Enhanced Design Tools Assignment: Report

Overview

This strategy report is an insight into the development of the “Tardis Pencil Sharpener”. The project took six weeks from the brief to the completion of the prototype and the tools and techniques will be included in the report. While the sharpener is fun and quirky, the current design is not entirely feasible due to the use of multiple battery packs; one for the sharpener and one for the lights. The constant removal of the AAA battery pack for the neopixel to completely disconnect power is a cumbersome task.

There is also the inability to safely transport the prototype while the hot gluing of the sharpener at the top could eventually wear out. A possible future suggestion would be to connect the sharpener, the neopixel and the addition of speakers so that when a pencil is being sharpened, the lights and sounds work in conjunction. Due to time and skill restraints, the current prototype does not cover this. However, it does demonstrate the potential for all the electronics to be connected.

The Brief

The original idea for the TARDIS pencil sharpener was derived from my affinity for Doctor Who, and the difficulty of the project itself required me to hone my skills learned in class. The particular skills required were: laser cutting, 3D printing, and the BBC Micro-Bit. The product was intended purely as an aesthetic piece, with no expected commercial value.

The reason for selecting wood as the base material for laser cutting, is due to the TARDIS in the TV show Doctor Who was also made of wood; thus creating mine in a similar material, would make it more authentic. Wood is also a biodegradable product, which made it suitable from an environmental standpoint. The 'console' element of the project was 3D printed due to the high degree of detail in the piece, and the selected printing material was Polylactic Acid (PLA), a biodegradable “vegetable-based plastic material, which commonly uses cornstarch as a raw material” (Sculpteo, n.d). Sustainability was a core concern in these decisions.

A Micro-Bit processor was used to power the electronic component of the project, to test and demonstrate programming capability – a core requirement of the modern design skill-set in the digital age. The source code was kept relatively simple, making use of basic logical expressions such as “if” statements, commonly used across all programming languages.

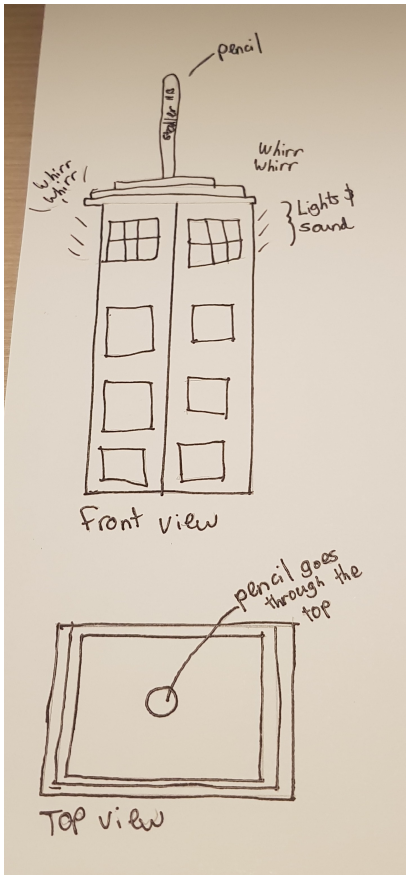
Planning Stage

This stage was about gathering the materials and forming a strategy for the entire project. So, the first step of building the TARDIS was selecting the required materials.

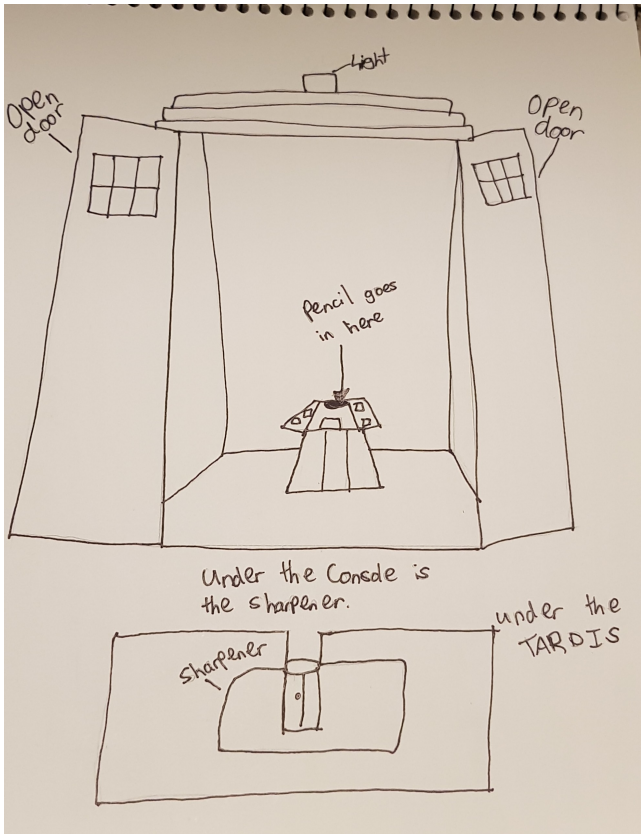
Materials:

- Cardboard
- 4mm plywood (around 3 planks)
- Sandpaper
- Blue paint
- Hinges
- Battery operated sharpener
- Neopixel
- Button
- Wires
- BBC Micro-bit
- 2x battery packs = 1xAA and 1xAAA
- Baking paper

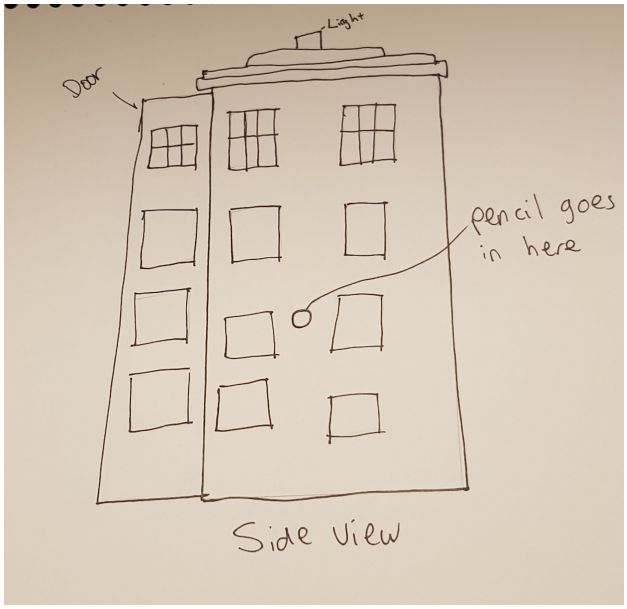
Some sketches of what the final product could look like:



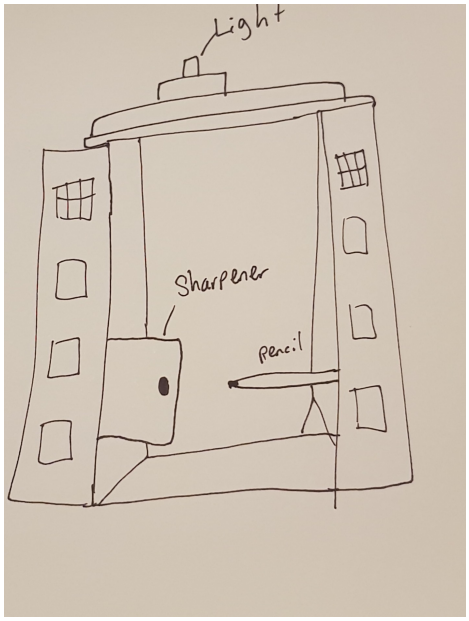
First Sketch



Second Sketch



Third Sketch - Part 1



Third Sketch - Part 2

Laser Cutting

The laser cutter is a tool that cuts and etches certain materials based upon an image. This laser cutter can cut wood, acrylic and cardboard; these options needed to be taken into consideration with the prototype. The selected material was 4mm plywood, as it is easy to cut, etch, and paint.

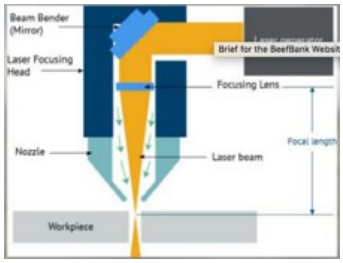


Image: Laser Diagram. Bardini, P (2018)

The cutter required an Adobe Illustrator (AI) document to be provided with the given constraints:

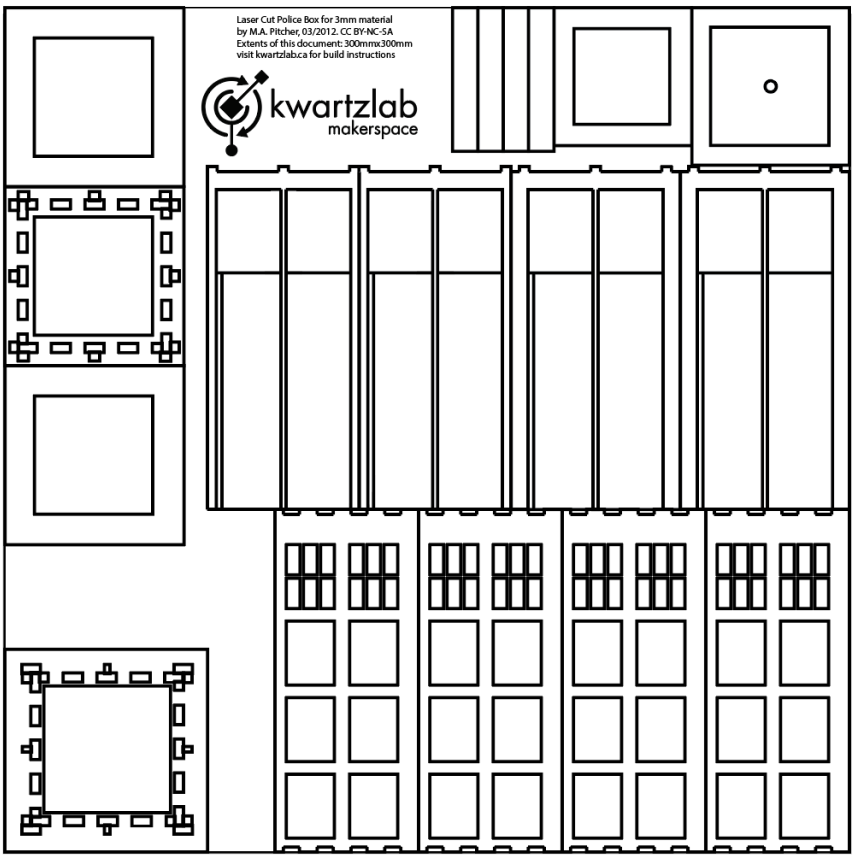
- colours to be saved with an RGB (Red, Green, Blue) profile
- parts to be cut marked with red lines (0.01pt thickness)
- etchings indicated with black lines (variable width as required)

The following is a sample of etching and cutting. The dragon on the left had a black etching of 0.01pt which made it difficult to see. The dragon on the right has a black etching of 1.0pt which can be clearly seen. This test proved invaluable for determining the ideal width of the etchings to be used in the TARDIS.

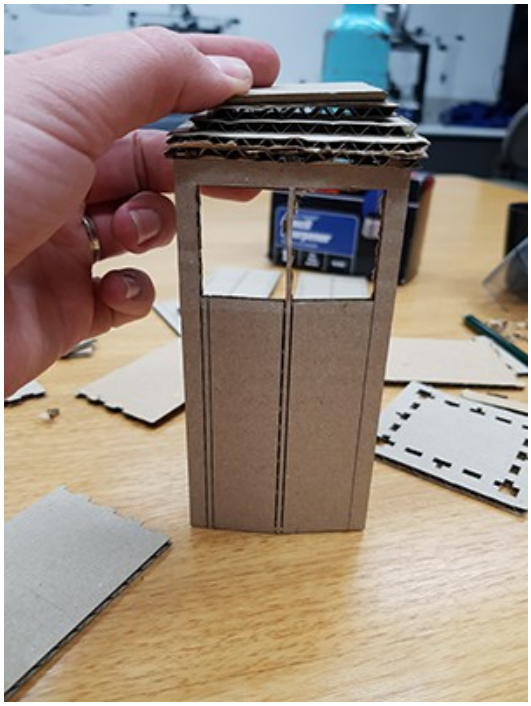
Dragon with 0.01 black etching

Dragon Two with 1.0 black etching

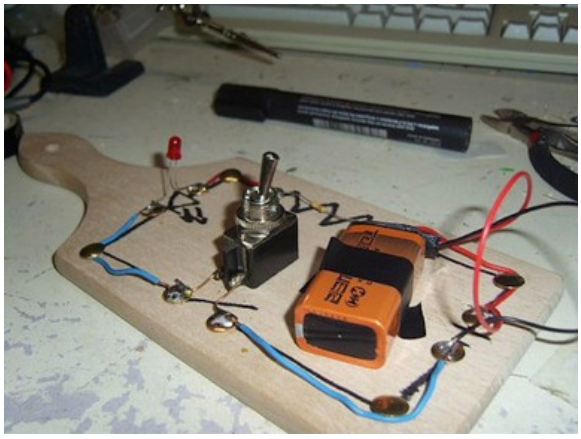
To schematics for the TARDIS were taken from the Thingiverse website (open sourced by the artist, Markp). This was a time-saving measure to ensure the final product could be delivered on time, without the additional overhead of determining the correct measurements from scratch. Below is the downloaded file to be cut with cardboard.



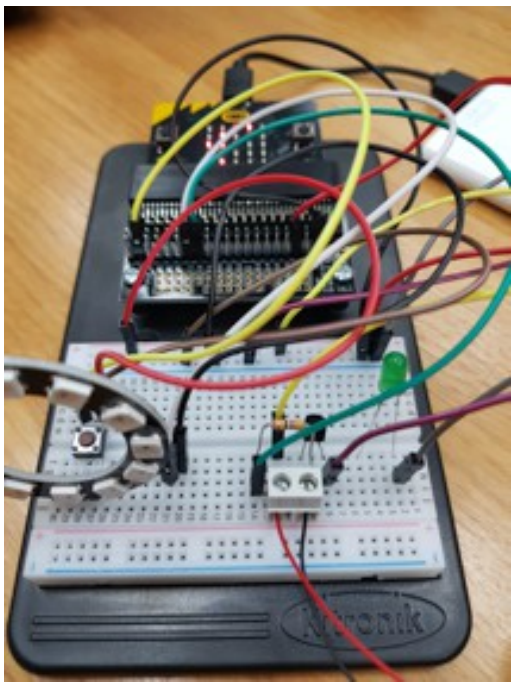
The box component was first tested with cardboard to identify any issues before attempting a cut with more expensive materials. The prior sketches used in the report provided valuable experience in finding a well designed schematic for the box, and with additional resources and time, a purely custom design would be entirely feasible.



During the testing, it was determined that the schematics were far too small for what was need. It was briefly considered that the breadboard would have to be used inside the TARDIS (it was later discovered that this was not the case), and therefore the TARDIS would need to be bigger. As an aside, the term “breadboard” was found to have a fascinating origin; the first wave of tech enthusiasts would commonly use actual cutting boards for loaves of bread as a platform for nailing down the wiring and electronic components (much larger at the time).



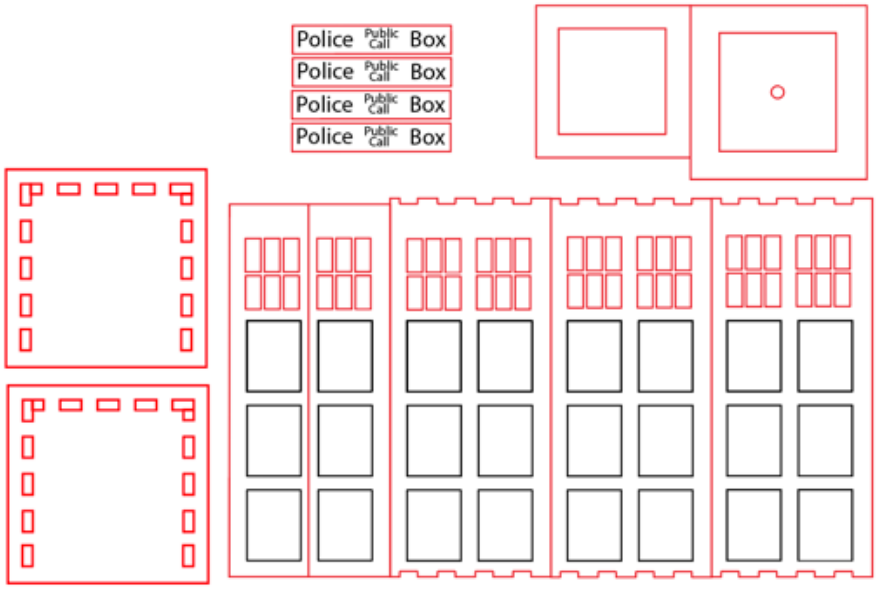
The original breadboard by Mischka



The modern breadboard with wiring to prototype lights, a button, and a neopixel.

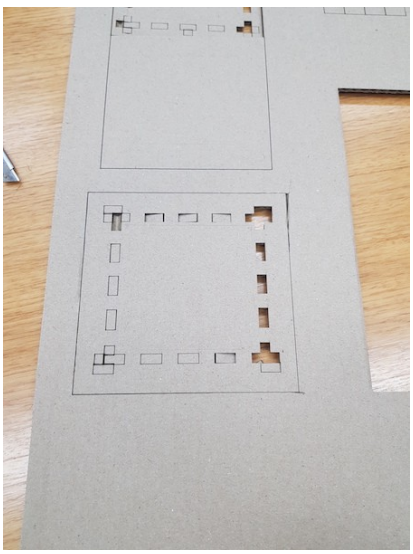
As the project progressed, it became apparent that that the use of a breadboard was not actually required, however the initial provisioning of space still proved useful, as ample room was required for the sharpener, lights, and 3D printed console.

To rectify the sizing issue, the blueprints were edited in Illustrator and adjusted to necessary dimensions, followed by another cardboard test to confirm the new measurements. The blueprint was also modified to strip away unnecessary parts and facilitate functional doors, as the original design did not allow this.



Not to scale

The following images show the successful second cardboard test with the updated dimensions.



Once the new blueprints were verified, the next stage was to perform the cut with 4mm plywood. This material proved ideal for crisp cutting and painting, however cutting time was a factor as the wood had a high risk of burning.

The importance of laser cutting technology in digital media

Graphic design in the corporate space is currently dominated by purely digital media, in the form of websites, logos, e-zines, e-commerce, etc, however printing still holds a firm place in the industry as providing a unique experience beyond that of any purely electronic experience. A great example of this is the use of 3D printing to produce vibrant and innovative business cards.

Business Cards: Acrylic v Metal v Wood

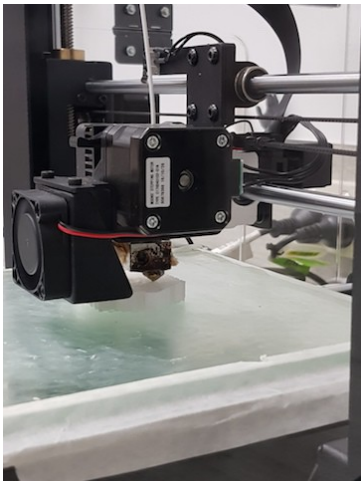
A prolific designer, Andy Morris, has taken this concept even further, by producing a Lego replica of himself as an accompanient to a CV, alongside a card reading “Unwrap your newest employee”. This could be easily replicated and improved upon with the use of 3D printing technology.

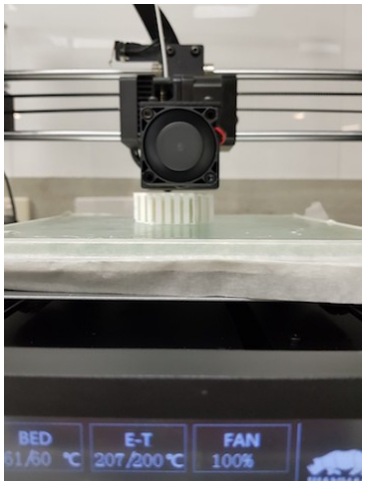
3D Printing

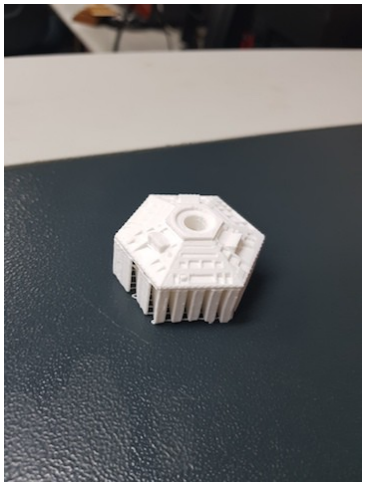
The TARDIS project contains a “console” component which operates as a button for the light circuit, and was an ideal candidate for 3D printing.

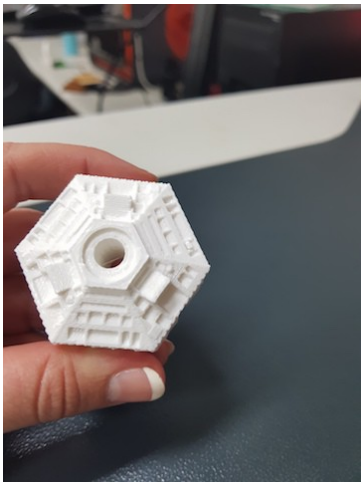
There are many uses to 3D printing which fall under rapid prototyping and rapid manufacturing. Rapid prototyping is “the speedy creation of a full-scale model” (Rouse, 2014). Meaning that anyone who wishes to demonstrate what a product could look like without going to the trouble of building it, a 3D prototype can assist with saving time, money, and materials. Rapid manufacturing is “a process that employs additive fabrication technology to produce end-use items, directly from Computer Aided Design (CAD) data.” (Barnett, K 2009). Therefore, 3D printing the console could be not only be produced quickly, but also sufficiently small, thereby using minimal materials.

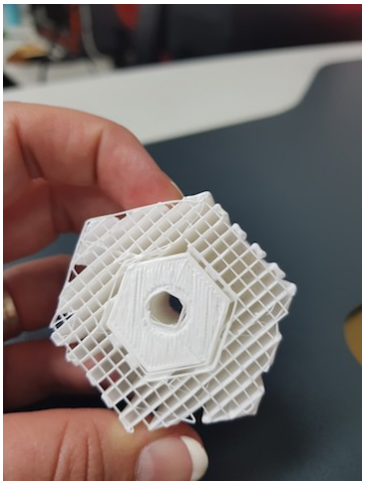
The Thingiverse resource was again used to find a console model, this time provided by the artist Peacockpete.







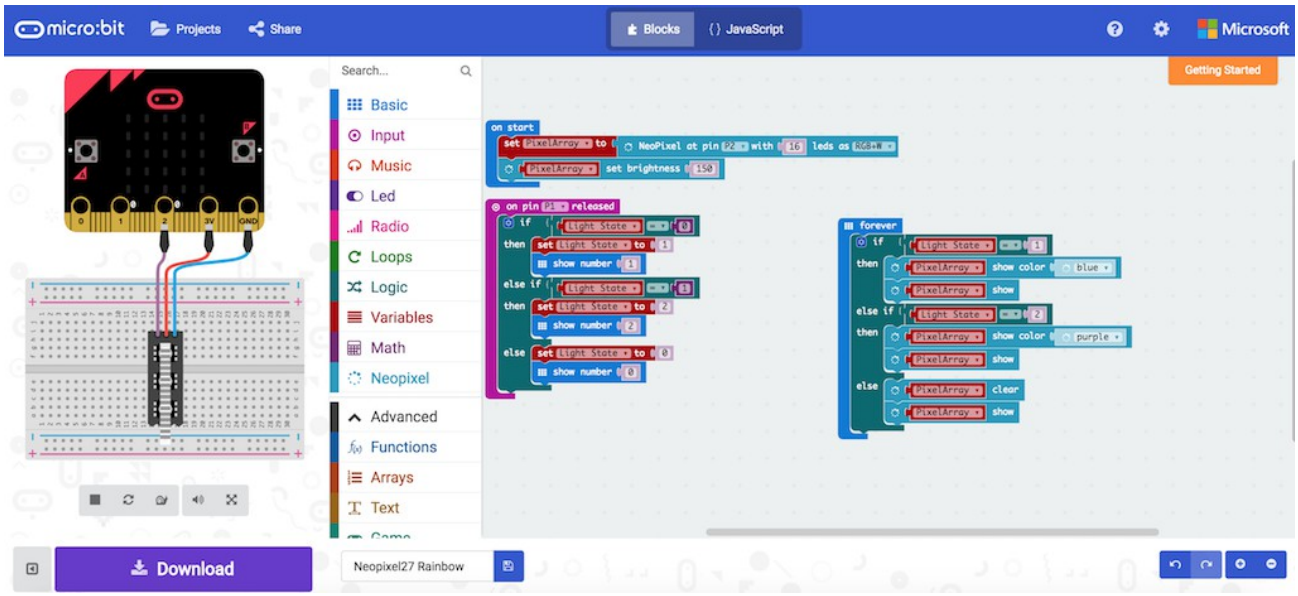




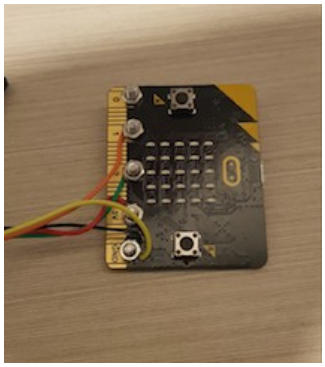
As can be seen with the above images, the console contained intricate details which would have been impractical or impossible to produce using a laser cutter.

micro:bit

The next stage in the project was to program and install the BBC micro:bit. This technology came from the BBC and is “a pocket-sized codeable computer with motion detection, a built-in compass and Bluetooth technology.” (BBC). Using this processor, it was possible to write a program to control the button-activated LEDs, without taking up much of the valuable real estate inside.



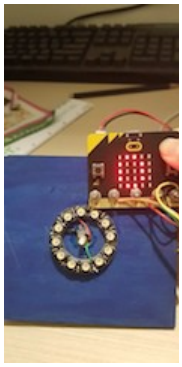
the code for the micro:bit



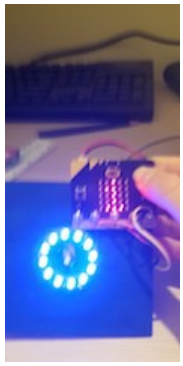
Micro-Bit

Wiring

Neopixel



Start

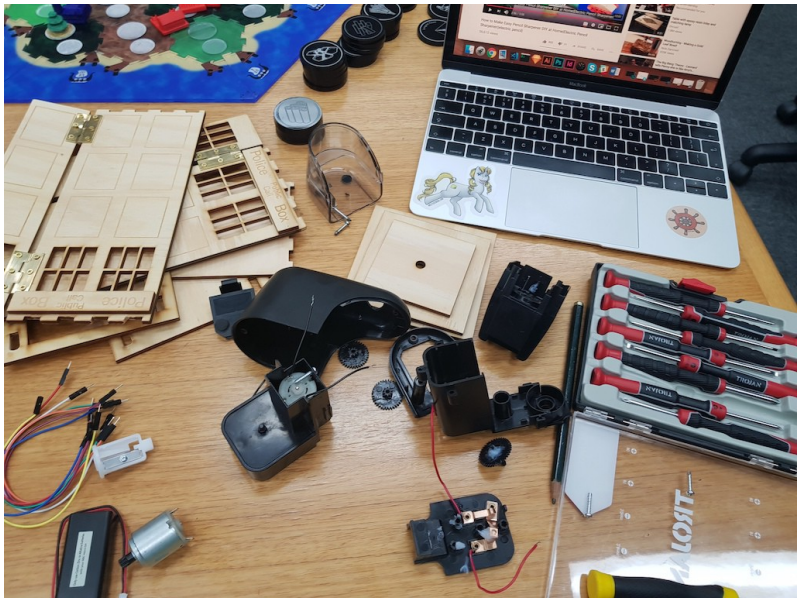


Light 1: Blue

Light 2: Pink

The Sharpener

The TARDIS project was intended to contain both an aesthetic and practical function, so an electronic pencil sharpener was modified to fit the box. The first step to planning the installation, was to disassemble the sharpener to determine what parts could be removed to save space.



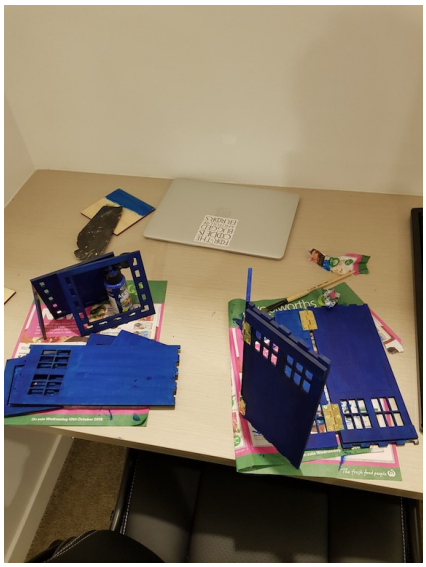
The sharpener contained a plastic casing which served as a safety measure, and prevented the machine from operating with it removed. The protective mechanism had to be modified to allow the sharpener to operate without the casing, thereby reducing a large percentage of the unnecessary bulk.

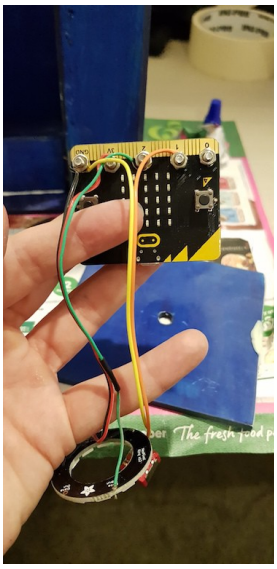
The two images below show the original casing, and the final stripped down sharpener functioning without the extraneous components.

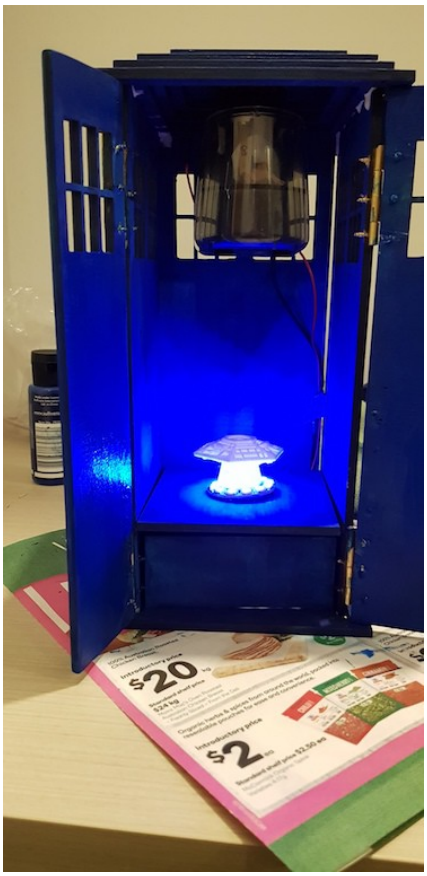
TARDIS Assembly

With the individual components now produced, this stage involved manually attaching and wiring the wooden frame, along with sharpener, printed console button and other circuitry.

It can be seen that not all the wires could be connected to one program and battery pack. The lights and sharpener being triggered by one action would have been ideal while the addition of the iconic TARDIS sound would make the prototype even more exceptional.







Conclusion

As seen from the final product, the prototype can be considered an overall success. The TARDIS, once built, programmed, assembled, and painted, has achieved all of the desired goals on both an aesthetic and functional level, with fully operational lights and sharpener.

Throughout the process of building the product, several key lessons were learned which would have resulted in a superior result:

- Despite the cardboard test print, the TARDIS schematic was found to have been misaligned in several places, resulting in a large manual effort in the way of sanding and filing to line up the joints during assembly. In future iterations, it would be wise to spend more time checking the measurements carefully from all externally sourced models.
- The circuitry aspect was rather challenging, and left much room for an improved experience. For future prototypes, it would be a great idea to attempt connecting the sharpener switch to the lights and/or button, to allow the entire electronics to be activated as one – it may even be feasible to extend the existing prototype to facilitate this functionality.

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- Sound for video - Doctor Who soundtrack Bad Wolf theme
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- Presentation of the Practice Based Assessment 2
  - https://www.youtube.com/watch?v=PXg3JxtizeA