Lo Power Mode: A Low Energy Checkout System for the Future

My project is a design fiction prototype of a self checkout to bring awareness of energy wastage.

Contents

Context

This document presents my work and process to achieve my outcome from my project proposal; “Creating a Design Fiction Prototype of a Future Self Checkout Based on a Low Energy Scenario” Lucca Muchmore December 2023. I will recap my proposal followed by showing the research process development through to my final outcome. This document will also show any outcome changes, limitations and more.

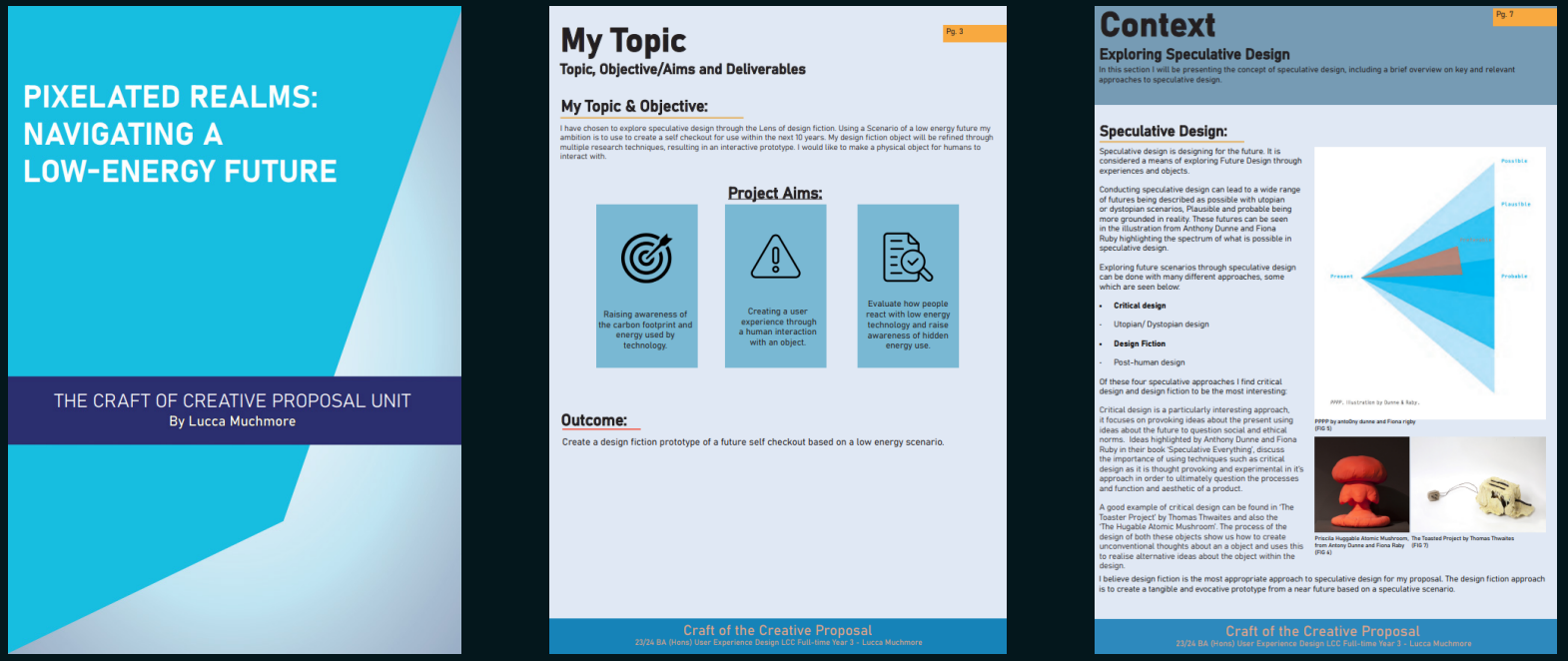


Fig 1. Screen shots from my craft of creative proposal submission by Lucca Muchmore 2023

My Original Proposal and the Subsequent Changes

In order to prepare for this final unit I created a proposal which included relevant research into energy use and trends for a future scenario. I also researched and explored the theory around speculative design and design fiction practitioners and their methods. Through this unit I used methodologies on how I would carry out my research and achieve prototyping. During the process many changes occurred, such as adding and subtracting methods and tasks. I still used my overall double diamond technique. Changes were also made to methods of research, due to time constraints I started my prototyping earlier and substituted the co-collaborative workshop with additional user testing and other research based interviews.

Design Fiction/ Speculative Design

The phrase "Design fiction" was coined in 2005 and is a form of speculative design to express objects of design from the future. This is written about in the book 'Creating Design Fiction' by Julian Bleecker, who is both an engineer and a designer. He created 'The Near Future Laboratory' in partnership with Bruce Sterling.

In the book *'Speculative Everything' by Anthony Dunne and Fiona Raby 2013* , they talk about the different future scenario in which they show the idea of PPPP which refers to the futures that are possible, plausible, probable and preferable. The aims of my project is that it falls into being a future 'PPPP' scenario, with both the object I have created and my scenario of needing low energy alternative for the future.

Methods and Techniques of Design Fiction

Some techniques that I've used from my original selected approaches to explore design fiction prototyping were:
Scenario: An important step in creating a world for this object to exist and allows for me to conduct my user research and understand how people will interact and behave in a low energy future.
Prototyping : Especially relevant as it allows someone to experience the object and allows for user feedback on how it feels and works. It is the final step to completing my outcome as set at the start.

Key Takeaways

Producing a speculative design based on the near future

Containing 'PPPP' - Possible, plausible,probable, preferable

Exploring design fiction through scenario & Prototyping

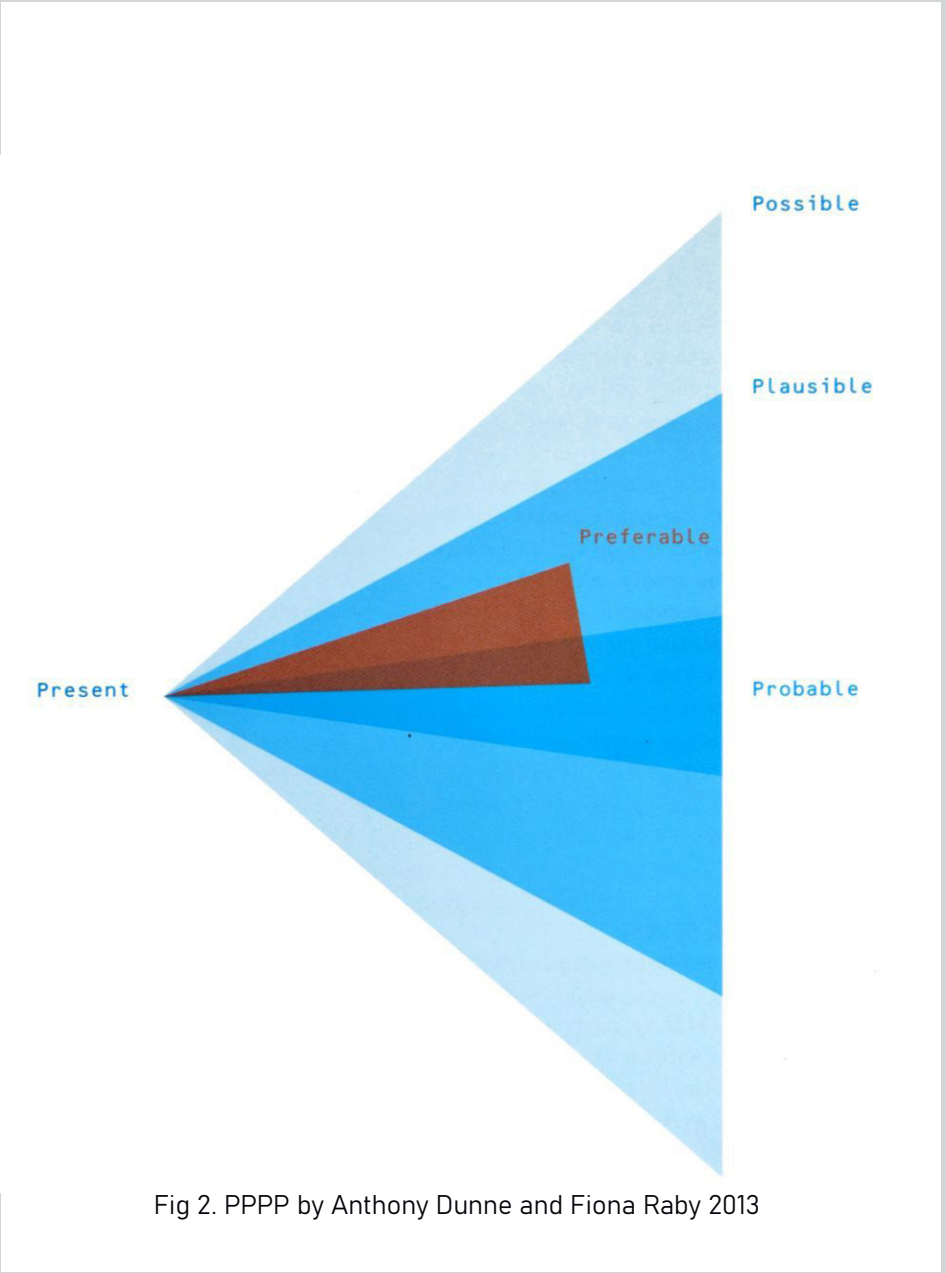


Fig 2. PPPP by Anthony Dunne and Fiona Raby 2013

Energy

Why explore Energy Use?

The future landscape of energy usage consumption and price is always changing based on market factors such as the supply of fossil fuels & weather, as well as political changes such as war, sanctions and more. Currently within UX design we have a lot of freedom to create solutions using design, interfaces & experiences and through this project I wanted to explore how these could affected a future where energy consumption is monitored and actively reduced.

Reasons why I chose to explore energy use and low energy design:

The UK is set to increasing energy demand set to grow by 89 million tons by 2040 from 232 million tons. Information provided by the UK government

The average house hold bill to increase by 24% by 2030. Information provided by the climate change community

Non renewable resources account for 70 percent of UK energy (coal, oil and natural gas) Published by BP

Wasted energy -This is the continual use of energy by stealth technologies such as Cash Machines & Petrol Pumps which are always active.

Key Takeaways

- Focusing on energy demand and consumption
- Cost of living and the affect of energy prices
- Exploring a low energy possible future scenario where tech choices are designed and built with low energy in mind.

Phase 1: Research

Self Checkouts

To begin my research I chose to look in more depth at Self Checkouts, these machines use stealth energy by being constantly switched on. They are also using high colour screens and other forms of energy hungry components. I researched the demographics of Self Checkout User. Looking at specific issues such as age, trends, popularity and growth of the industry along with any known issues. From the research it is clear that Self Checkouts as a facility are popular in use and are a growing part of the retail industry experience.

Key Takeaways

- From the study "Self checkout a global customers perspective" by NCR corporation. 86 percent of people who go to super markets use self checkouts with the highest demographic age group being 18-34 year olds.
- The study shows that 42 percent of people use self checkout for convenience, 21 percent of people use it for privacy of their purchases and 39 percent use it for time efficiency - believing it to be a faster user experience. As seen in "Self checkout a global customers perspective" by NCR corporation.
- Another study produced, ' Self-Checkout Is Changing the Retail Landscape' by Rimma Kats stated that 59 percent of people use a self checkout regularly. 39 percent of 55-65 year olds use it regularly.
- The self checkout industry is meant to grow by 31 percent by the year 2029 to 55 billion. From the publication 'Self-Service Market Size & Share Analysis - Growth Trends & Forecasts (2024 - 2029)'

Fig 13 Picture of one of areas of non participant approach Wait-rose self checkout area by Lucca Muchmore 2024

Research Into Low Energy UX

Following secondary research into Self Checkouts with a focus on the energy usage of parts of the machine, I wanted to focus on what makes certain interfaces energy efficient and look at techniques people use - in order to gain a deeper understanding of the power consumption of screens on devices.

Low energy and Power efficiency techniques

- Avoidance of specific colour
- Minimal use of white
- Single purpose of buttons
- Minimal use of scrolling
- Text thickness
- No or less images
- Thin Icons
- Screen and black colour scheme is most effective at reducing power consumption

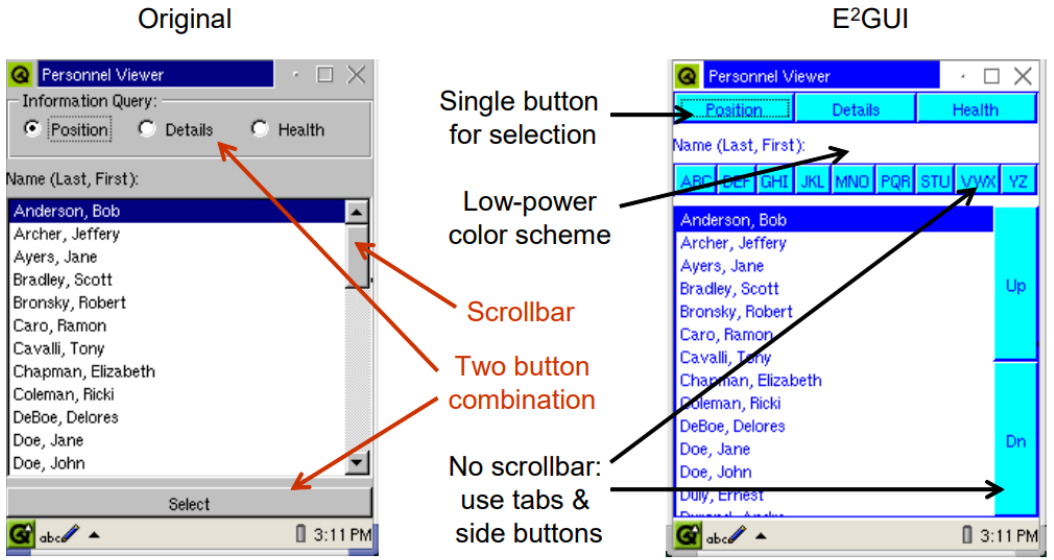


Fig 4. Energy-Efficient Graphical User Interface Design personal viewer bench mark by Keith S. Vallerio Membe 2004

Most common screens these days apart from OLED use a backlight which is needed to display interfaces. These techniques reduce the amount of energy needed by manipulating the way the backlight works

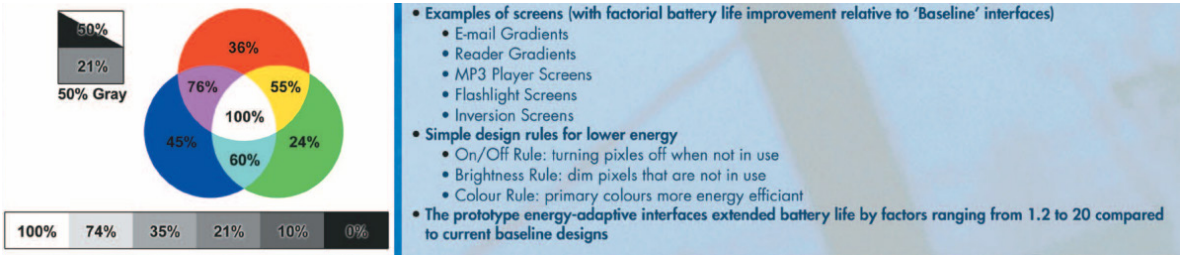


Fig 3. Energy-aware user interfaces by Parthasarathy Ranganathan, Erik Geelhoed, Meera Manahan, and Ken Nicholas 2006

Key Takeaways

- Screen display colours, font sizes and thickness can consume lots of energy
- This document is a low energy document with a choice of lower energy consuming font and a black colour scheme
- We can make choices about the technology we use and the design choices we make to save energy.

Component Research

My primary research looks at how self checkout machines are used and made. I began with component research of current checkouts. This involved visiting multiple different stores and locations and identifying components in the self checkout experience in order to back up the issues found in articles and information online of what components were built-in or separate. Through this I wanted to gain an understanding of the technologies used.

The main physical components used for modern self checkout systems are:

- Screen
- Bar code scanner
- Payment terminals
- Bagging area
- Receipt printer
- Scales
- Camera

Following these components I thought about which components were necessary for my prototype being:

- Screen
- Payment
- Bar code scanner
- Processor/computer

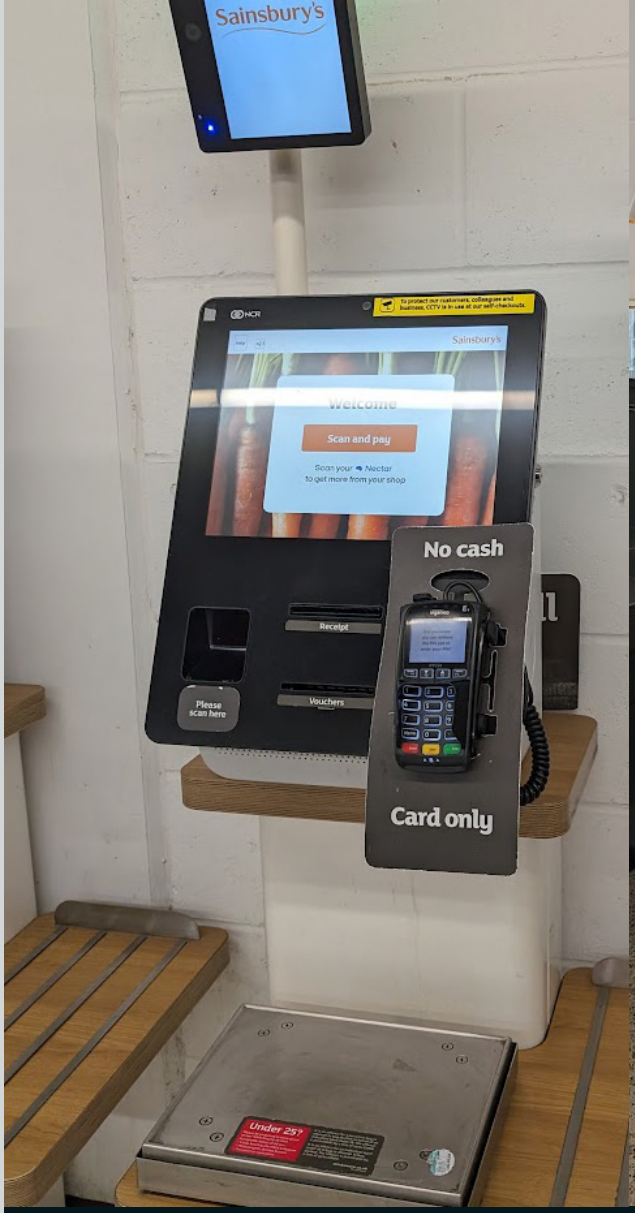


Fig 5. Sainsburys local self checkout unit by Lucca Muchmore 2024

Fig 6 (Waitrose stand alone scale) by Lucca Muchmore 2024

Analysing Existing Interfaces

Following secondary research into UI/UX energy saving methods and techniques in interface design I looked at and analysed existing interfaces of self checkouts for colour, layout and navigation. I also noted the previous research into what makes a low energy interface to view these through the lens of low energy.

Fig 7. Waitrose Self Checkout by Lucca Muchmore 2024

Fig 8. Sainsburys Self Checkout by Lucca Muchmore 2024

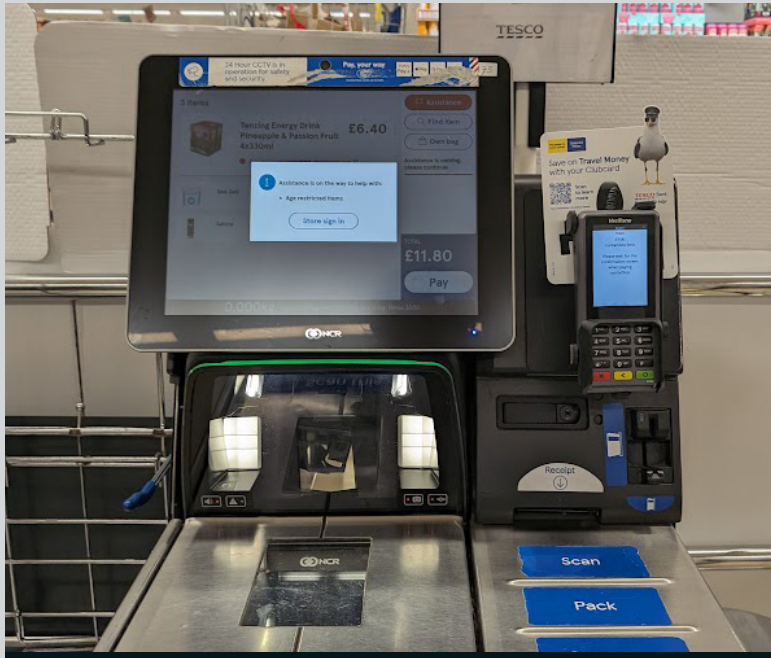


Fig 9. Tescos Self Checkout by Lucca Muchmore 2024

Discoveries from the self ethnographic research:

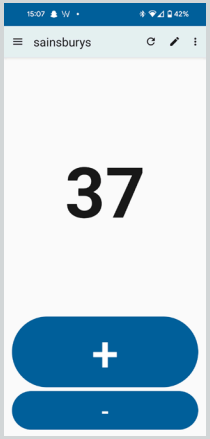
- Unused space
- Images and videos
- Bright colour scheme
- Idle sitting for long periods of time drawing power
- Scrolling up and down
- Thick text

Key Takeaway

- Self checkouts are currently made with many power hungry components
- Always in a state of power consumption even when not in use

Non Participant Observation

My primary research led me to non participant observation. I believe non participant observation was the most appropriate method of research to conduct in order to get an unbiased understanding of how most users navigate self checkouts and in order to discover the most used features, hindrances and user habits.



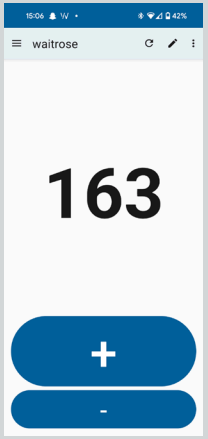


Fig 11. & Fig12. Screen shot from tally app of people using self checkout area by Lucca Muchmore 2024

Fig 13. Picture of one of areas of non participant approach Waitrose self checkout area. By Lucca Muchmore 2024

super market	no.1 of people watched using self checkout	# items < 7	# items > 7
Waitrose	163	122	41
sainsburys local	37	33	4
Aldi	117	63	54
Tescos	84	21	63
total	388	59.75	40.5

Fig 14. Table of non participant observations by Lucca Muchmore 2024

I carried out non participant approach at different grocery stores of varying sizes in the South London area. For a comprehensive view I went to 4 stores for 30 minutes between the 10-12 in the morning. I recorded the amount of people using the checkout, size of the store and behaviours. These observations were recorded in either my notebook or app.

Interesting observed behaviours:

- Issues sometimes with weight would result in store assistants coming over and helping them
- Confusion in a few people on where to put basket
- Store assistants help and assist with bar codes on a card/piece of paper
- Very few people used anything other than scan item at the till with a small amount of users choosing the hand held self scan device
- Most transactions were straight to card payment with only a few using loyalty cards for discounts or points
- half of the chcekouts would remain closed in a dorman t statet but still on.

Acknowledging Bias:

From my non participant approach the time of day was a factor that I acknowledge from my research. All observations were made before midday over a period of time from around 10-12noon. Viewing them at different times to this means I could have seen the lunch rush in some stores and not in others, which could impact the item count. Another factor was the weather on the day when research was carried out as it rained. I heard the deliveroo orders beep a lot more than when the weather was sunny.

Tracking the User Journey

From research of the components of current self checkout systems and observing how people use them I created a user journey, documenting whether it was an output process or input and used this to come up with a list of components that I would need. I discovered that I needed a processor, pay point screen and bar code scanner.

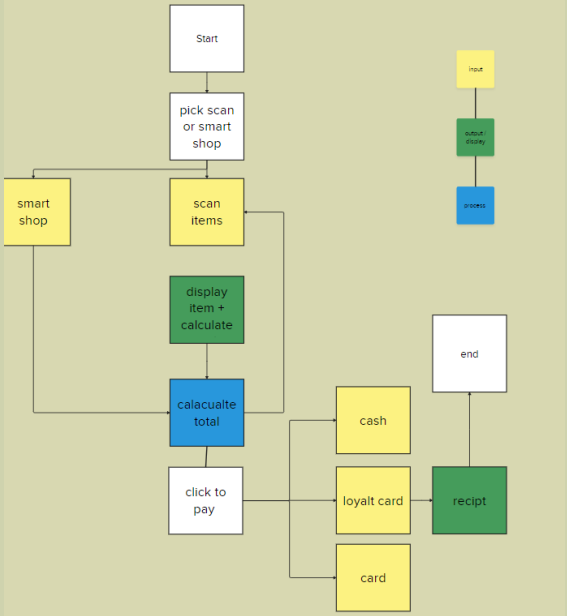


Fig 15. User journeys from non participant observation by Lucca Muchmore 2024

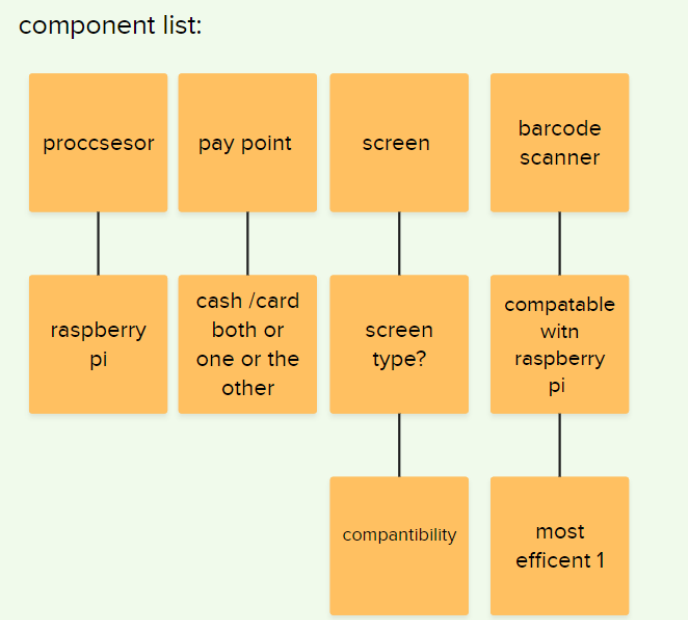
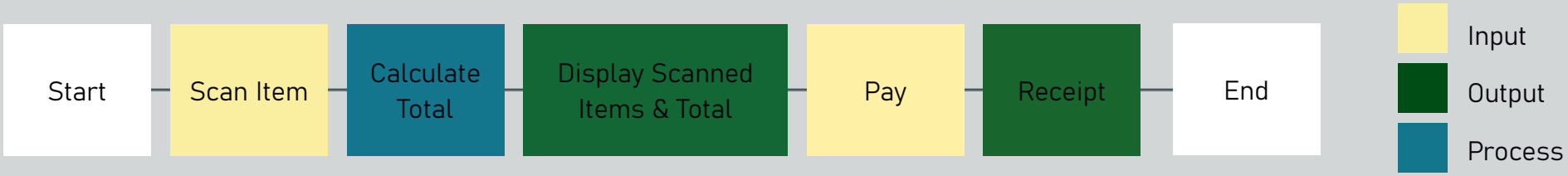


Fig 16. Component list extracted from user journeys by Lucca Muchmore 2024

Creating a user journey map for my prototype checkout with my components in mind.



Interview

After carrying out my non participant approach I contacted and interviewed a manager of a local store. I got into contact with a manager at a super market to gather more insights on common issues maintenance and cost.

1. **What kind of common issues happen with the checkout systems?**
   Bar code errors such as not scanning, wrong bar code, incorrect prices
   People double scan products
   Customers having issues finding features like coupons.

2. **How much does the checkout system cost to install?**
   The store recently got 12 new checkouts costing £90,000 for install and units.

3. **What kind of maintenance is needed?**
   The machines are new so not a lot of maintenance has been needed with these machines but had some connectivity issues with the system that runs with it have arisen.

4. **How much does the maintenance cost?**
   Not sure how much maintenance costs on these as the repair men paid by head office so they bill them directly

5. **How much energy do the machines use?**
   No specific amount used but compared to the previous model they were to reduce energy usage by 37 percent saving us money

Following this I wanted to find out more about the energy used so I conducted some secondary research to find more about the energy of a checkout unit.

Key Takeaway

- Self checkouts are costly but moving their models towards less energy consumption
- Unclear how much maintenance is used for both software and hardware aspects of the self checkout.
- There are common user issues

Energy Used

The screen is a low energy OLED touch screen. Using a calculator at Tings.com, the average screen size which is 22 inches on for 24 Hours a day at an energy cost of 0.25p per Kilowatt costs £68.00 per day.

22" OLED Screen x 24 hours = £68.00

A typical barcode scanner uses 60 milliamps when sleeping and 120 milliamps when active. Running for 24 hours a day (active for 8 of those hours) at 0.25p per Kilowatt costs typically £0.00002 per day.

Barcode Scanner ((120 mA x 5v x 8 hours) + (60 mA x 5v x 16 hours)) = £0.00002

Total £86.00002

Acknowledging Bias

I have looked at the running cost of the same components that are used in my prototype and made an estimated calculation based on some assumptions of time and equipment used. There are also additional components of a self checkout machine, such as a receipt printer, card reader and cash holder. In all online calculators that I used it is acknowledged by their authors that values are estimates. Also for practical reasons I have not had data for the same OLED screen running in low power mode and how that compares when in use.

Creating My Scenario

Following my research I began to create my scenario for my design fiction object, it was suggested by tutor to create a time line in addition to my scenario.

In order to create my scenario I used Julian Beckers and the 'Near Future Laboratory' technique of analysing trends and synthesizing information in order to gain insights of what a scenario could look like. I went on to use the insights gained from research into energy in order to create the scenario as explained on their website.

Insights from my research on scenario

- Fossil fuels running out
- Reliance on renewable energy
- Demand for energy not being met.
- Significant increases on costs due to energy demand exceeding supplies.

Scenario

As the population grew, demand of energy grew with no growth in limited natural fossil based energy sources. As the environmentally damaging fossil fuel supplies diminished, a focus was on changing to renewable energy types. Demand for energy was much higher than natural energy resources could supply, which caused soaring energy prices.
This lead to a low energy revolution in which technology develops and uses Lo Energy in order to become the most efficient use of energy possible. This in turn helps ease users into a future of lower energy use with minimal loss of everyday technology facilities.

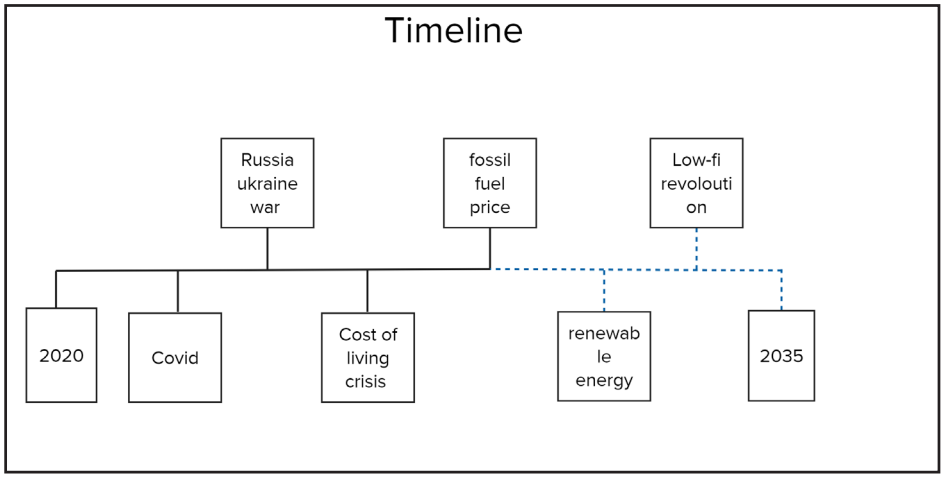


Fig 17. Scenario and time line by Lucca Muchmore 2024

Phase 2: Prototyping

Initial Ideas

Generating via sketchbook some initial ideas for interfaces of the design. I decided to base my interface from the Waitrose self checkout, as it was one of the newer models. Through conducting my interview and non participant approach I established a good basis on how they work for customers and staff who operate the machines.

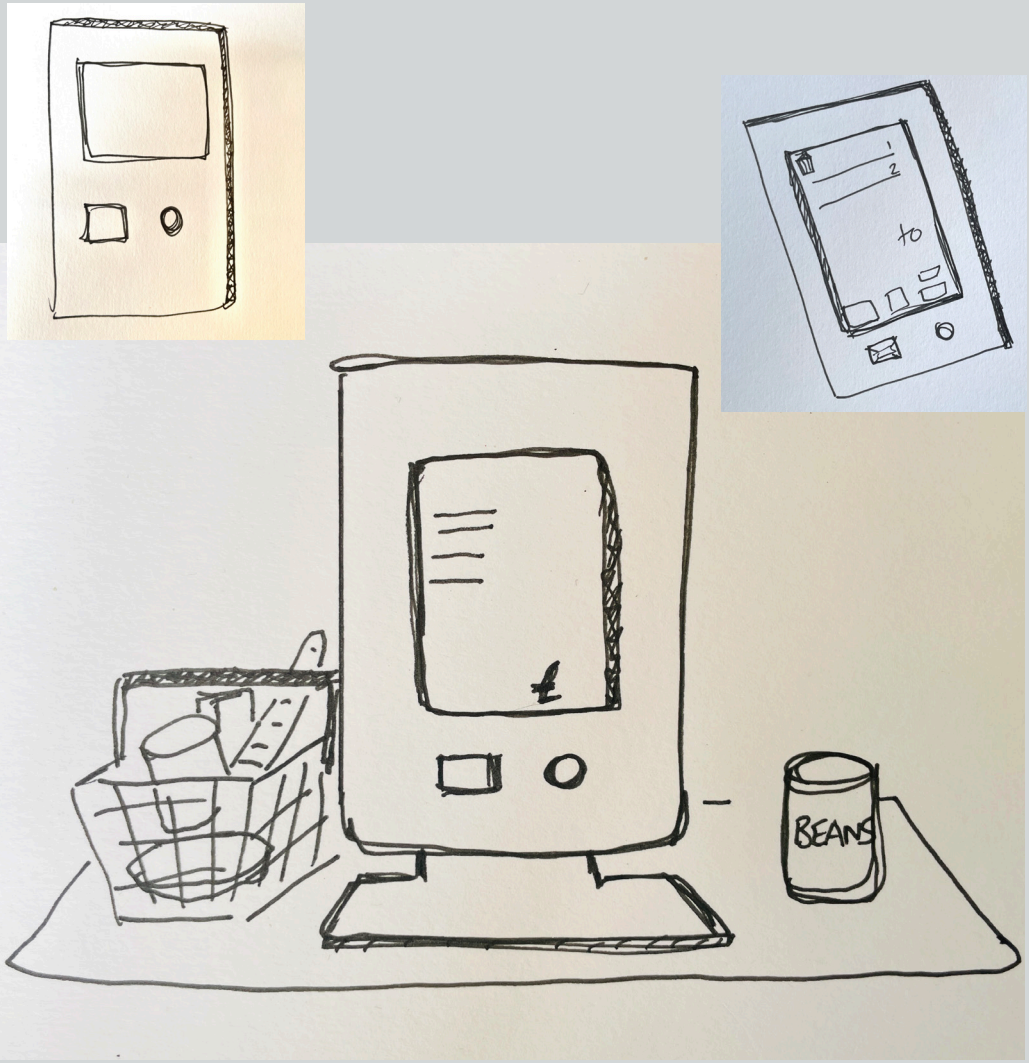


Fig 18 (Initial sketches of checkout) by Lucca Muchmore 2024

In addition to initial ideas and sketches I took part in crazy 8s where I created 8 designs in 8 minutes to help generate different ideas and variations on what it could look like.

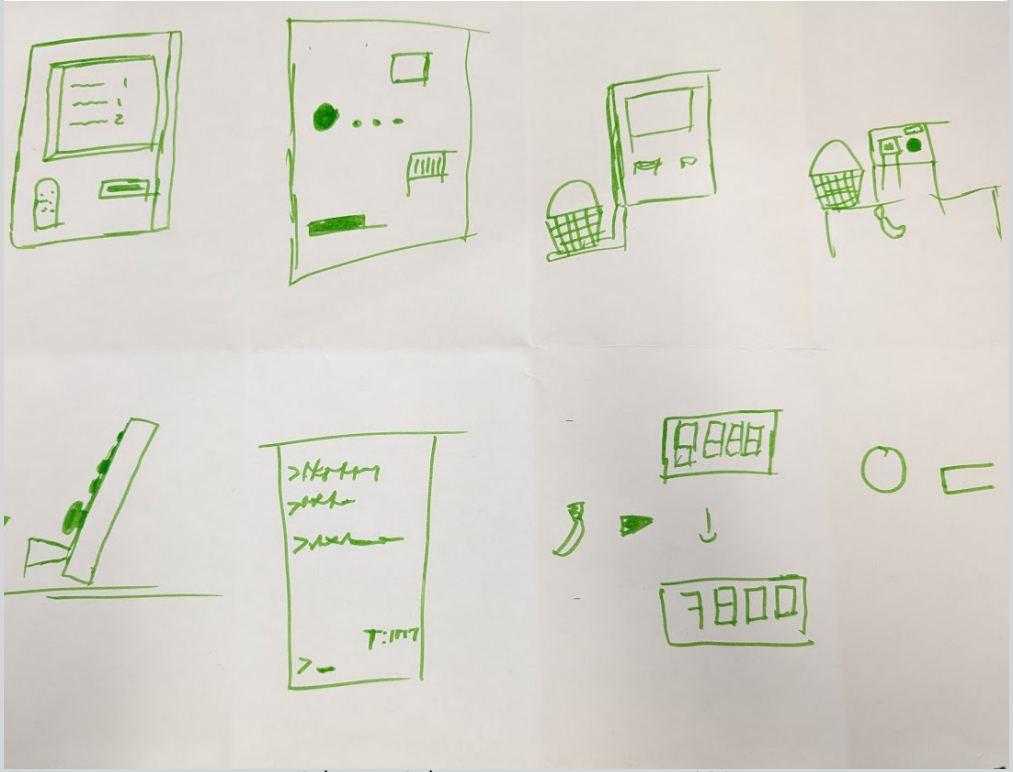


Fig 19 (crazy 8s) by Lucca Muchmore 2024

Displaying Your Self Checkout Shop

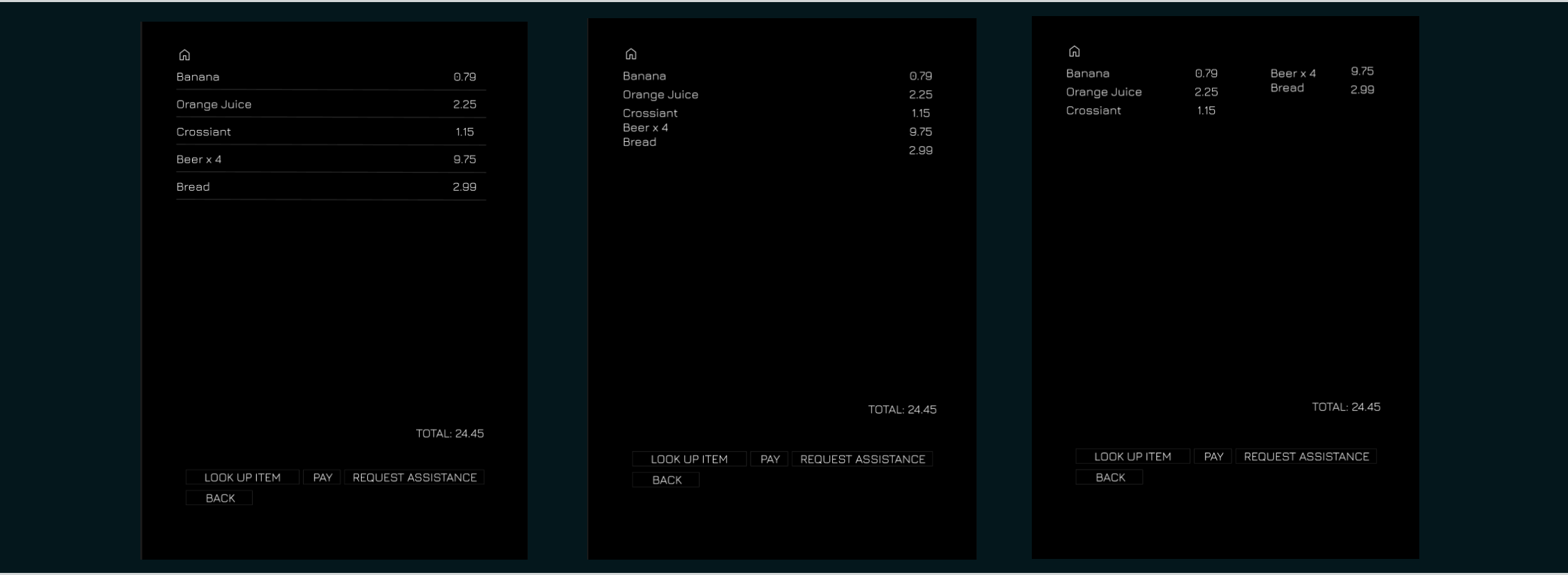


Fig 20. Initial wire frames for user testing by Lucca muchmore2024

The first element I wanted to test in my design was how to display a users data. I created wire frames, backed by my secondary research which I could use and test for user feedback and also help inform how to proceed and get an idea of what is easier for people to read and understand in a short time window of use.

Creating Personas

Following my research I created personas to better understand the user experience of my interface design. My persona was informed from the different demographics that arose from secondary and non participant observation.

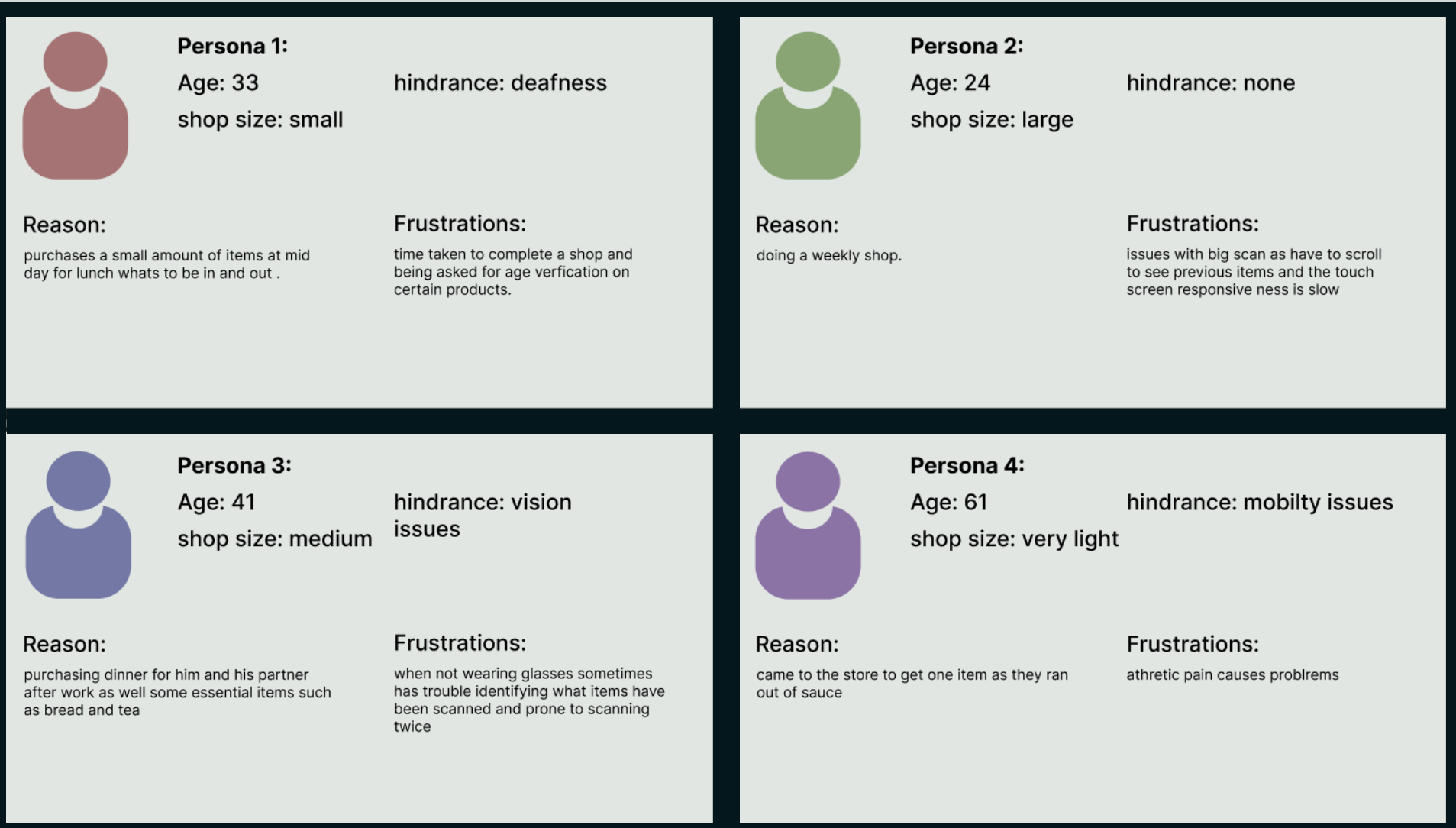


Fig 21. Personas by Lucca Muchmore 2024

User Testing & Feedback

I gathered 7 users in 21-51 age range based on the personas created from my secondary reseach to test out some preliminary wire frames and interaction with the low energy interface.

Feedback expressed from multiple users

- Alignment was off with some blocks
- No need for lines separating them if its low energy unless dimming them
- Buttons too small
- A way to show energy used

Feedback from peers and masters students:

- Consider using low fi prototype to user test
- A way of showing how much energy is saved
- Add a way of indicating energy used
- Make a way to be more interesting with end of the cart process
- Present the scenario when explaining as presently its quite hard to understand

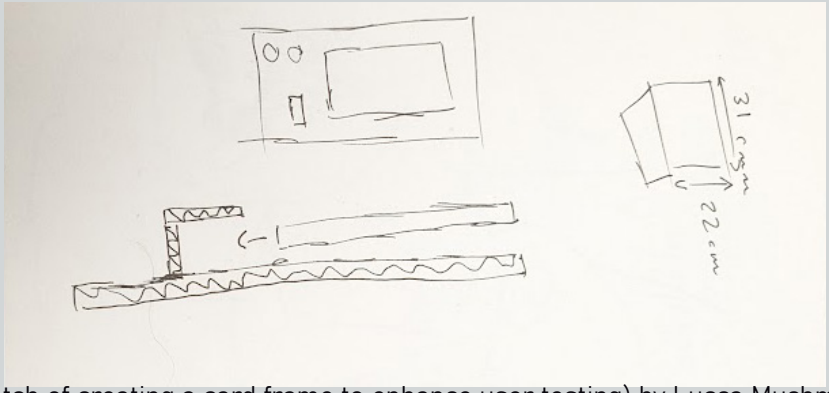


Fig 23 (sketch of creating a card frame to enhance user testing) by Lucca Muchmore 2024

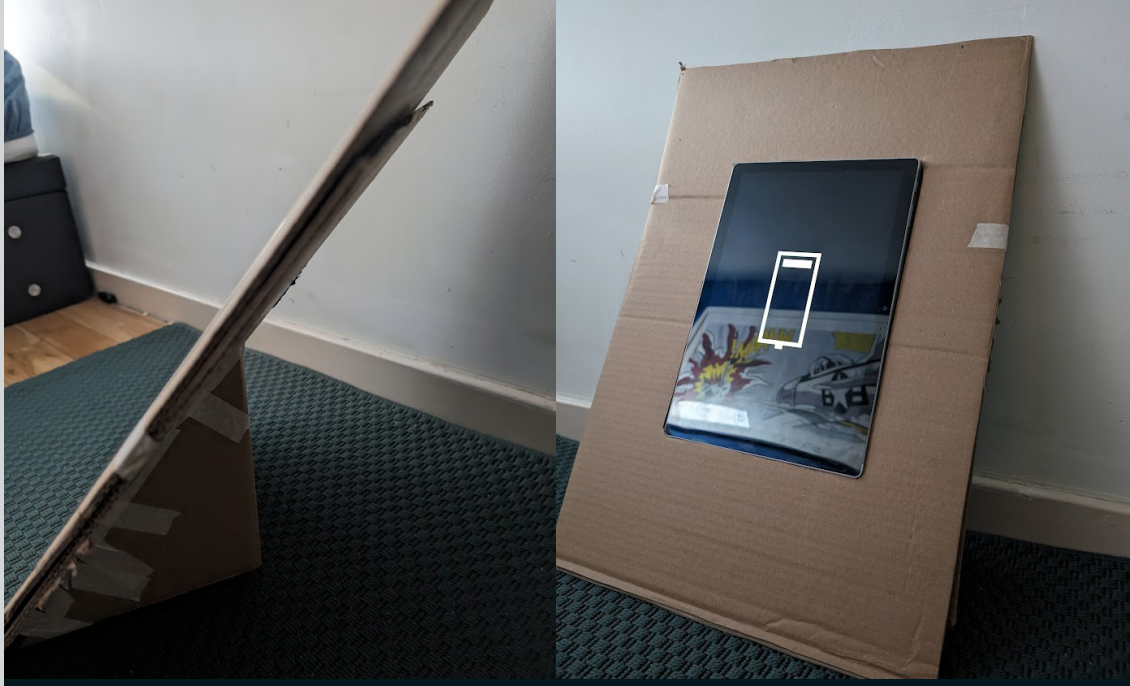


Fig 24 Sketch of creating a card frame to enhance user testing by Lucca Muchmore 2024

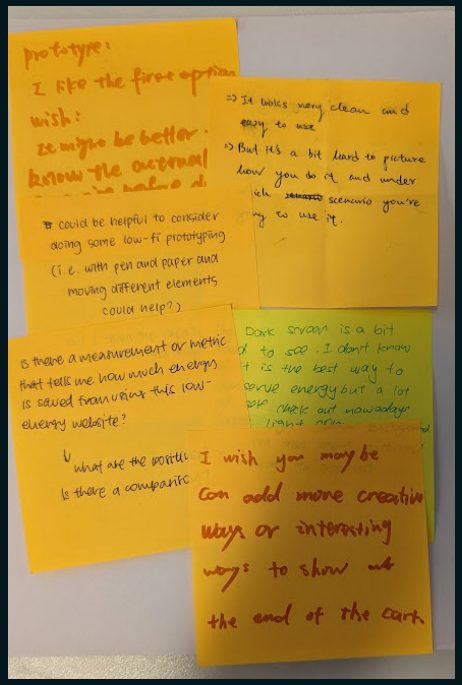


Fig 22 Sticky notes with Peer/ma students feedback by Lucca Muchmore

Design Development from User Feedback

Following feedback from peers and user research, I created a second iteration of wire frames, taking on feedback and other considerations about user journey.

Some of the changes to the design are listed below

- Including an ‘Eco’ icon of how much energy used being a light bulb progressing from yellow to red and from talking to peers again it was suggested to use money instead of joules or voltage as they are more understandable to wider groups.
- Created a more interesting final basket stage, where the energy used was added to the total
- Fixing some alignment issues in the design, such as buttons and icons
- Increasing button size and reducing size and opacity of the boxes and line
- Other changes included the general layout

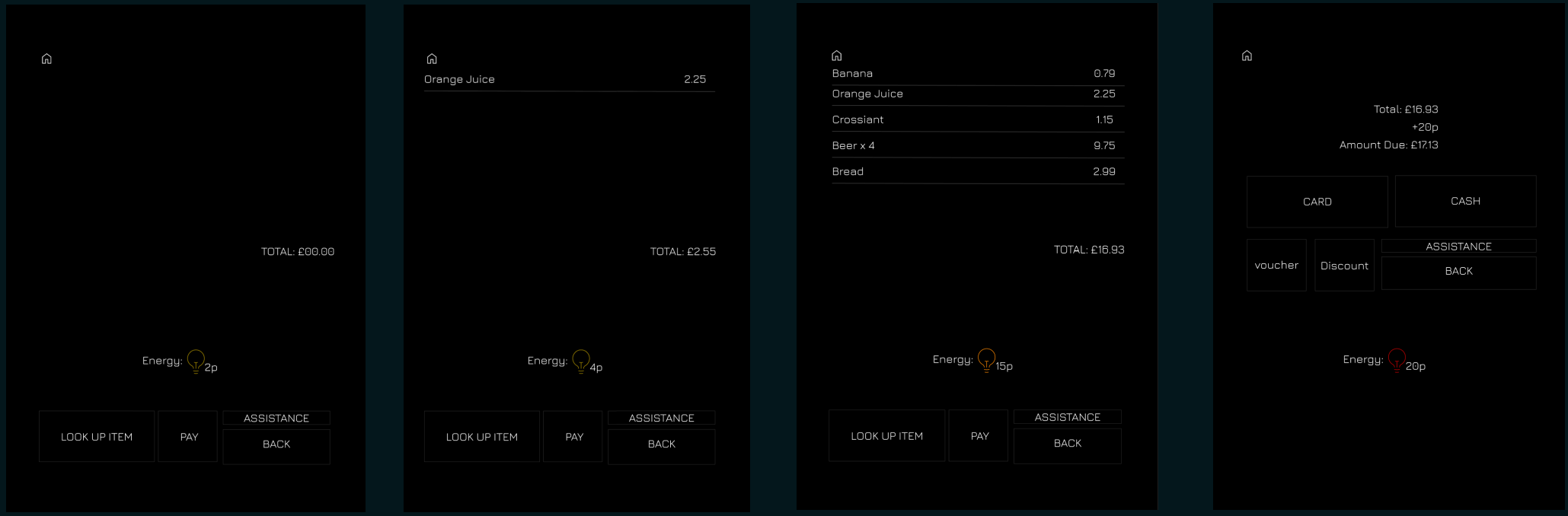


Fig 25. Wire frames 2 by Lucca Muchmore 2024

Model and styling

Following improvements to the interface and a further developed idea of how the checkout would work, I created some 3d models from initial ideas to help people have an improved understanding what kind of product I would be creating.

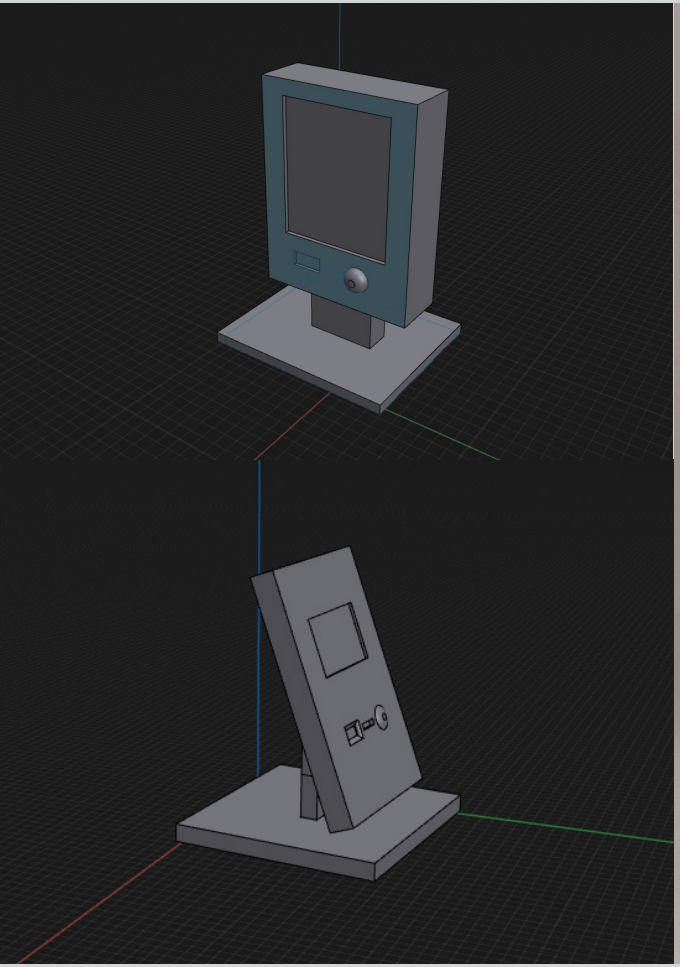


Fig 26. Sketch of frame by Lucca Muchmore 2024

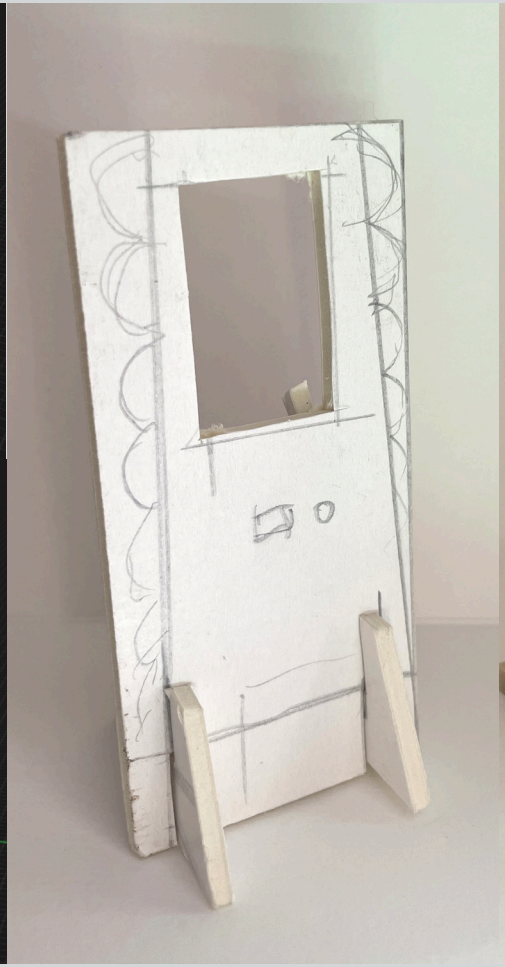


Fig 27. 3d print process/model by Lucca 2024

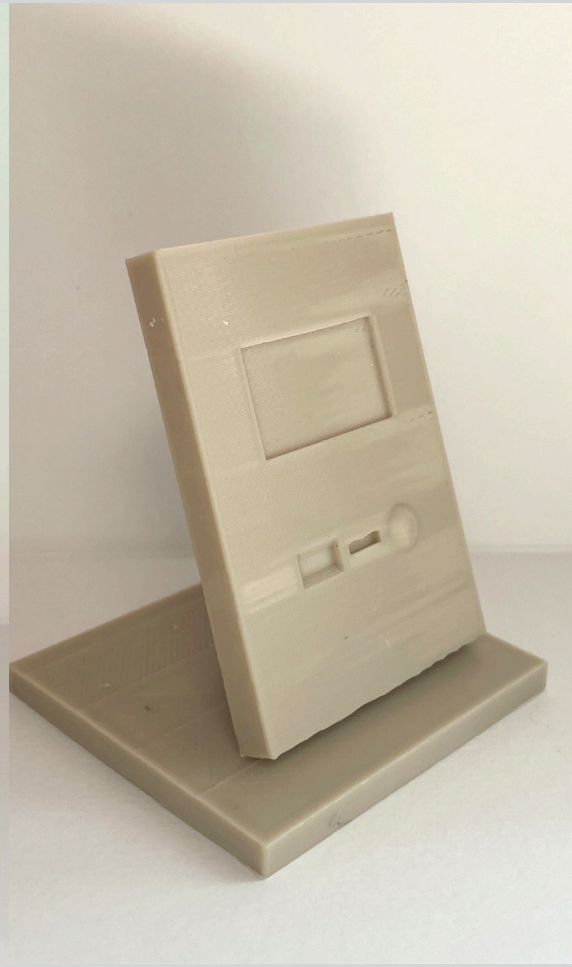


Fig 28. 3d model by Lucca Muchmore 2024

I experimented by creating some 3d models using foam board and went on to model them in shap3r which I then printed to create a physical object to show to peers, tutors and users.

Researching Low Energy Screens

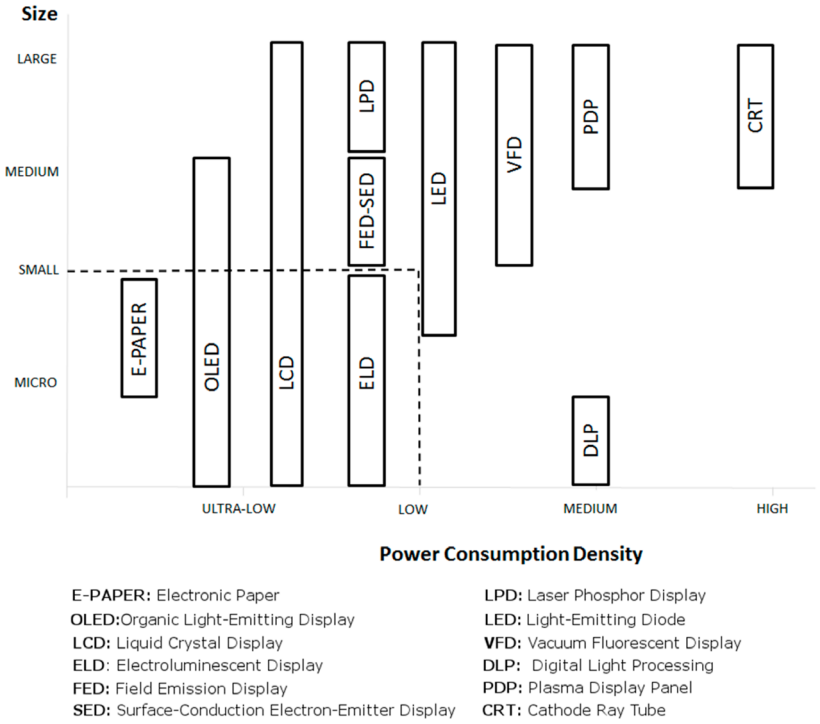


Fig 29. Chart showing power consumption for size of screen types by Samantha Marsh M.Sc., Cliona Ni Mhurchu Ph.D., Yannan Jiang Ph.D., Ralph Maddison Ph.D. 2015

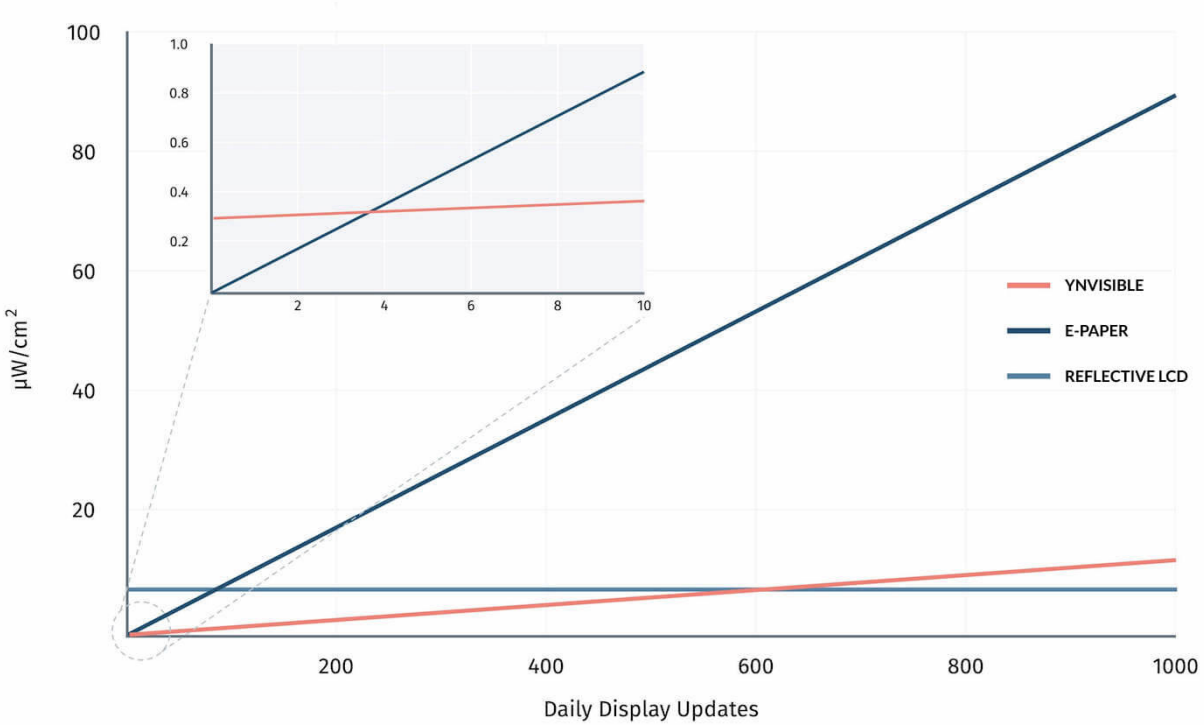


Fig 30. Comparing power consumption of 3 ultra low energy usage screens by rdotAB

Following my user testing, I wanted to get a refined and definite idea of my screen. I planned to build my prototype design around that screen choice, which would lead to secondary research in order to gain an understanding of the power consumption of screen types based on their model. The secondary research I conducted involved looking at studies, datasets and papers on google scholar using the keywords "energy, screen, types, efficiency". I used the information within the studies along with raw data and visualisations in order to inform me of which screens would be appropriate.

The research indicated the use of an e-paper screen as my chosen form for low energy screen. I then discovered other similar products to e-paper, such as r-dot screens and reflective LCD.

Screen Comparison

E-paper

Fig 31. E-paper screen by PI HUT

Dimensions
12cmx9cm
Cost
£56.00
Flexibility to display
Can create a wide range of displays and user interfaces as seen by people online and google

Reflective LCD

Fig 32. Reflective LCD screen By Pi Hut

Dimensions
5cmx 8cm
Cost
£19.90
Flexibility to display
Limited to numbers and letters on this version of compatible reflective LCD screen

R-dot

Fig 33. R dot screens By rdotAB

Dimensions
1-10cm x 2x10cm
Cost
£8-25
Flexibility to display
Limited to what ever each model offers, choice of with or without numbers.

Why E-paper

After looking over choices I settled on using an E-Paper Screen. One of the most known examples of e-paper is an Amazon kindle. Another product that utilises e-paper is the light phone.

Reasons to pick e-paper:

- Can display an interface with no use of energy
- Low energy to change state of the screen
- A range of sizes available
- Grey scale and coloured options
- Freedom to design unique user interfaces

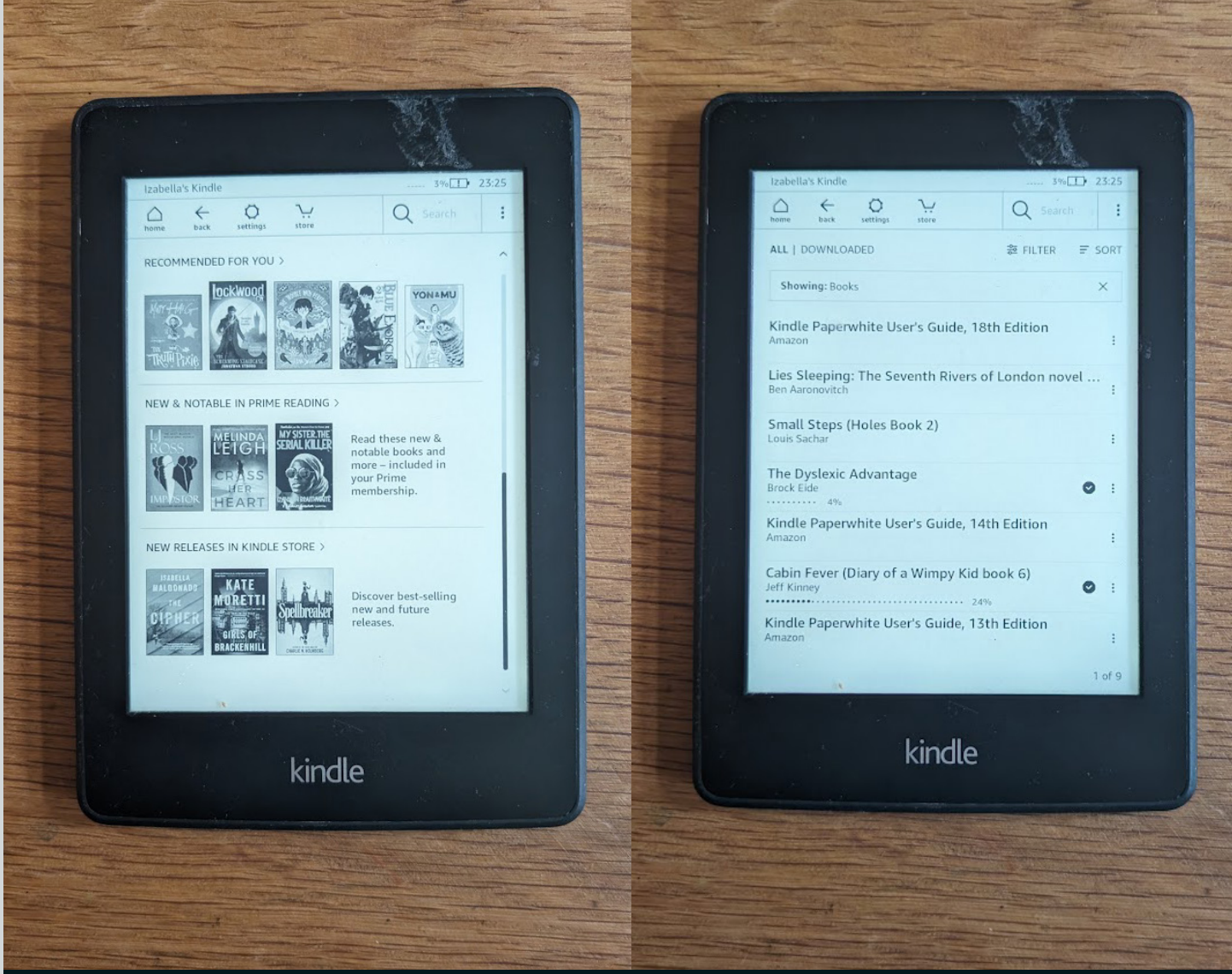


Fig 34 (kindle screen /interface) by Lucca Muchmore 2024

My Components

Other components that I would need is a processor. I chose to use a Raspberry Pi due to familiarity with the Pi working on previous projects and economic reasons as I do not need to purchase a new one in addition the pi requires a lot less power to run than a normal computer but still does use more power than Arduino. These reasons I chose to use this for my checkout prototype. Another component I would also need was a bar code scanner so I conducted research on Pi compatible bar code scanners and how they work. I learned they have automatic and manual modes as well as features like a sleep. I choose to pick a bar code scanner which had both a sleep and automatic mode.

Bar code Scanner

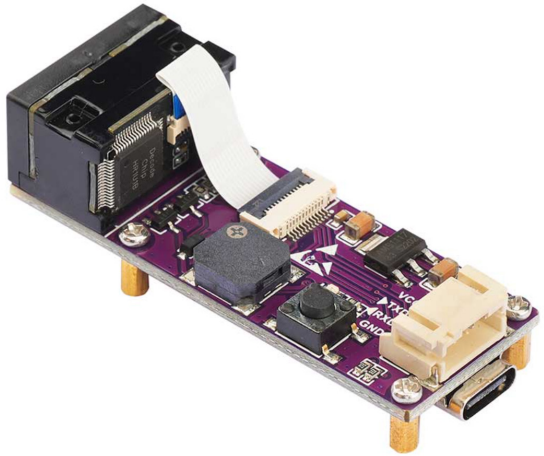


Fig 35. Bar code scanner 2d/1d By SeenGreat 2024

Screen

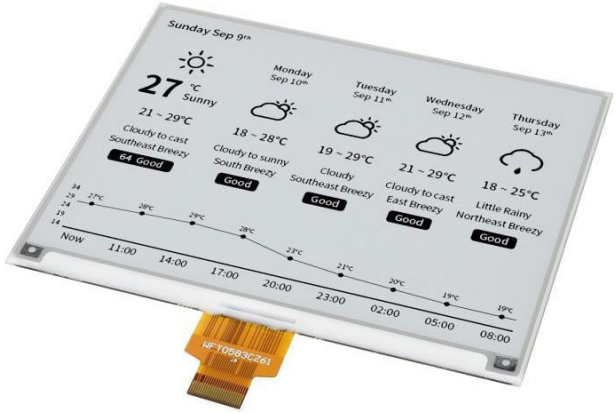


Fig 31. e-paper screen by PI HUT 2024

Processor

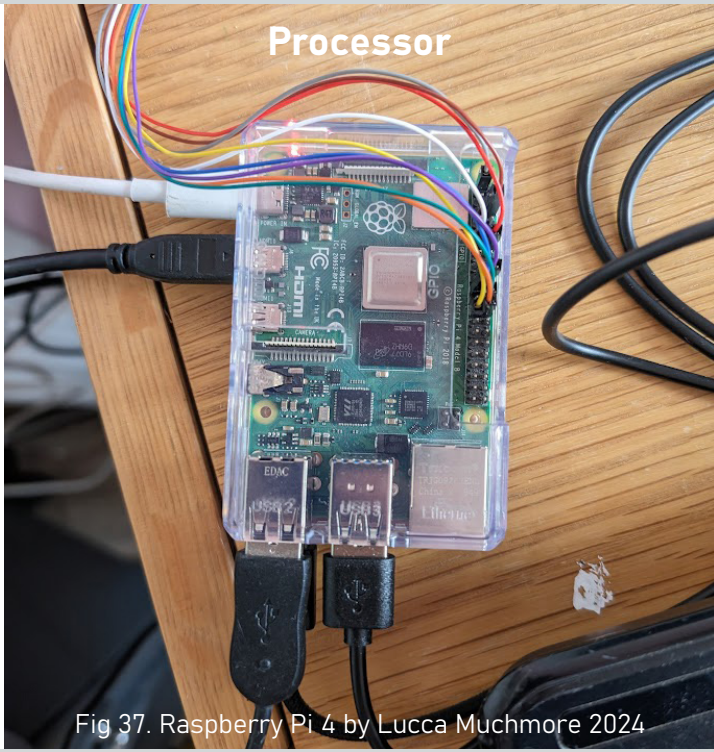


Fig 37. Raspberry Pi 4 by Lucca Muchmore 2024

Interaction between the user in the initial testing of the wire frame with the layout was done via touch screen but a new issue arose which was the lack of touch screen with ultra low power displays. After this realisation I did more research that included talking to people about my problem and also looking into using joysticks to navigate, like a old arcade machine. I realised that I could design the display around scanning and went on to later understand that I needed to have and additional input to allow for people to finish with their shop and set the process for another user.

Making a Frame

Having decided on my components I needed to create a frame for them. I took the measurements of each part and drew it out. I also used the laser to cut an A4 piece of acrylic in the technical workshop. The acrylic had correct screen size as well as a hole that would fit the bar code scanner. This process was completed in the 3d workshop using their laser cutters.

Dimensions

Screen: 12cm x 9cm x 1cm
Bar code scanner: 2cm x 1cm x 5cm
Pi: 9cm x 5cm
Acrylic frame: 29.6cm x 21cm (approx A4)

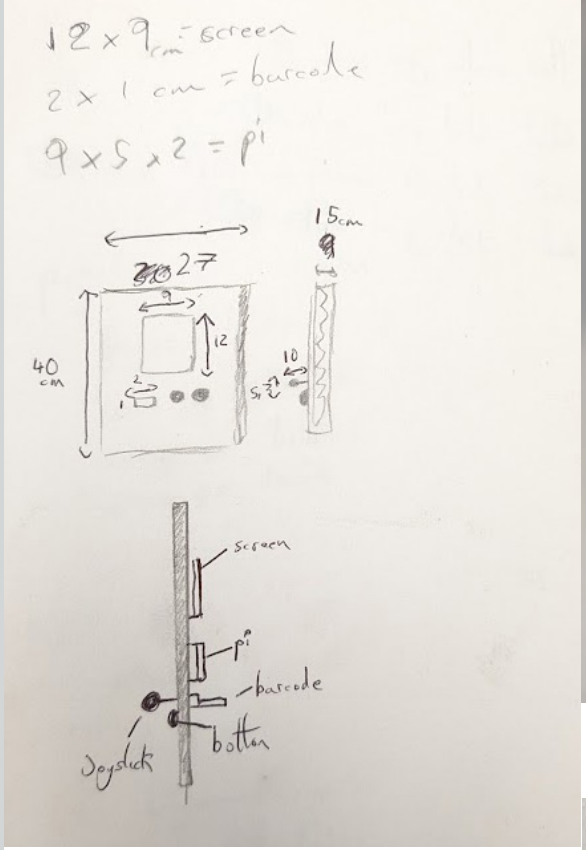


Fig 38. Layout of the screen and components how they could attach by Lucca Muchmore 2024

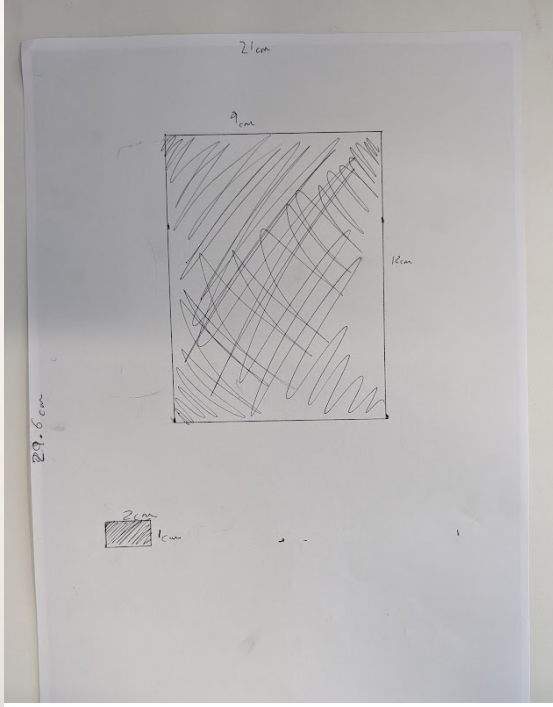


Fig 39. Dimensions of screen to made to be laser cut by Lucca Muchmore 2024

Fig 40. Laser cut acrylic cover by Lucca Muchmore 2024

Adjusting the Design for My Components

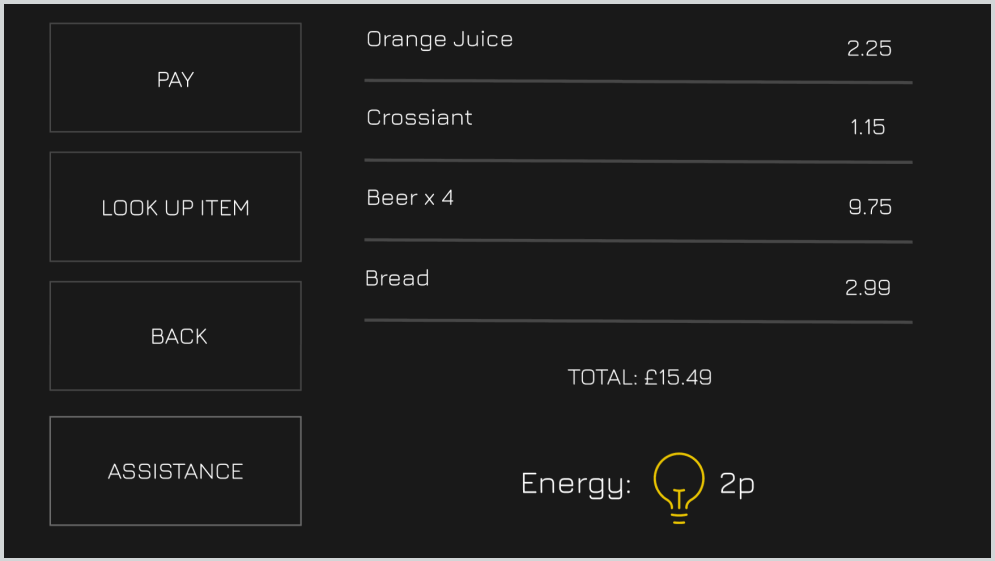


Fig 41. Wire frame to correct scale in landscape by lucca Muchmore 2024

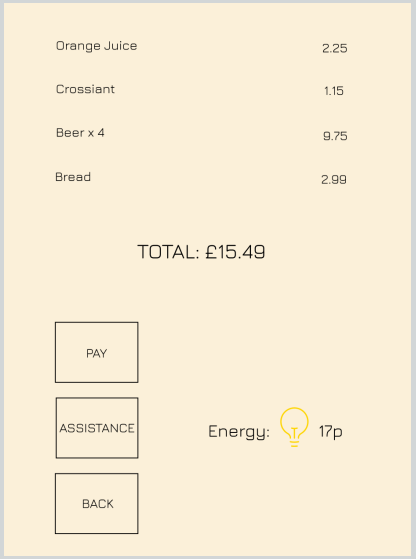


Fig 42 (wire frame lighter version portrait) by Lucca Muchmore 2024

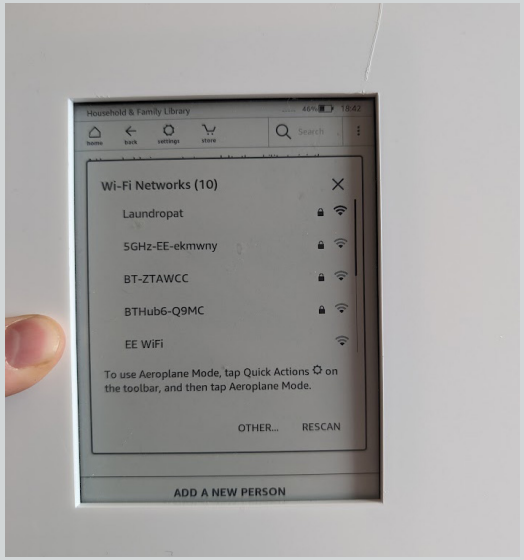


Fig 43 (kindle screen in my laser cut) by Lucca Muchmore 2024

Using the research information I had to now adjust my original design to the correct size and height which I could use to test on users.

Through this process I also got some feedback from peers after presenting my work to them in which they suggested that the use of the e-paper screen, that I didn't have to stick to the black background and white text, and to modify these to make it easier for the user to engage with and understand.

Testing and User Feedback

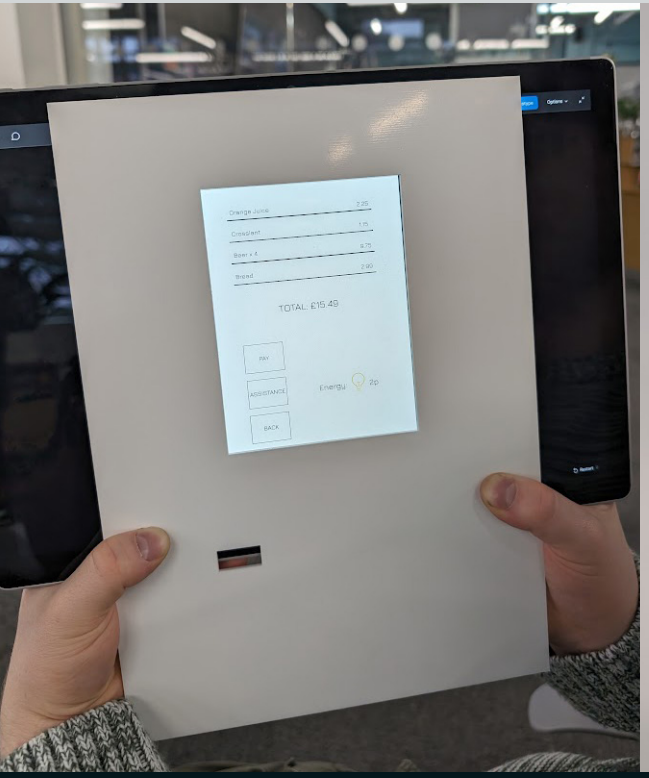


Fig 44. User testing with the frame by Lucca Muchmore

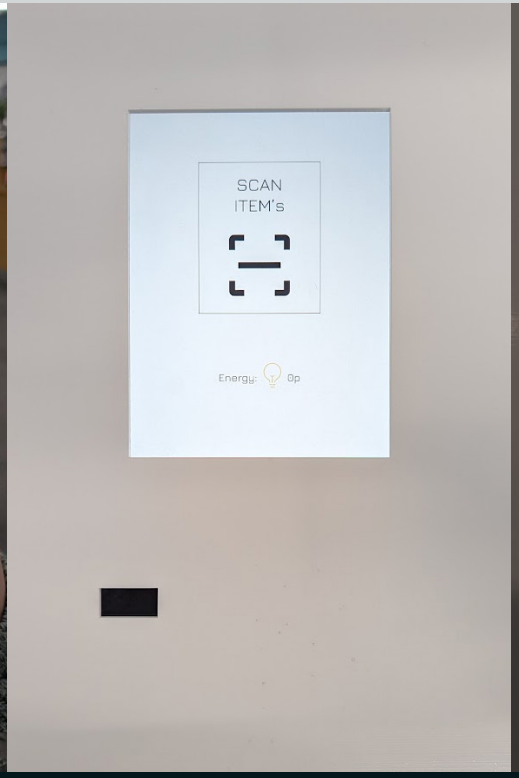


Fig 45. Start page by Lucca Muchmore

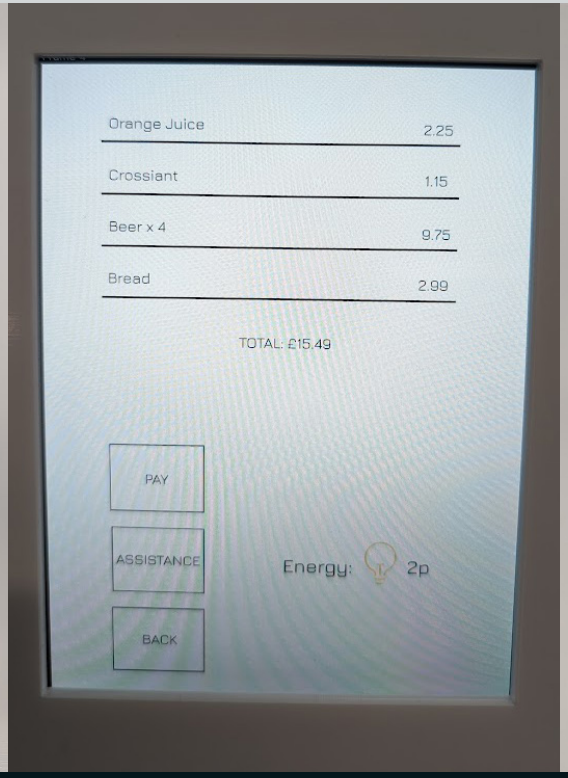


Fig 46. Items and list page by Lucca Muchmore

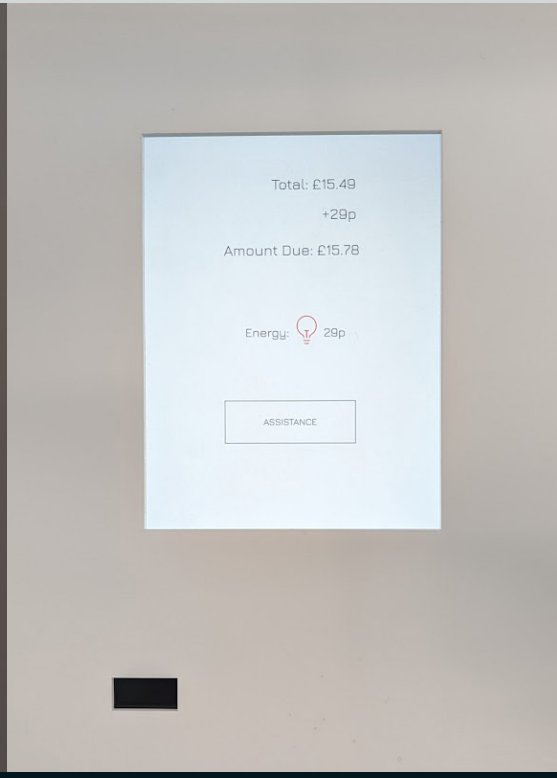


Fig 47. Checkout page by Lucca Muchmore

Feedback from user interaction included

- The colour choice didn't contrast enough with the base
- Alignment was off
- The buttons for navigation layout was confusing
- The energy usage and icon changes position a lot and should be more central

Phase 3: Creation

Bar code Scanner

The first part of the prototype I choose to tackle was the bar code scanner. I tested how it worked by connecting the bar code scanner by cable to the pi. The bar code scanner became an input to the pi interpreting the bar code into a string of letters and numbers.

After experimenting with the scanner I created bar codes using an online resource which allowed me to name the product- for example: Bread, Banana, Milk etc. I went on to create a file of products in which I listed 6 popular items in a shop with a price and a name. I now had my inventory from which the bar code scanner could match items.

How it works

The bar code scanner works by reading a bar code as a string, which is actually a piece of number text such as "108391" .

When scanning I ask if the input from the bar code matches with a reference in my data file and then I display the price and name.

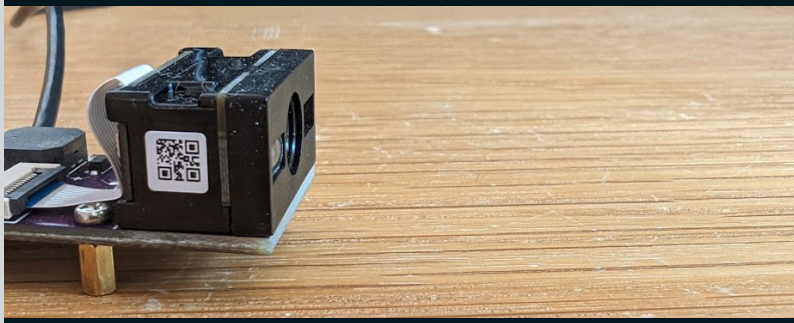


Fig 48. Bar code scanner not scanning by Lucca Muchmore

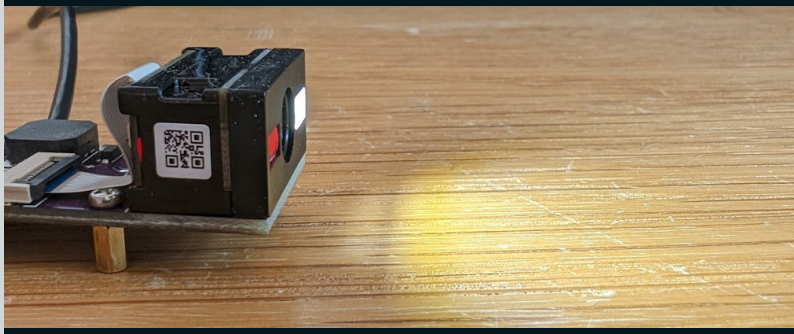


Fig 49. Bar code scanner scanning by Lucca Muchmore 2024

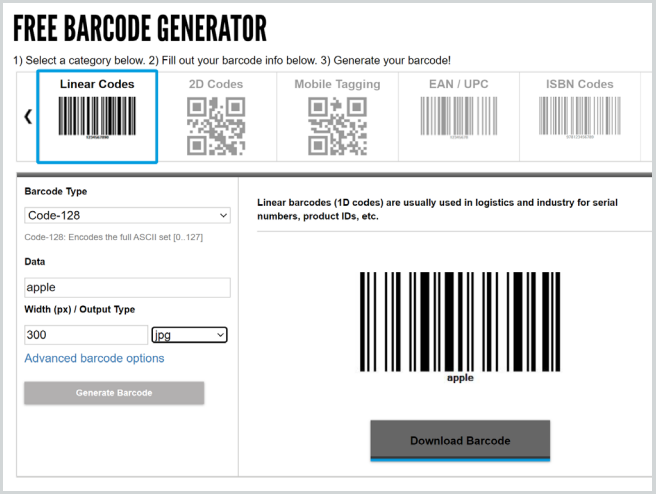


Fig 50. Online bar code maker by Lucca Muchmore 2024

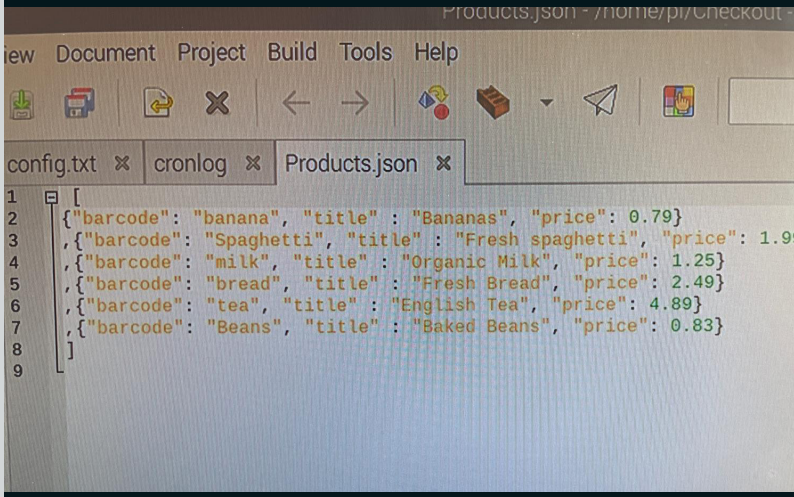


Fig 51. Data file of bar code scanner numbers by Lucca Muchmore 2024

Coding On The Pi

With the bar code scanner, data file and a list of bar codes I began to code using Python 3.

As established through my research on user journeys I needed key elements outputted on my device which are:

- Product Name/Identifier
- Price
- Total
- Number of items scanned

Pseudo code of how this works

```
set total = 0 + price
print (scan something)
if (input == string in data base)
     print (name) + (price)
     print (total)
else
     print (scan something else)
```

Key Takeaway:

- This area of the process was complex and required many iterations to make this area work successfully
- Using real life elements such as the bar code scanner and screen but this is not a regular scenario to apply these to, making these work together with synergie was a challenge.

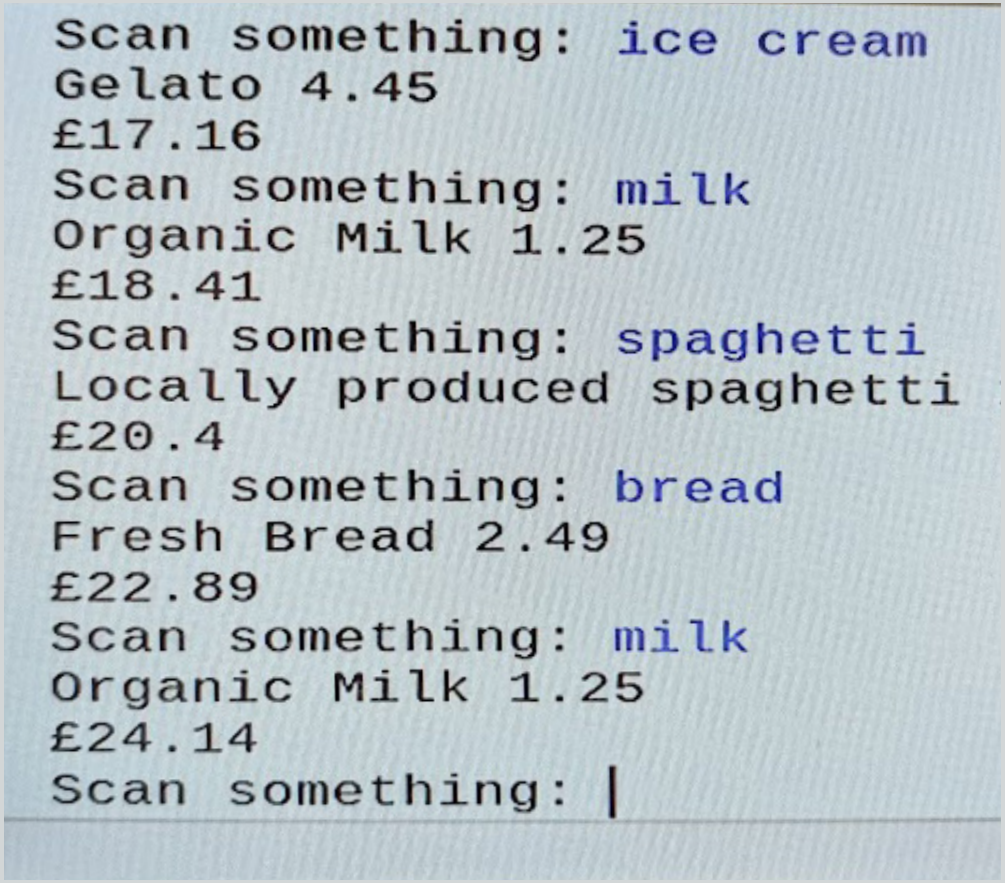
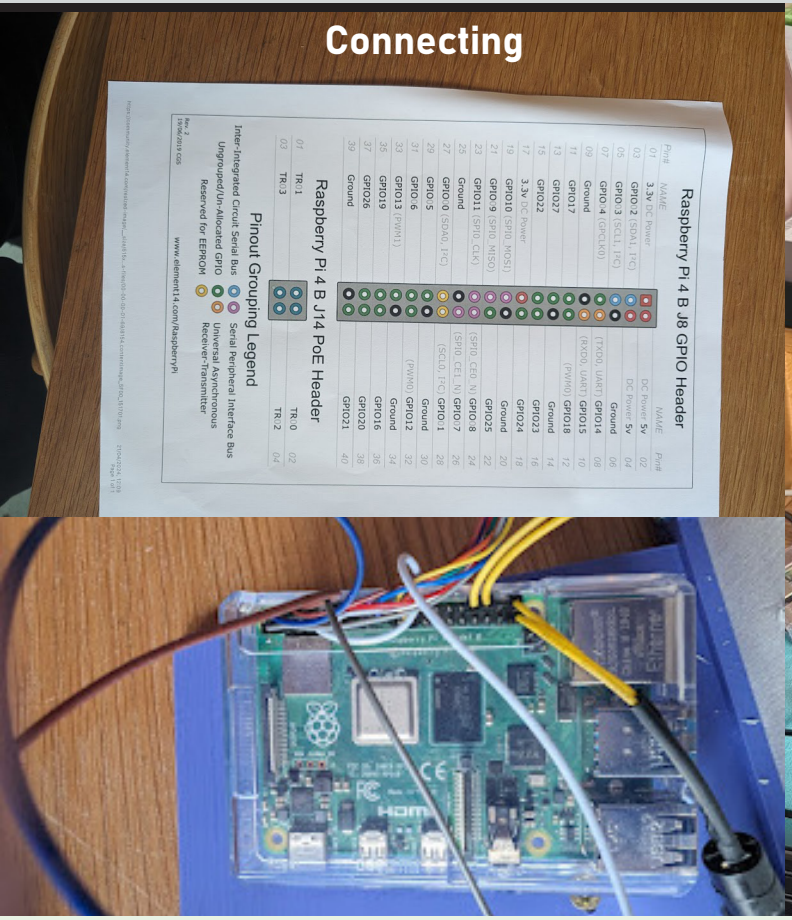


Fig 52. Output from scanning a item by Lucca Muchmore 2024

Understanding E-Paper



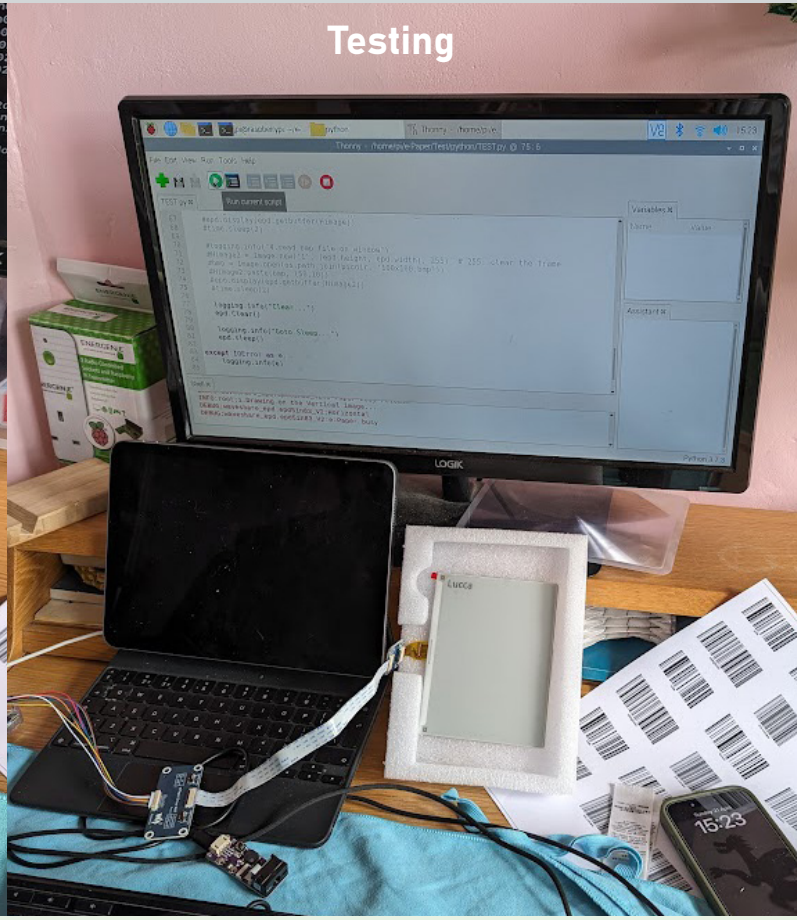


Fig 53. Gpio pins and connecting by Lucca Muchmore 2024

Fig 54. Editing tutorial by Lucca Muchmore 2024

Fig 55. An image on E-paper by Lucca Muchmore 2024

After the initial phase of coding and displaying outputs from my inputs I connected the e-paper screen through the pins on the Raspberry pi and then following set up instructions using command prompt to download required files to make it run and get the demo running.

This was a long and challenging process with many issues to make it run such as optional files being needed not running correctly using files outside the demo and the file wouldn't run after playing the demo video multiple times. I managed eventually to edit one file in which I wrote my name and displayed it. Following this small triumph I went on to adjust my previous code to output to the e-paper screen.

Fig 56, Displaying inputs from bar code scanner by Lucca Muchmore 2024

```
result = [x for x in data if x["barcode"] == barcode_data]
energyUsed += 1


if scanningStarted == False:
    #only really need to di this once when scanning has started
    draw.rectangle((0, 75, 480, 800), fill = 255)#white out below logo

    #labels in boxes
    draw.rectangle((0, 80, 240, 115), fill = 0)
    draw.text((40, 80), 'Your Items', font = fontLabel, fill = 255)
    draw.rectangle((245, 80, 480, 115), fill = 0)
    draw.text((315, 80), 'Totals', font = fontLabel, fill = 255)

    scanningStarted = True

    #epd.display_Partial(epd.getbuffer(Limage),0, 0, epd.width, epd.height)
```

Fig 57 Code to display items by Lucca Muchmore 2024

Displaying My Input

The main difference between the regular OLED/ LCD screen and an e-paper screen is how it displays information. As opposed to simply printing text, with an e-paper screen you have to draw the text with the x,y co-ordinates of the screen and setting other factors like font size and style.

The process looks like this: **`draw.text(x,y) "scan to start", font=40`**

The draw function on the epaper can be used to draw more than text. One can see in the demo code examples of images, text and shapes. I went on to set all my code to draw instead of print, which allowed me to update the screen and output data driven from my bar code scanner. Some issues arose around this when I layered images, which I solved by changing the y positioning of every scan using increments of 20 pixels. I created the working prototype which takes an input displaying an output.

Key Takeaway

- Layouts had to be coded to work allowing for the restrictions and peramiters of the technology that was used.
- I designed around the object and technology in order for them to work together, finding solutions for issues when they arose.

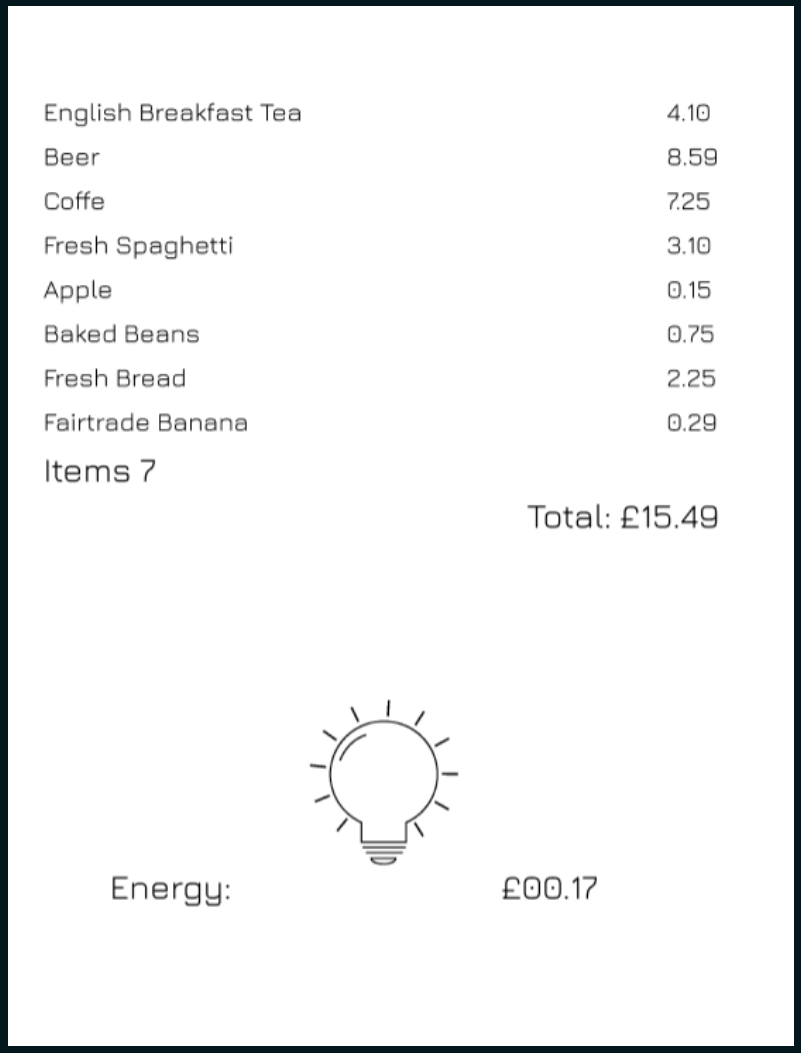


Fig 58. Wire frame to create by Lucca Muchmore 2024

Building The GUI

From the image on the left you can note the development of my screens as I adapt my code to match my figma wire frame. Using some of my personas and group feedback I adjusted information and resized elements to fit the requirements for people to make sure they can see all key parts.

Energy used

In order to create the value of energy used, I needed to look back into the project and remind myself of my scenario: A future where energy is squeezed and one that comes with a high price tag due to demand and availability. I decided on a value of £00.04 to assign to the energy use as it would be enough in today's standard to make an impact on people in order to take note but it also wasn't so far fetched that seemed unrealistic.

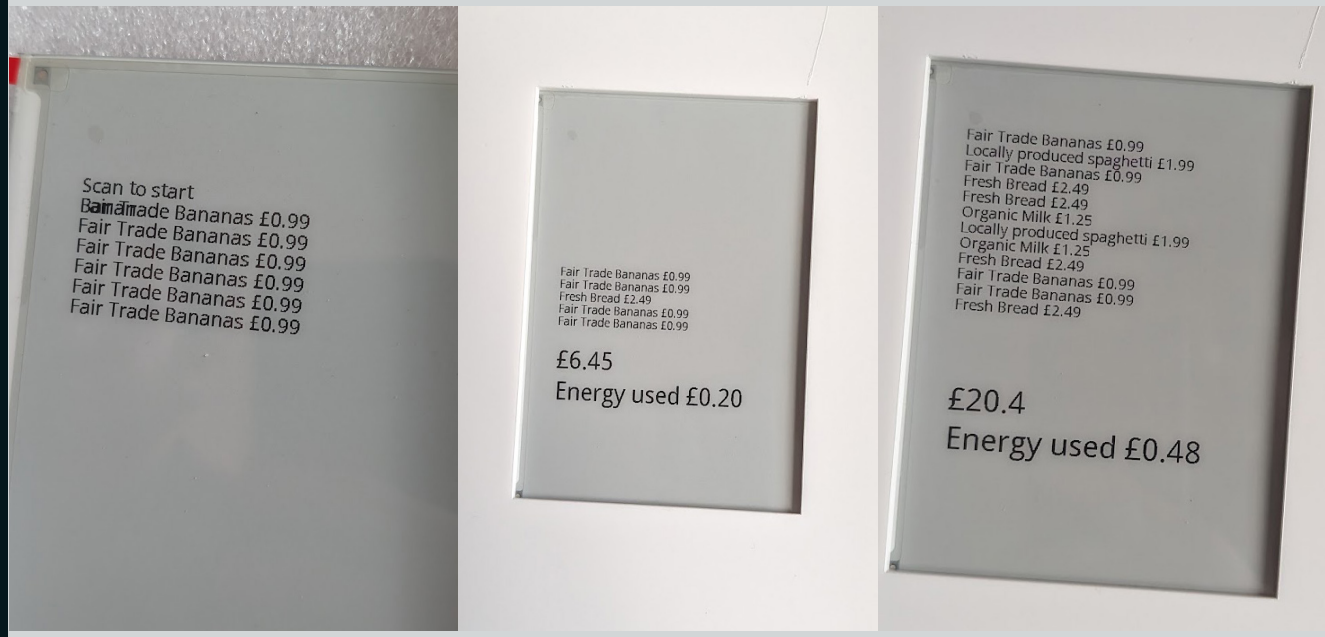


Fig 59. Development of GUI by Lucca Muchmore 2024

Preparation For User Test

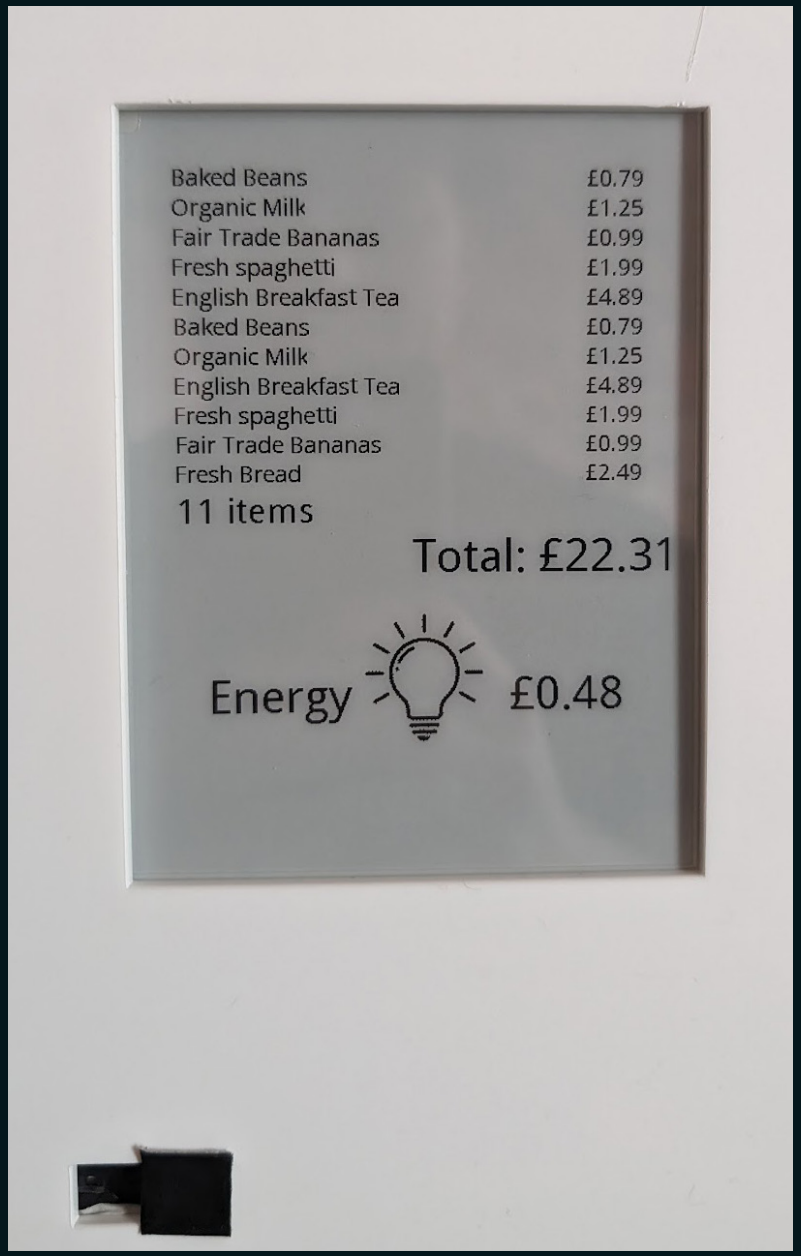


Fig 60. Interface development by Lucca Muchmore 2024

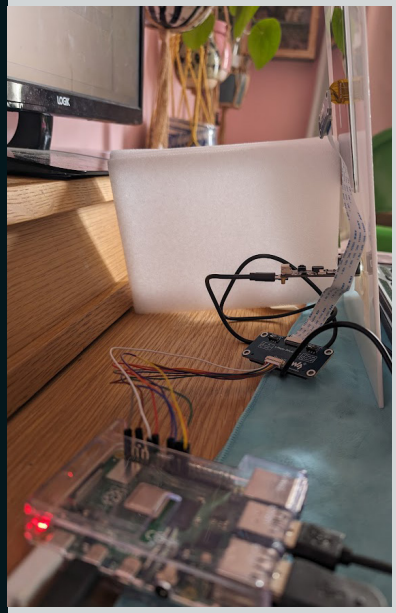


Fig 63.5 Behind the acrylic Showing components by Lucca Muchmore 2024

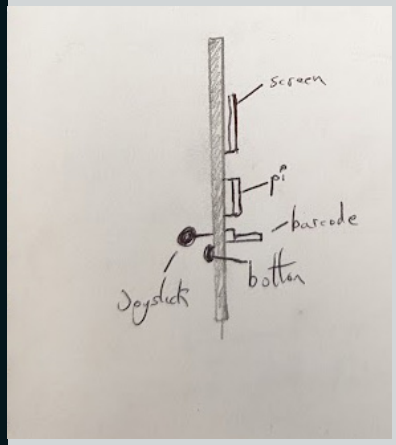


Fig 61. Image of screen by Lucca Muchmore 2024

In preparation for user testing I designed and created a product for a user to scan as an alternative using a sheet of bar code.

I feel this helps the user gain an understanding immediately of what the prototype is designed to do and helps them engage from an everyday real life access point to the experience. It was important that the items are everyday products you might encounter but with the added brand of Lo Energy to illustrate the overarching project.

I also added additional parts to the acrylic frame using tape to hold in place.

Fig 62. Lo Energy branded beans by Lucca Muchmore 2024

User Testing And Feedback

5 seconds per update

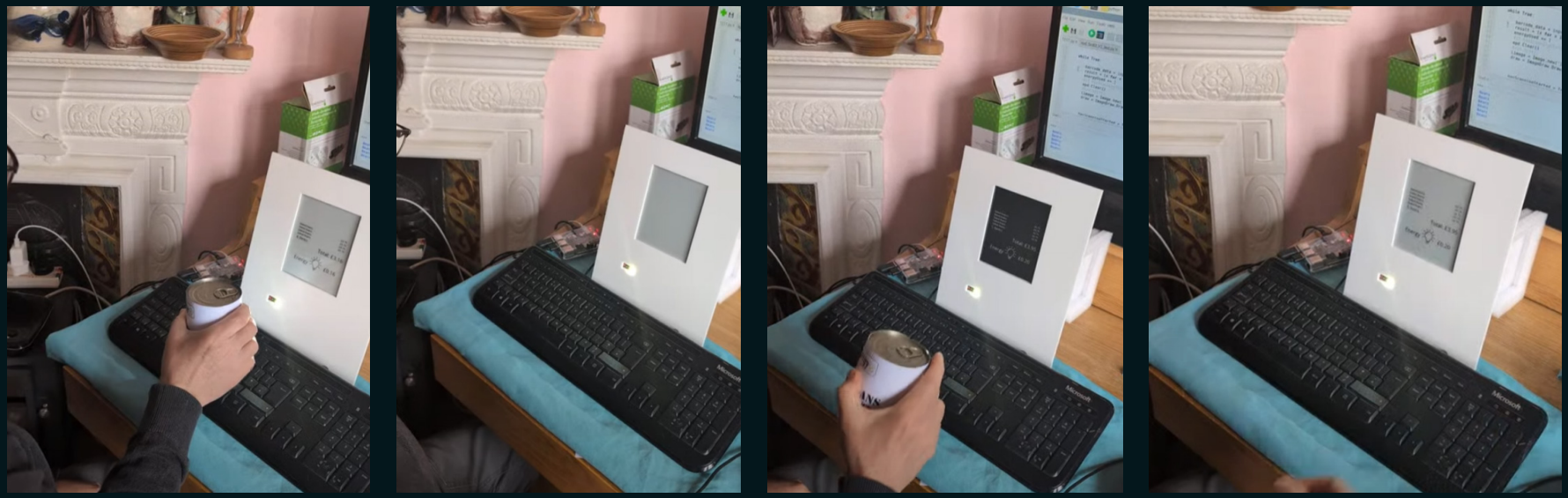


Fig 63 Process of a user operating the prototype by Lucca Muchmore 2024

The user testing session highlighted two commonly experienced issues, one was the response time- the screen was too slow to update with the newly scanned information taking around 5 seconds. This had not been an issue previously until the user testing phase.

Another issues found by the user testers was the icon not changing or updating with the amount of energy used. Additionally the interface was described as too bland, having some alignment issues and issues with labelling certain areas for what they are like total price and items.

Finding Solutions

After some research on trying to find a solution to the issue of screen refreshing and updating at a faster speed, I found out about partial refresh. Partial refresh allows only a part of the screen to refresh and after trying to experiment with my screen I found that was not compatible for this. The solution was to look in to alternative versions of the e-ink screen that may solve this issue and after seeking out different products I came across a screen similar in size to mine for an appropriate price that allowed for partial refresh.

Key Takeaway

- Programming a partial refresh which allowed for speed and ease of use for the user
- Changing which e paper screen is used in order to speed up the process for the user

Fig 65. Second e-paper screen by waveshare

Features At A Glance

- No backlight, keeps displaying last content for a long time even when power down
- Ultra low power consumption, basically power is only required for refreshing
- Standard Raspberry Pi 40PIN GPIO extension header, supports Raspberry Pi series boards, Jetson Nano
- SPI interface, for connecting with controller boards like Raspberry Pi/Jetson Nano/Arduino/STM32, etc.
- Onboard voltage translator, compatible with 3.3V / 5V MCUs
- Comes with online development resources and manual (examples for Raspberry Pi/Jetson Nano/Arduino/STM32)

Specifications

OPERATING VOLTAGE	3.3V/5V	DISPLAY COLOR	black, white
INTERFACE	3-wire SPI, 4-wire SPI	GREY SCALE	2
OUTLINE DIMENSIONS	170.2 × 111.2mm	FULL REFRESH TIME	5s
DISPLAY SIZE	163.2 × 97.92mm	FAST REFRESH TIME	1.2s
DOT PITCH	0.205 × 0.204mm	PARTIAL REFRESH TIME	0.4s
VIEWING ANGLE	>170°	REFRESH POWER	26.4mW(typ.)

Fig 66. Stats of new screen with refresh times by waveshare

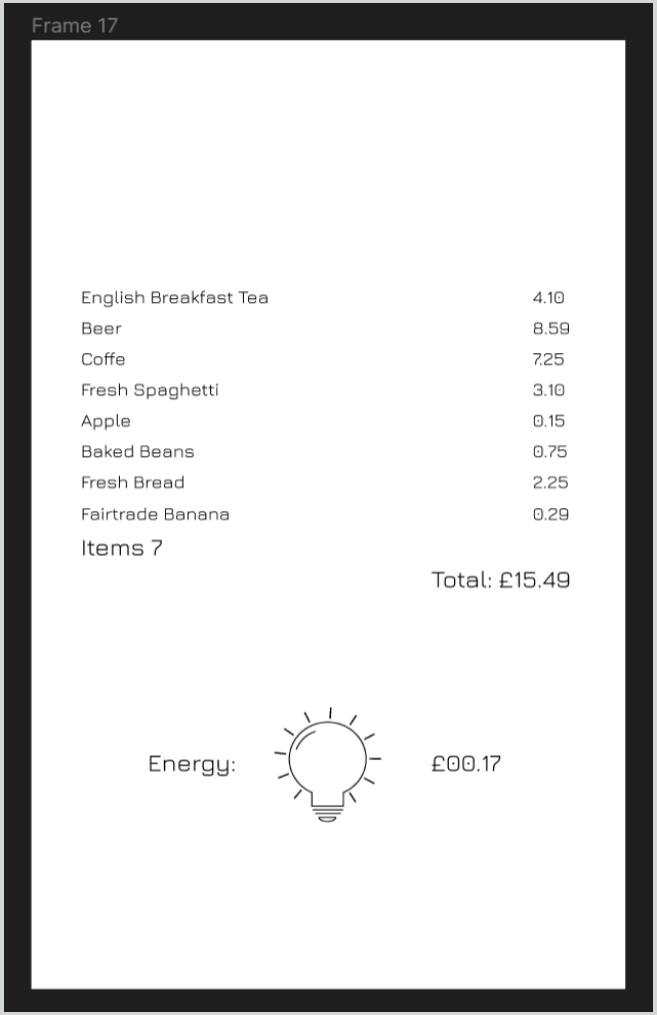
PART NUMBER	COLORS	GREY SCALE	RESOLUTION	DISPLAY SIZE (MM)	OUTLINE DIMENSION (MM)	FULL REFRESH TIME (S)	PARTIAL REFRESH	FLEXIBLE	INTERFACE
1.02inch e-Paper	black, white	2	128×80	21.76 × 14.00	32.57 × 18.60 × 0.98	2	√		SPI
1.54inch e-Paper	black, white	2	200×200	27.60 × 27.60	37.32 × 31.80 × 1.05	2	√		SPI
1.54inch e-Paper (B)	red, black, white	2	200×200	27.60 × 27.60	37.32 × 31.80 × 1.05	14			SPI
1.54inch e-Paper (C)	yellow, black, white	2	152×152	27.51 × 27.51	37.30 × 31.80 × 0.98	27			SPI
1.64inch e-Paper (G)	red, yellow, black, white	2	168×168	29.568 × 29.568	45.5 × 36.4 × 0.91	12			SPI
2.13inch e-Paper	black, white	2	250×122	48.55 × 23.71	59.20 × 29.20 × 1.05	2	√		SPI
2.13inch e-Paper (B)	red, black, white	2	250×122	48.55 × 23.70	59.20 × 29.20 × 0.98	15			SPI
2.13inch e-Paper (C)	yellow, black, white	2	212×104	48.55 × 23.70	59.20 × 29.20 × 0.98	15			SPI
2.13inch e-Paper (D)	black, white	2	212×104	48.55 × 23.70	59.20 × 29.20 × 0.30	2	√	√	SPI
2.13inch e-Paper (G)	red, yellow, black, white	2	250×122	48.55 × 23.70	59.20 × 29.20 × 1.00	25			SPI
2.36inch e-Paper (G)	red, yellow, black, white	2	296×168	52.096 × 29.568	68.1 × 37.9 × 0.85	12			SPI
2.66inch e-Paper	black, white	2	296×152	30.704 × 60.088	36.304 × 71.820 × 1.00	6	√		SPI
2.66inch e-Paper (B)	red, black, white	2	296×152	30.704 × 60.088	36.304 × 71.820 × 1.00	15			SPI
2.66inch e-Paper (G)	red, yellow, black, white	2	360×184	60.05 × 30.69	72.59 × 37.11 × 1.00	26			SPI
2.7inch e-Paper	black, white	4	264×176	57.29 × 38.19	70.42 × 45.80 × 0.98	6	√		SPI
2.7inch e-Paper (B)	red, black, white	2	264×176	57.29 × 38.19	70.42 × 45.80 × 0.98	15			SPI
2.9inch e-Paper	black, white	4	296×128	66.89 × 29.05	79.00 × 36.70 × 1.05	3	√		SPI
2.9inch e-Paper (B)	red, black, white	2	296×128	66.90 × 29.06	79.00 × 36.70 × 1.20	14	√		SPI
2.9inch e-Paper (C)	yellow, black, white	2	296×128	66.89 × 29.05	79.00 × 36.70 × 1.18	15			SPI
2.9inch e-Paper (D)	black, white	2	296×128	66.90 × 29.06	79.00 × 36.70 × 0.34	2	√	√	SPI
3inch e-Paper (G)	red, yellow, black, white	2	400×168	70.4 × 29.568	86.4 × 39.2 × 0.85	12			SPI
3.52inch e-Paper	black, white	2	360×240	74.51 × 49.67	84.70 × 54.41 × 1.18	1.5			SPI
3.7inch e-Paper	black, white	4	480×280	47.32 × 81.12	54.90 × 93.30 × 0.78	3	√		SPI
4.01inch e-Paper (F)	7-Color	2	640×400	86.40 × 54.00	96.80 × 68.70 × 0.91	30			SPI
4.2inch e-Paper	black, white	4	400×300	84.80 × 63.60	91.00 × 77.00 × 1.18	5	√		SPI
4.2inch e-Paper (B)	red, black, white	2	400×300	84.80 × 63.60	91.00 × 77.00 × 1.05	15			SPI
4.26inch e-Paper	black, white	4	800×480	92.8 × 55.68	129.33 × 62.37 × 0.93	4	√		SPI
4.37inch e-Paper (G)	red, yellow, black, white	2	512×368	90.11 × 64.77	99.5 × 79.5 × 0.85	14			SPI
5.65inch e-Paper (F)	7-Color	2	600×448	114.9 × 85.8	125.4 × 99.5 × 0.91	<35			SPI
5.79inch e-Paper	black, white	4	792×272	139.00 × 47.74	150.92 × 56.94 × 1.00	3.5	√		SPI
5.79inch e-Paper (B)	red, black, white	2	792×272	139.00 × 47.74	150.92 × 56.94 × 1.00	24			SPI
5.83inch e-Paper	black, white	2	648×480	119.232 × 88.320	125.40 × 99.50 × 1.18	5			SPI
5.83inch e-Paper (B)	red, black, white	2	648×480	119.232 × 88.320	125.40 × 99.50 × 1.18	20			SPI
6inch HD e-Paper	black, white	16	1448×1072	122.40 × 90.60	138.40 × 101.80 × 1.01	<1	√		Parallel port
7.3inch e-Paper (F)	7-Color	2	800×480	160 × 96	170.2 × 111.2 × 0.91	35			SPI
7.3inch e-Paper (G)	red, yellow, black, white	2	800×480	160 × 96	170.2 × 111.2 × 0.91	16			SPI
7.5inch e-Paper	black, white	2	800×480	163.20 × 97.92	170.20 × 111.20 × 1.18	5	√		SPI
7.5inch e-Paper (B)	red, black, white	2	800×480	163.20 × 97.92	170.20 × 111.20 × 1.18	26			SPI
7.5inch e-Paper (G)	black, white	2	800×480	163.20 × 97.92	177.20 × 118.20 × 2.00	5	√		SPI
7.5inch HD e-Paper (B)	red, black, white	2	880×528	163.24 × 97.94	170.20 × 111.20 × 1.25	21			SPI
7.5inch e-Paper (C)	yellow, black, white	2	640×384	163.20 × 97.92	170.20 × 111.20 × 1.18	16			SPI
7.8inch e-Paper	black, white	16	1872×1404	158.18 × 118.64	173.80 × 127.60 × 0.78	<1	√		Parallel port

Fig 64. E-Paper Screens with refresh times by Waveshare

New Screen / New Interface

Taking on board feedback from my users, I began to make changes to the wire frame with the new screen size.

The new screen would set up to allow only a few parts of the screen to refresh. I also used the same name of product as talking to tutors it would be helpful to add the name of the project to it which would help with its branding, identity and communicates its overall purpose.



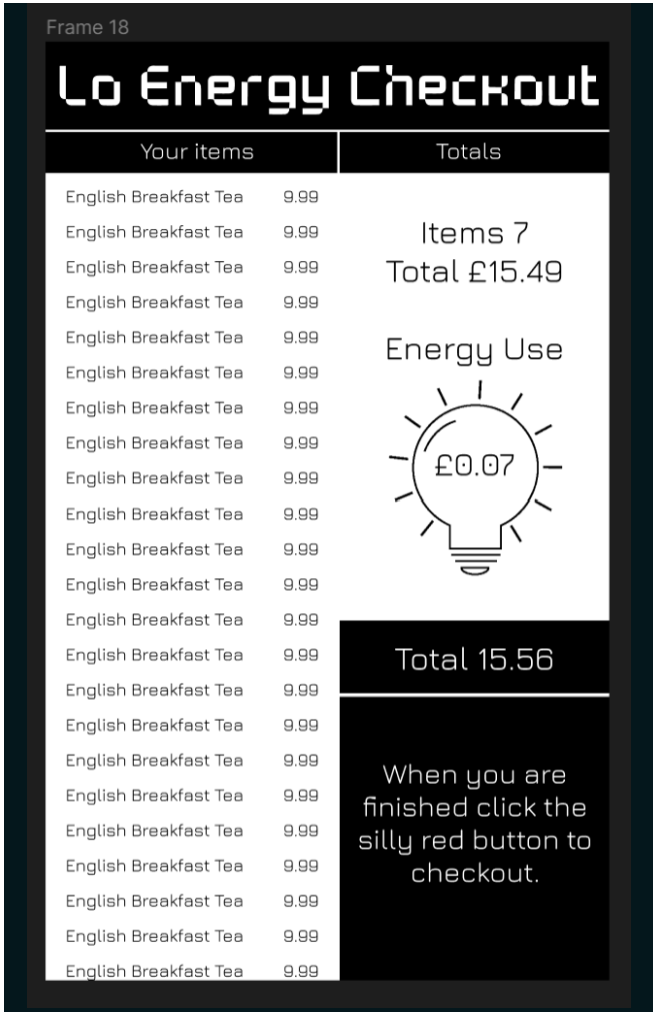


Fig 67. Screen shot of wire frame of GUI interface development by Lucca Muchmore 2024

Screen Refreshes

Old screen

Full refresh time : 5 seconds
Partial refresh : n/a

New screen

Full refresh time: 5 seconds
Partial refresh : 1.2 seconds

My figma design allows for zones in which I will set up partial refresh for immediate updates, such as adding a new product and changing total and more.

Key Takeaway

- Modifications around timing and refresh zones were necessary for the user experience process

Partial refresh

Full refresh

Energy Meter

Iconography

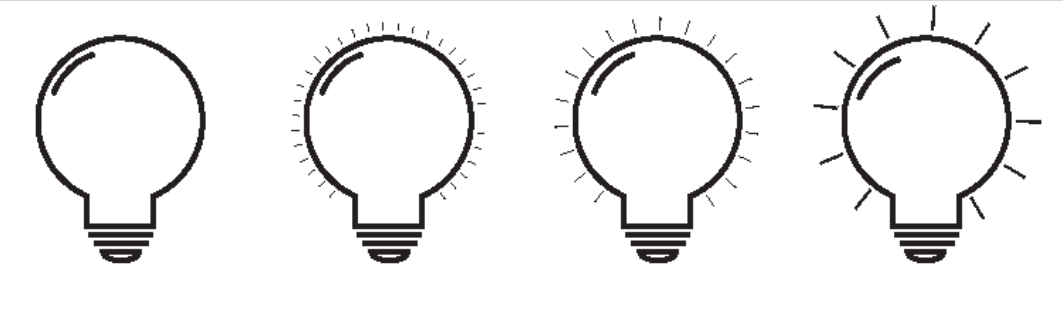
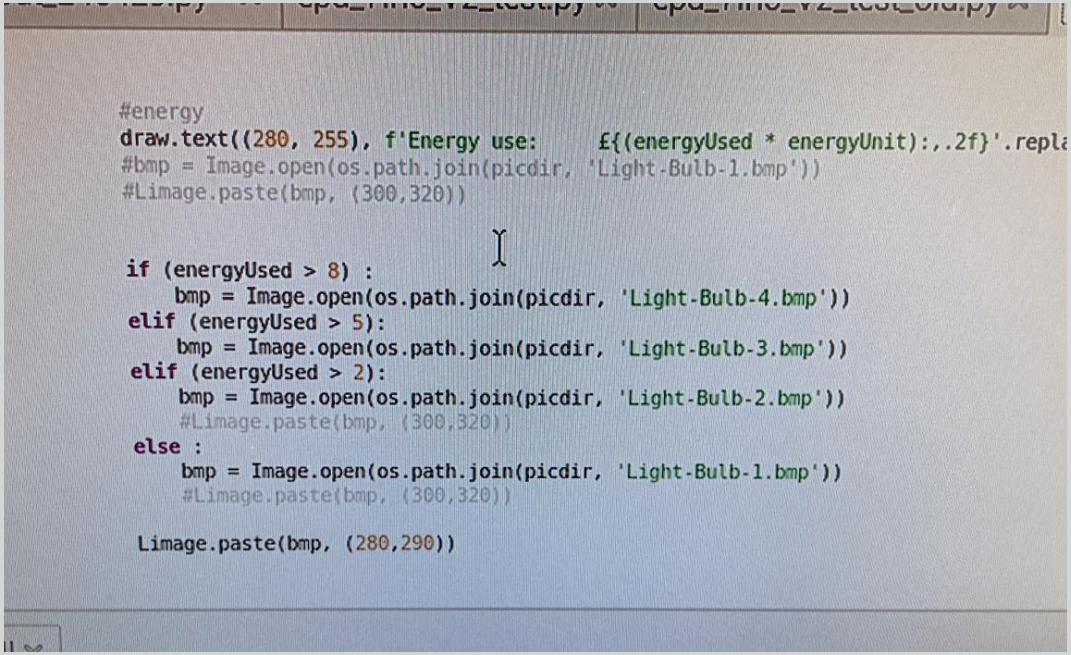


FIG 67.5 light bulb icon changing by lucca muchmore



```
#energy
draw.text((280, 255), f'Energy use:     £{(energyUsed * energyUnit):,.2f}'.repla
#bmp = Image.open(os.path.join(picdir, 'Light-Bulb-1.bmp'))
#Limage.paste(bmp, (300,320))


if (energyUsed > 8) :
    bmp = Image.open(os.path.join(picdir, 'Light-Bulb-4.bmp'))
elif (energyUsed > 5):
    bmp = Image.open(os.path.join(picdir, 'Light-Bulb-3.bmp'))
elif (energyUsed > 2):
    bmp = Image.open(os.path.join(picdir, 'Light-Bulb-2.bmp'))
    #Limage.paste(bmp, (300,320))
else :
    bmp = Image.open(os.path.join(picdir, 'Light-Bulb-1.bmp'))
    #Limage.paste(bmp, (300,320))

 Limage.paste(bmp, (280,290))
```

Fig 68. Code of icon changing based on items scanned by Lucca Muchmore 2024

I wanted to improve elements guided by user and peer feedback. It was also important to communicate the energy usage to a user in order to highlight the projects aims.

Previously in the wire frames I chose to use colour but due to the higher energy used in producing colours my colour palette choices were limited to black and white and so I needed to adapt the design around these parameters.

Through the group discussion it was suggested to use lines around the bulb as to show it brightening and display as more energy is used the brighter and longer the lines get.

Within the code they are set to:

- 0-2 scans
- 2-5 scans
- 5-8 scans
- 8 + scans

Key Takeaway

- Using group discussion to develop visual energy clues for the user.
- Discussing the colour palette choice with explanation on why they have been made with Low energy in mind.

Reset

After adding in my interface to the new screen and the partial refresh I then realised I would need to create a way to reset the system between users so that someone could start a new scanned shop process without adding to the previous shop.

Firstly I explored through my user journey again and realised that I would need one additional input for my prototype so I went on to explore two options for this.

Option 1 :
Using a bar code to be read by the bar code to reset the device.

Option2 :
Using a button to reset the products

I chose to add in a button. After considering both options and weighing the benefits and drawbacks, one of the downsides of option 1 would be that I would have to add additional information to explain what a bar code did.
I believed that this would hinder the immersion for the user and also create potential confusion. As a result I took another trip to the laser cutter to create a new hole and bigger frame for the checkout.

Fig 69. New interface by Lucca Muchmore 2024

Progress

1.2 seconds per update

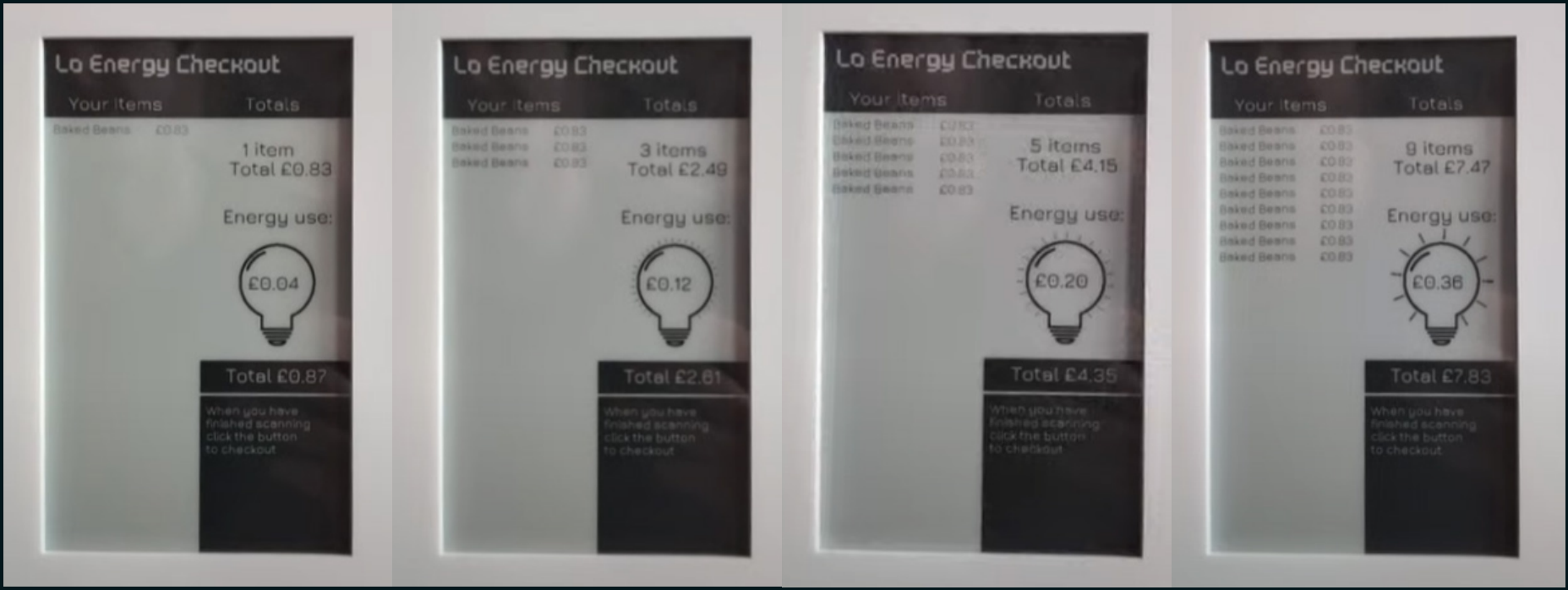


Fig 70. New interfaces and refresh by Lucca Muchmore 2024

The modified screen with the partial refresh display now roughly takes 1 second to display the new information in the chosen area. The icons also change at different values, which visually shows the user how much energy they are using .

Presenting To Peers/People In Industry

Feet

In preparation for presenting to people from industry I realised I had an issue of how to physically hold up the checkout on a desktop space, so I created 3D printed feet that the acrylic would slot into and be held up at 87 degree angle.

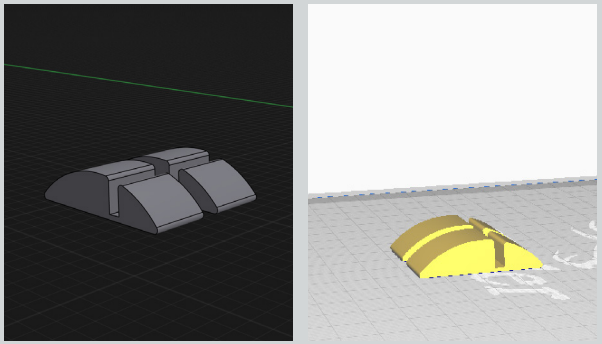


Fig 71. 3d print of leg stands by Lucca Muchmore 2024

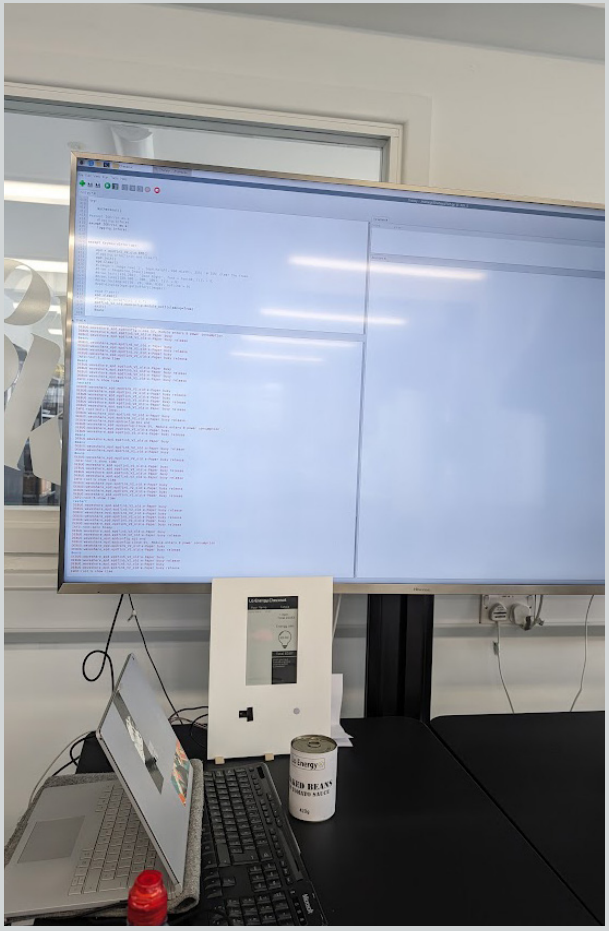


Fig 72. Set up used for peer and industry people by Lucca Muchmore 2024

I received some feedback from Jason who is a user experience designer at the BBC. He offered constructive feedback on how to present my work in the graduate show and my process book.

Jason suggested using design elements to include a summary of statistics and to highlight my research more along with the reason for why I am exploring energy through design fiction. In short, make sure I am communicating my main points of the project.

He highlighted a need for creating a wow factor by using images for the refresh and partial refresh areas of my screen.

Key Takeaway:

- Useful information from industry professional has helped me think about wow factor
- Highlighted the need to show statistics to help communicate the projects aims and need for low energy.

User Testing With Peers

Following our industry presentation, I gathered classmates to come and do some user testing of my prototype to help me better understand if there were elements that I was missing or that were confusing about how to interact with the machine.

The feedback from the session was

- The inner part of the icon was a bit confusing as people mistook it for progress.
- The frame material was made from plastic, a non renewable resource even though the project has environmental concern at its heart. Was there a more sustainable option?
- No button to help restart the programme other than typing restart - the machine would benefit from a button.
- The process needs instructions from me on how to use and say where the bar code scanner is. The suggestion was to add a text label instruction for ease of use.

Key Takeaway

- Very useful session that helped me consider the ecology of the materials used for the prototype
- Interface hurdles were established where main areas of confusion were.
- The need for a button

Input Challenges

After the user feedback and presenting my idea to peers and industry I decided to work on making the button facility and focused on creating a working and compatible button for the Raspberry pi.

The button I decided to use was a Squid button non-latching which would act as my reset.

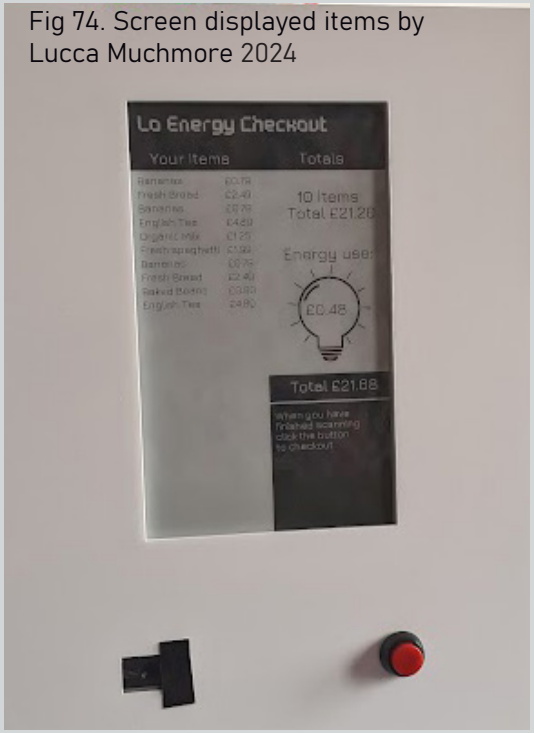
Some issues I went through with the buttons was that it only working at particular times because it would run the code constantly in a loop but would only look for button press at certain points in the cycle so I had less than a second to get the timing correct. This was a challenge.

The solution was to set the button as an on off switch for the pi and make the programme run on start up and this worked very well apart from the delay between customers so I added a screen showing details and saying 'Please wait'.

Fig 75. Squid button by Lucca Muchmore 2024

Fig 73. Screen with button added by Lucca Muchmore 2024

Fig 74. Screen displayed items by Lucca Muchmore 2024



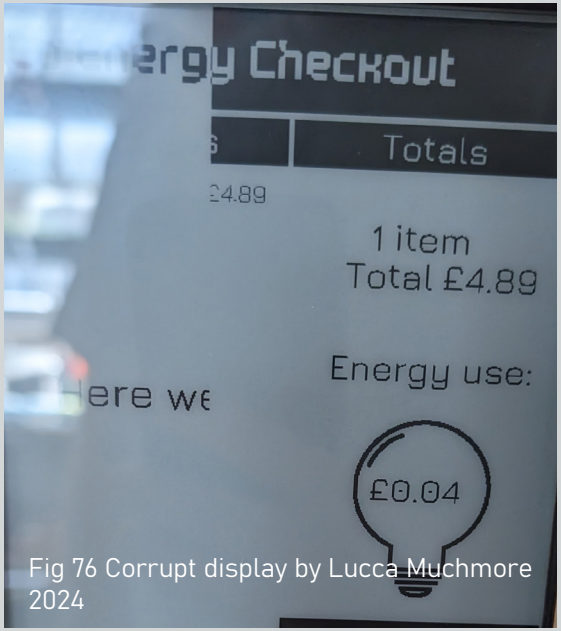


Fig 76 Corrupt display by Lucca Muchmore 2024

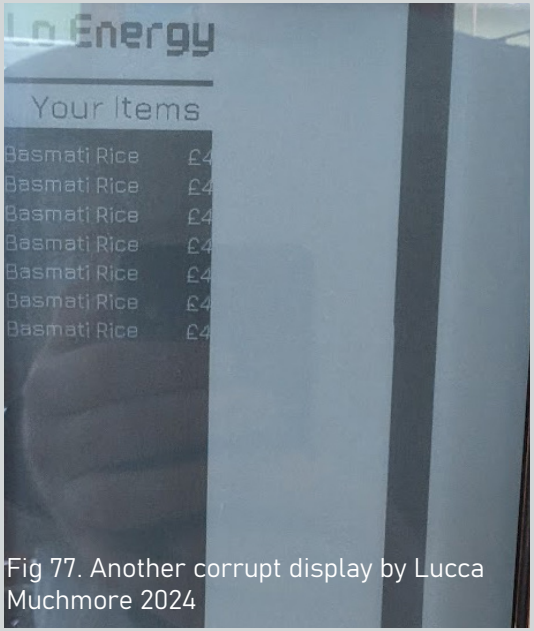


Fig 77. Another corrupt display by Lucca Muchmore 2024

Phase 4 : Finalising

Rebuilding the Frame

With the user testing complete, I began to make a design that was more stable. I used the user feedback such as using a renewable material for construction that also fits in with the low energy scenario.

In order to provide more to my design fiction elements within the object, I created 3D prints to help store and hold my designs in place which would help to limit movement and look complete and considered.

I used laser cut 2 6mm plywood in the UX Laser to be able to mount some 3d printed designs which would hold my components in place.

The software that I used to create all the 3D prints was shapr3d.

Fig 78. Wood laser cut by Lucca Muchmore 2024

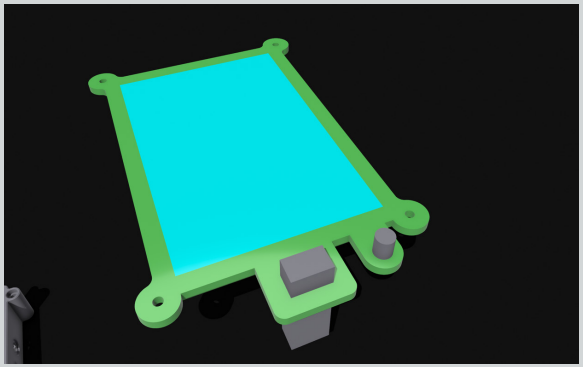


Fig 78.5. 3d print design by lucca Muchmore 2024

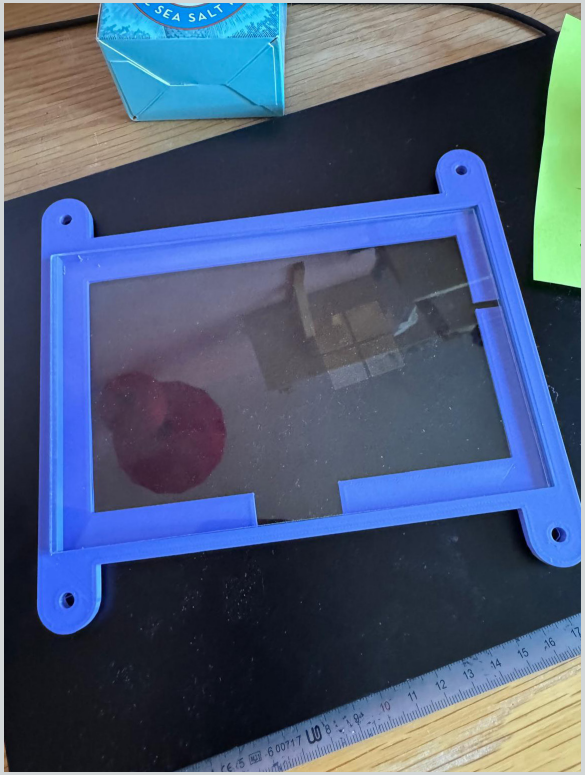


Fig 79. 3d print and glass protector by Lucca Muchmore 2024

Rebuilding the Frame

An assembly of all the model components that hold the technology elements together, created in 3d print using filament made from corn-starch.

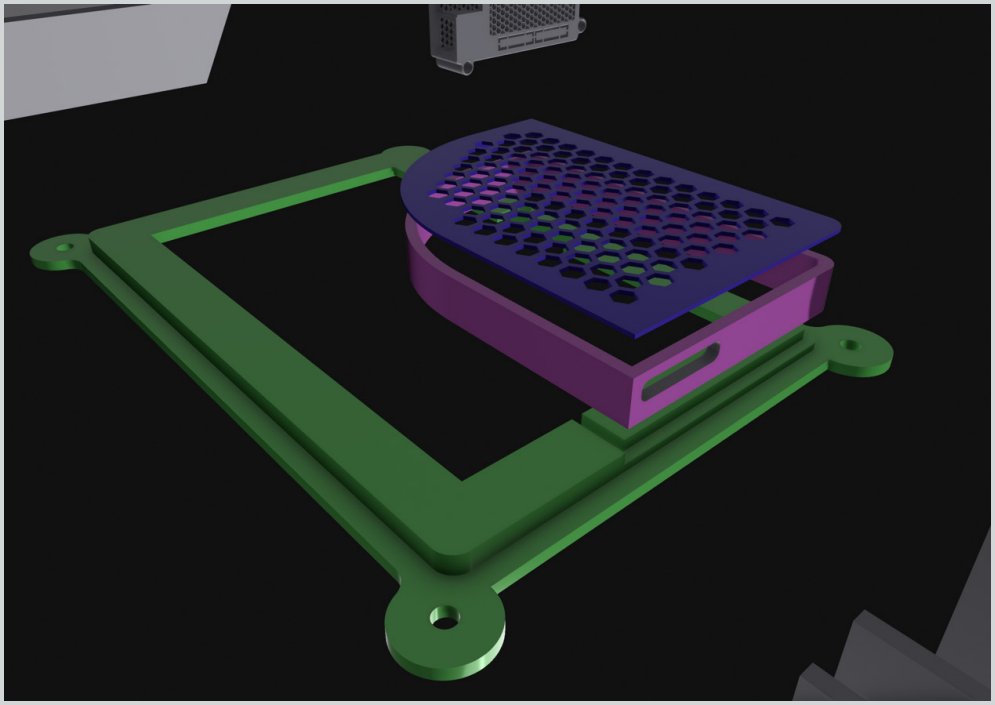


Fig 80. 3d dsign for components by Lucca Muchmore 2024

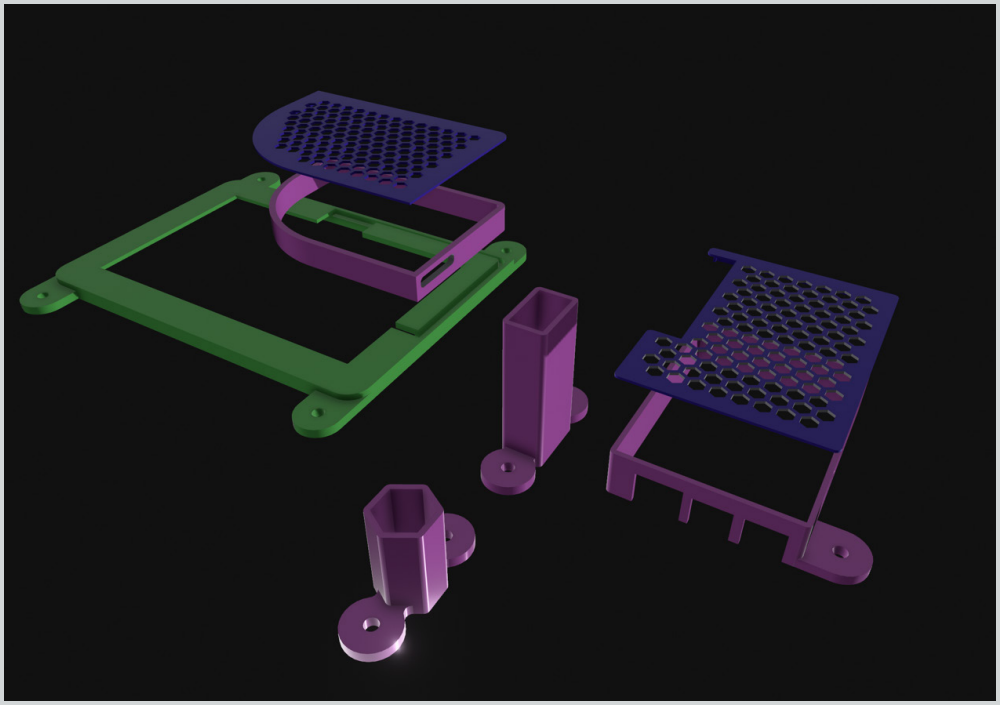


Fig 81. 3d design for the components by Lucca Muchmore 2024

Final Outcome

This is the final version of the prototype that I set out to achieve in my proposal.

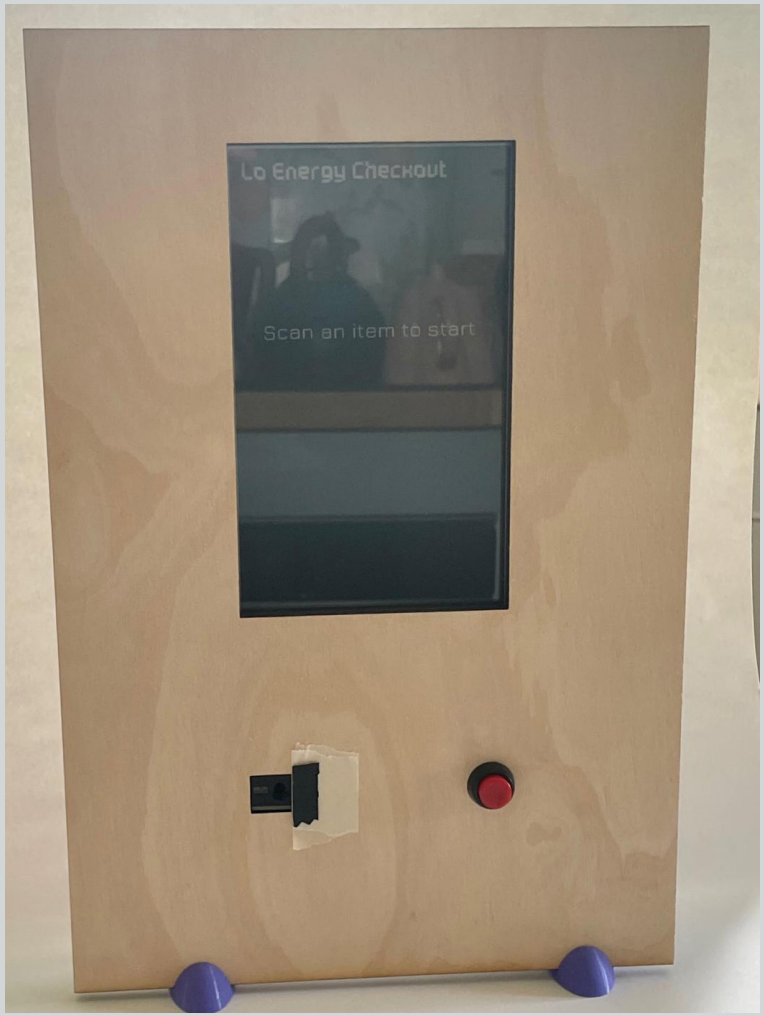


Fig 82. Final Assembly Front by Lucca Muchmore 2024

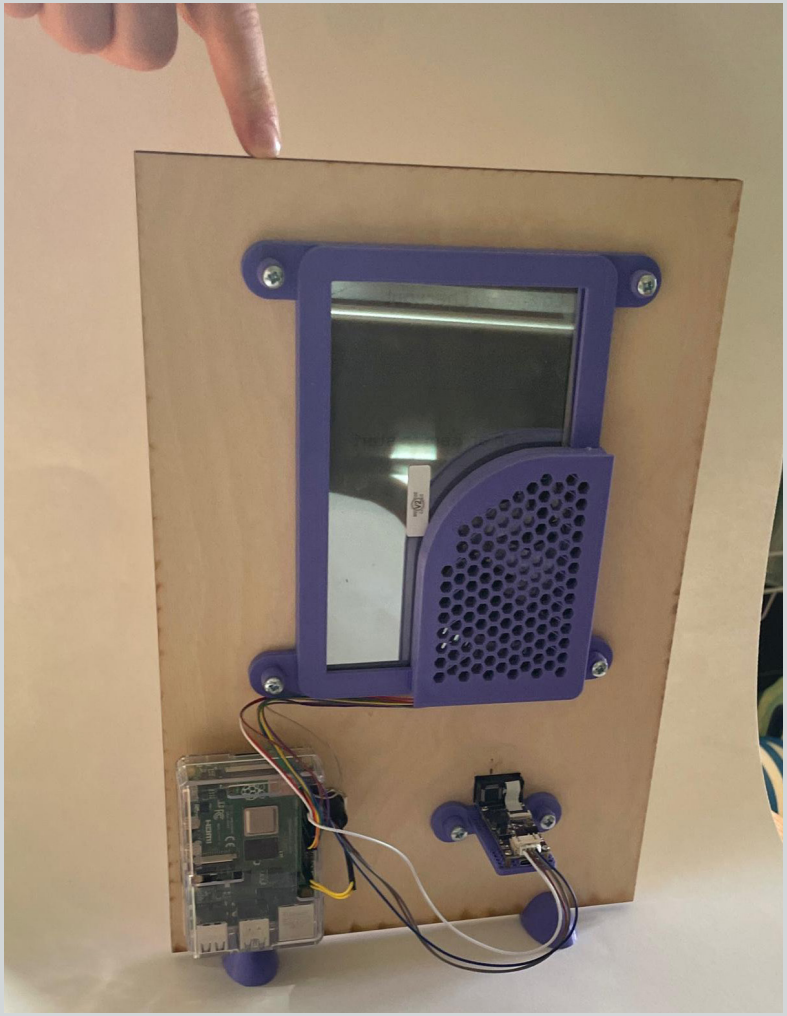


Fig 83. Final Assembly Back by Lucca Muchmore 2024

For this prototype the energy cost excluding the pi is £9.8404 for 8 hours scanning. If the machine was working for 8 hours, serving 246 customers per hour potentially uses only 12% of the power using the same components (breakdown of calculation is in the appendix). As the technology improves this prototype could be even more energy efficent and continue to improve on the energy it uses today,

User Testing

On completion of the assembly of the prototype, I undertook some final user testing with my peer UX designers again to get any final insights to help me reflect on my work.

Feedback

- No issue with the speed of scanning compared to previous version
- There were a few issues of the button corrupting the screen or would no working all the way.
- Make it easier to understand the total with energy combined
- Colours fit with the design
- The layout of where to place items need to be easy to understand as usually get confused

Fig 84. Final user testing by Lucca Muchmore 2024

Development for Graduation Show

Fig 85. Products and prototype by Lucca Muchmore 2024

For my graduation show I have a few more things done or plan to do.

These are:

- More prop products for a user to scan (approx 6)
- Making an improved sturdier stand
- A receipt printer with the energy used and contact details
- A laser cut ply storage basket for the products to be housed in.

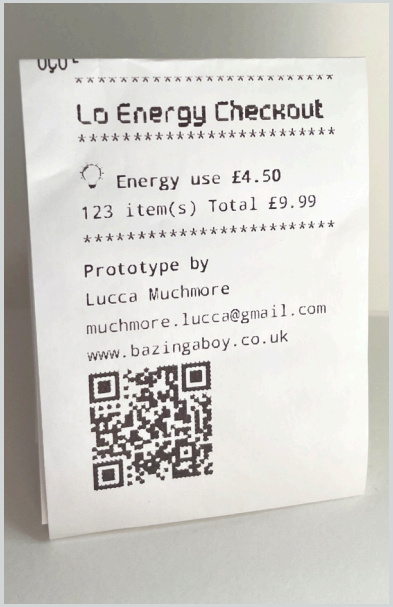


Fig 87. Receipt by Lucca Muchmore 2024

Fig 88. basket by Lucca Muchmore 2024

Reflection/ Conclusion

There have been many things that I have learnt from making this project, such as using and setting up new components on a pi, building GUI on a screen using python, connecting and testing new components and also carrying out more extensive and new research techniques in order to gather insights. Being able to conduct a number of user tests on the realisation prototype is also a new experience for me . When working on this project, the most challenging parts was the feeling of hitting a brick wall with some of the issues and problems, particularly with the process of making all the technology work together. Often I would try another method if the original method didn't work and I found that taking a step back and thinking more objectively really helped me think of some solutions, for example the addition of a button screen and more.

I think that the most helpful part of designing and realising my work was the use of user feedback as it really helped inform decisions and also made me adapt to hurdles. The user feedback sessions, conducted with a range of users helped to ultimately elevate the design in an agile way. I really enjoyed this way of working and appreciate that as much as you have ideas yourself it makes a big difference to get users to test that and as a designer how to respond.

I think that the prototype's use in the future has lots of potential and I see it as a beginning of a focus on low energy technology. One could go on and get better screens in the future or with more funding it would have the potential to enhance the experience in many different ways, such as considering all elements of the build and each elements energy use. It has potential because you can add data bases in order to be able to scan items you see in store not just dedicated ones for bar codes thus enabling these for real use in store (at the moment these are bar code's I have made for this experience).

From the proposal stage through to the realisation I believe I have achieved my goals, not to say that these haven't had to have necessary modifications and adaptations. The process to get to the realisation and prototype stage, with removal of workshop and the increase in more user testing and other technology based issues have all been part of the journey. I can see that through low energy interfaces, many technologies could be adapted to many interfaces in any location and this is a very interesting concept that could change how much energy we use. I am pleased to have explored this and realised it with a working prototype.

In addition to completing the proposal the changes and development it is important to realise the affect of the build. The 3D printing substance was made from cornstarch filament instead of normal plastic filament but considering it is permanently in that shape it is not renewable or is hard to repurpose. In addition the receipt printer is potentially carcinogenic and it is not printed on recyclable paper but justifying this it comes as a like a business card for people to see my project with as it fits with the theme of my project a bit more than just a business card.

Figure List

Fig 30. Comparing power consumption of 3 ultra low energy usage screens by rdotAB
https://www.ynvisible.com/news-inspiration/energy-efficiency-electrochromic-displays-e-paper-reflective-lcd accessed on 06/02/24

Fig 31. E-paper screen by PI HUT
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Fig 32. Reflective LCD screen By Pi Hut
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Fig 33. R dot screens By rdotAB
https://rdotdisplays.com/prototype-manufacturing accessed on 07/02/24
Fig 34 (kindle screen /interface) by Lucca Muchmore 2024

Fig 35. Bar code scanner 2d/1d By SeenGreat 2024
https://seengreat.com/product/230/barcode-scanner-reader
Fig 37. Raspberry Pi 4 by Lucca Muchmore 2024

Fig 38. Layout of the screen and components how they could attach by Lucca Muchmore 2024

Fig 39. Dimensions of screen to made to be laser cut by Lucca Muchmore 2024

Fig 40. Laser cut acrylic cover by Lucca Muchmore 2024

Fig 41. Wire frame to correct scale in landscape by lucca Muchmore 2024

Fig 42 (wire frame lighter version portrait) by Lucca Muchmore 2024

Fig 43 (kindle screen in my laser cut) by Lucca Muchmore 2024

Fig 44. User testing with the frame by Lucca Muchmore 2024

Fig 45. Start page by Lucca Muchmore 2024

Fig 46. Items and list page by Lucca Muchmore 2024

Fig 47. Checkout page by Lucca Muchmore 2024

Fig 48. Bar code scanner not scanning by Lucca Muchmore 2024

Fig 49. Bar code scanner scanning by Lucca Muchmore 2024

Fig 50. Online bar code maker by Lucca Muchmore 2024
https://www.cognex.com/en-gb/resources/interactive-tools/free-bar-code-generator Accesed
Fig 51. Data file of bar code scanner numbers by Lucca Muchmore 2024

Fig 52. Output from scanning a item by Lucca Muchmore 2024

Fig 53. Gpio pins and connecting by Lucca Muchmore 2024

Fig 54. Editing tutorial by Lucca Muchmore 2024

Fig 55. An image on E-paper by Lucca Muchmore 2024

Fig 56, Displaying inputs from bar code scanner by Lucca Muchmore 2024

Fig 57Code to display items by Lucca Muchmore 2024

Fig 58. Wire frame to create by Lucca Muchmore 2024

Fig 59. Development of GUI by Lucca Muchmore 2024

Fig 60. Interface development by Lucca Muchmore 2024

Fig 61. Image of screen by
Lucca Muchmore 2024

Fig 62. Lo Energy branded beans by Lucca Muchmore 2024

Fig 63.5 Behind the acrylic
Showing components by Lucca Muchmore 2024

Fig 63 Process of a user operating the prototype by Lucca Muchmore 2024

Fig 64. E-Paper Screens with refresh times by Waveshare
https://www.waveshare.com/7.5inch-e-Paper.htm accessed 13/04/24
Fig 65. Second e-paper screen by waveshare
https://www.waveshare.com/7.5inch-e-Paper.htm accessed 09/04/24

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Why they use sefl checkout
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chart showing power consumption for size of screen types
Modern Screen-Use Behaviors: The Effects of Single- and Multi-Screen Use on Energy Intake by Samantha Marsh M.Sc., Cliona Ni Mhurchu Ph.D., Yannan Jiang Ph.D., Ralph Maddison Ph.D.accessed on 01/02/24
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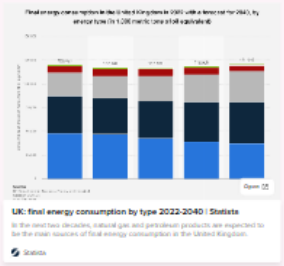
Appendix:

energy trends



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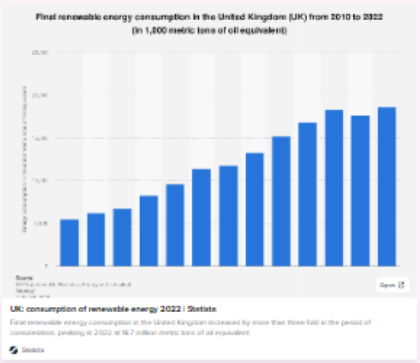

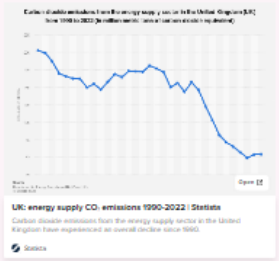

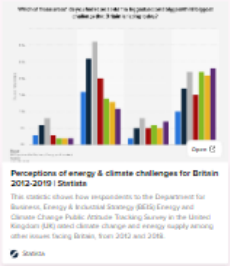

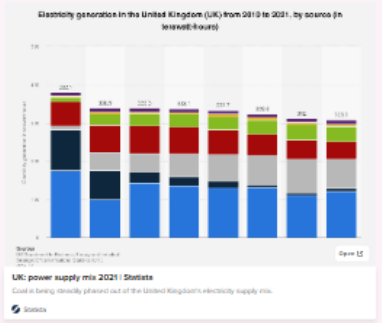

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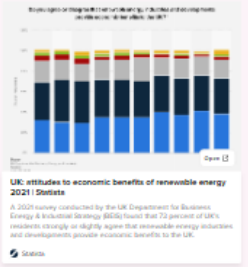
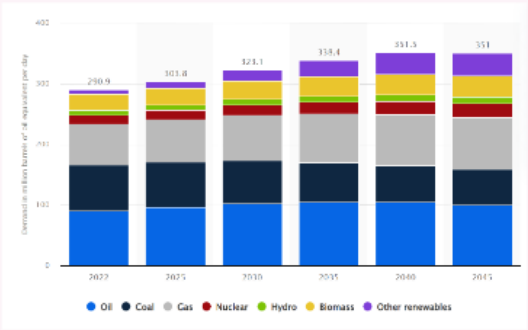
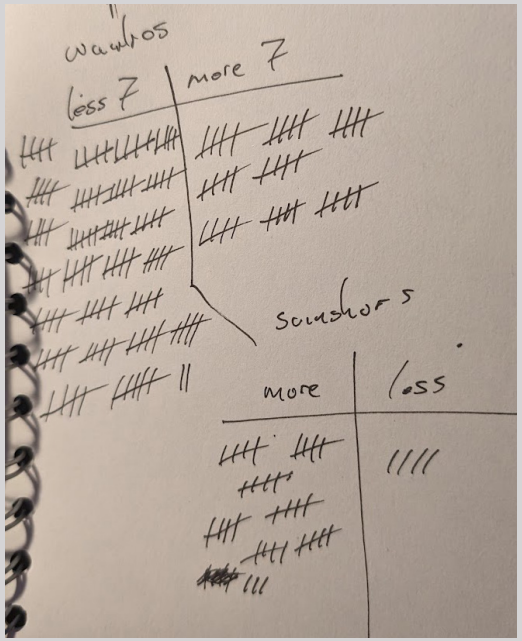
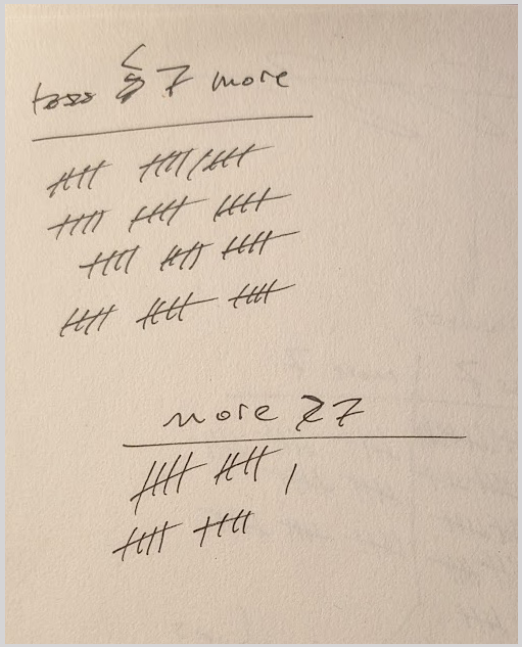
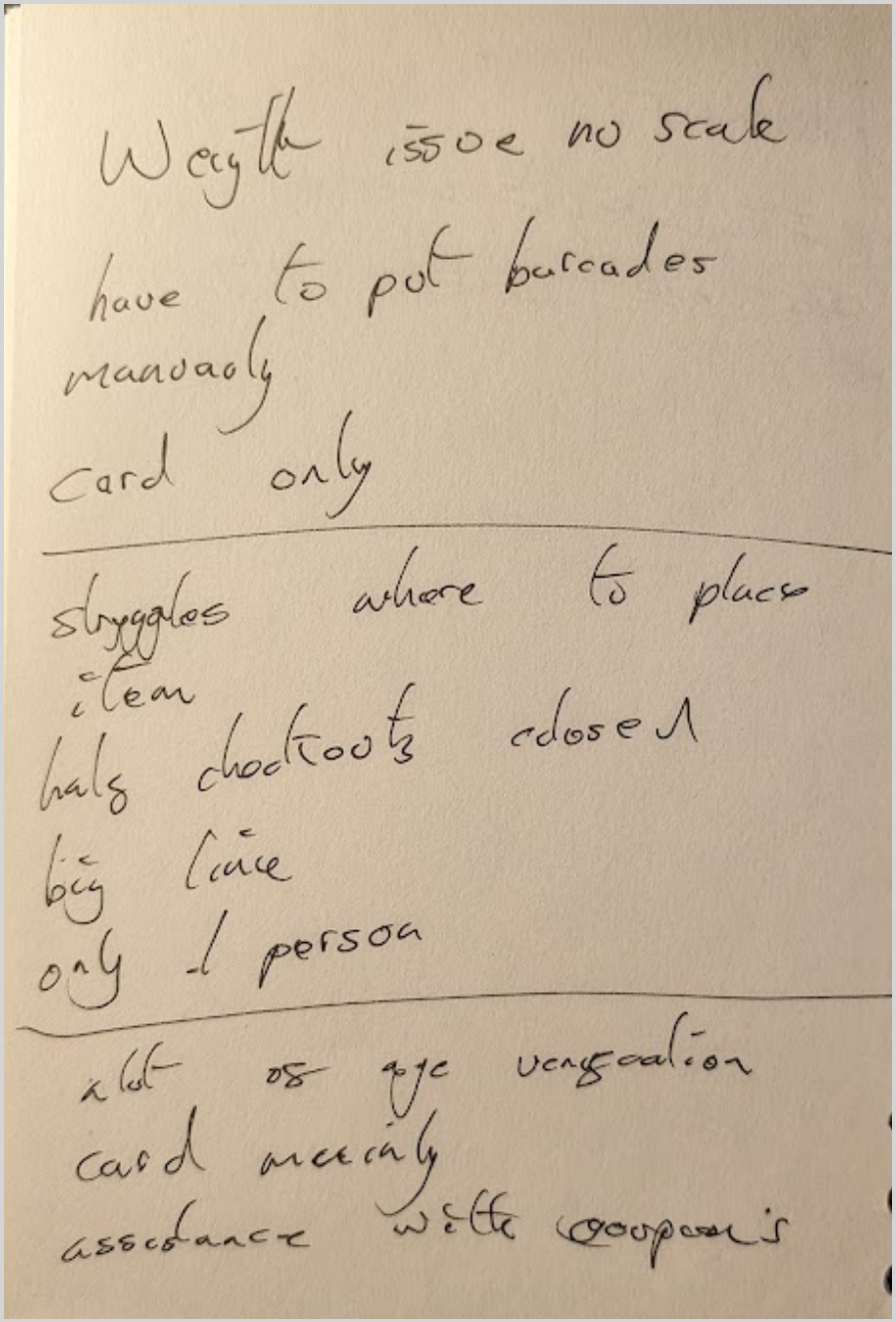




screenshot of my reserach and studys on energy trends and gathering infomration for my scenario







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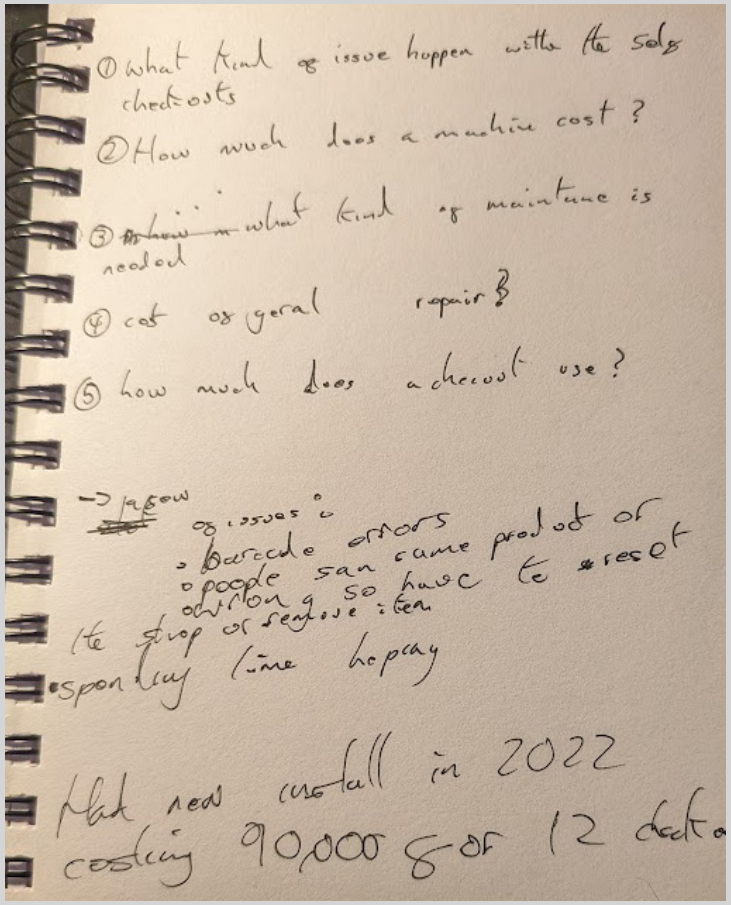

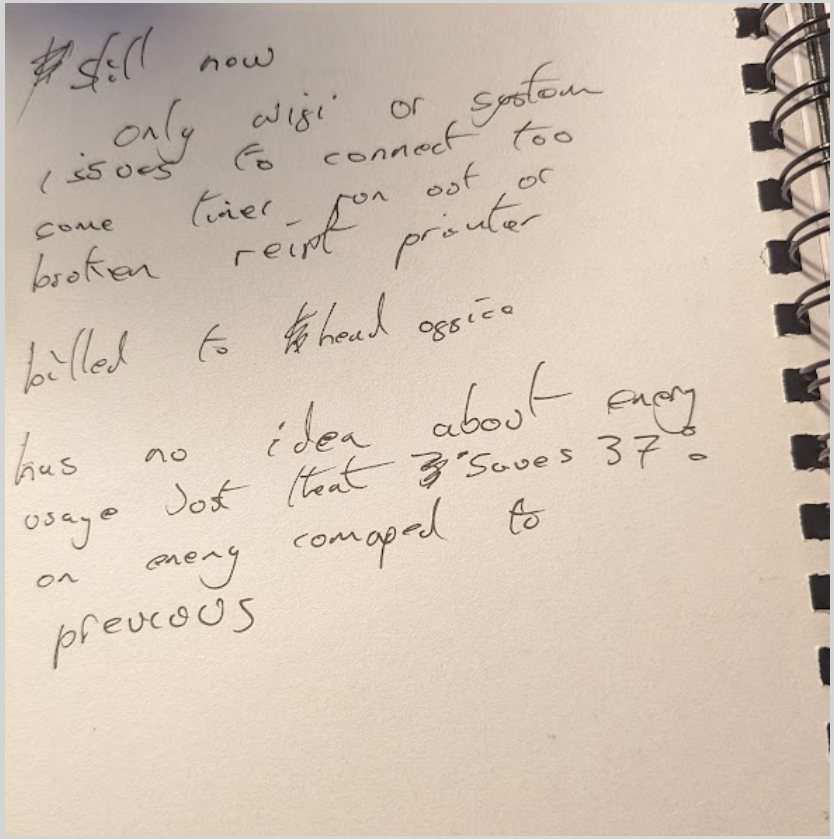

Notes from interview with manager

PARTICIPANT Form

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Signature:

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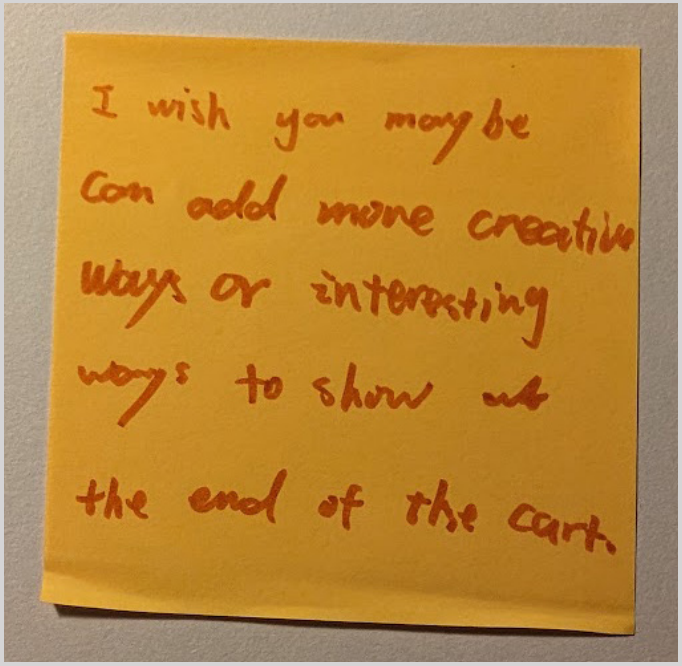
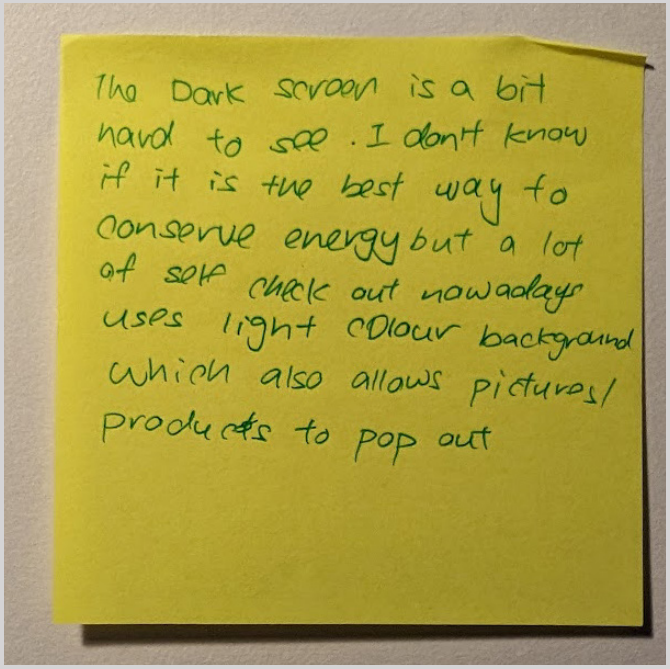
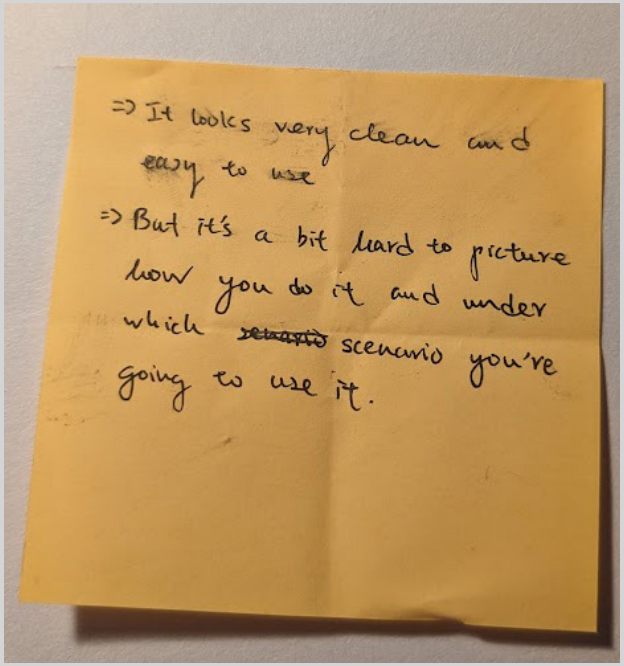
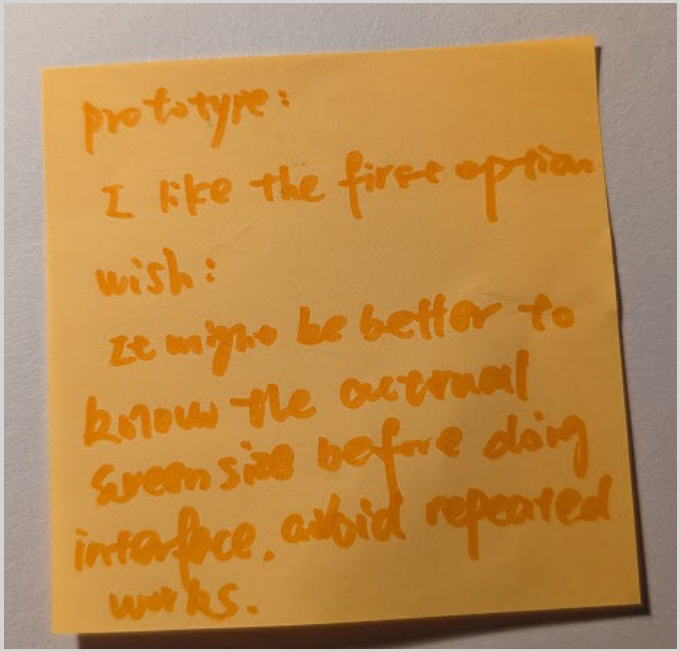
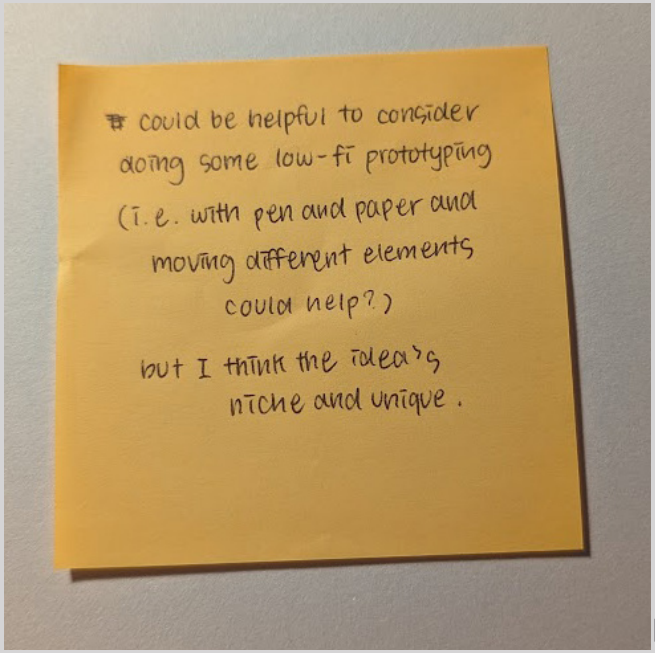
Partipantion form interviewee

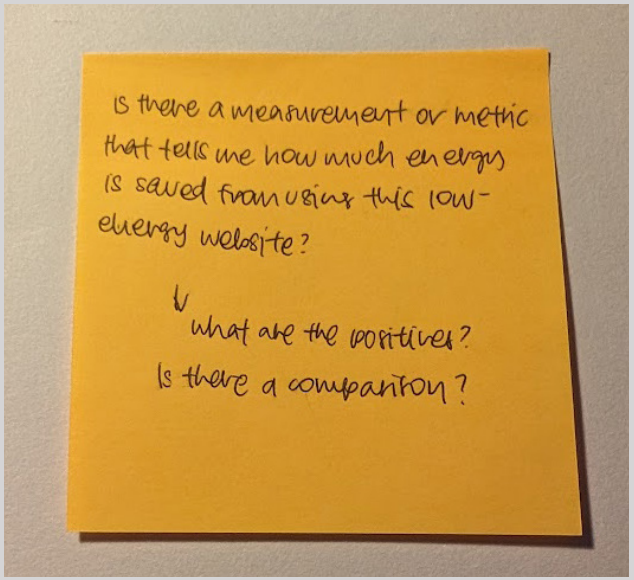




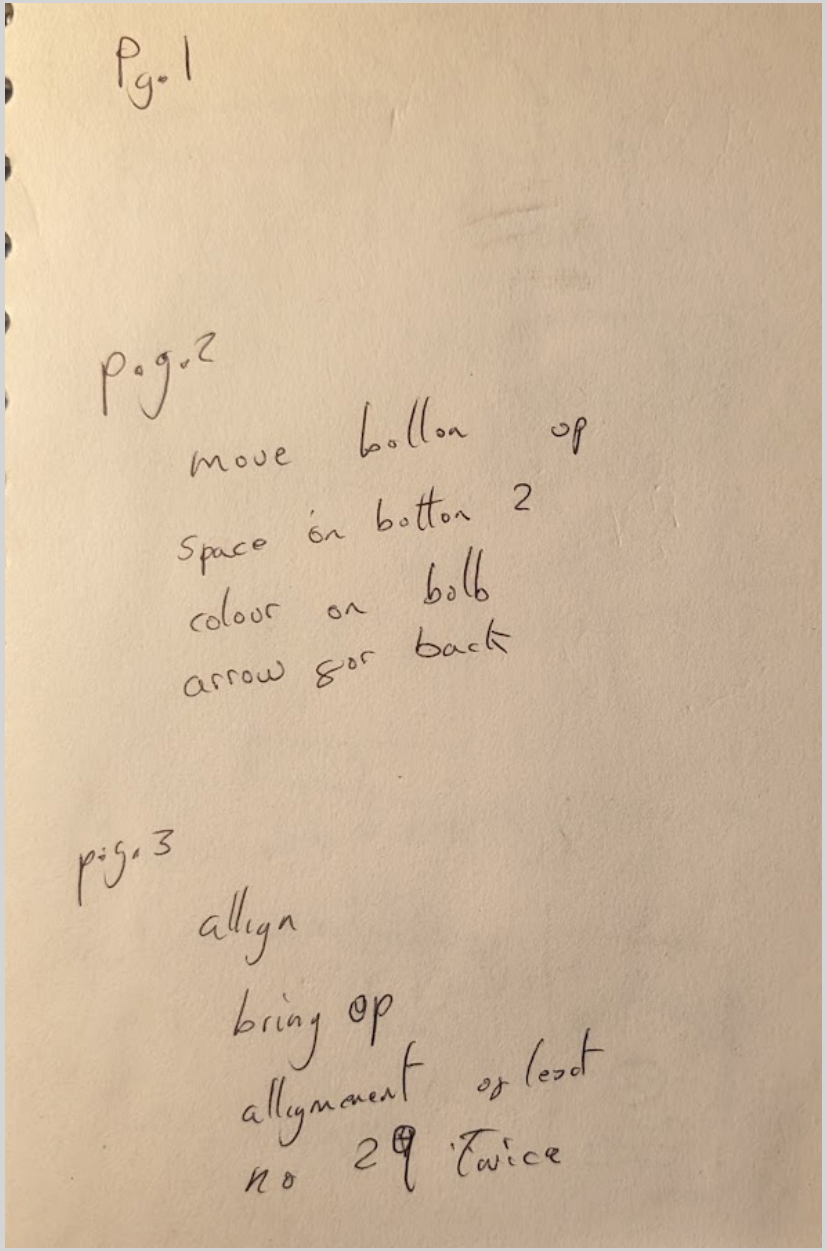


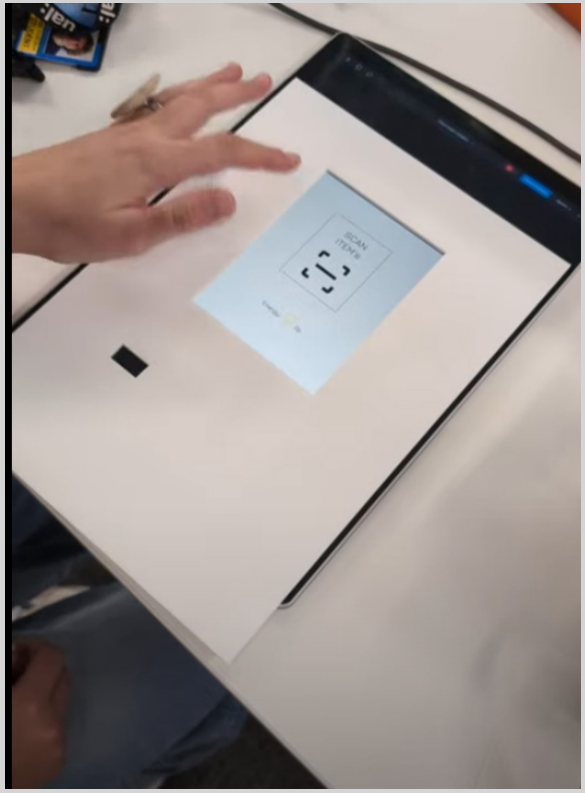


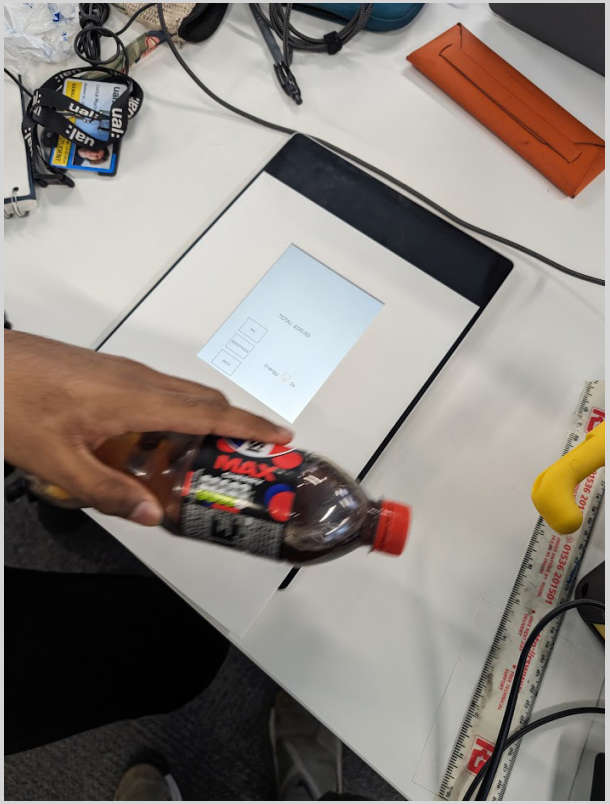




peer and master students and turtor feed-back post it notes





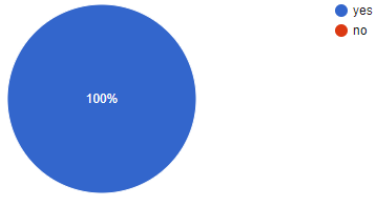


User testiong on adpated interface eveidnce of use and feedback for feed back

do you consent to the testing of low energy checkout

Copy

3 responses



how was the experience using the prototype? any issues or confusion

3 responses

There was no checkout but in general very satisfying to scan products and easier than in normal supermarket. In real life scanning I always get confused where to place the product in order to be scanned, here is very clear the process

Just some crashing when I press the button

no problem with prototype, very intuitive

what do you think about the interface? e.g. the layout, colour ,text speed

3 responses

The interface is simple, straightforward and understandable. The contrast was enough in order for me to read everything

Everything seems fine

I think the interface is clear and easy to use. Colours are in line with the theme of the project. No problem with the speed

how does this make you feel about current checkouts and their energy usage?

3 responses

I like the simple chick design that isn't overcrowded with colors and images. While it might not be inclusive or accessible for everyone, it definitely makes it easier for me to differentiate what's happening. I'm happy to be aware of my energy usage because we usually don't think about our everyday energy consumption.

I feel that compared to the current checkouts in stores today they seem to use a lot more energy compared to what you made

I think it's good to highlight the problem we are facing about energy consumption and environment. It makes sense to generate awareness about it by making the consumer pay. I wonder if in doing so we are leaving out the responsibility of environmentalism crisis from big corporations. Why consumers are paying the price? where is the money going to? planting trees ect..

any opinions on the product desgin?

3 responses

I would like to be painted and the outside part to match the software/ screen view and ofc on eye level, I felt like i am working in as a cashier because I was sitting and scanning products

No seems good

The design very functional and easy to use. In line with the theme of the project

any other feedback?

3 responses

Good job, very engaging outcome, playful tactile product that hover a big crucial topic in our society

Fix the bugs

Maybe tell the costumers after they pay something like; the amount of money extra you paid helps to reduce the carbon emission and plant a tree..the rest is good not like Chelsea

screenshot of final user testing

PARTICIPANT Form

Project Title: Lo-power mode

Student Researcher: Lucca Muchmore, Muchmore.seven@gmail.com

Supervisor: Antonella nonnis, tutor London College of Communication,

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Participant's Name: Mila krasteva

Signature: 

Contact Information If you have any concerns or require more information about the research, please contact:
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Participant's Name: Rahul Jigmet

Signature: 

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Participant's Name:

Signature: Saganias Asrat

Date: 30/05/24

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Participant's Name: James Muchmore

Signature:

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Signature:

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Participant's Name: Emile Swzelkowski

Signature:

Date: 23/03/24

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Participant's Name: Malachi anon-nickloson

Signature:

Date: 23/03/24

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