*Click on page titles (works on all pages) for navigation

Coronavirus Statistics Terminal for Organisations

Adrian Escartin
Centre No: 71526
Candidate No: 9056
Teacher: Mr McGlade

Problem Identification

In a pandemic, it is ***essential* to isolate and quarantine people** to slow the spread of the disease. The spread of a disease is exponential, where if it is left unchecked, it is able to easily infect a whole population within a month. The Coronavirus' natural production rate is around $R_0 \approx 2.5$ and what this means is that without any precautions, one person is able to infect over two people with Covid19. With Northern Ireland's population of around 2 million people, a single positive case is theoretically able to infect the entire country within only 16 days! Locking down the country is able to reduce the **R_0 number to be lower than 1** which will then regress the number of active cases the country.

However closing off the country has a massive economical impact - to minimise this affect this quarantining has on everyday life, education and the worldwide economy, it is ideal that **only those who have tested positive** isolate themselves.

The Situation Now

With the second wave arriving in Northern Ireland this autumn, it is essential for organisations such as schools and businesses to be able to **keep track and log people** who have the coronavirus. By doing this, they ensure they keep as much of the organisation running to reduce the impact the pandemic has on their revenue, or teaching hours given to students.

The **difficulty of this task scales as the size of the organisation grows**, so there needs to be a solution that is **user friendly, simple to operate, and where the data clearly presented** and communicated.

Design Brief

With my project, my end goal is to allow a user to change and display the number of Coronavirus cases, the exact number of staff in quarantine, and to show what level of restrictions the organisation is on. These considerations are made with the acknowledgement of the information gained from the interview, and school synopsis.

The way the final product is to accomplish this goal is via easy to understand input methods and visual outputs such as LCDs, 7 Segment displays and an array of LEDs. The control system I am considering to use would be an IC from the Genie series and a BASIC program. This would allow me to concisely control the inputs and outputs for a fluid user experience.

Who: Targeted towards organisations with around 500-1500 people. Since it will be in this setting, the product has to be easily cleaned and sanitised.

What: Being able to showcase the current situation regarding with how the organisation is dealing with Covid19.

When: Ideally, this product will be used when a new positive case is reported to the administrative staff, and the statistics are then effortlessly updated by the user.

Where: In the reception area of the building, this is to let staff or students passing by to see the current situation.

Why: Critical information (such as the current number of cases) between administrative staff and the rest of the organisation is not communicated quickly enough. This project aims to hasten the spread of this type of information.

How: Understandable user inputs and display outputs of the product will present data clearly on the current Covid situation.

Factors to be Considered

These factors discussed below are what I will use to benchmark the functionality, purpose and if the final project has fulfilled its initial design goal. For clarity, the factors are divided into three main categories of consideration.

Concepts

Purpose & Function: The end objective of the project is to allow administrators to quickly and easily update their current situation regarding on the number of Coronavirus cases they have present - and in addition, showcased these up to date statistics to the rest of the organisation's staff or students. Functionally, it will do this with a series of labelled inputs and outputs that anyone will be able to understand and operate.

Control Systems: To control and store the information that is input to the project, a programmable Integrated Circuit (IC) is necessary to use. The option I will go with is a Genie series IC since it the software package - Circuit Wizard - that we use to design and program circuits with, has a variety of different Genie chips that I can use. The IC series is capable enough for me to control and program for the purposes of this project, but also basic enough for me to comfortably understand.

Design

Aesthetics: The product's design aesthetic will be a sleek and modern design. This is to allow it to fit in a wide variety of environments without looking out of place - e.g. on the front reception desk in a school.

Anthropometrics & Ergonomics: The user inputs (keypads, buttons, variable resistors) will be sized appropriately to be operated conformability by the majority of the population with one or two fingers. This is since smaller buttons are less comfortable to press than a fingertip sized once due to the extra pressure needed. Ergonomically, the statistics display panel needs to be at an angle whereby it is comfortably viewed by a person standing in front and above the product (will be positioned on a desk the majority of the time).

Material: Polypropylene is a candidate of choice since the material can be moulded to shape easily. It is also a widely recycled plastic and this improves the end-of-life sustainability of the used product.

Safety: Since the whole world is socially cautious, the product *has* to be sanitised with ease. Ways to accomplish this would include making the control surface as flat as possible to lower the effort of wiping the device - and to add to this, the has to be able to remind the previous user to sanitise it after use.

Environmental Impact: A majority recyclable polypropylene body will be used, as recycling plastics has a lower environmental impact in comparison to making a fresh batch of plastic from oil. The electronics have to be easily taken apart and repurposed into other projects, if the product is not needed any more.

Manufacture

Cost/Economics: With the cost of the electronic components being around £10 and materials around £4, a £20 price point would be achievable for the product, allowing multiple units able to be purchased cheaply for even small schools.

Mass Fabrication: All of the electronics will have to be integrated into a single small PCB instead of various PCBs in the prototype to reduce cost. The body of the product will have to be injection moulded as little number of parts as possible to minimise machine tool and joining costs.

Maintenance: Semi permanent joining methods will be used to join the few body parts together - in addition to this, the 3D CAD files will be available online to allow the user to 3d print a broken component.

Quality Control: A validation program will need to be loaded onto the Genie IC to ensure all electronics are properly functioning and connected.

Sustainability: To make the product sustainable, its components needs to be repurposable or recyclable. PP as the material choice ensures it can be recycled in the majority of areas, and the Genie platform can be repurposed by the user into their own electronics project if they so chose.

Research Into the Issue

To be able to tailor my solution towards the target user base, I first needed to collect data on; what is their **view on the problem, what will they do to keeping track of people, and the requirements they need** with the product. The first piece of information I will collect is from a short interview I arranged with our school's principle - Miss McLaughlin.

Interview

Me: Hello, what is your view on the problem of tracking students in quarantine and how do you intend to address it?

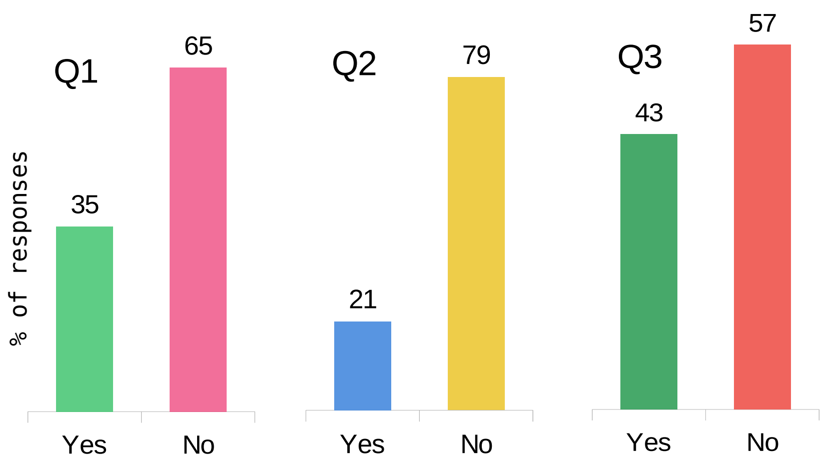
Miss McLaughlin: Tracking the numbers of both students and staff in quarantine is a critical part of balancing the safety and restrictions the school needs to impose, and the ability of our teachers to interact and teach our pupils.

Currently we use a software based method of tracking people in our college, via the combination of SIMS and Excel spreadsheets however, it does take considerable time to be able to learn how to use those software packages and to understand the data being presented.

Me: So from what I understand, you require an easier to use and understand solution?

Miss McLaughlin: Very much so. At the moment, it is time consuming for the administration team to constantly communicate and update our information regarding the number of cases in our school. What I would simplify our work is a product that both allows everyone in the management team to use, and is able to communicate quickly with our students and staff what the current number of teachers and pupils in quarantine are. Add to that too, it is also able to show what level of restrictions is implemented at that moment in time. Also ideally it would be able to be quickly sanitised after use.

Me: Thank you for your time.



School Synopsis

To complement the information I have gotten from Miss McLaughlin, I have also performed an in-school survey where the participants are from a mix of categories such as students, teachers and support staff. The number of responses I have gotten is around 95 and the data in the chart above is represented in a percentage out of 100.

Q1 "Do you have a rough idea on about how many **positive cases the school has had last week**?"

Q2 "The second question was, "Do you know, out of those positive cases, do you know **how many were teachers or students**?"

Q3 "Do you have a **clear understanding of the restrictions** put in place in the school?"

With the data from this survey, I am able to conclude that quite a large portion of people not in the school's administration rules are not exactly sure on how much the school is affected by the Coronavirus and what restrictions are put in place.

With this in mind, I will focus on making these pieces of information more clear to the majority of the school with my project.

Research Into Similar Solutions

DaVinchi Resolve Mini Panel

Overview

Click images for source

This product has the most premium design out of the other solutions. Reusing components with another product skew to production line cost is also another positive.

However the high cost and hard to fix/maintain nature of this product are downsides I would need to take note of.

Overall it does carry out its main purpose excellently when in use by a professional, albeit at a high price.

Concepts

Purpose & Function: By having a whole control panel mapped to shortcuts in the video editing software (DaVinchi Resolve), the key purpose of this product is to accelerate the workflow of the user. Having tactile buttons, dials and roller balls.

Control Systems: Internally, many electronic control systems are needed for this project, LCD drivers, rollerball output circuits and an advanced IC to communicate the inputs to a desktop computer. The software the control panel runs also needs to be fully compatible and integrated with the editing software so it functions reliably and with low latency.

Design

Aesthetics: Being aimed at professionals, the grey colour scheme ensures it looks in place in a studio environment. To improve visibility in a dark environment, all of the buttons are LED backlit.

Anthropometrics & Ergonomics: Since the product is mostly by a user sitting on a desk, the upper panel is angled towards the user so the information on the LCD Displays can be easily viewed.

Material: "Die-Cast and Machined Aluminium" are the primary materials used in the housing of the product. This is to make the product have a premium feel and weight and to ensure the chassis has high durability.

Safety: To minimise the chances of the product falling and damaging itself or the user, large high friction rubber pads are fitted to the underside of the product.

Environmental Impact: The aluminium of the control panel is made from recycled sources, this saves 95% of the energy that is normally used to make new aluminium.

Manufacture

Cost/Economics: Costing £2,425, only organisations that are into video production professionally will see this product as a worth while investment; therefore it has a low sales volume.

Mass Fabrication: The design of this mini control panel shares a common input surface with the micro panel; an initial common assembly line can be initially used for both product SKUs.

Maintenance: Most of the product is easily cleaned with the exception of the trackballs. Cleaning this component is more difficult and it has to be cleaned frequently to ensure the balls roll smoothly.

Quality Control: The manufacturing company has to scrutinise the quality of the manufactured product to justify the large price tag, and to keep positive rapport with the clients.

Sustainability: Being built with a shared lower section with the micro control panel, the manufacturing line can repurpose and reuse a damaged mini panel into a micro panel.

Control Panel For Powder Coating Oven

The construction method and component choice of this product are its best traits. Using common electrical components in the electronics, allows the clients to maintain and repair the product on their own.

The aesthetics of this product are not the most pleasing, however the function first nature of the product makes up for it.

Whilst still being expensive, it is a solution geared towards industrial oven users, so it is still seen as a worthwhile investment to save the company time and effort.

Purpose & Function: The objective of this product is allow the user to run oven heating elements up to 18k watts, and to control the temperature and time of said heating elements. This solution saves time for the client since they themselves can just use this pre-made control system to ensure they have a safe and functional control panel for their industrial oven.

Control Systems: Using a PID controller, the product is able to automatically set the power requirements to hit and maintain the target temperature specified by the user.

Aesthetics: Being used in an industrial environment, the function of each knob and button of the product is clearly seen with the high contrast labels tagging their operation.

Anthropometrics & Ergonomics: The product is the majority of the time mounted onto a wall – with this consideration in mind, all of the inputs and outputs are directly facing the user so they are easily seen.

Material: Steel is the material of choice for this products to make sure it is durable, and weldable.

Safety: The safe operation of this product is paramount to the safety of the user - since it is a control system for an up to 18k watt heater. The SYL-2362 thermometer is able to monitor the temperature of the system; if this component fails, there is a redundant thermometer completely shuts off the oven if the temperature becomes unsafe.

Environmental Impact: The product's function is to automatically manage a user's powder coating oven, as such it can lower their energy use in comparison to manually operating the oven.

Cost/Economics: By being an industrial design solution, this control panel costs £900. This is because the product is positioned as an investment for the company, as it saves the client time on configuring the control system of their industrial oven.

Mass Fabrication: To lower production cost, the main shell of the product is comprised of several pre-cut steel sheets welded together. This saves on the need for a die or moulding machine, lowering cost.

Maintenance: Being aimed at technical clients, being user serviceable is a key feature. The wiring and inputs inside are user replaceable since they are joined with semi-permanent screws.

Quality Control: Rigorous quality assurance is needed to assure the client that the product is able to function as intended as if it does fail, it is able to shut down itself.

Sustainability: Standard electrical components in the product are able to be repurposed, and the steel body is readily recycled.

LEFTEK 4D Joystick Camera Controller

The choice of using polypropylene lowers the sustainability of the product in comparison to using other plastics.

The product's input methods is nevertheless useful for the user, as it allows them to have fine granular control over their monitoring cameras.

If the product's material choice , environmental impact and difficulty of maintained were improved, the product would overall be more competitive

Purpose & Function: This camera console allows the user to switch and control in detail up to 7 CCTV cameras simultaneously. It does this by offering a wide variety of input types, buttons for digital functions, and sliders, knobs and even a joystick for variable functions such as adjusting a connected camera's pan, tilt and zoom.

Control Systems: This product is used as an input method for several cameras. As such it uses an *S2 camera controller* to allow it to communicate the user's inputs into camera adjustment outputs over RJ45 (ethernet port) connections.

Aesthetics: Using dull grey and black as the colour scheme, it lets the product fit appropriately into an office environment.

Anthropometrics & Ergonomics: The product's use scenario is being on a desk. As such the body is angled slightly towards the user to make the text and inputs more accessible to a person sitting down.

Material: A variety of materials are used in this product. A steel plate is used on the main face to improve its strength and reduce deck flex. The rest of the body is made from a single polypropylene mould to reduce production cost.

Safety: Rubber feet are situated on the bottom of the product to prevent it from falling off the user's desk.

Environmental Impact: Polypropylene being the main material of the shell of the product, has a negative environmental impact as the plastic is not as readily recyclable as other plastics due to the processing cost. The electronic system is likely to end up in landfills, further worsening the products impact on the environment.

Cost/Economics: Positioned at £300 and targeted towards any surveillance client, the product has a moderate production volume.

Mass Fabrication: The lower plastic shell of the body is moulded from a single piece via compression mouldering, and the steel plate is cast into the desired shape of the product.

Maintenance: The surface of the product is able to be cleaned easily, however, the internal electronic components would be difficult to repair if damaged due to the compact nature of the product.

Quality Control: All possible inputs and outputs of the product have to be tested, particularity the analogue ones to ensure they operate smoothly and fluidly. The control system also needed to be quality assured, so make sure the product fulfils its main purpose to the user.

Sustainability: When the product is thrown, the polypropylene is likely not going to be recycled, and the electronic components likely not going to be reused, lowering the sustainability of this product.

Project Design Specification

1 – Purpose & Function

1.1 The product's data on the organisation's Coronavirus statistics and current restrictions must be able to be easily changed by the user with appropriate inputs.

1.2 The outputs showcasing the data mentioned above should be easily understandable and legible by anyone passing by the product.

1.3 If the statistics reach critical numbers (for example, the R_0 of the organisation is greater than 1) or the level of restriction is high, the product must be more noticeable to communicate that they have to be more socially cautious.

1.4 Ease of use is a high priority since it broadens the number of prospective customers that may purchase it.

1.5 The complexity of the data should be just enough to roughly give a current overview of how the organisation is affected by the Coronavirus. It should not be too much so that it takes over 12 seconds to know what is going on.

2 – Control Systems

2.1 A programmable IC is necessary for this project so that all inputs and outputs are able to behave exactly the way I specify

2.2 Data must be able to be stored in a non-volatile way, so that some information is still retained every time the user turns on and off the device.

2.3 A variety of input methods should be used, like a keypad and a variable resistor instead of only push to make switches.

2.4 Output components should include a LCD display that displays the number of coronavirus cases in the school weekly along with seven segment displays showcasing the number of students in quarantine.

2.5 The PCB designs should be as small as possible to allow them to fit in as small of a volume as possible – which allows me to design the product housing without worrying about PCB housing as much.

2.6 Programming will be done in BASIC to improve the speed of writing a complex program controlling multiple input and output components simultaneously

3 - Aesthetics

3.1 A toned down colour scheme will be chosen to make the product able to fit any environment such as office spaces.

3.2 Any user inputs or outputs will be coloured or illuminated (button backlighting could be a considered) to stand out from the body of the product.

3.3 A QR code will be added to the body of the product which sends them to a website if they scan it to give extra information to the user.

3.4 The purpose of the product must be intuitively told by its design, so that users immediately understand its function and purpose of broadcasting the organisation's current coronavirus situation.

3.5 The design language of the product should be clean and minimal to be as modern as possible whilst still conveying all of the necessary information.

4 – Anthropometrics & Ergonomics

4.1 Any output must be visible when any input is used. This may be done by putting the outputs above the inputs so the user's hand does not cover them.

4.2 Since the product will be viewed the majority of the time on a desk, the outputs must be ergonomically angled towards a standing standing users that are around 1.65m tall (average human height).

4.3 The dimensions of the product should ideally not exceed 250x350x250 or else it would be unwieldy to move around.

4.4 Inputs and outputs must be easily interacted with and viewed upon by a user at least 1 meter away.

5 – Material

5.1 The materials chosen for the main body of the product must be readily recyclable. Acrylic would be a candidates of choice.

5.2 The choice must also be sufficiently durable to withstand regular use of the product and low drops around 30cm.

5.3 The thickness of the surface holding the inputs must be enough to ensure it does not bend under a 10N force.

5.4 For aesthetic purposes, the material should also come in a wide range of colours and be able to be given a variety of finishes such as matte or glossy.

5.5 The choice of material must also be easy to work with. It should be able to be injection moulded and allow joining methods such as screws to be used.

5.6 The compatibility with as many of the school workshop's machine tools such as polishers or line benders is a desirable trait for the fabrication of the model.

6 – Safety

6.1 To prevent accidental slips and drops of the product, rubber feet should be incorporated in the design so it increases surface friction and prevents sliding from up to a 30° inclined surface.

6.2 The corners of the body should be filed down to not be too sharp, as to not injure the user if they hit them too hard.

6.3 The product has to be easily sanitised since it is able to be interacted with by multiple people. Surfaces should be as flat as possible to hasten sanitation time via alcohol wipes.

6.4 The control system should remind the user to sanitise it, with the product emitting a buzzer sound and blinking a LED if left without user input for over 20 seconds.

7 – Cost/Economics

7.1 The raw bill of materials of the product should not exceed £15 to ensure the product is able to be sold at a highly accessible £20-30 price point.

7.2 The surface material finish and build quality of the product should be comparable to products of that price point.

7.3 By being aimed at organisations such as schools and medium sized organisations, the product should see manufacturing price benefits from being made in a moderate production volume.

8 – Mass Fabrication & Quality Control

8.1 Mass production methods should be able to be used such as injection moulding. This depends on the material of choice.

8.2 The body of the product should be comprised of as little parts as possible (ideally only a top and bottom part for the body) to reduce production cost and improve the ease of maintenance.

8.3 A diagnosis program should be written and applied to the finished circuit of the model to ensure all inputs and outputs function as intended.

8.4 The surface of the model has to have as little defects as possible (or at least not be visible from a 30cm distance) and the inputs have to operate smoothly (such as the variable resistor).

8.5 The mass production process of the product should be able to be detailed and planned so it is as close to real life as possible.

9 – Maintenance

9.1 A pair of 6v batteries should be able to keep the product running for at least a week. It will be able to turn itself off after 5 minutes to conserve power. Easy access to them should be incorporated in the design of the housing.

9.2 The QR code of the product should contain the production process of the product and the 3D CAD files. These are to be hosted online in the event the user needs to repair the product themselves.

9.3 The electronics of the product should be easily accessible as possible to ease the prototyping phase and the effort of end-user replacement.

9.4 Regular maintenance of the product should be kept at a minimum (ideally able to function as intended for at least 6 months) therefore it has to be robust, durable and reliable as possible (regarding the electronics having a low chance of malfunctioning and the body of the product being thick enough).

10 – Environmental Impact & Sustainability

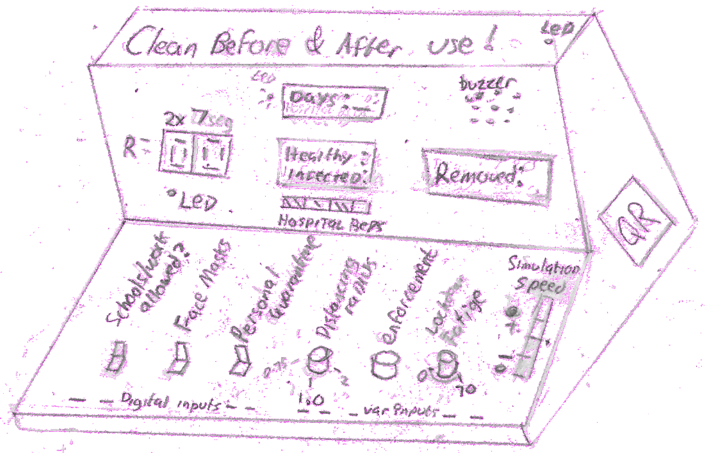
10.1 Only a widely recyclable plastic will be considered for use in the product. It has to be able to be recycled in most parts of UK and Ireland.

10.2 The design should enable the quantity of material to be minimised which reduces the environmental cost of the materials, and also reduces weight characteristics of the product.

10.2 The product's electronics should be able to be repurposed by the user at the end of its lifecycle. Hence, the electronics should be user removable as possible.

10.4 Disassembly of the product body should also be a priority to allow it to be repurposed. Use of permanent methods such as liquid solvent cement should be minimised as possible to allow extraction of small material sheets from the end of life product.

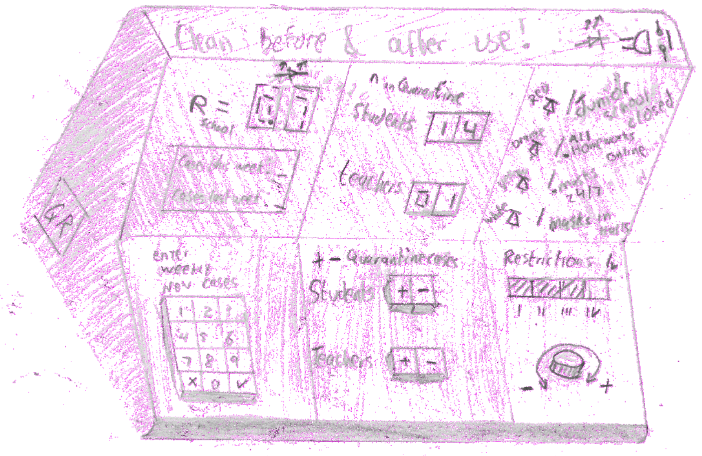
Initial Design Ideas



Affects of Restrictions

This concept would showcase the drastic affects of changing restrictions and how applying them all in tandem can severely reduce the rate of Coronavirus spread.

This numerical model concept was then scrapped since it would have been hard to program for especially since the Genie programming software only allows integer operations.

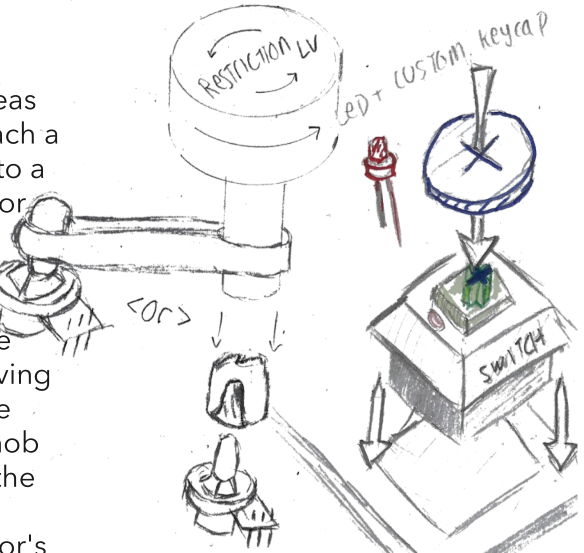


Information Log

A second draft of this casing shape has a more simple electronics design - where the aim is for the user to input their current information on how many cases and what current restrictions are put in place in the organisation. This to allow everyone to track the current situation on how spread of the virus is being managed.

Input Knob

This drawing showcases ideas on how to attach a custom knob to a variable resistor input. One is using a rubber band as a pulley The other is by having a shape on the base of the knob that matches the shape of the variable resistor's pin.

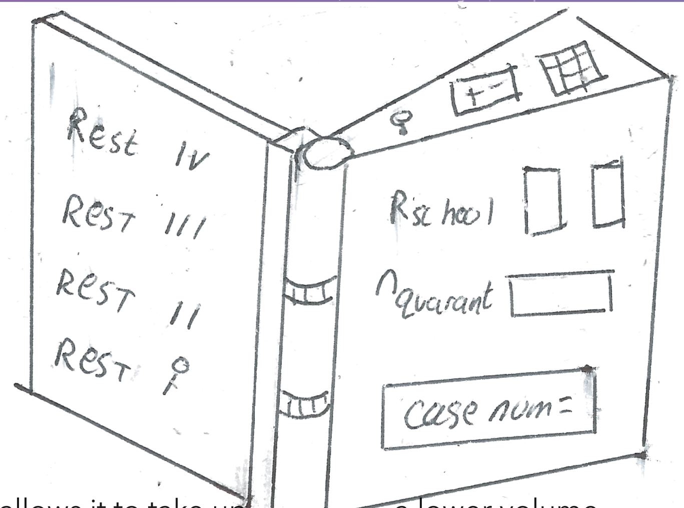


Switch Choice

Early on, using Cherry MX switches as the PTM inputs was a design consideration since they came in different tactile feedback options They allow LEDs to be inserted and custom key caps to be fitted to specify what information would the input change to the user.

Foldable

One way on making the information more visible to people passing by, is to display it over a larger area. The book-like design does this and also prevents the casing from being easily tilted over when folded at the right angle.



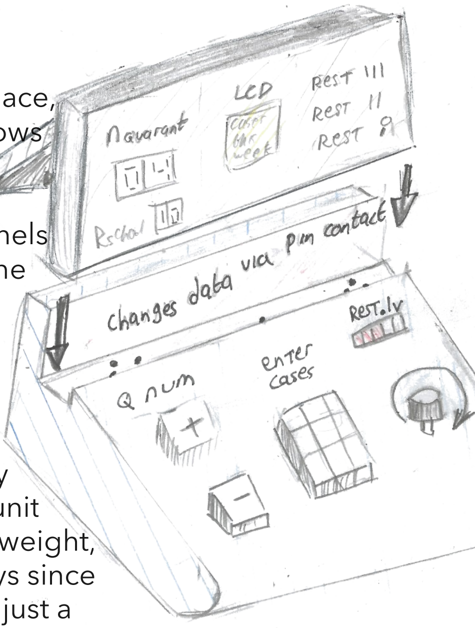
It also allows it to take up a lower volume when folded, which helps with storage and transportation. Here the LCD and 7 Segment displays are on top to avoid scratching with the resting surface and with the product body itself.

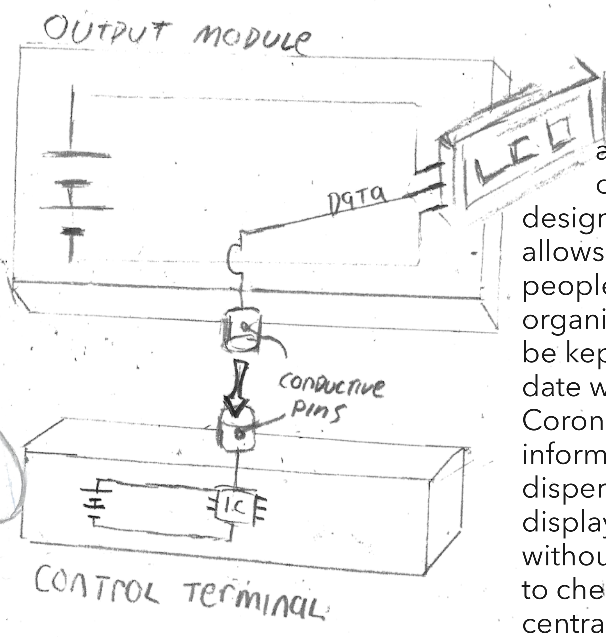
A hinge design would be needed to allow this to work and that would be something that needs to be developed if I take this concept sketch onto later design stages.

Detachable Displays

Instead of having the information stuck in one place, this detachable design allows an operator to load information onto removable information panels to be distributed around the building.

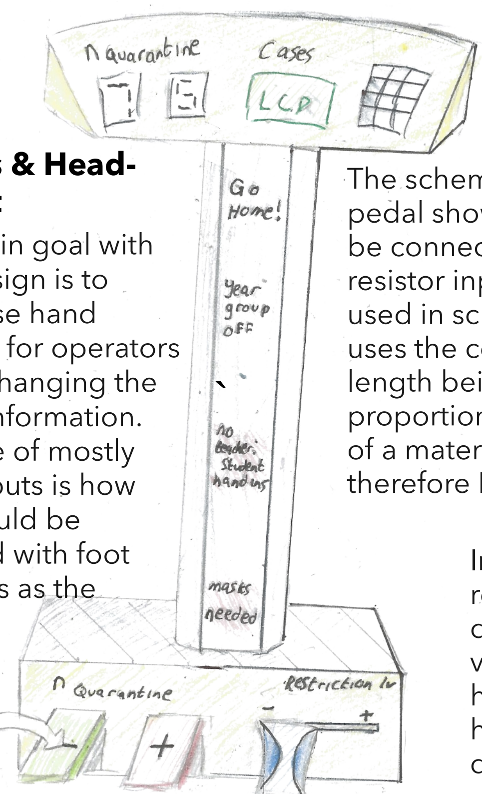
An idea to make this work is to have all of the logic take place on the input terminal and then have the data sent to the display via pins when the display unit is docked. This lowers the weight, cost and size of the displays since no control PCB is needed, just a power source.





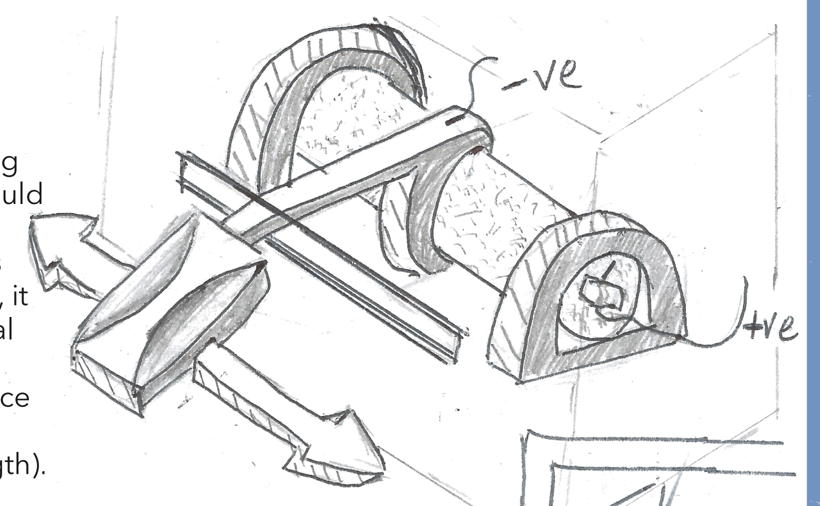
A large advantage of this design is that it allows more people in the organisation to be kept up to date with Coronavirus information with dispersed display units without having to check a central terminal.

Pedals & Head-height

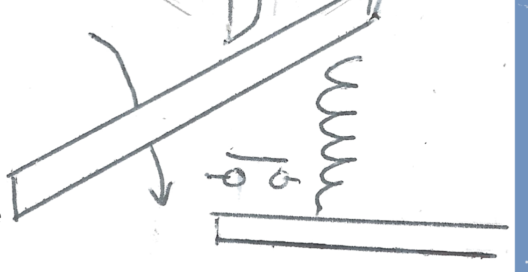


The main goal with this design is to minimise hand contact for operators when changing the cases information. The use of mostly foot inputs is how this would be achived with foot paddels as the inputs.

The schematic on the sliding pedal showcases how it would be connected to a variable resistor input. Like the ones used in school laboratories, it uses the concept of material length being directly proportional to the resistance of a material (RA = LP, therefore Resistance ∝ length).



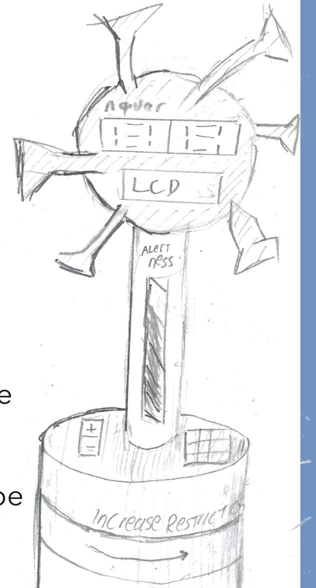
Information on what implemented restrictions that should be followed is displayed on a the pillar to increase its visibility and other info is placed on the head of the product, at human head height to reduce the effort of seeing the data presented.



The inputs are on the back of the design on a triangular prism which gives this design stability and room to fit the electronic components.

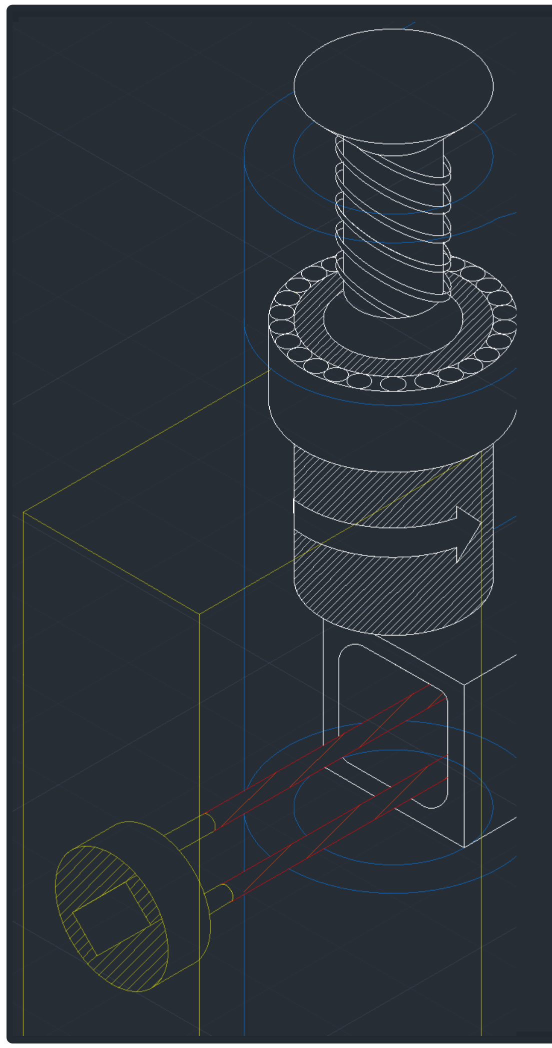
This concept uses LEDs that illuminate translucent acrylic to effectively make a larger 7 segment display and the information about restrictions is displayed by engraved transparent acrylic.

The head shape being the shape of a virus model makes obvious to the users what the subject of the terminal is on about. However, this design would have been more costly to manufacture and transport/store due to the shape of the head.



This also makes use of the pillar to display information on what restrictions that need to be followed and the base of the product is able to be rotated as a variable input to the pillar display.

Casing Concept I



Purpose & Function

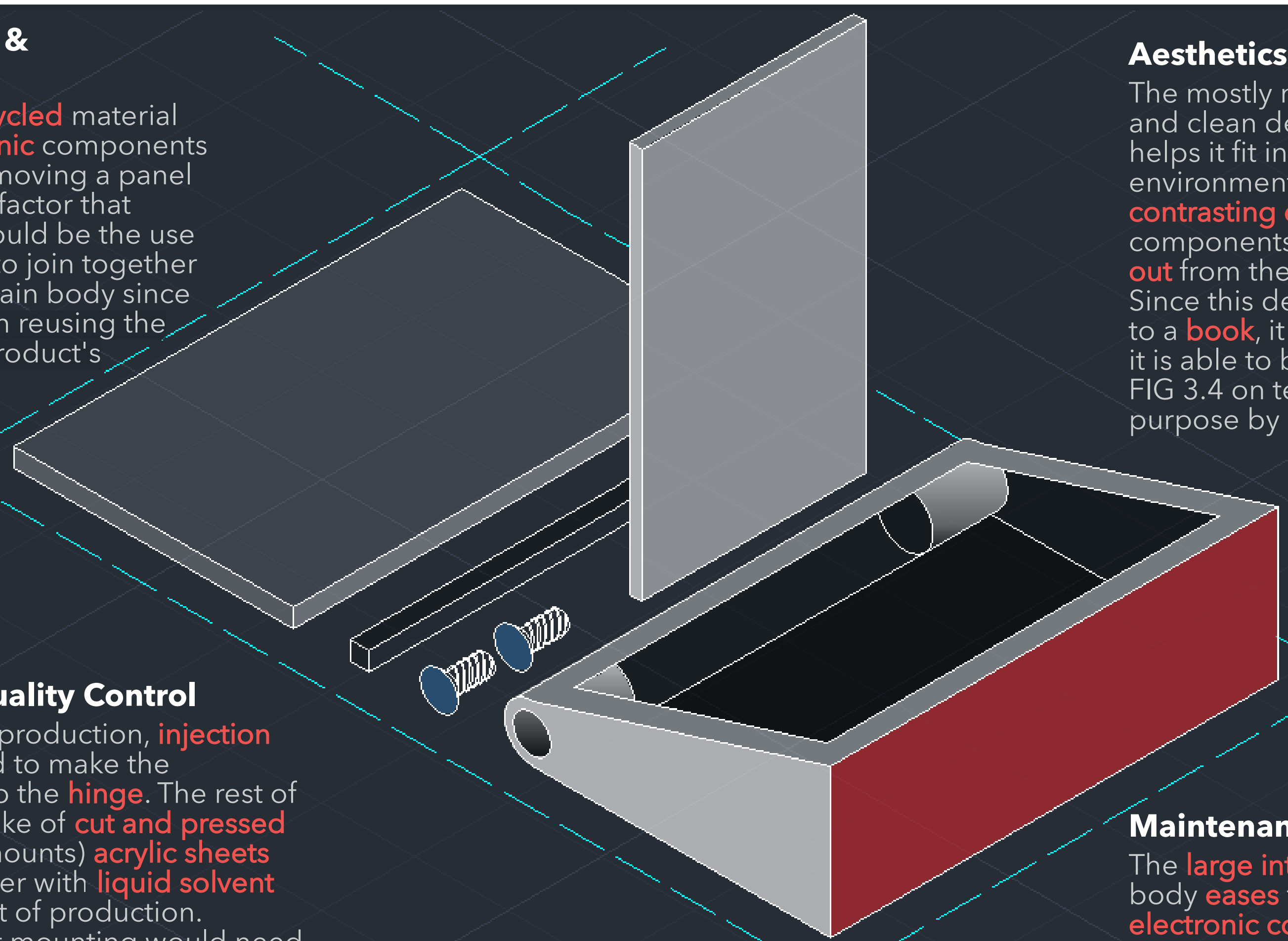
The goal of this concept casing is to explore the most space effective way of carrying out the purpose of showcasing the organisation's Coronavirus statistics and allowing the user to modify the showcased data. To do this, the shape of this casing allows it to fold onto itself and its also constructed out of flat sheet material to enable this and to lower fabrication cost. All inputs and outputs of this design are on one side of the product and all of the electronics are housed in the same volume for quicker access which eases the effort of manufacturing and repair.

Cost/Economics

The cost of this casing design would be higher than the others proposed because of its ability to be folded - ball bearings, moving components and more quality control would be some of factors increasing production cost.

Environmental Impact & Sustainability

Acrylic is a commonly recycled material (FIG 10.1) and the electronic components are user removable by removing a panel from the main body. One factor that lowers its sustainability would be the use of liquid solvent clement to join together the acrylic sheets in the main body since this prevents the user from reusing the plastic at the end of the product's lifecycle.



Mass Fabrication & Quality Control

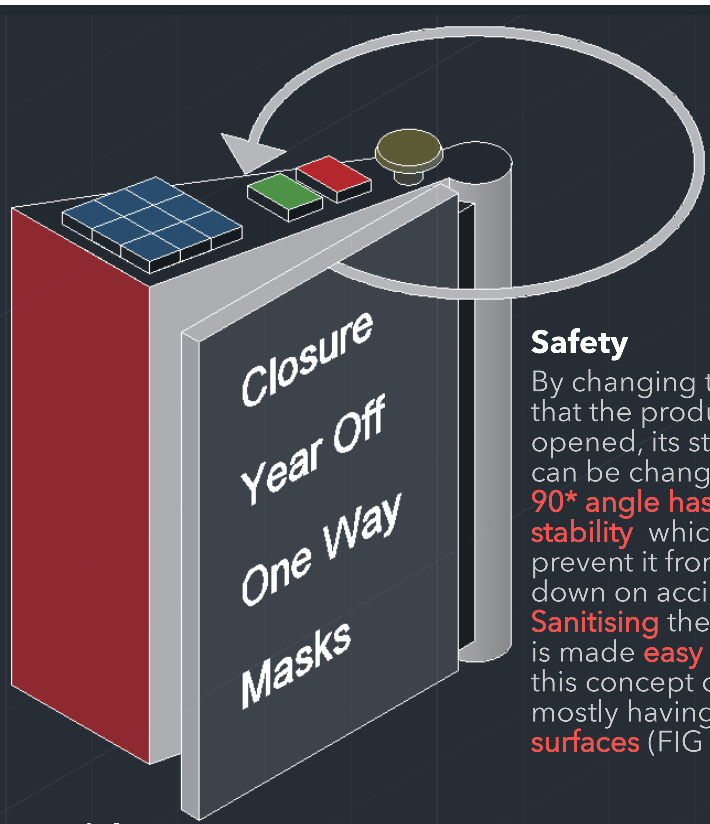
To meet FIG 8.1 on mass production, injection moulds would be needed to make the components that make up the hinge. The rest of the body is able to be make of cut and pressed (for the I/O component mounts) acrylic sheets permanently fixed together with liquid solvent cement to help lower cost of production. Clearance for component mounting would need to be checked for QC but the smoothness and durability of the folding hinge would be another aspect of this design that does need pass quality control.

Aesthetics

The mostly neutral colour scheme and clean design of the product helps it fit into many professional environments (FIG 3.1) and the contrasting colours on the input components makes them easily stand out from the rest of the product body. Since this design has a similar shape to a book, it suggests to the user that it is able to be folded which meets FIG 3.4 on telling the product's purpose by its design.

Maintenance

The large internal volume of the main body eases the effort of accessing the electronic components (FIG 9.3). The use of ball bearing significantly smoothens the hinge mechanism and it also gives an attachment/detachment point to allow the product to be disassembled when necessary



Safety

By changing the angle that the product is opened, its stability can be changed. A 90* angle has high stability which helps prevent it from tilting down on accident. Sanitising the product is made easy due to this concept casing mostly having flat surfaces (FIG 6.3).

Material

Acrylic is the main choice of material for this design due to its recyclability and its ability for a high gloss finish to be applied. It also being available in translucent or transparent forms also is useful for the large illuminated information display since its a less brittle and cheaper substitute for other see through materials such as glass.

Summary

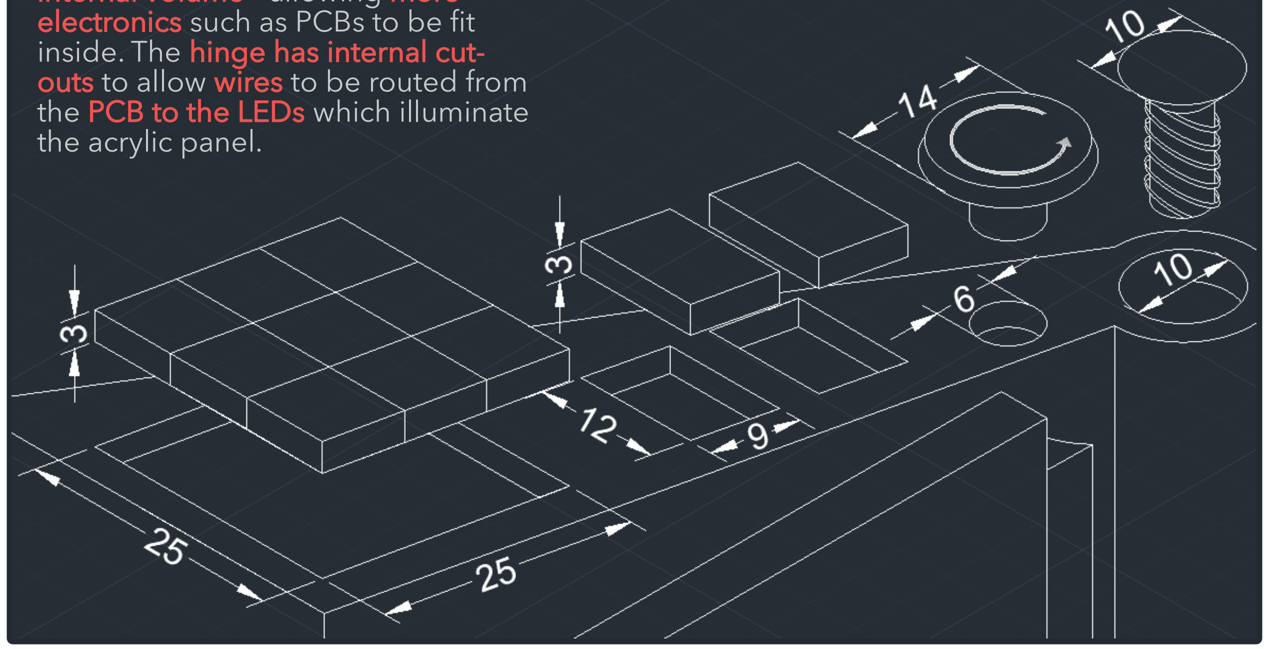
The main feature in this design - the ability to fold - does have multiple benefits to the function of a statistics terminal. It lowers its volume when in transport, its stability is able to be increased and information can be shown over a larger area however the added complexity of the hinge compared to a fixed design does increase the cost of production and likelihood of a component breaking. I saw the value of using AutoCAD to replace hand drawn technical drawings because of the greatly increased drawing speed and accuracy

Control Systems

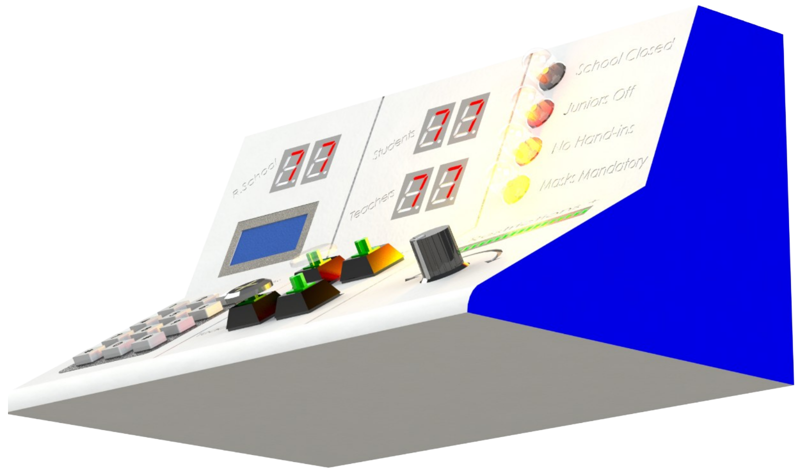
As specified by FIG 1.4, engravings on the inputs helps ease of use since it will tell the user the function of each input (e.g. the arrow on the variable resistor). A variety of electronic components were considered with the design of this casing. The triangular shape on the top face allows larger input components to be fit on the top of the product and also increases the internal volume - allowing more electronics such as PCBs to be fit inside. The hinge has internal cut-outs to allow wires to be routed from the PCB to the LEDs which illuminate the acrylic panel.

Anthropometrics & Ergonomics

By placing all the inputs on the top, they are less visible to people walking by but are easily seen and accessed by a user standing close to the product. The dimensioned drawing showcases the proposed dimensions of the input component cut-outs The PTM switches are of a size that is big enough to be comfortably pressed by the user. Another benefit of the folding design is that it helps the terminal achieve FIG 4.3 of the anthropometrics part of the specification since by lowering its volume when folded - it makes it easier to move around.



Casing Concept II



Purpose & Function

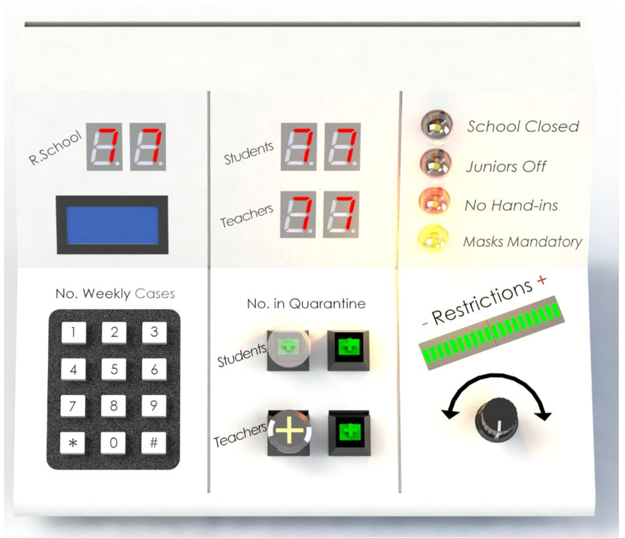
The goal of this concept casing is to explore the most simple way of carrying out the purpose of showcasing the organisation's Coronavirus statistics and allowing the user to modify the showcased data. To do this, the shape of this casing has flat surfaces to reduce the cost of its fabrication and it also has no moving parts when under normal use. All inputs and outputs of this design are on one side of the product and all of the electronics are housed in the same volume which eases the effort of manufacturing and repair.

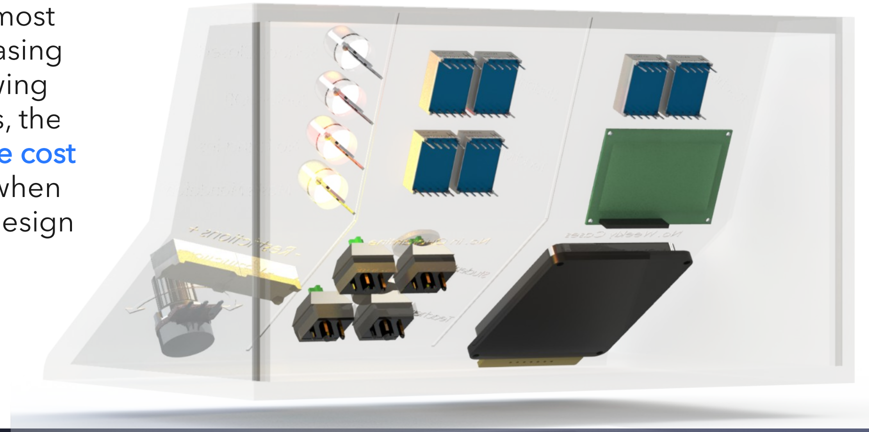
Safety

The completely flat surfaces makes it easy to sanitise the surface of the product after use and the large base of this case design makes it very stable at all times. The blue and white contrasting colour choice is also for visibility, reducing the chance of accidentally bumping into the product.

Control Systems

Due to the number of input and output components that can be mounted onto this casing design - its inner volume also needs to be able to fit multiple control IC PCBs such as Genie 08, Genie 14, and 4510+4511s at the same time. This to ensure that all the pins of the I/O parts are able to be connected and controlled by a programmable IC. This concept also explores the use of using a keypad as an input method since its large size compared to other input components requires a large cut-out for proper and secure mounting.



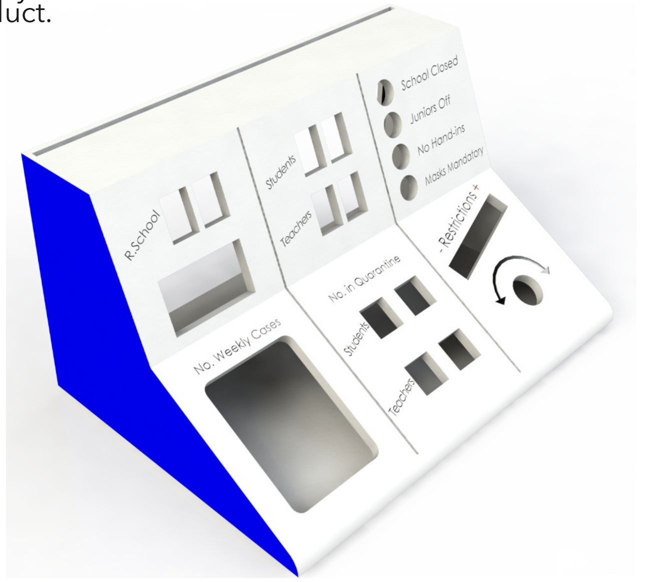


Material

ABS is chosen for this design concept as its surface texture and appearance even without any polishing looks aesthetically pleasing. Its also a durable material that is able to be work with easily. Machining or giving a sanded surface finish are easily done, making it suitable for a casing model to be made in the school workspace.

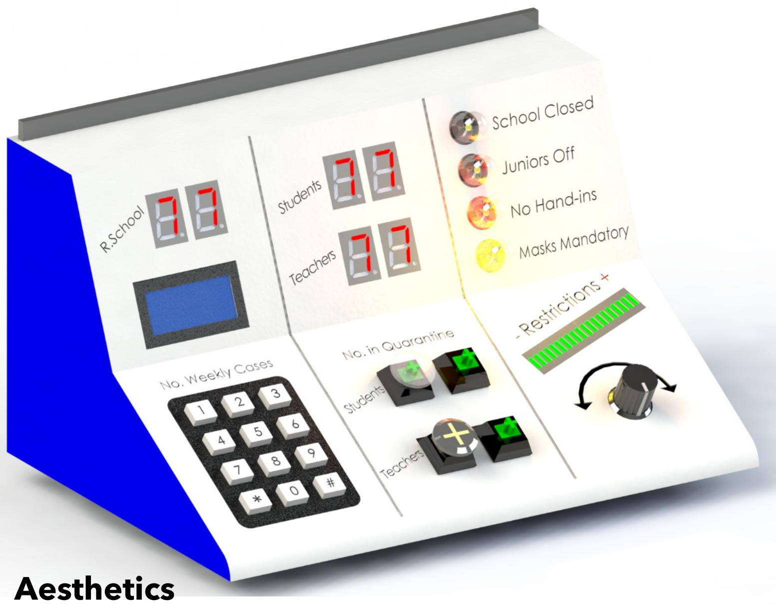
Cost/Economics

Due to this casing being designed to be manufactured with a single mould and sheet plastic for its back panel, its the most cost effective casing concept. Due to the minimal surface finishing needed for ABS, even more money would be saved in the manufacture of this product.



Mass Fabrication & Quality Control

The main shell of this design is able to be injection moulded from white ABS granules and the back panel cut from ABS plastic sheets - lowering factory setup cost due to the number of custom moulds needed only being one. The sides of the product are then sprayed to apply the accent colour. The aspects of this casing concept that do need to be quality validated are 1: if the back panel slides in and completely covers the internal volume of the case, and 2: the component cut-outs are able to hold the mounted I/O parts.

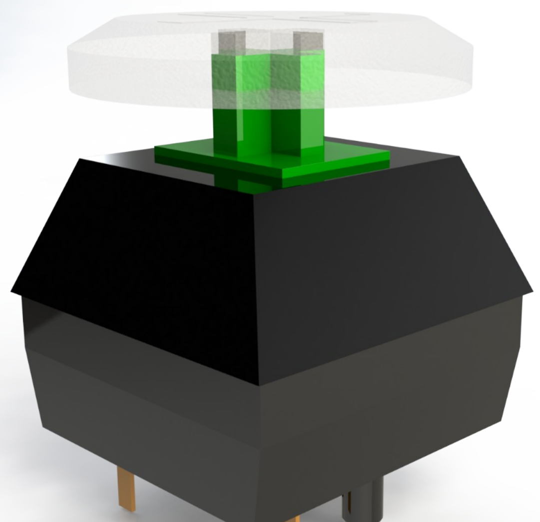


Aesthetics

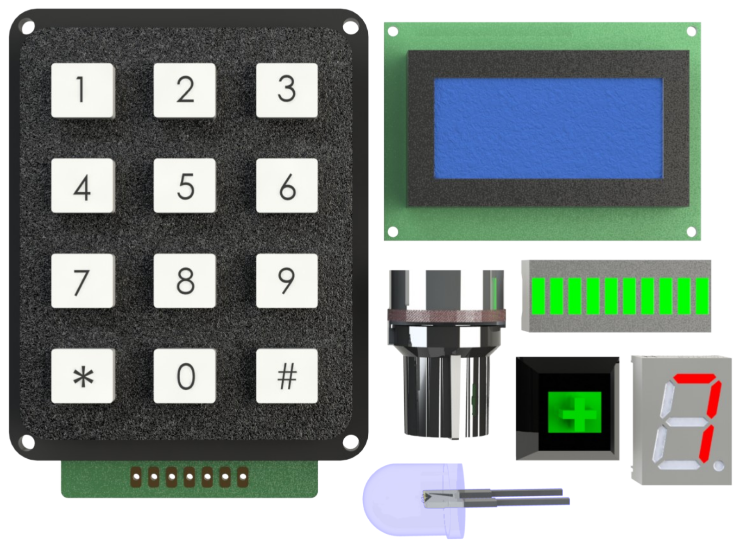
The shape of this casing concept makes it apparent to the user its an information terminal due to the bottom-input and top-output panel design. Two engraved lines run on the output face continuously to the bottom face - these are to visually classify the input on the bottom face with the associated output above it. The colour white is chosen for the majority of the product as to contrast with the input and output components - improving their visibility. FIG 3.5 is met since the minimal shape and aesthetic details of this cashing design makes it look modern and functional.

Anthropometrics & Ergonomics

Since this product is primarily placed on a table, the input panel is more shallowly angled so that it is easily viewed by an operator that is up close to the product. The angle for the information panel however is greater so that it can be seen more easily by users walking by the product. Taking into account the user's hand, the input components are therefore placed below the output components so that the outputs are always visible even if the input parameters are being changed.



**Click on a component here for its GrabCAD source*



Environmental Impact & Sustainability

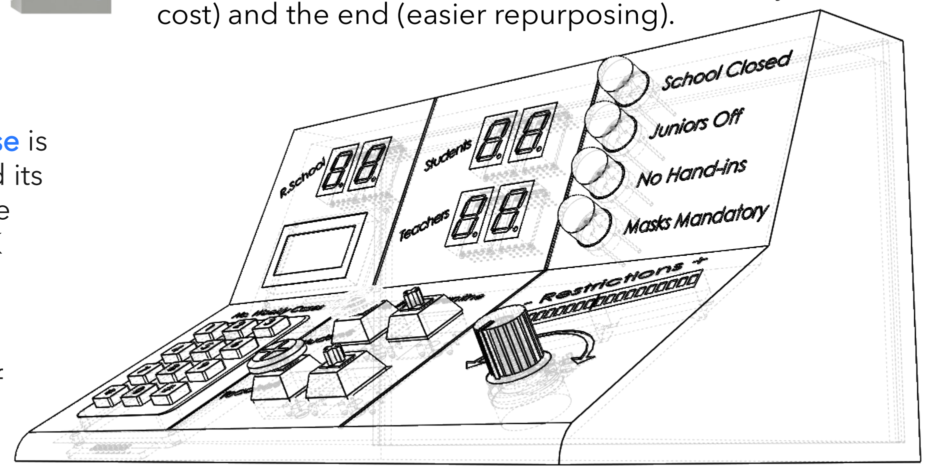
Recyclability of the product is made easy as the case is only made up of 2 components, the main body and its backplate. After separation from the electronics, the ABS is readily recyclable by organisations in the UK and Ireland (FIG 10.1). Since permanent joining methods are not featured in this casing design, disassembly and repurposing of the casing and electronics is made easier for the user at the end of the product's use cycle (FIG 10.4).

Maintenance

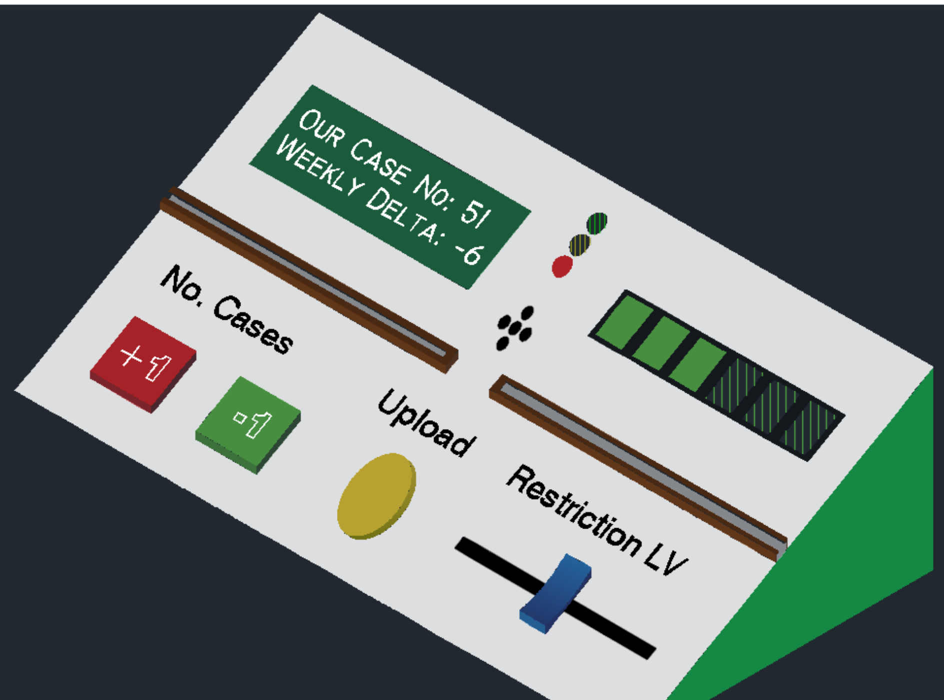
Accessing the electronics of this casing design is also made simple since removing the back panel allows all of the electronic components to be accessed. Not having moving parts and its simple construction reduces the likelihood of maintenance being required for the case.

Summary

Even though this design is the most simple of the casing concepts, its the easiest to manufacture due to its fixed 2 component design and still is able to carry out its purpose of informing people on current information about how the organisation is dealing with the Coronavirus. However compared to the folding design, it does take up a larger volume when stored and transported, however its simpler disassembly and construction benefits the start of a units lifecycle (lower cost) and the end (easier repurposing).

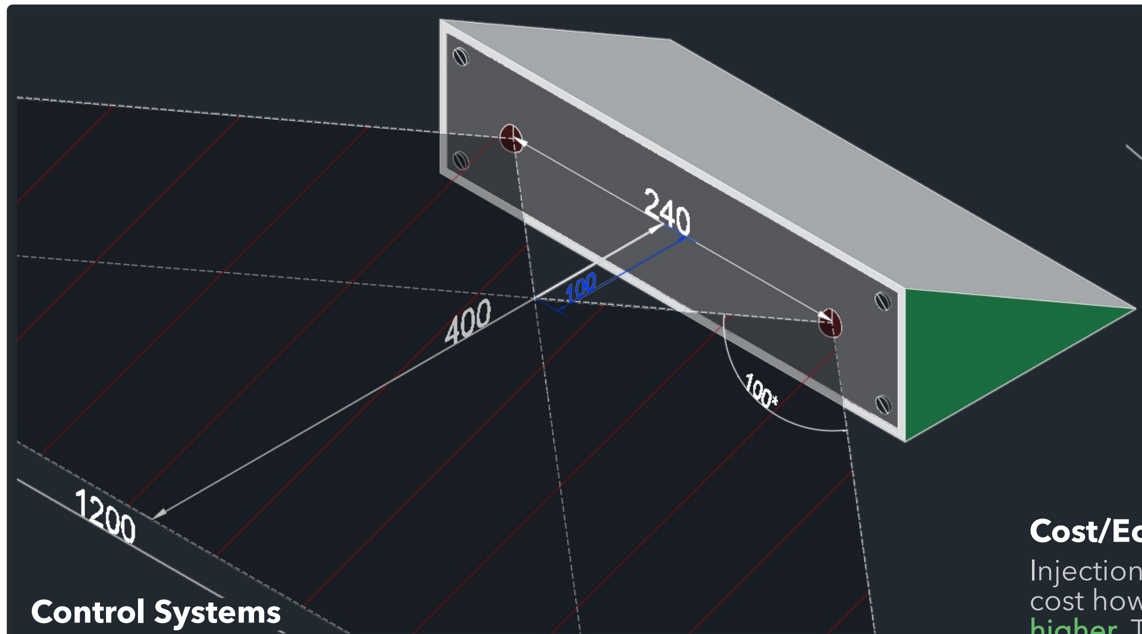


Casing Concept III



Purpose & Function

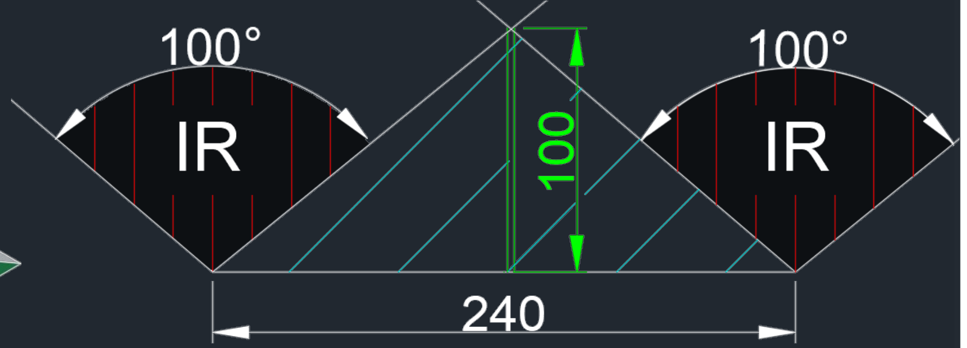
The main purpose of this casing concept is to allow the user to move and distribute multiple information displays around their organisation which highly helps with its ease of access of information (FIG 1.4). This is achieved by having a main control terminal where all the user inputs are, and several information terminals that get their info from it. To synchronise of the information is done via IR communication where the input terminal has IR LEDs and the info terminals have IR receivers. Another design feature of this concept is that the different terminal types are able to attach to each other by use of a rail - reducing storage volume.



Control Systems

To be able to use IR communications, both types of terminals need to have a Genie IC in them - IR LED for the control terminal and IR receiver for the display units respectably. Sending the information to the displays is initiated with a dedicated button. LEDs are used to indicate the status of if the information has been modified. Whenever the information is changed on the input terminal before it is sent, the red LED is active. Blinking yellow indicates IR is being sent and green shows there is no change in information since the last time the IR is active.

The region that the IR light is sent is showcased these 2 images. There is a 24cm separation between two identical (100 degrees) IR LEDs which gives a 1.2m wide area that the IR can be detected 40cm from the terminal. A downside of separating the LEDs is that there is a 10cm dead-zone where no IR is sent directly in front of the control terminal.



Min IR LED separation for a 100mm high IR Deadzone

Cost/Economics

Injection moulding for the majority of the casings helps drive down the cost however compared to the casing ideas, cost of assembly may be higher. This is due to this concept being comprised of multiple different bodies which each need to have their own injection mould, assembly and validation of the electronics.

Summary

Being able to distribute information via multiple display terminals spread around the organisation's building makes this design concept the most effective at meeting FIG 1.2. The use of the rails to attach the control and display terminal helps keep them secure and lowers packaging volume during distribution is also another positive aspect of this casing design however there are negative aspects for it. The main one would be the higher quantity of components needed to assemble the product set which leads towards increased production cost and environmental impact however because of the functionality achieved by this casing design, it is worth exploring and developing further.

Maintenance

Having 2x IR LEDs helps with long term function as the control terminal is still able to work when 1 fails. In that event, the electronics in the casing are able to be replaced in this design however the catching railing on the control terminal is not. This is because it is part of the main body of the product since it is part of the injection mould. Due to this feature not being easily replaceable it has to be manufactured with high durability.

Aesthetics

White is the primary colour for the body of the product for contrast with input/output components. Due to Cherry MX switches having a removable key-cap, large coloured ones can be custom made for this product to improve aesthetics and visibility. Brown is chosen for the colouring of the rail feature of the terminal bodies and this along with how the product is packaged (docked together) indicate to the user that they are able to be attached with one another.

Mass Fabrication & Quality Control

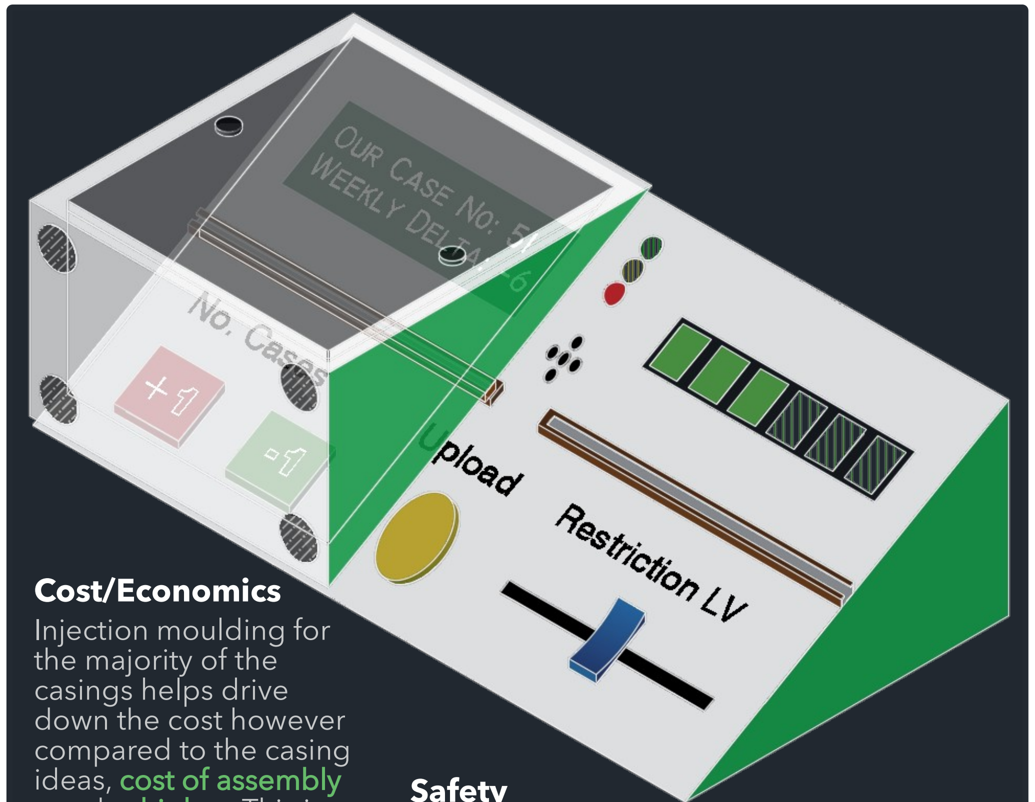
Since polypropylene has a low melt viscosity it is able to fill detailed moulds easily. Because of this a proposed manufacturing method for mass fabrication would be injection moulding. Since there are ICs in each terminal, each one needs to be tested to assure they are able to use IR communications reliably

Environmental Impact & Sustainability

Being comprised of polypropylene this concept is able to be widely recycled in the UK/Ireland however due since it being multiple different terminals the environmental impact of this product is higher. This is due to the higher amount of materials and electronic components being used.

Material

Polypropylene is the material considered for this design concept. An advantage that it has over acrylic/ABS is that it has a lower density (≈0.9g/cm³ compared to >1.0g/cm³ for the other materials). This lowers the weight of the casing making it more easier to move around - especially important for the display units. Its friction coefficient is low which makes it suitable for being the material for the docking rails.



Cost/Economics

Injection moulding for the majority of the casings helps drive down the cost however compared to the casing ideas, cost of assembly may be higher. This is due to this concept being comprised of multiple different bodies which each need to have their own injection mould, assembled and tested individually and together.

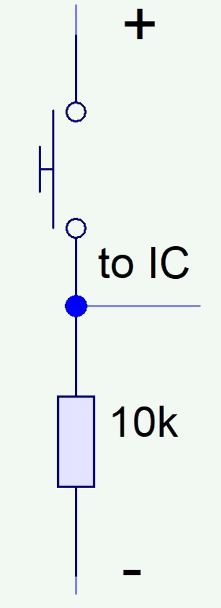
Safety

Circular rubber stubs are present on the bottom of the terminals to increase the friction with a surface - making them more stable and less likely to fall over. A small speaker cut-out is present on the centre of the control terminal which ensures the speaker that reminds the user to sanitise the product after use is audible.

Circuit Concepts I

These concept systems are for me to *experiment and see the suitability of certain components* for my product's control system. The first purpose of the first circuit concept is to do a numerical countdown that both flashes a bi-colour LED and a buzzer where its intended function is to remind the user to clean the product after they have used it (*FIG 6.3* under Safety).

Input

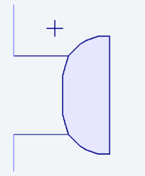


Push To Make Switch The input choice for this circuit idea are push to make switch. Its a substitute for any other inputs will consider to use the final circuit.

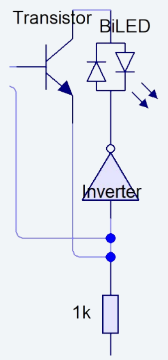
How it works is shown in the circuit symbol. Pressing the switch connects both contacts allowing current to flow. A high resistance *pull down resistor* is used in conjunction since it ensures that the current flows to the lower resistance rail to the IC.

Below are images of PTM switches. The left is a typical project switch and the right is a blue mechanical keyboard switch. I'm considering designing my product with keyboard switches since they come in a variety of input pressures, tactility and click sound variants (blue has a clicky sound and a tactile bump).

Output



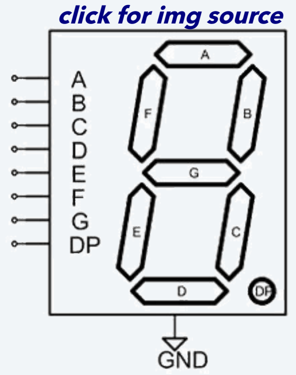
Buzzer I may use a buzzer in my project since it is able to catch the user's attention, reminding them to clean the product (*FIG 6.4).* A rapidly pulsing current attracts a thin diaphragm which then goes back into place. This movement creates the buzzing sound.



Bi Colour LED To be able to control all three states of this LED the circuit shown on the left is needed. The power to the transistor turns the component on/off and current to the inverter switches the colour profile.

This LED is able to flash 2 different colours at the user with only a single component – now there's visual and auditory stimulus for (*FIG 6.4) – sanitation reminder.*

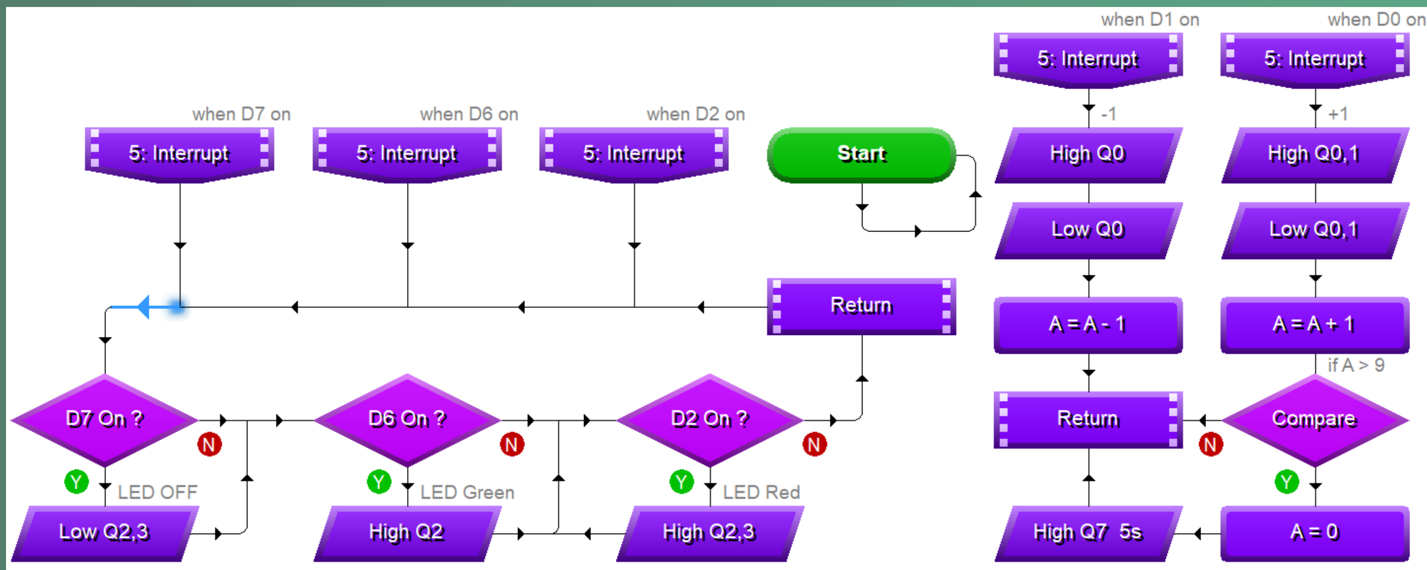
click for img source



7 Segment Display 2x 7 segment displays in series can display a maximum people in quarantine statistic of up to 99 people (*FIG 1.2 + 2.4*)

Mini LEDs correspond to each letter on the shown pinout. The 4511 automatically encodes data to match the pins so a number is displayed.

Programming

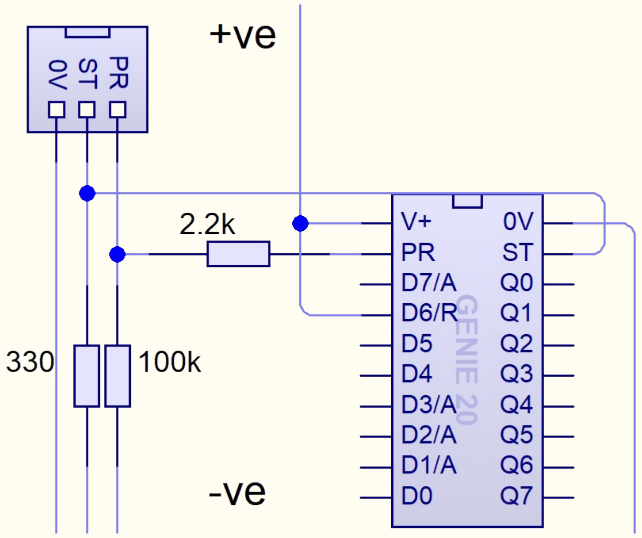


This flowchart makes frequent use of the **interrupt function**. This allows me to spread each individual function of the flowchart more clearly and it allows the circuit to **instantly respond to any input** (even bypassing wait commands).

The **left section controls the Bi-Colour LED**, if any of the 3 switches are pressed it enters this section then goes down to do 1 of the 3 output functions as labelled above.

The **right part controls** the pulses sent to the 4510 IC, which then controls a 4511 which finally drives the **7 segment display**. The +1 branch sets the U/D pin high and sends a pulse which makes the 4510 add 1 to its register and to the Genie's as well. If A>9 (max on one 7SD) it resets the genie's counter to 0 to match the 7SD and then turns on the buzzer. The -1 branch does not send a high signal to the U/D pin before a pulse so then the 4510 -1 from its register and so the 7SD's value drops by one.

Control ICs



Genie 20 Mandatory pins shown above.

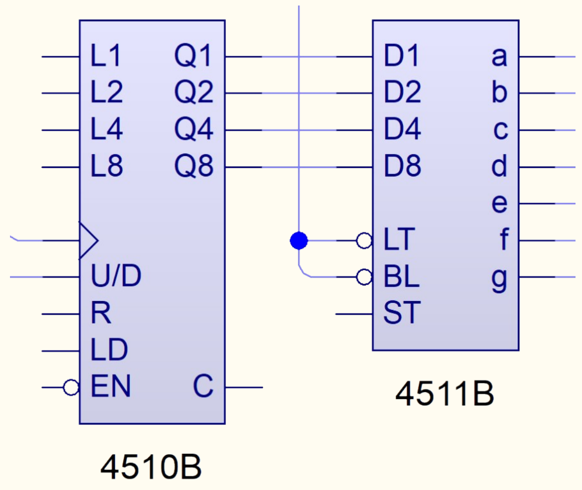
- A download 3.5mm jack socket to programming input + status pin allows the IC to be programmed from a desktop.
- V+ and 0v for power supply
- Reset needs to be connected

On this Genie SKU, there is 4x D-in pins and 4x of them are Analogue-in OR D-in. There is 8x digital outputs. I will consider variations with more or less pins for the final circuit however this model has enough for this concept circuit.

For the main IC this a programmable chip (*FIG 2.1)* This is to fully control all other ICs and input and output components so they work together to fulfil the function of my product. (FIG 1.1+1.4)

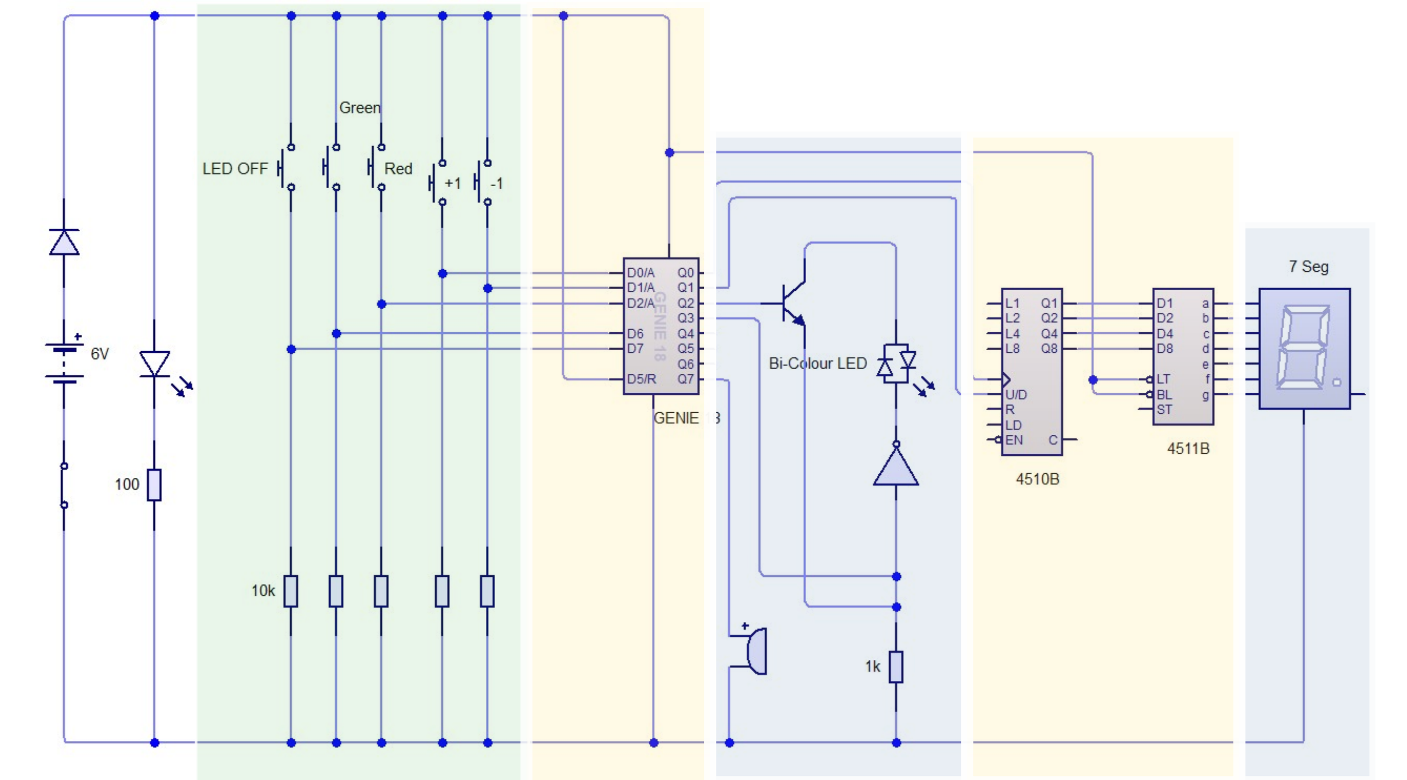
It also able to store data even after the device is off (*FIG 2.2*) which allows the user to see previous information from when the product is used.

(*FIG 2.4*) on 7 segment displays is met with the ICs on the right. Compared to connected a 7SD to a genie directly which uses 7x output pins, only 2 pins are needed to be connected to the 4510 (Pulse, Up/Down). This saves on the number of genie output pins needed to drive a 7SD.



4510B Counts pulses sends a 4bit output
- L pins allow a 4bit (up to 16) number to be initially loaded
- Clock (triangle) pin senses a pulse
- U/D pin does +1 on a pulse if high and -1 if pin is low
- Q pins are 4bit digital outputs, connects to a 4511B's 4bit digital input pins.

4511B 4bit inputs to 7 segment signals
- Lamp Test and Blanking pins need to be set high, or they turn on/off all output pins
- Letter pins match up to a 7 segment display's letter pins to display a number.



Full Circuit Conclusion

After understanding and using these components in this concept circuit, there are some I will consider using in the final one. The **buzzer is very easy** to wire up/program since only 1 function box and input is needed to make it work and the **4510+4511** makes driving a 7 segment display easier since it can **save on the genie's output pins** and it automatically encodes numbers to outputs that match a 7SD's pins.

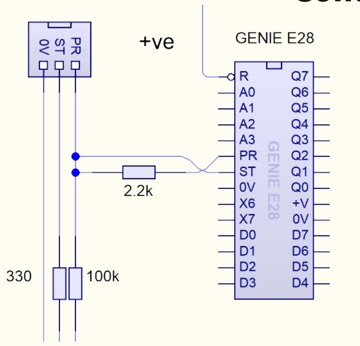
I will not however want to continue using a bi-colour led, since its extra function of 2 different colours is much more easily accomplished by just having 2 discrete monochrome LEDs instead. This is because a **transistor and inverter are needed as extra components** to make this LED work.

I may use the 451x + 7SD to display statistics in the final circuit, and the buzzer for a sanitation reminder.

Circuit Concepts II

The idea behind this circuit is to test the suitability of using an *IR communications* system to *share information between 2 Genie ICs* in the case that a *single Genie does not have enough IO pins* for my use. This may help the project to meet the requirements of the specification since even single components such as a keypads (Fig 2.3) take up as many as 7 input/output pins.

Control IC



Genie v2 ICs

Programming	
Memory	**10K bytes**
Variables	**26 (A-Z)**
Data memory	**256 bytes**
EEPROM locations	**16 bytes**
Start limit	**16**
Subroutine limit	**No limit**
Call stack limit	**32**

Genie v1 ICs

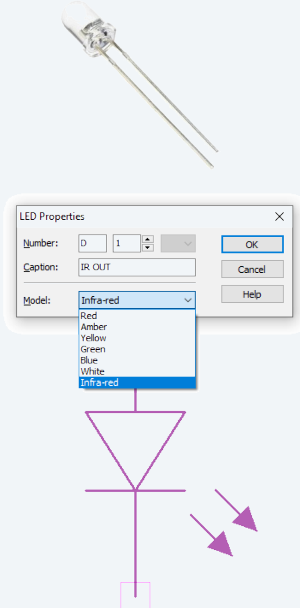
Programming	
Memory	**3.2K bytes**
Variables	**10 (A-J)**
EEPROM locations	**16 bytes**
Start limit	**4**
Subroutine limit	**No limit**
Call stack limit	**32**

Genie E28 Mandatory pins same as the Genie 20

The G20 has [4x D/A-In + 4x D-in + 8 D-out] but the E28 has 4 more input/output pins [4x A-in + 8x D-in + 8x D-out]. The discrete analogue input pins instead of being integrated into 4 digital input pins is what brings in the increase in pin count - useful especially if I incorporate analogue inputs in my final circuit.

However it is part of the v1 series (G20 is a v2 series IC). The lowered variable count is a disadvantage if I were to make a program that required a large number of variables.

Output

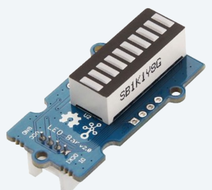


IR LED This is wired up similarly to a regular LED however to be able to send data with it however the program command for it is different. The "irout" command is able to encode variables into light pulses (in a 12 bit format modulated at 38kHz according to the circuit wizard manual), which are meant to be read by an IR receiver.

(*FIG 2.3+2.4*) where various input/output component are required can be assisted with this wireless IR communication exchanging information between 2 ICs in the instance a single Genie IC does not have enough IO pins.

Liquid Crystal Display

These displays are the most easily used (*FIG 1.2*) and convey information clearly. The downside however is that they are more expensive to purchase in comparison to other components - limiting their use is needed to keep costs down.



Bargraph Display

This display type functions as a bundle of small individual LEDs. This is useful for showing if a variable has reached its max/min (e.g., the current level of restrictions in place.

Programming

```
    ` Left IC
start
        do

A = A0
A = A/3
wait 0.1

lcd 0, "[A]"
lcd 0, "[move 0 0]"

if A0 <> A

    irout A,0,1

endif

        loop
    ` Right IC
start
        do

irin B,0,0
lcd 7, "[B]"
lcd 7, "[move 0 0]"


if b < 30
    low 0,1,2,3

    elseif b > 30 and b < 45
    low 1,2,3
    switch on 0

    elseif b > 45 and b < 55
    low 2,3
    switch on 0,1

    elseif b > 55 and b < 67
    low 3
    switch on 0,1,2

    elseif b > 67
    switch on 0,1,2,3
end if

      loop
```

For these circuits and the ones I will use moving forward, I will use *BASIC* (*FIG 2.6*) for the programming instead of flowcharts. Even though it is not as visual as a flowchart program, you can still follow the program's logic line by line

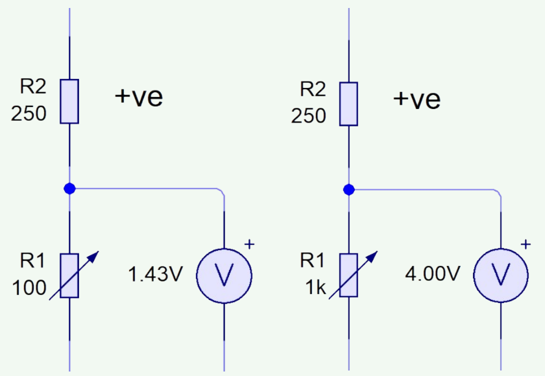
This is because after learning the coding syntax, I find it easier and quicker to write programs since there is **no need to find boxes, then drag them around and then input parameters** into them. In BASIC they are just typed out which is a **significant time saver** especially when doing numerical operations such as a = a + 1.

Since this is a dual programmable IC circuit, two separate programs for each IC are needed as shown in the image. The left circuit is the one with the **variable resistor** as its input and stores the **analogue value as variable A**. It sends an **IR output** (sends the value of variable A as light pulses through the IR LED) when it detects that the analogue value does not match the variable A – happens only **when the value of the resistor is changed**.

The right circuit detects the digital IR signal and then displays this transmitted value of A with 2 different components. First is displaying the **variable's value on an LCD**. The other is to send varying numbers of inputs to the bargraph display where the bar is **fully filled** when the **potential divider circuit** reaches its **maximum output voltage**.

Because of the time saved when making a program, using BASIC in the final circuit may allow me to make a more complex program with less bugs within the same time-frame.

Input



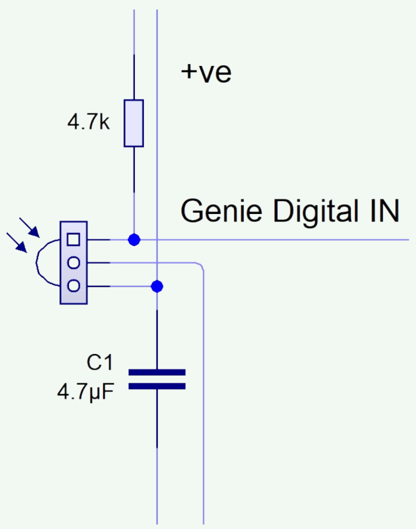
Variable Resistor A variable resistor is used in this concept circuit to provide granular input to the user with only 1 component. To allow the variable resistor to change the voltage reading going into analogue input pin, a potential divider circuit is needed.

Numerical Analysis - *Potential divider*

$$V_{out} = V_{in}\left[\frac{R2}{R1+R2}\right]$$

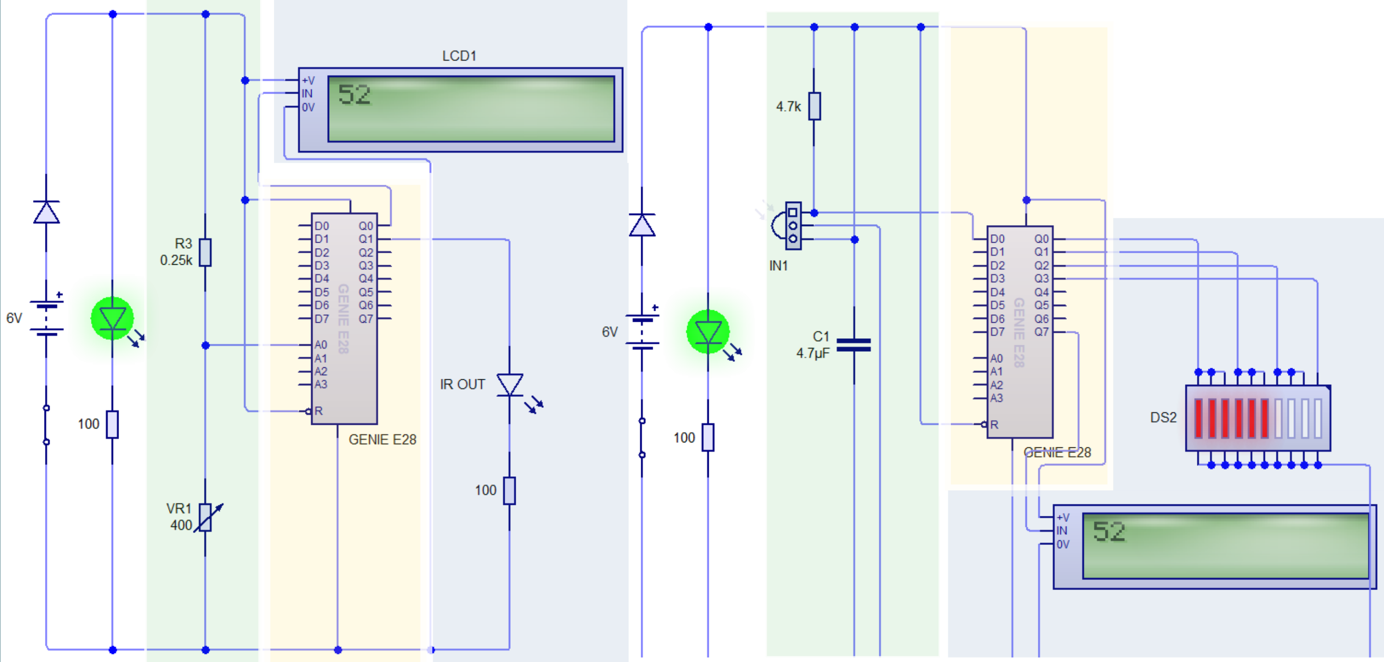
where V_{out} is dependant on the the changing variable R2 where R1 and V_{in} are constant.

Due to the way the equation is set up, V_{out} increases as the resistance R2 increases - so here, R2 is the variable resistor. This works since when the value of R2 goes up, less current passes through ($I^{V}=V/R^{\wedge}$) so more current instead goes down the other junction (the one that goes through the Genie). This changing voltage is then detected as an analogue input.



IR receiver To be able to read IR data sent by the IR LED an IR receiver circuit is required. To get this component working, it is essential for the pin arrangement to match the one on the diagram.

- Top pin (output) is connected to a Genie's digital input pin (this is because the IR signal is encoded and outputted as digital information).
- The middle pin in the ground pin
- Bottom pin is power supply for the receiver. It needs a capacitor between it and ground in order to allow the receiver to function - will not otherwise.



Full Circuit Conclusion

The **Genie E28** can be advantageous in scenarios where I need **4 extra input** pins, however due to its **reduced** programming capability (especially **variable count**), I will be more likely to use Genie v2 ICs. After using **BASIC** for this circuit concept, the **improved speed of writing programs** is the main factor of why I will use it for the final circuit design.

The **LCD and variable resistor** accomplish (*FIG 1.4*) of the specification due to their easily understood function to the user. Them needing only **1 data pin** is also another factor on why I will use these components for my project.

The **bargraph** display is also a good compact information indicator, but because of the **number of output pins** needed to use it, I am hesitant to use it in the final circuit. **IR** communications is a useful tool, but I still need to decide if **sharing data** between 2 different Genie ICs **is necessary** or just make them stand-alone and have them only use data from their own inputs.

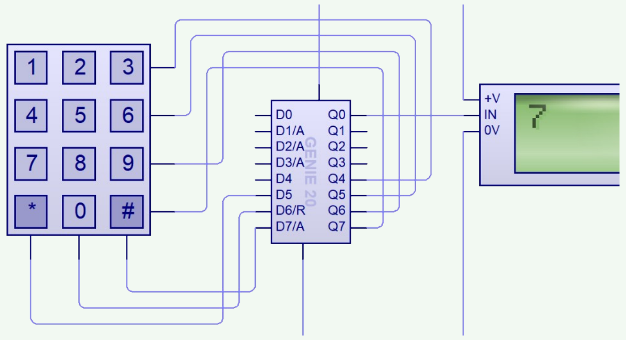
Circuit Concepts III

This last set of circuit concepts are looking at each component in its own ***discrete circuit***. This is because components such as the keypad and 5x7 matrix display are most suitable being in their own circuits due to the large number of pins required to control them with a Genie.

In the case I do use these ***pin intensive components***, I explored the properties of smaller Genie ICs for use in their own circuit.

Keypad

```
start
            do
lcd 0, "[A]"
lcd 0, "[move 0 0]"

high 4
    if input 5 = 1
    A = 1
    elseif input 6 = 1
    A=2
    elseif input 7=1
    A=3
endif
low 4

high 5
    if input 5=1
    A=4
    elseif input 6=1
    A=5
    elseif input 7=1
    A=6
endif
low 5

high 6
    if input 5=1
    A=7
    elseif input 6=1
    A=8
    elseif input 7=1
    A=9
endif
low 6

high 7
    if input 6=1
    A=0
endif
low 7
          loop
```

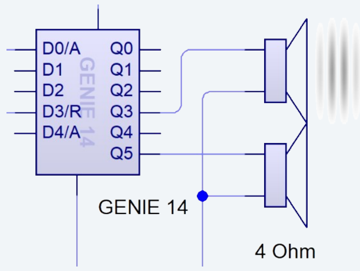


Having a keypad as part of the statistics terminal is the move intuitive numerical input method for users - meeting (*FIG 1.1*) of the specification.

The way it works is on a row by row basis. 1 row is powered by the Genie, then if any buttons in that powered row are detected, that column input is sent to the Genie. The column+row value determines what button on the pad was pressed. The row is set to low and the next row is powered.

The code to make it work is quite lengthy however it should be able to be shorted if I use the "table" function in BASIC.

Speakers




```
start
          do

if a0 >200
tune stereo 3, 5, "Despacito 2.mid"
end if

          loop
```

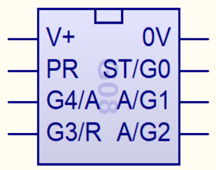
Compared to a buzzer, a speaker is more expensive however it is able to make more exact sounds – useful for making sounds (e.g. an alarm noise) such as reminding users to be cautious if $R_0 > 1$ (*FIG 1.3*).

For the more complex midi files to be played, a Genie 14, 18 or 20 is necessary (in the Genie v2 series) and the required sound file has to be initially be on the programming desktop first.

In the programming, it can be specified if the sound is mono or stereo – in the second case 2 speakers need to be wired up for the effect to work. LEDs can also be controlled under the same function where they will flash matching the current amplitude of the sound file.

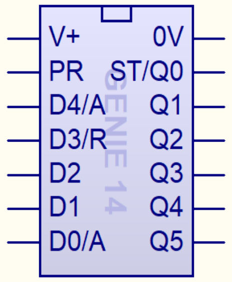
Small Genie ICs

GENIE 08



Programming	
Memory	**1K bytes**
Variables	**26 (A-Z)**
Data memory	**16 bytes**
EEPROM locations	**16 bytes**
Start limit	**2**
Subroutine limit	**No limit**
Call stack limit	**16**

GENIE 14



Programming	
Memory	**10K bytes**
Variables	**26 (A-Z)**
Data memory	**256 bytes**
EEPROM locations	**16 bytes**
Start limit	**16**
Subroutine limit	**No limit**
Call stack limit	**32**

Genie 08 *Mandatory pins same as bigger Genies.*

This Genie IC primarily uses multi-purpose pins – 3x Analogue-in/D-in/D-out pins and 1x D-in/out pin. It also has reduced programming capability with lower max program sizes.

These would be useful controlling a small discrete circuit with little input/output components due to its lower cost and PCB footprint.

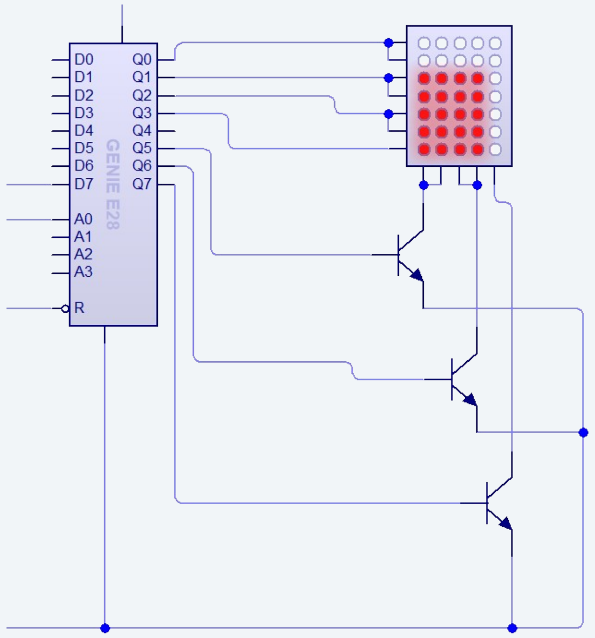
Genie 14 *Mandatory pins same as bigger Genies.*

This has more discrete function pins than the 08, allowing more components to be connected simultaneously to the IC (3x D-in, 2x D-in/A-in, 6x D-out). It also has the same programming specs as the other large ICs in the v2 series and it is also able to play midi files when paired with a loudspeaker output.

Because of the increased number of discrete output pins, I am more likely to use it to control a separate circuit with a keypad and LCD output.

5x7 Matrix Display

```
start
          do

    if A0 < 100
    low 0,1,2,3,4,5,6,7

    elseif A0 > 100 and A0 < 145
    low 0,1,2,4,6,7
    high 3,5

    elseif A0 > 145 and A0 < 175
    low 0,1,4,6,7
    high 3,5,2

    elseif A0 > 175 and A0 < 200
    low 0,4,7
    high 3,5,2,1,6

    elseif a0 >200
    high 0,1,2,3,4,5,6,7

    endif

            loop
```

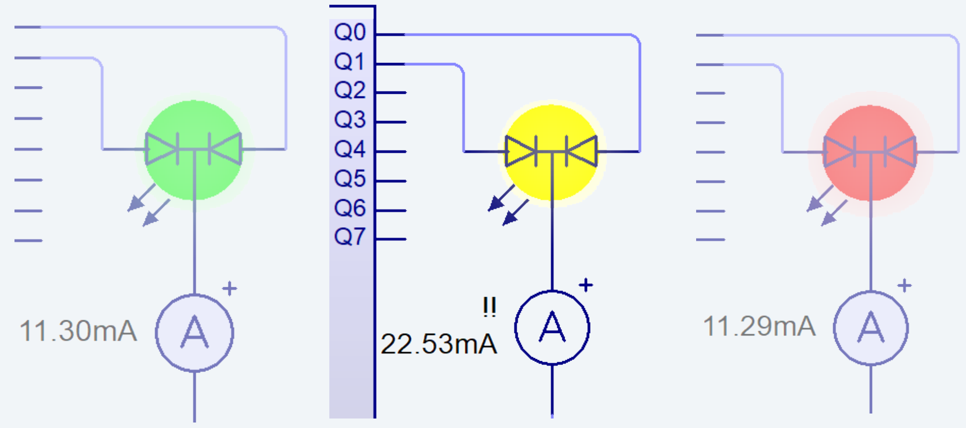


Matrix displays function similarly to bargraph displays – working due to a bundle of small individual LEDs in the package. The benefit this type of display has over a bargraph is that it is also able to display information in both rows and columns.

The extra pins needed to fully control a matrix display is its negative aspect – shown on the image above. It also needs output pins controlling the transistors if both row and column control is needed. Its increased cost over a bargraph display is also another downside.

Having both row and column control allows this display type to showcase simple variable over time graphs – in my case, it could be able to display the current day's increase of the number of people in quarantine compared to the past 4 days. This is able to contribute towards (*FIG 1.2*) on presenting information clearly however due to its extra pin requirements, it is likely to consume an entire genie's 8x output pin on its own.

Tricolour LED



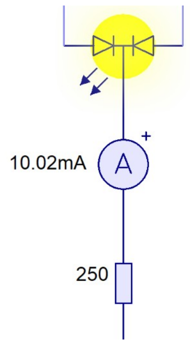

```
start
          do

if A0 < 145
    low 0,1

    elseif A0 > 145 and A0 < 175
    high 0
    low 1

    elseif A0 > 175 and A0 < 200
    high 1
    high 0

    elseif a0 >200
    high 1
    low 0
endif

            loop
```

Compared to a Bi-Colour LED, Tricolour LEDs are significantly easier to control and connect to a circuit – no inverter and transistor required to control its states.

The centre colour is achieved by combining and mixing the colour of both input LEDs, resulting in a doubling of current.

I will use this type of LED since it is able to output 3 different colours in the space of 1 LED, such as to signal the level of distancing restrictions in place.

Numerical Analysis – *LED Over-Current Protection*



$$Resistance = \frac{Voltage}{Current} \qquad \frac{2.5\,V}{0.01\,A} = 250\,\Omega$$

Due to the doubling of current when the combined colour is turned on exceeding the safe 20mA value for 5mm LEDs, a resistor needs to be put in place.

To lower it to a safer current that will allow the LED to run longer and less hot, a 250 ohm resistor is added to the end of the LED as shown in the equation.

Conclusion

The component that I will certainly use after testing them in concept circuits is the Tricolour LED. It is much easier to wire up to a bi-colour LED and it allows me to output **3 different colours in the space of a mono colour LED**. The keypad is also another component I am intending to use – mostly due to it being an **intuitive numerical input**.

The speakers being able to make a wide variety of sounds allows it to play **more roles than a buzzer** – e.g. make an alarm noise if the R number is too high or play a beeping noise to remind users to sanitise the device. I will use the Genie 14 if I decide it is better to use it to control its **own input/output components** rather than just connecting those components to a **large E28 IC** instead.

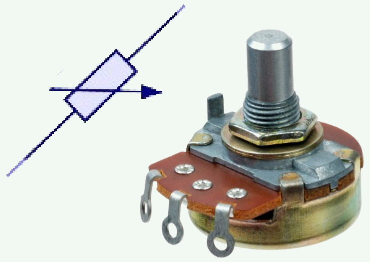
The matrix display, because of its **large pin requirements** is a part that I am unlikely to use in the final circuit, since the less pin intensive bargraph display is able to do most of its functions instead.

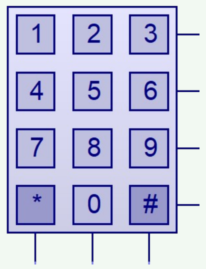
Shortlisted Component Choice

Due to their *ease of implementation* and suitability of *meeting the (FIG 2) specification criteria*, these are the electronic components I am most likely to use in the final control system design.

I am also going to detail in this page on the process of how I will develop these individual components/circuits into something more suitable for use in my final circuit.

Inputs





Push To Make Switch Instead of using small switches, I will develop my project's casing around mechanical keyboard switches.

Also having key-caps, they can have information printed on them (improving ease of use under *FIG 1.4*).

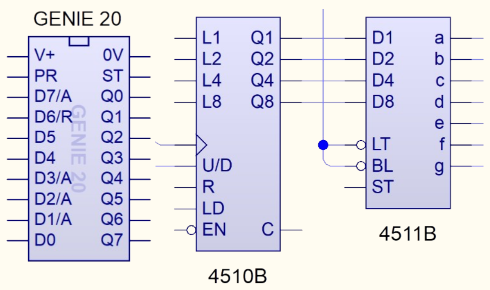
Variable Resistor This component allowing giving the user granular control with only 1 part is why I will use it in the final circuit.

I will implement this is with a bargraph display to highlight the severity level of social distancing measures put in place (*FIG 1.5* on giving a quick overview to users).

Keypad I will use it to allow the user to input the number of confirmed infected persons in a day.

By further learning other BASIC commands such as the table function, I will be able to make the programming for this component shorter and more logical.

IC Choices

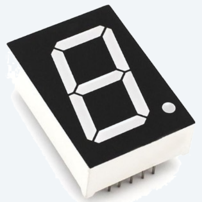


Genie 20 I value this IC's high pin count and full programming capability. Instead of making multiple circuits with smaller or larger genies, I will just use multiple G20s and fully use up all of their pins.

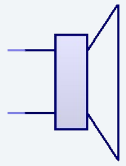
Also in the final circuit, I will make use of the *READ and WRITE* commands to store the user's data in the permanent EEPROM memory (*FIG 2.2*).

4510B + 4511B I will use these ICs to control 7 segment displays since they lower the programming effort needed to increase/ decrease numbers in increments of 1- helps simplify the code I will write to allow the user to change how many people I their organisation are in quarantine.

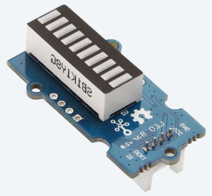
Outputs



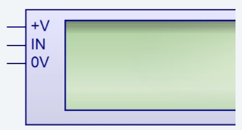
7 Segment Display To further develop the concept circuit's 7SD implementation, I will use pairs of 7SD displays along with pairs of 451x ICs to display numbers up to 99. Suitable for medium sized organisations since having >99 people in quarantine on working days is unlikely



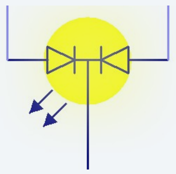
Speaker Giving users audio feedback further increases the interaction with the user. The flexibility of making different noises in comparison to a buzzer is why I will implement speakers when I develop speakers the final circuit



Bargraph Display These excel on showcasing maximum/minimum information – will be used, together with tricolour LEDs either the severity of coronavirus cases in the organisation, or fully lighting the display when the maximum level of restrictions are put in place.



LCD Although costly, these are able to display the most complex information. In the final program, I will also use these to even give the user instructions on how to use the product when the device is turned on.

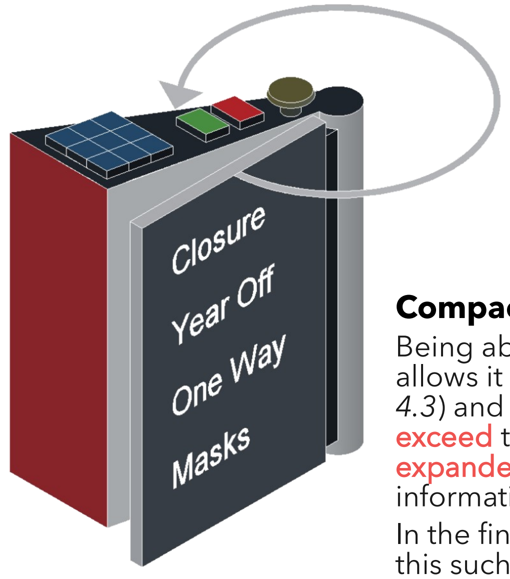


Tricolour LED This part has higher functionality than other LEDs and also easy to implement. I will use this display *stop-light-colours* which would be able to give a instant overview of the situation to onlookers (*FIG 1.5*).

Casing Features of Interest

The casing features in this page are chosen due to a myriad of factors. Ideas that increase the visibility of information in the statistics terminal is one of them which was explored in different ways such as making the information display unit discrete from the input terminal.

As such, I will continue to *develop a final casing design* with these features as a starting point to aim for the *best balance* of functionality, manufacturing ease and cost in the finished model.



Acrylic Display

Using acrylic as the material to showcase restriction information is primarily due to it being available in transparent/translucent forms. This allows customisable information to be engraved onto the display as required by the organisation and then its visibility increased when illuminated by coloured LEDs.

Compactable Design

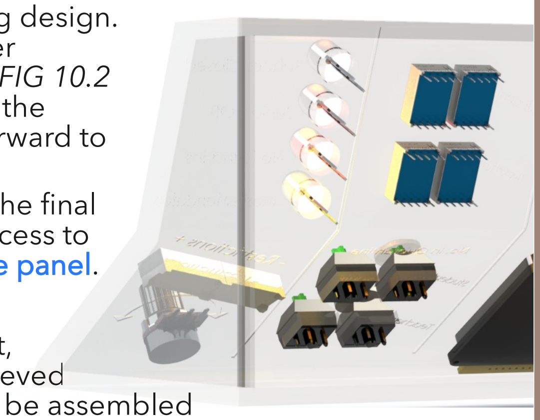
Being able to compact the product into a smaller volume allows it to be moved around more easily by the user (*FIG 4.3*) and during transport. It also allows the product to exceed the specified specification dimensions when expanded which can increase the area and visibility of the information displayed.

In the final design, I will consider several ways to achieve this such as continuing with a foldable or collapsible design.

Component Accessibility

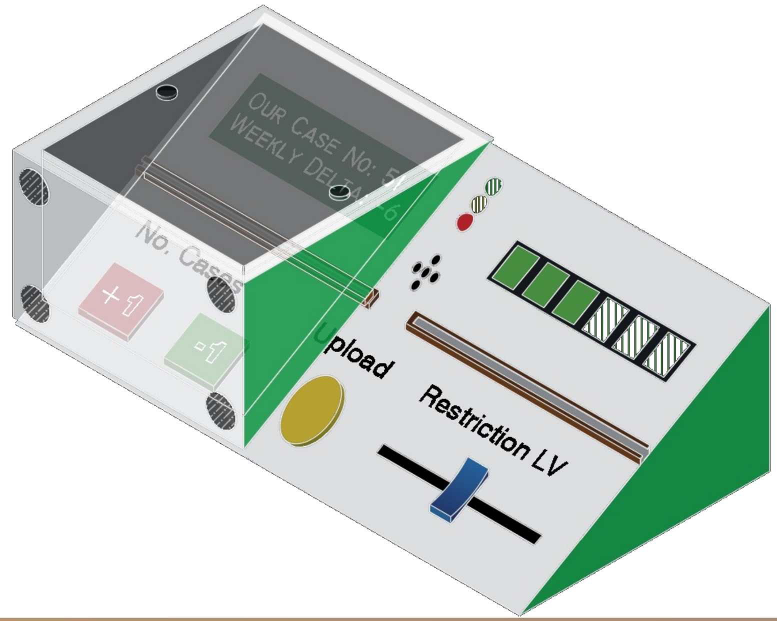
Designing with access to the electronics in mind is a strong consideration for the final casing design. This would not only cover *FIG 9.3* for user repairability/model workability, but also *FIG 10.2* where it would allow the repurposing of the electronic components to be straight forward to the end user.

Ways to incorporate this feature in the final design would be allowing user access to the electronics behind a removable panel.



Manufacturing Ease

As shown in the casing concept on the left, lowering the manufacturing cost can be achieved by reducing the amount of bodies that need to be assembled together (a single injection mould can be used). In the final casing, I will also design with manufacturing methods in mind such as using simple geometry to allow cut sheet plastic to be used in the construction of the casing.



Information Visibility

An important design consideration especially for a statistics terminal is the visibility of the information showcased.

This was best achieved by the 3rd casing concept due to its ability to detach multiple information displays and distribute them in multiple areas to present that data to as much people as possible.

One approach I could take for the final casing is to make it as cost effective as possible, that way the end users will be able to purchase multiple units and enter their data on them manually.

Rails

Having this design feature implemented in the final casing will be useful for its storability since if its designed with multiple detachable components, they can be secured together as a single unit.