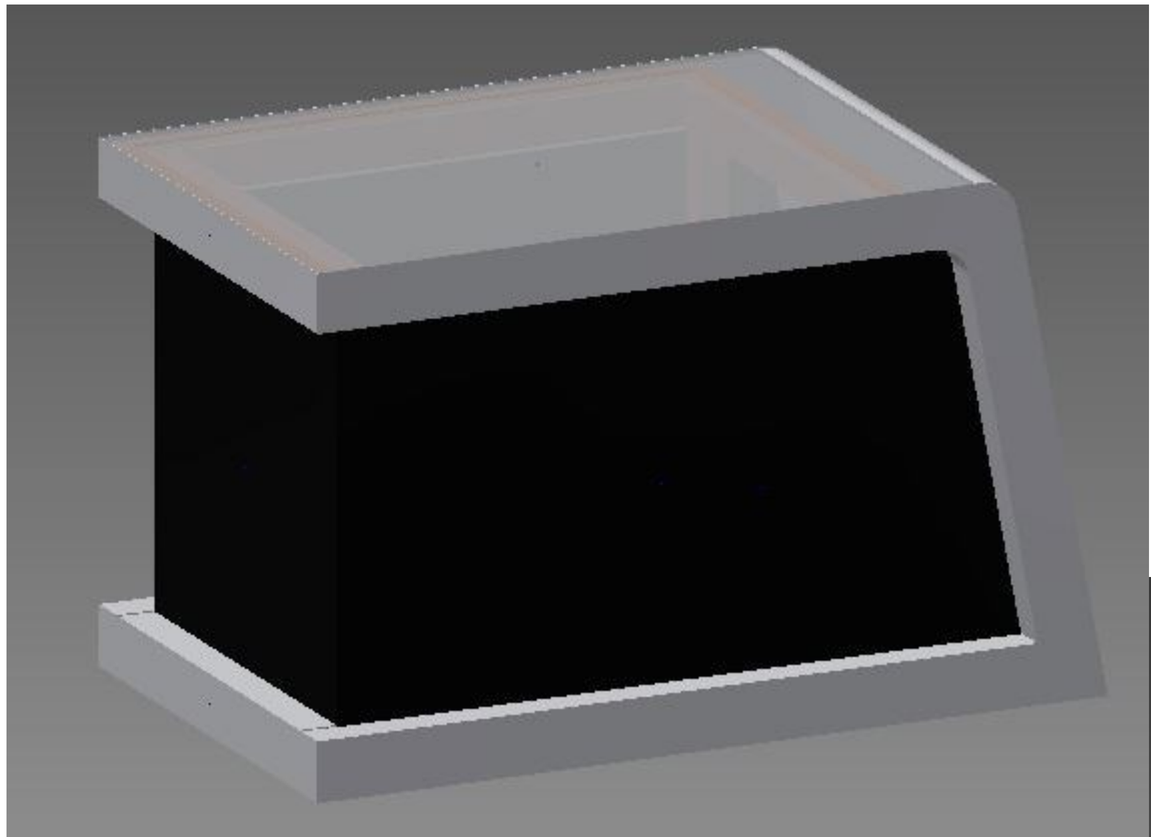
The pannells will be discretely screwed onto the wooden frame

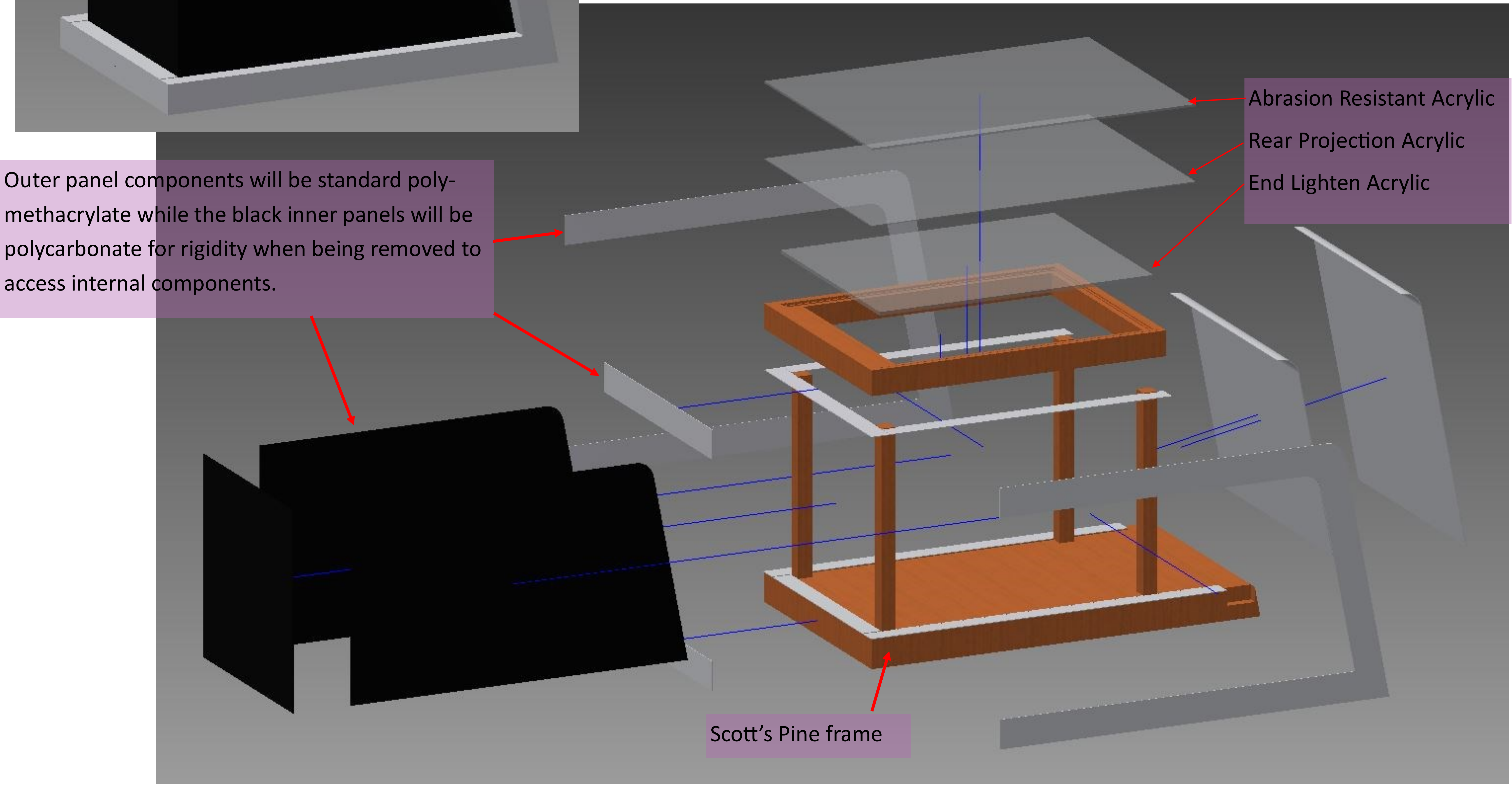


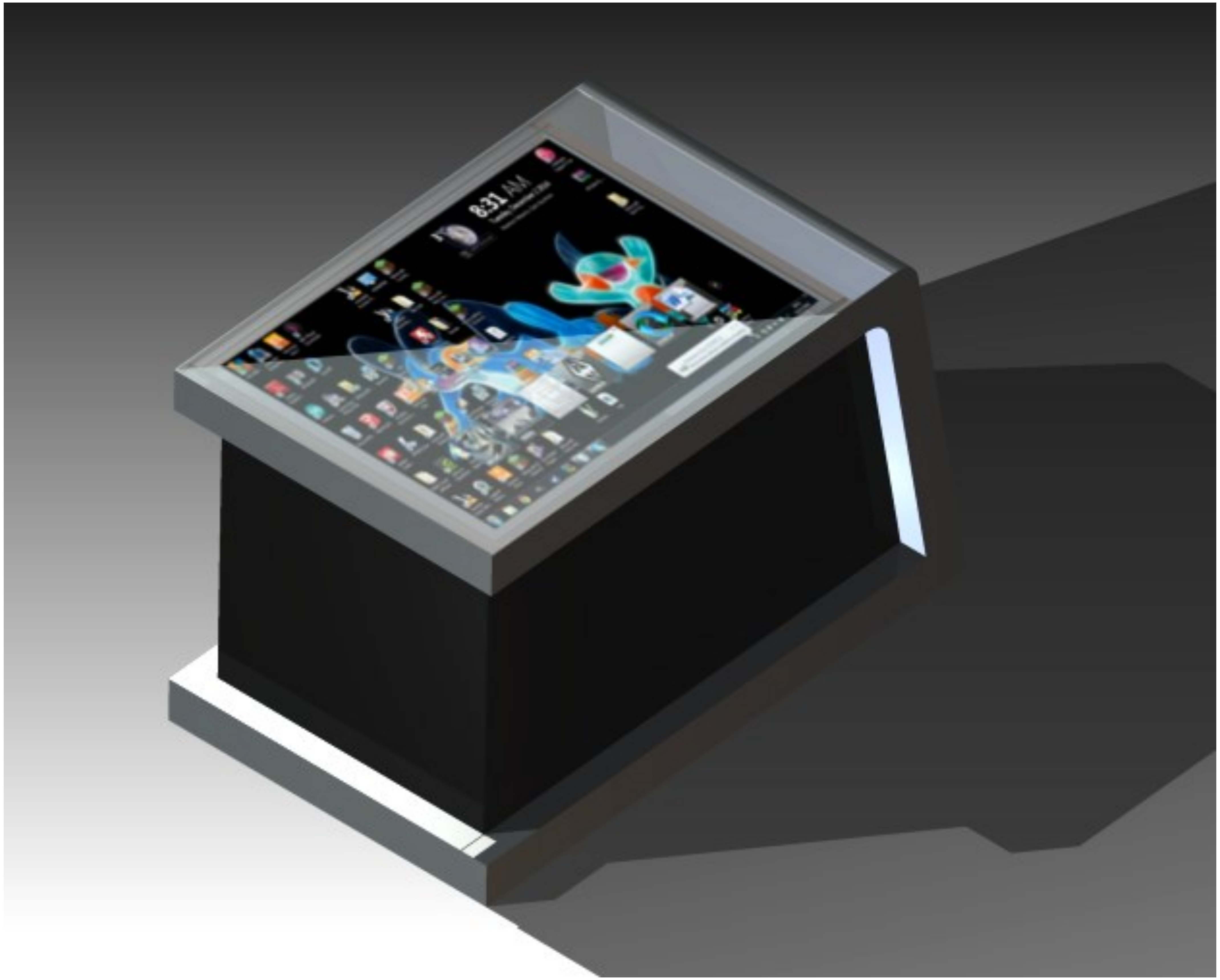
Full Dimensions can be found on the parts dimensions sheets.

At this point I decided to postpone the project as the cost of some of the types of acrylic was beyond my budget at the time and would be a waste should the prototype encounter problems. I do now have plans to revise the design however much of the design theory is in place, little additional work should be required.

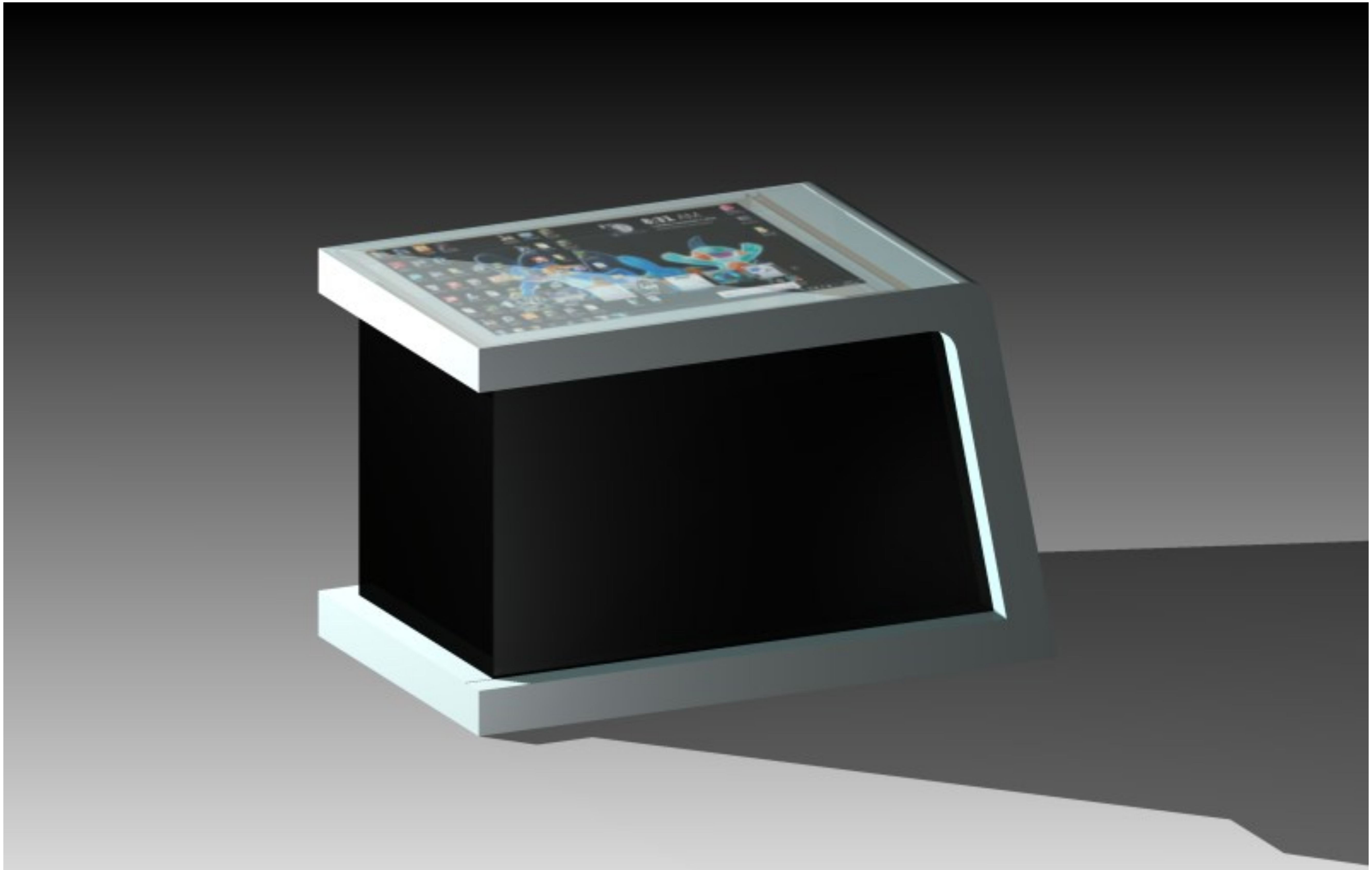
Shown here is a CAD model I created to get dimensions and manufacturing data including an exploded view with the materials annotated.







Rendered CAD Interpretation of Final Prototype



Rendered CAD Interpretation of Final Prototype