Museum in the cloud

Scott Smith & Rob King
Interactive Media Design
DE01226

Contents

The Brief

**“To propose innovative concepts and working prototypes around the theme of ‘Museum in the Cloud’ for Tyne & Wear Archives & Museums (TWAM).
In addition you will be asked to contribute to the design and running of a collaborative workshop or knowledge exchange event at Tyne & Wear Museums.”**

Work Requirements

1. Physical deliverables including (Interactive) prototype(s) demonstrating the proposed concept.

2. 2 Oral presentations:

i) Presenation of project outcomes for colleagues, faculty and jury (duration: 30 minutes/team) including a proof of concept demonstration (functional and visual).

ii) Oral presentation of an executive summary for a delegation of Alstom’s directorate (duration: 7 minutes/team).

3. A comprehensive Final Project Report (Design Document).

4. A separate reflection on the collaboration, summarising your individual contribution and learning (300–400 words). This document should also include evidence of your ability to collaborate where possible e.g. screenshots of your contribution to forums, blog posts, feedback to others etc.

Aims

This module aims to stimulate in the student an innovative response to a brief selected from a wide range of options which set out to provide creative solutions to many of the design challenges in contemporary life.

To develop students’ understanding of design in a socially and environmentally responsible context.

To facilitate students’ choice of project, and further develop their individual professional direction.

Learning Outcomes

Conduct comparative analysis of products and markets as a research tool to evaluate and propose potential solutions.

Demonstrate independent creative thinking and judgement in the pursuit of solutions to complex design problems and issues.

To effectively communicate and present creative and complex design solutions to professional standards.

Operate effectively within group or team to produce successful co-operative, collaborative or co-design projects.

TWAM Project Briefing

The opening week of the brief as a class we travelled to the Discovery museum, where we received a talk about the project from John Coburn, Digital Programmes Manager at Tyne & Wear Archives & Museums to help us navigate our research and development. We wrote down as many notes as we could from John's talk in no particular order and gathered them here. Some points are very similar in terms of definition but we left this in to highlight the importance of that factor.

"Improve public access."

"Trying to innovate access to museums."

"9 galleries cover most subject - ideally wanting scope on the discovery museum."

"Driven by outcomes, no expectations of the outcomes/solutions we provide at this point."

"Museums like to internalise innovation" - custom built exhibits, unique experiences in discovery only

"How do we push museums as a space?"

Ideas which could change the way we think of the word museum

Discovery predominantly has linear exhibits which tells a chronological story

"Dictating where people walk within an exhibition"

Experiential, wants to be fun

"Playfulness is relevant to all ages"

Science gallery is inspiration

Want a new approach

Surprising element to museums

Make people enjoy things they didn't they would ever like/take an interest in.

Distinct audiences for each of TWAM's.

Want to integrate technology into the discovery museum.

Young adults to be tapped into.

Don't be constrained by hours opening

Mixed methods of intaking information - liner routes and open spaces

What do people think of Museums?

Early on we decided to gain a small insight into what people think of the word museum out of curiosity before we explored museums. No matter how obvious, irrelevant they thought their words would be, we wanted to hear it. We asked friends, work colleagues and family without revealing the purpose of this task.

Old fashioned

Educational

History

Louvre (Paris)

France

Exhibition

Collections

Libraries

Iconic

Boring

Tiring

Mona Lisa

Interesting

Unstimulating

Books

Children

Grandparents

Slow

Reading

Pretentious

Cultural

Irrelevant

Uninspiring

Heritage

War

Our feedback from this short task was quite alarming yet brought a lot of potential to the brief and inspired areas to look at. All words in bold we see as negative and a priority to alter this perception. These are areas we have designated to improve and be at the central of our focus.

Research

For our research in the beginning we researched cutting edge and current technologies to help us become inspired and think big about the project. We did not allow ourselves to be constrained to factors like cost and feasibility at this point.

Tech we looked at:

Augmented reality

iBeacons

Google Glass

Research - Augmented Reality

What is it?

Augmented reality is a reality enhancing system that generates a composite view for the user that is the combination of the real scene viewed by the user and a virtual scene with additional information.

Augmented reality (AR) is the integration of digital information with live video or the user's environment in real time. Basically, AR takes an existing picture and blends new information into it.

How does it work?

Augmented reality programs are written in special 3D augmented reality programs such as D'Fusion. Unifye Viewer or FLARToolKit. These programs allow the developer to tie animation or contextual digital information in the computer program to an augmented reality "marker" in the real world.

The end user must download a software application (app) or browser plug-in in order to experience augmented reality. Most AR applications are built in Flash or Shockwave and require a webcam program to deliver the information in the marker to the computer. The marker, which is sometimes called a target, might be a barcode or simple series of geometric shapes. When the computer's AR app or browser plug-in receives the digital information contained in the marker, it begins to execute the code for the augmented reality program.

Existing Examples - Oculus Rift

Next-Gen Virtual Reality

The Oculus Rift is a new virtual reality headset that lets players step inside their favorite games and virtual worlds.

The Rift uses custom tracking technology to provide ultra-low latency 360° head tracking, allowing you to seamlessly look around the virtual world just as you would in real life. Every subtle movement of your head is tracked in real time creating a natural and intuitive experience.

Stereoscopic 3D View

The Oculus Rift creates a stereoscopic 3D view with excellent depth, scale, and parallax. Unlike 3D on a television or in a movie, this is achieved by presenting unique and parallel images for each eye. This is the same way your eyes perceive images in the real world, creating a much more natural and comfortable experience.

Wearable & Affordable

The Oculus Rift delivers a high-end virtual reality experience at an affordable price. The Rift is also designed to be as comfortable and lightweight as possible for long play sessions.

Oculus VR, (2014). Rift. [online] Available at: https://www.oculus.com/rift/ [Accessed 16 Oct. 2014].

Existing Examples - Ikea AR Catalogue

In 2013, IKEA launched their augmented reality catalogue which enabled user to visualise how Ikea's furniture could look in their home.
With the use of a smartphone camera, the app measured the size of the product and the room to give a real life representation of how the product would look in the room.

This has great potential to explore museum spaces. Simulating designs and constructions of buildings and placing this distorted reality over the top of current buildings would massively help blend the boundaries between reality and digital.

Existing Examples - IBM AR Application

Acting like a personal shopper, the IBM app uses augmented reality to give shoppers a personalised experience whilst browsing the shelves. Using the camera, it analyses food items, giving nutritional information. It allows the user to sort the items by category, like calories or protein. This gives the user the easy option of viewing before purchase, while enhancing their shopping experience.

Using mobile could be a huge factor when designing for the younger audience. Potential uses for this implementation of the camera could include pointing the camera towards objects in the museum which reveal more information on the mobile screen.

Existing Examples - Avatar Toys

Augmented Reality Toy Example that got some serious hype with the launch of Avatar. I think this is a great example of Augmented Reality can be used gifted with products or as a product themselves, and as the technology becomes more advanced, we'll be able to have toys like this interact in a very "game like" way making them even more appealing.

Research - iBeacons

What is it?

iBeacon is the name for Apple's technology standard, which allows Mobile Apps (running on both iOS and Android devices) to listen for signals from beacons in the physical world and react accordingly. In essence, iBeacon technology allows Mobile Apps to understand their position on a micro-local scale, and deliver hyper-contextual content to users based on location. The underlying communication technology is Bluetooth Low Energy.

What is iBeacon? What are iBeacons?

The term iBeacon and Beacon are often used interchangeably. iBeacon is the name for Apple's technology standard, which allows Mobile Apps (running on both iOS and Android devices) to listen for signals from beacons in the physical world and react accordingly. In essence, iBeacon technology allows Mobile Apps to understand their position on a micro-local scale, and deliver hyper-contextual content to users based on location. The underlying communication technology is Bluetooth Low Energy.

What is Bluetooth Low Energy (BLE)?

Bluetooth Low Energy is a wireless personal area network technology used for transmitting data over short distances. As the name implies, it's designed for low energy consumption and cost, while maintaining a communication range similar to that of its predecessor, Classic Bluetooth.

How is BLE different from Regular Bluetooth?

Power Consumption: Bluetooth LE, as the name hints, has low energy requirements. It can last up to 3 years on a single coin cell battery.
Lower Cost: BLE is 60-80% cheaper than traditional Bluetooth.
Application: BLE is ideal for simple applications requiring small periodic transfers of data. Classic Bluetooth is preferred for more complex applications requiring consistent communication and more data throughput.
How does BLE communication work?

BLE communication consists primarily of "Advertisements", or small packets of data, broadcast at a regular interval by Beacons or other BLE enabled devices via radio waves.

BLE Advertising is a one-way communication method. Beacons that want to be "discovered" can broadcast, or "Advertise" self-contained packets of data in set intervals. These packets are meant to be collected by devices like smartphones, where they can be used for a variety of smartphone applications to trigger things like push messages, app actions, and prompts.

Apple's iBeacon standard calls for an optimal broadcast interval of 100 ms. Broadcasting more frequently uses more battery life but allows for quicker discovery by smartphones and other listening devices.

Standard BLE has a broadcast range of up to 100 meters, which make Beacons ideal for indoor location tracking and awareness.

iBeacon.com Insider, (2014). What is iBeacon? A Guide to iBeacons. [online] Available at: http://www.ibeacon.com/what-is-ibeacon-a-guide-to-beacons/ [Accessed 22 October 2014].

Existing Examples - Macy's

Macy's.

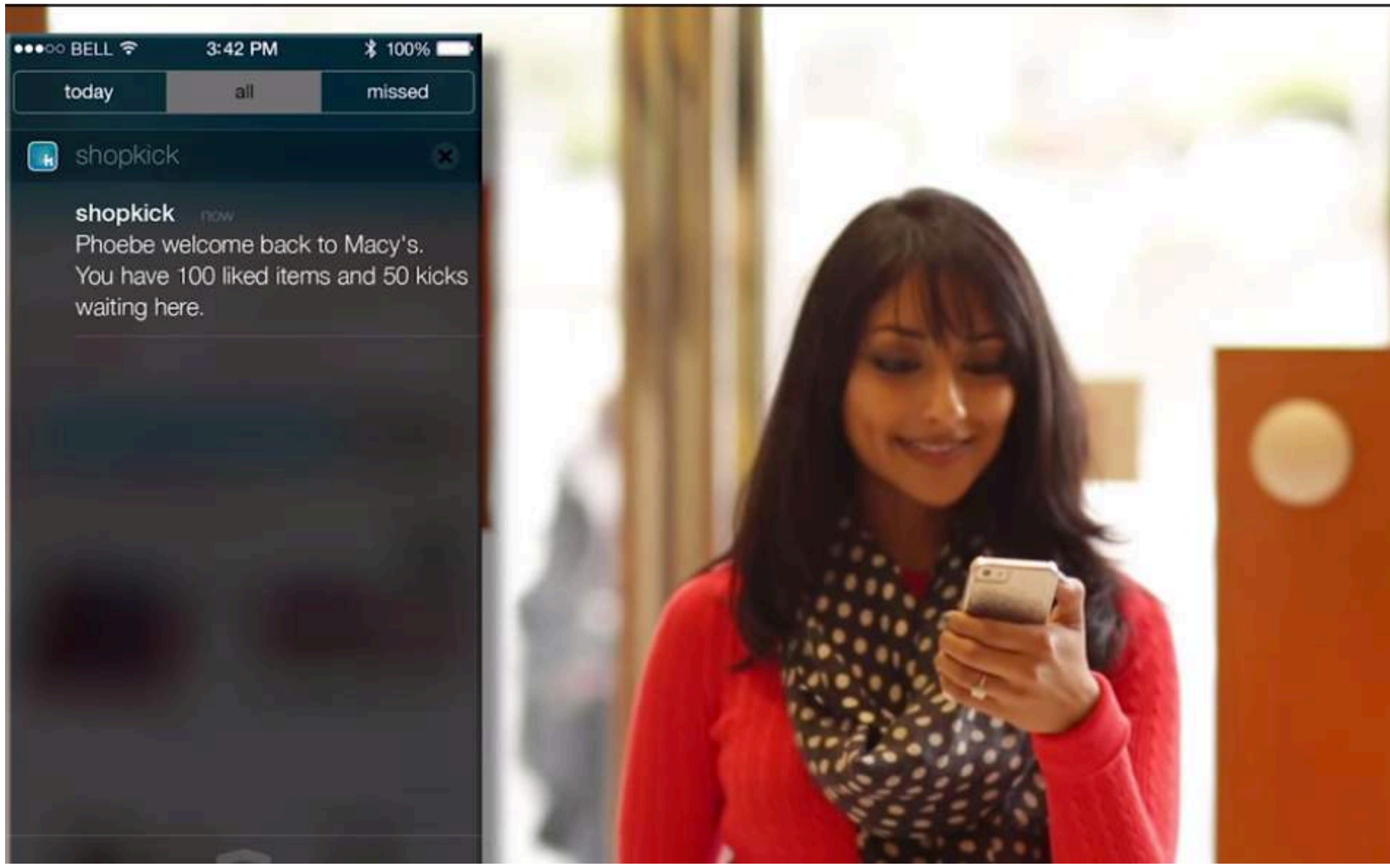
The famous U.S store has been experimenting with iBeacons, which is set to take off in 2015. In the trial, you can see the smartphone picking up push-notifications when coming into proximity with an iBeacon.

The app shows the customer how many items they have liked in the store and keeps pushing offers and deals to their smartphone as they walk around the store.

Although it's clearly a prototype video, you can really see the potential for this simple technology, especially in the retail space. Again, users must have an app installed on their phone in this instance.

A link for a demonstration video can be found here.

https://www.youtube.com/watch?v=CipsLFB8KFk



Existing Examples - Football

Sky Bet Title sponsor of the English Football League introduced wireless location based technology, iBeacons to Championship Football Stadiums Elland Road (Leeds United) and The New York Stadium (Rotherham United) in late october 2014

SkyBet management confirmed that the test project could lead to a roll-out to Football League stadiums nationwide. Sky Bet head of core products Andrew Walton commented: “This is a really exciting opportunity to use our unique title sponsorship with the Football League and its clubs to improve the fan experience at football grounds across the country. The feedback from both clubs has been encouraging and, although this technology is still very new, the potential is enormous. Our customers could soon be receiving tailored messages and offers at every Sky Bet Football League game, allowing them to benefit even further from our sponsorship.”

A Leeds United spokesman commented on the technology:”To be one of two clubs involved from the start with Sky Bet’s iBeacon project is very exciting. The iBeacon technology was tested at Elland Road during our game with Sheffield Wednesday. For any of our fans wishing to bet on the game it helps them find the best place for special offers and promotions from our betting partner Sky Bet.”

Read more: http://www.sbcnews.co.uk/technology/2014/10/27/sky-bet-trials-ibeacons-technology-at-leeds-rotherham-united/#ixzz3OydwNxpl

Google Glass

Google Glass is a wearable device which takes the clunkiness of holding a smartphone camera in front of an object into the user's peripheral vision.

By overlaying the interface onto the user's direct line of vision, it replaces the phone app based augmented reality, making it easier to interact with the content that is focused on.

Some ways Google Glass has enhanced reality in some scenarios:

- Speedometer
- Peripheral viewpoint photography
- GPS directions
- Read emails while walking
- Find the weather instantly
- Live action POV recording
- Instant Google search

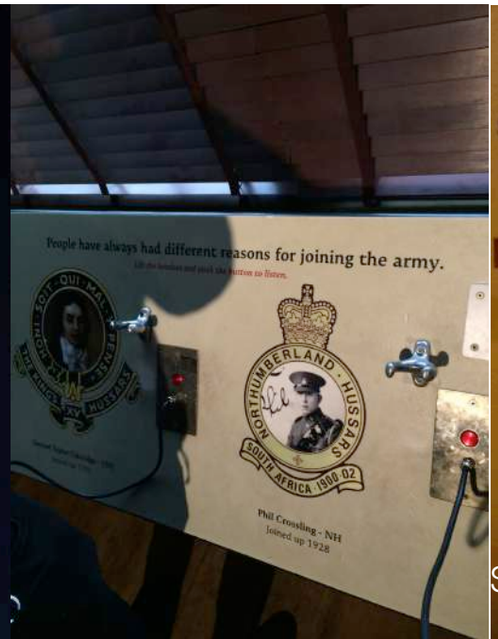
Inside the Discovery Museum

As a way of getting to know the space we were working with, we decided to visit the museum. By exploring the different exhibits, we were able to see what areas would appeal to the targeted demographic, and we could see what interaction was available for the visitors to experience.

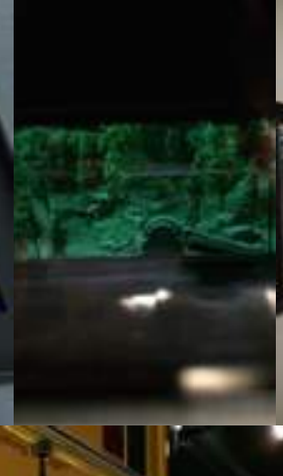
Newcastle Story(Left)

A Soldier's Life (Centre)

Science Maze (Right)



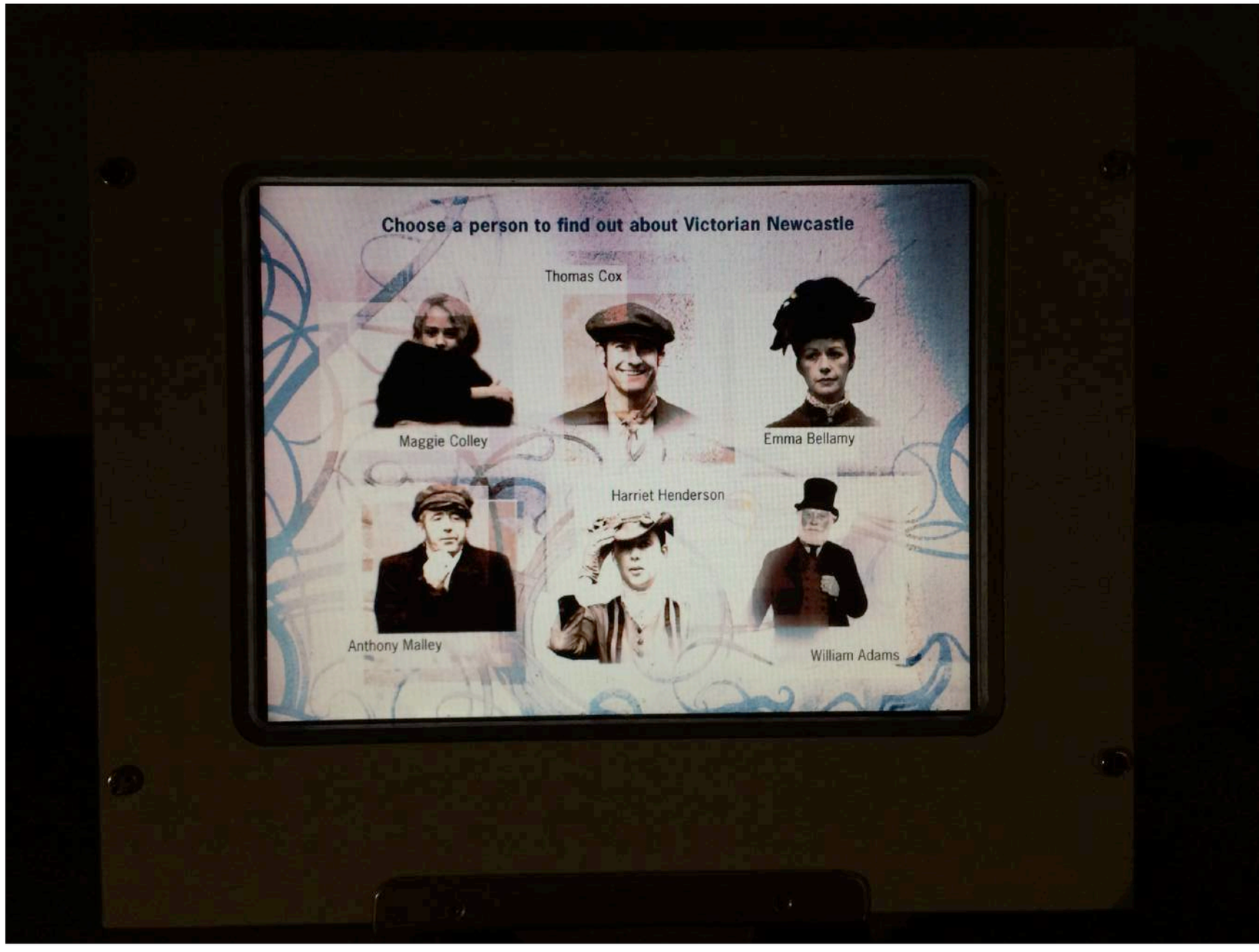
Inside the Discovery Museum



Inside - Newcastle Story

The Newcastle Story was full of relevant and interesting information about the how the city evolved throughout the main historic periods. From the Medieval and Victorian eras, to the 20th and 21st century, the exhibit shows a rich display of information of how life was for people and the events that shaped the areas surrounding Newcastle.

The display was very linear, where we were encouraged to follow a certain route throughout the exhibit, which is expected as it was timeline based.
There wasn't much interaction within the space, with the interaction coming through handling physical objects. The only digital interaction was an unresponsive touchscreen allowing the user to choose a specific video reel.



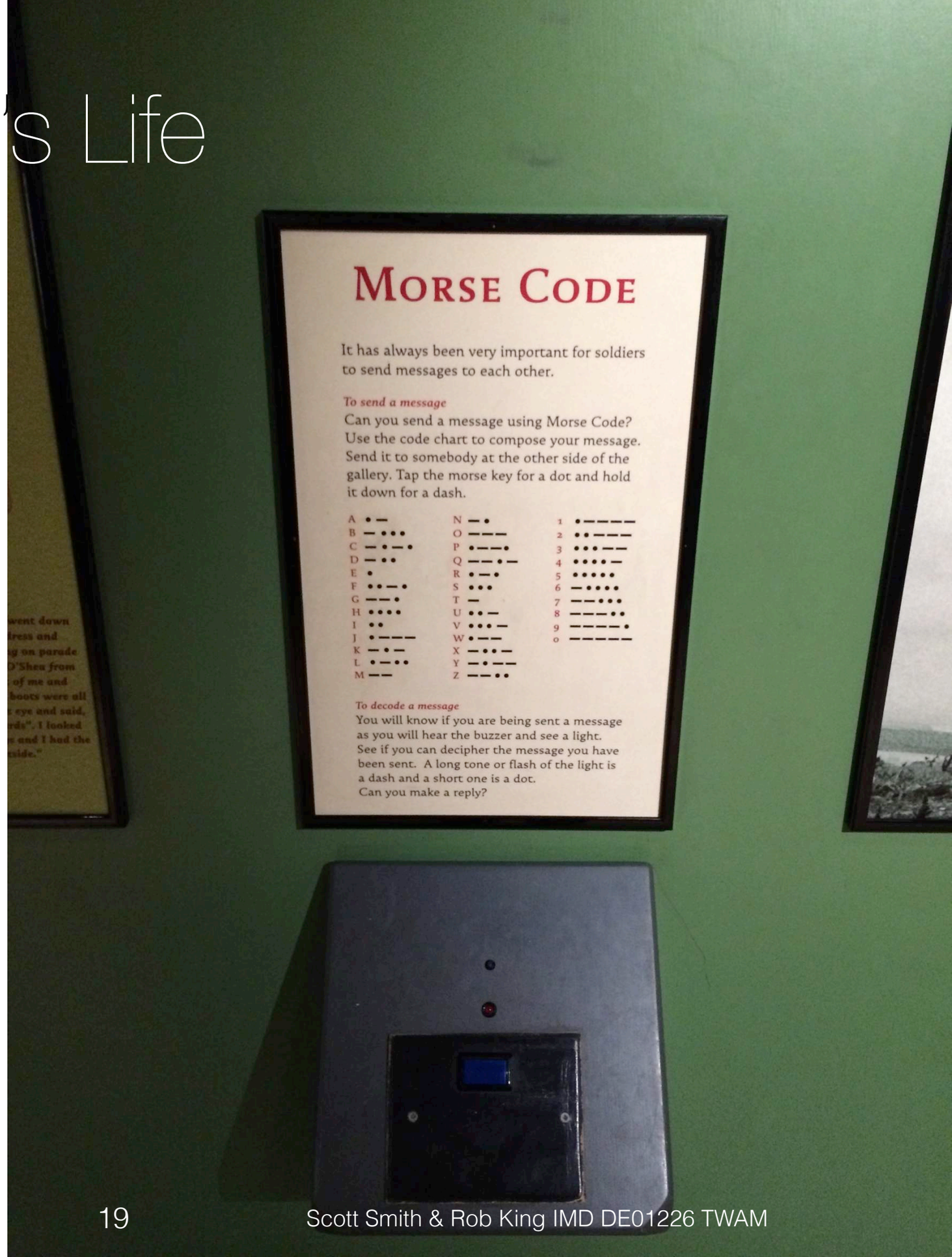
Inside - A Soldier's Life

Another historic display, which showed what life as a soldier was like throughout modern history. This display had many interactive features, both physical and digital.

There was a message via telephone installation which when holding the telephone to your ear, a message from a soldier was played out.

Another interaction, a morse code alphabet, gave the visitor the freedom to create a morse code message through dots and dashes.

The problem we both found here was that your input wasn't going anywhere. The button buzzed when you had your finger pressed down but that was it. You weren't told if your input was correct and it wasn't going anywhere. The way this particular interaction worked, there was no use for the Morse Code alphabet to be on the wall.



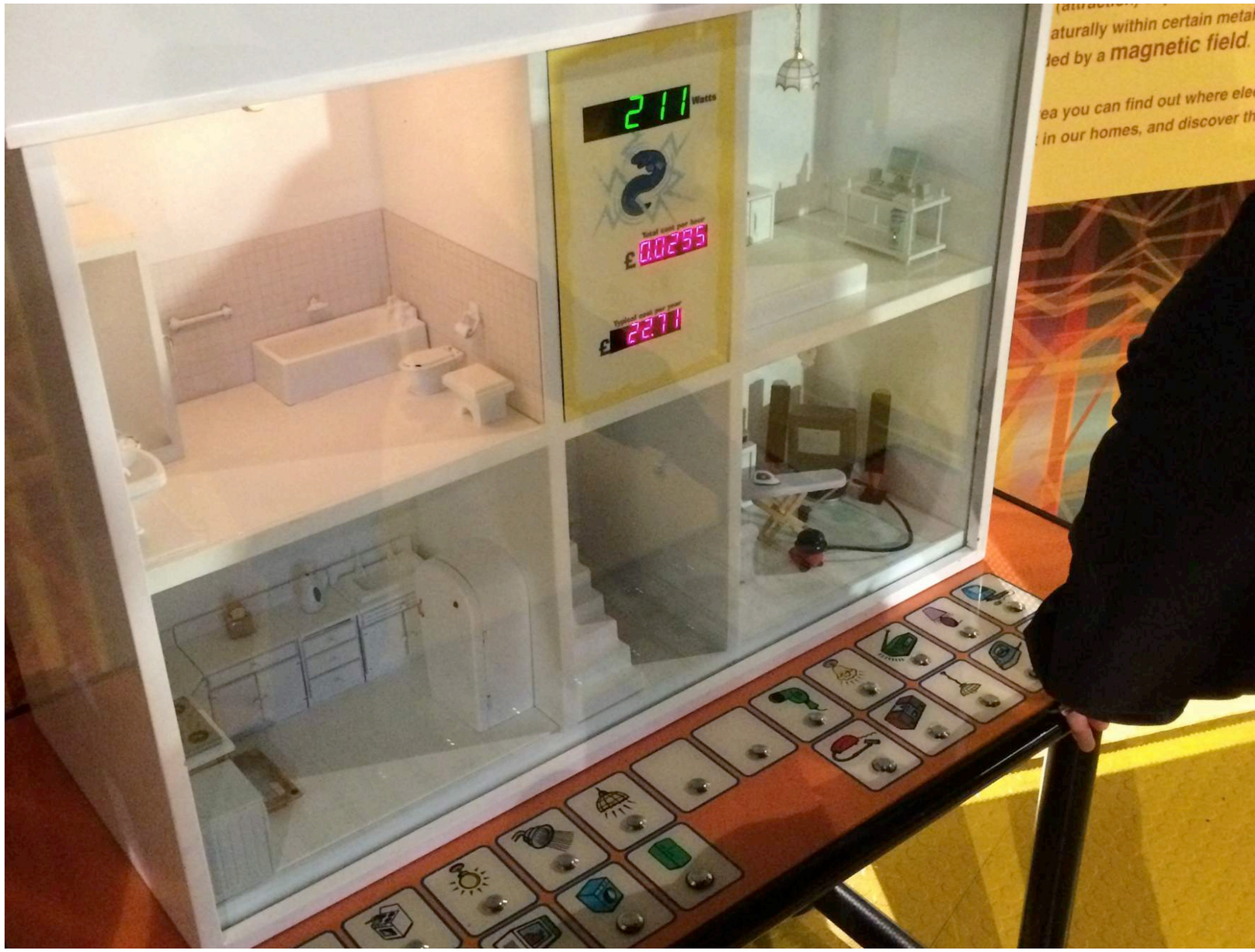
Inside - Science Maze

The Science Maze was the most interactive space in the museum, with a combination of physical and digital interactions. It was the busiest part of the museum, with most people playing with the displays on show.

Magnetic fields, vibrations and electricity were the most engaging subjects in the display, as we personally spent more fascinated by them, especially the electricity, where we could see how much electric appliances cost to run per year.

We could see how much energy each appliance uses, while also giving a running total for each appliance selected.

It had an element of simulation as you learned about the history of the cost of energy



Inside - 20th century entertainment system

We looked at non interactive pieces in the museum which was essentially just decoration and quickly analysed objects for their potential and used some of these as concepts.

Potential concept:

Incorporating Arduino into this entertainment system. Having authentic archived files so you can actually use the nobs on the bottom to change channels and allow the viewer to immerse themselves in what people around this time could feel. Simiulating emotions of the people from this time. Hear war propaganda and warnings, hear music that played on the airwaves from this time in the same audio quality.

We have discovered..

We have found that by digitally overlaying information on to a real life scenario, it removes the stop start restriction for getting information by not having to keep looking at one thing to another. Augmented reality allows the user to view the information while maintaining focus of a subject in their peripheral vision, therefore the technology will make going museums more engaging and interactive for visitors as the experience will be more seamless and flowing.

We have also found that there is lots of scope to improve the existing displays in the Discovery Museum. There is a lack of interaction so with more thought, we can integrate the augmented reality into an interactive and engaging space, that will attract young people back to the museum.

Static

A lot of the interactive elements within Discovery are very similar in the way these function and the technology in which they're built. Almost all of the interactive pieces operate via a touch screen.

Getting ‘Generation Z’ into museums?

Generation Y have grown up alongside technology, playing a big part of their lives.

For the people born post-2000:

Here’s some things a lot of the younger generation won’t ever face the burden of:

- Being lost without a map

  Every smartphone today has easily accessible GPS maps. iPhones come pre loaded with Apple maps. Android phones have Google maps installed.

- Searching for change to make a pay phone call

  Although there are still public pay phones available in absolute emergencies, they’re no where near used as what they used to be 15-20 years ago. Just about all of ‘Gen Z’ have a smartphone in their pocket.

- Having nothing good to watch on TV (or conversely

  With smart TV’s now becoming commonplace, they can stream TV services like Netflix and Amazon straight from their TV’s, so there’s never “nothing good on tele”.

- Having to decide between simultaneously scheduled favourites)

  With BBC, 4OD etc, people never need to worry about choosing which programme to watch if two or more are on simultaneously.

- Checking prices with a travel agent (or realtor, or banker, or car dealer, or…)

  Comparing websites make it convenient to stay at home with your feet up and do all the hard work in the comfort of your own home or while on the move with a smartphone.

- Waiting for the bank statement to arrive to know your balance

  With Online/mobile banking today, people can make payments to contacts instantly and check their balance anytime they desire.

‘Generation Z’ - Kinaesthetic Learning

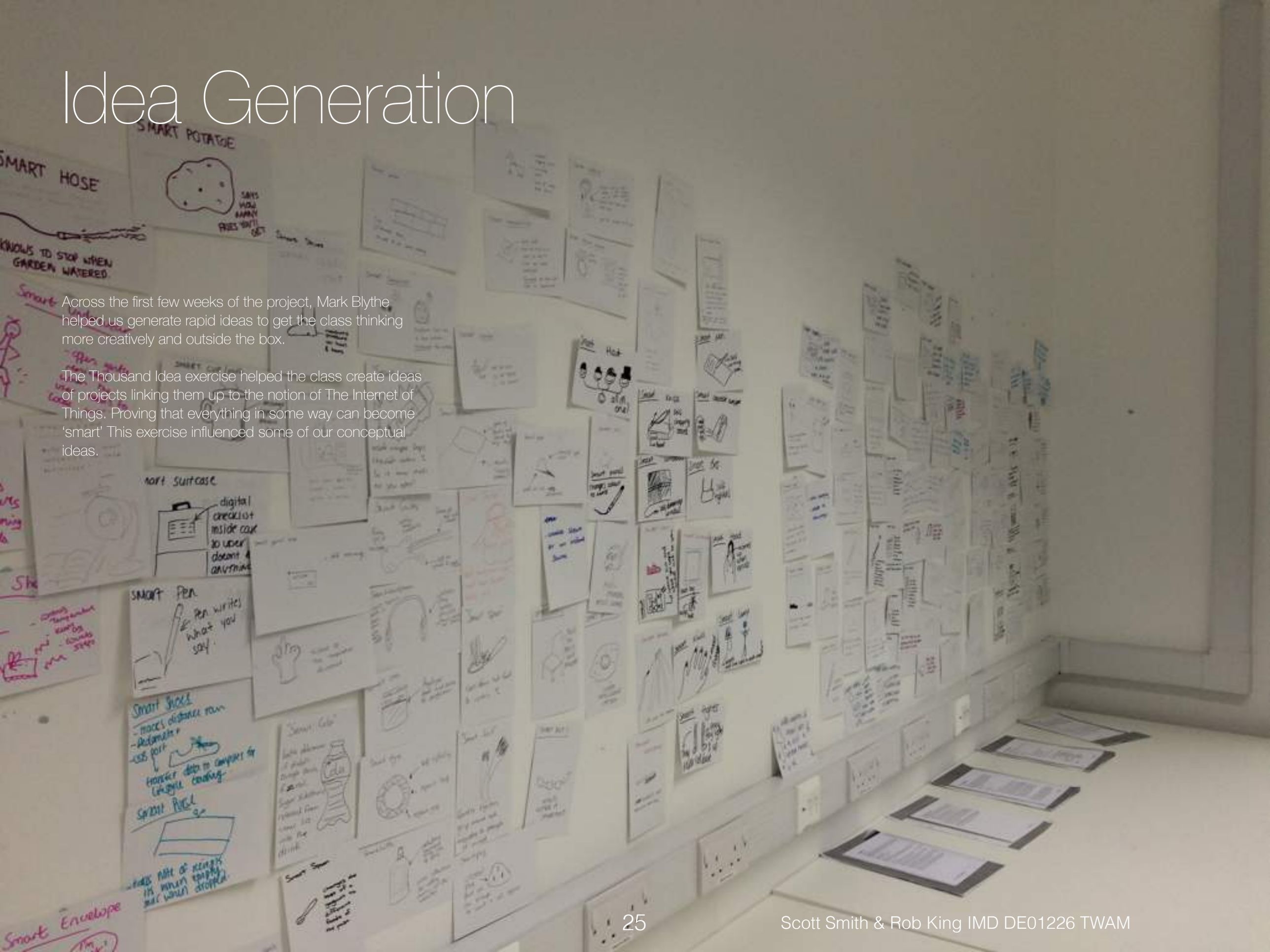
Technology allows us to interact with objects in ways we never thought possible. With a vast majority of ‘Gen Z’ carrying smartphones everywhere they go, they’re constantly intaking information from the web, they’re accessing this information by finding it themselves using their own fingers. They learn to use new apps and programs by physically using them and getting accustomed to the way it works. More and more people are becoming kinaesthetic learners, taking information onboard the best when they perform a physical activity and emotionally invest themselves in it.

This is what our end product will do. We will create an experience that will get a user emotionally involved. The best installations/experiences achieve the best results when it alters a users emotional state that attaches them to it, which then resonates within them and they spread the word and tell their friends and family about their experience.

We want to emulate this feeling and create something which people will want to tell others about and spread the word, which could potentially lead to bringing in a younger demographic, a key part to what Jon Coburn was highlighting in the initial talk we had with him back at the start of the brief.

Visual	Auditory	Kinaesthetic
Posters	YouTube clips	Note taking
Mind maps	Dictaphone	Copying out notes
Post it notes	Discussions	Games
Note taking	Question/Answer sessions	Talking-Walking Study
YouTube clips	Mnemonics	Re-enactments
Colour coding	Revision songs/rhymes	Trace words with finger
Timelines	TV Programmes	Doodling
Grids/Tables/Charts	Revision Videos	Trips and Visits
Fact Lists	Listening to music whilst revising	Construct posters and other revision resources
Facebook Profiles	Study Groups	

Idea Generation



Across the first few weeks of the project, Mark Blythe helped us generate rapid ideas to get the class thinking more creatively and outside the box.

The Thousand Idea exercise helped the class create ideas of projects linking them up to the notion of The Internet of Things. Proving that everything in some way can become ‘smart’ This exercise influenced some of our conceptual ideas.

Conceptual ideas

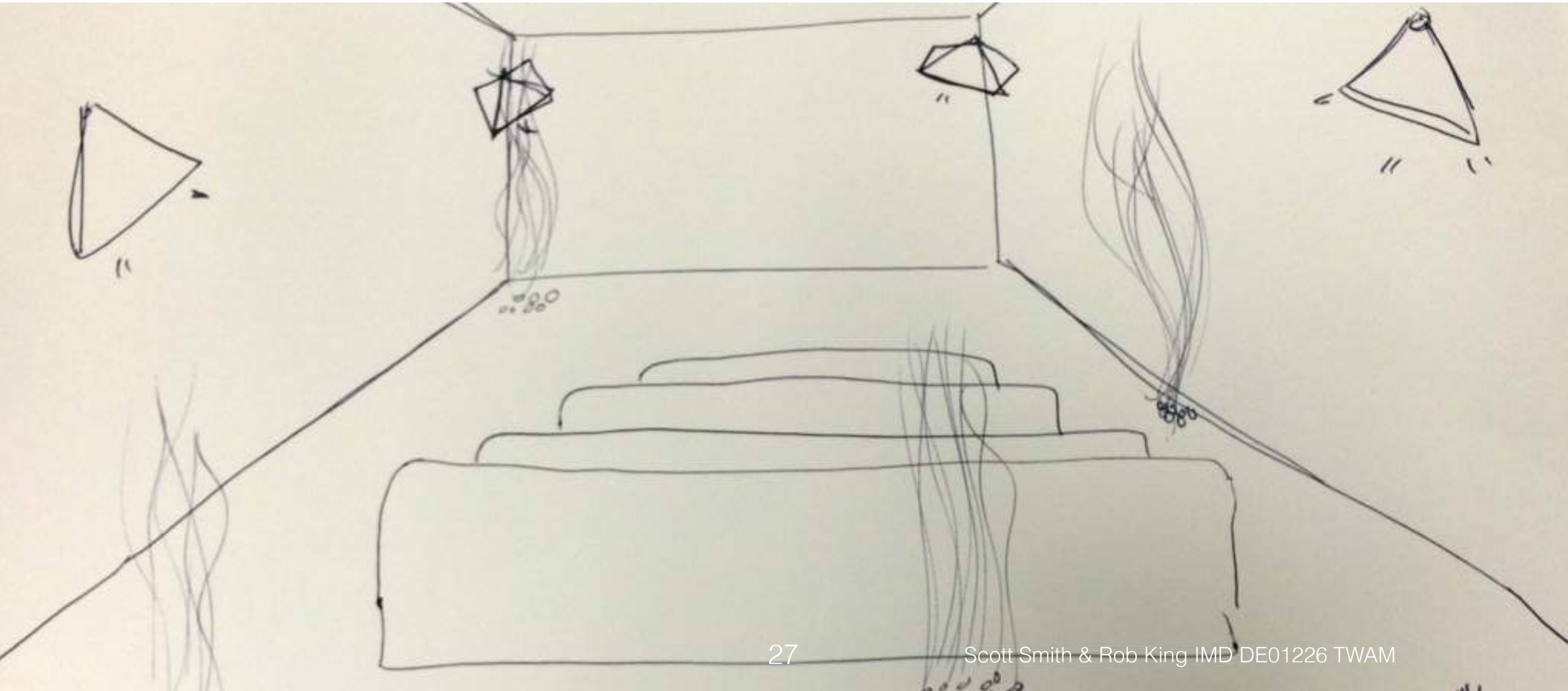
A morse code telegraph which would allow a user to see the letters they type out. This would enable the user to learn first hand how difficult communications across nations were in a different time period.

The educational aspect was received well, but the idea at this stage is by far from anything new.

Conceptual ideas

A room which is totally blacked out which requires a user's imagination to create their own imagery for them and brings their mind to the forefront of the experience. With full surround sound and smoke machines, sound files and effects from a battle ground would blast out of the speakers. The smoke machines would accompany the sounds. If a bomb explosion went off, seconds later the user sitting down would then smell gunpowder which is sealing out of the smoke machines. With all of these sounds, the user will create imagery in their head relating to the sounds and smells they intake.

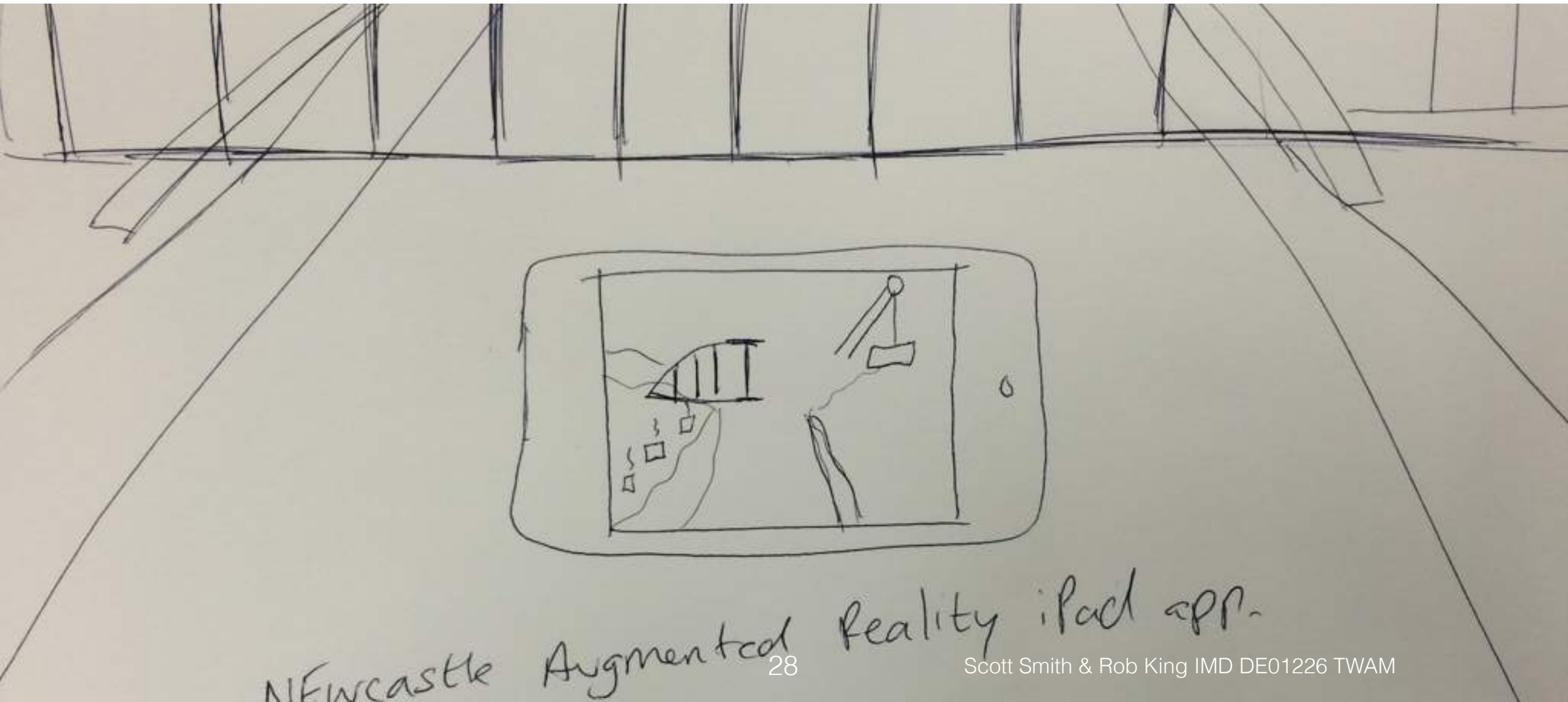
Feedback from this idea was generally well received. People liked the concept of pushing a users imagination to the front of the experience. As good as this could be. I recalled John's initial talk at the start of the brief explaining how to integrate technology to these projects. This idea doesn't boast any new technologies or doesn't use a particular technology in any way.



Conceptual ideas

This is an AR app which allows a user to visually step back in time to look at a city in an entirely different light. Looking back at how the city used to be in an all new experience.

John wasn't such a fan of this particular idea, although he did like the AR side of it. He felt as though the project is being created to purely show off AR. There's a lot of historical imagery around the museum which portrays newcastle from many decades ago. It would be incredibly expensive to create, as well the amount of iPads the museum would have to purchase.



Conceptual ideas

Incorporating Arduino into this entertainment system. Having authentic archived files so you can actually use the nobs on the bottom to change channels and allow the viewer to immerse themselves in what people around this time could feel. Simiulating emotions of the people from this time. Hear war propaganda and warnings, hear music that played on the airwaves from this time in the same audio quality.

This would really immerse a user and place them back into a country-defining period in history.

John really liked the idea of using Arduino because of it's cost efficiency and abilities to create just about anything that can be thought of with the correct tools.

Scott Smith & Rob King IMD DE01226 TWAM

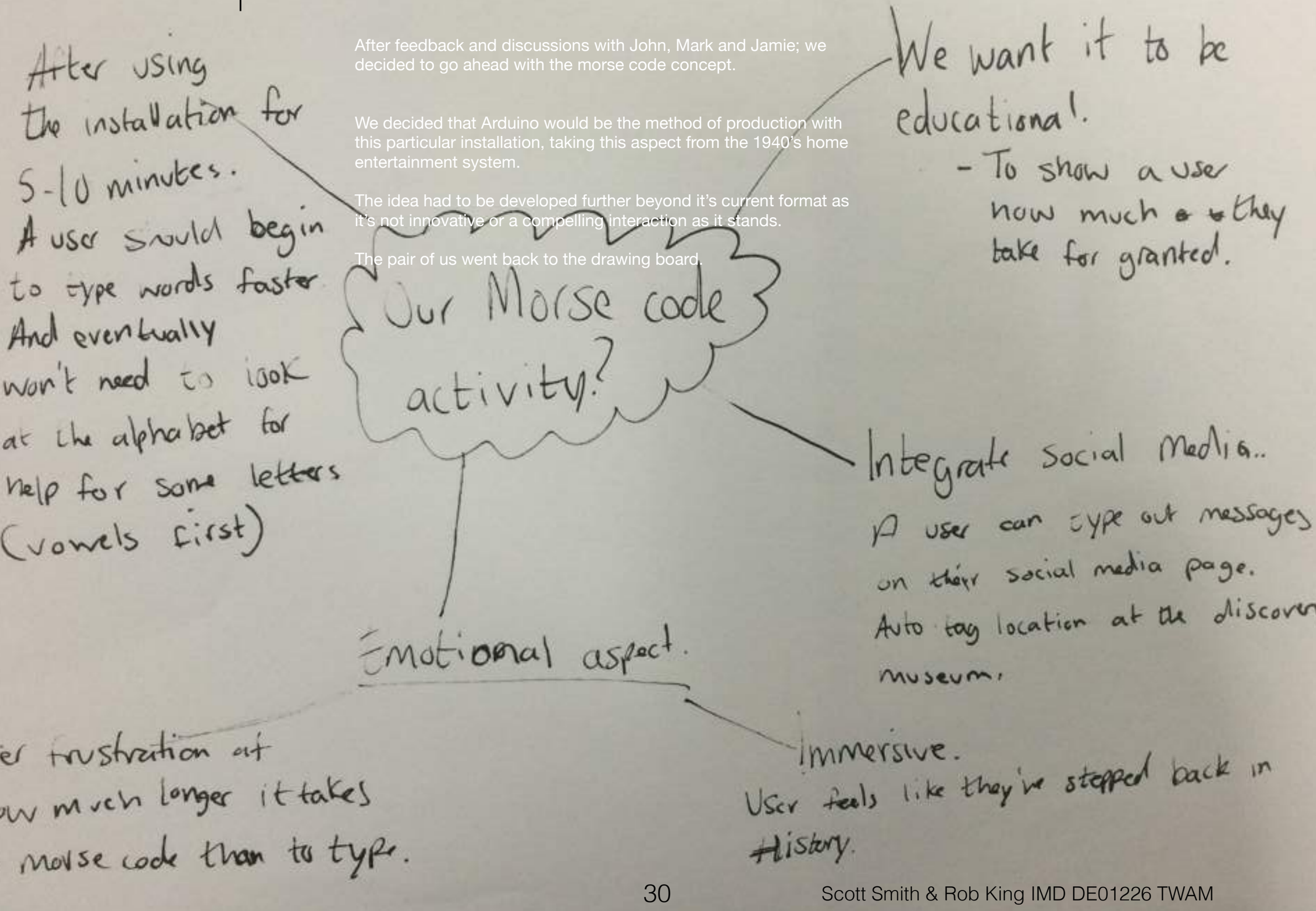
Conceptual ideas

After feedback and discussions with John, Mark and Jamie; we decided to go ahead with the morse code concept.

We decided that Arduino would be the method of production with this particular installation, taking this aspect from the 1940's home entertainment system.

The idea had to be developed further beyond it's current format as it's not innovative or a compelling interaction as it stands.

The pair of us went back to the drawing board.



Morse Code Installation

The idea.

We are going to make an installation for the ‘A Soldier’s Life’ exhibit in the museum. The installation will be based on the current morse code interaction that is already there.

At the moment there is limited user interaction in the installation because at the moment the sole function pressing a button to create the dots and dashes sounds with the aid of a morse code alphabet.

We saw there was scope to improve the installation because at present it is a very underwhelming feature of the museum and it may be overlooked by some visitors, especially the younger generation who are used to digital interaction.

The features of the installation.

By physically sending the morse code signal through a telegraph and with an Arduino decoding the signal, we can create an input that acts as a keyboard.

There will be three activities that will be available to do and the user selects which one to do through a touchscreen interface.

There will be a Twitter feature where the user can tweet a message via the telegraph. When the tweet is sent, it will automatically set the location as ‘The Discovery Museum, Newcastle upon Tyne’ and send the hashtag ‘#MorseMuseum’.

There will be a timed challenge where the user has to write a series of words. The faster the time of completion, the bigger chance of them getting their name on the leaderboard.

There will also be a two player challenge which requires both users to compete against each other in a war based scenario. The task sees both users tapping out a message with the same number of characters, one user is trying to bomb England, while the other is trying to stop the other from bombing. The outcome will be dependant on who ever taps their message out the quickest.*******

***** We decided to keep it one player, explained later**

Morse Code Installation

Here's a screen that we designed which the telegraph will interact with.

The user selects the activity they want to do. There are three options.

Time Attack

Users a given a set length of time to correctly tap out Morse Code a phrase before time runs out

Speed Morse

User is timed for each word they tap out in Morse. A leaderboard will be placed within the interface so users have an incentive to get their names on the leaderboard in the museum as the fastest communicators in Morse.

Social Telegraph

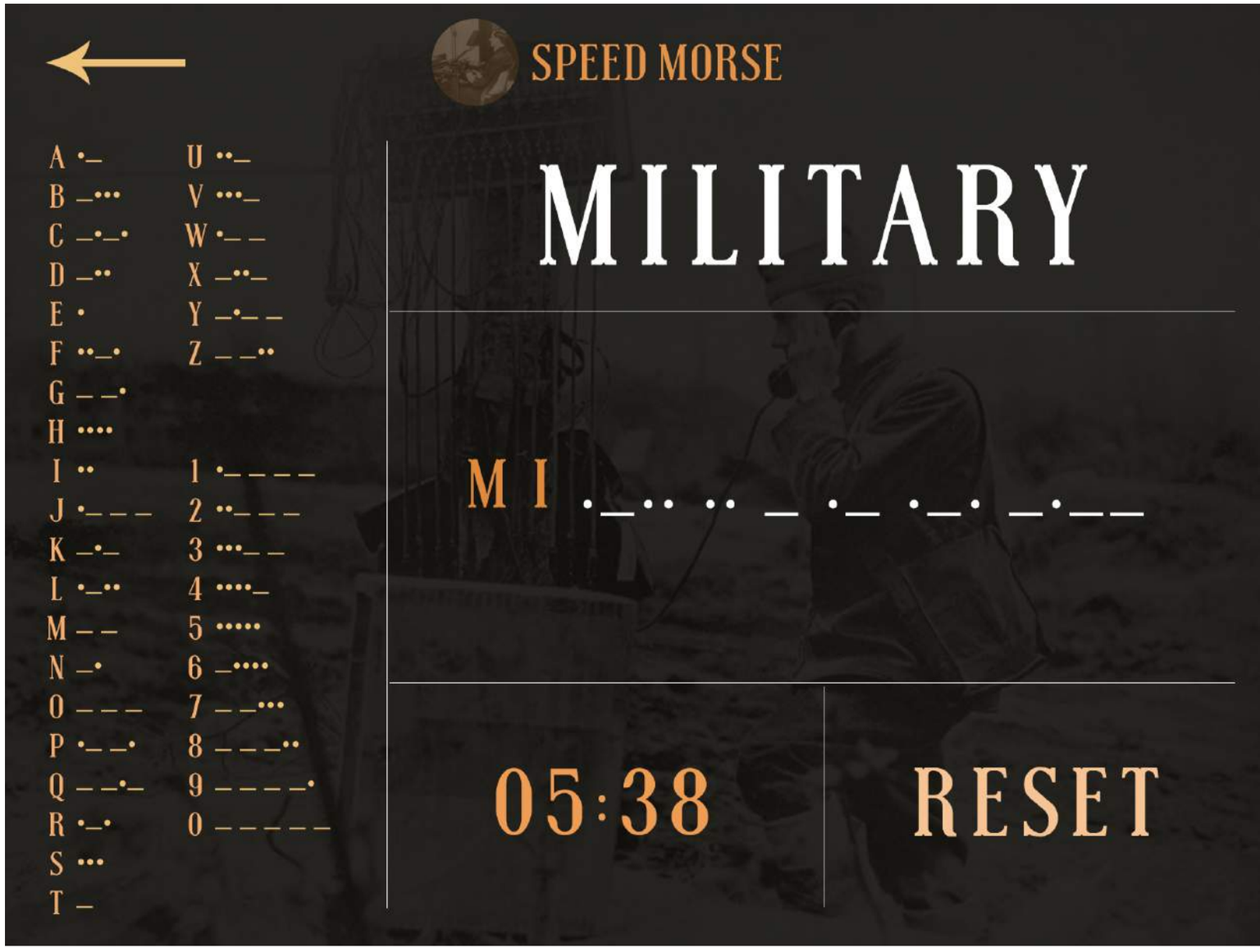
Here the user can update their twitter or facebook status, purely in Morse Code. On each platform there will be an auto location attachment so when they post to their social media, everyone can see where they are updating from.

The features of the installation.

Morse Code Installation

A screen shot of the proposed screen. The hints are on screen so the user does not have to learn Morse off by heart to be able to play. They simply follow the on screen prompts. If they make an error, they have to tap the screen to restart the word.

After asking for feedback on these screens so far, there was confusion about the interface. There was the morse control, as well as finger control on the touchscreen and some classmates and lecturers got confused by this concept, noting it would be frustrating switching between the two. Also with having the prompts in the middle, several classmates questioned the need for the alphabet to be there on the screen too, as it was taking up a lot of space.



PLEASE SELECT ONE OF THE ACTIVITIES BELOW.

TIME ATTACK!

TRANSMIT FIELD MESSAGES
BEFORE TIME RUNS OUT!

SPEED MORSE

SEE HOW FAST YOU CA
EACH WORD AND SEE H
AGAINST OTHER CH

Morse Code Installation

How it will connect

The two connecting points on the telegraph are hooked up to the Arduino board through the digital input and ground point.

By using a serial port program on the Mac like ‘Tinker.it’, we can effectively use the telegraph as an input device, because the serial ports allows the arduino and computer to communicate with each other.

With the use of the right code, we can assign each morse signal to a character on the keyboard. This then allows us decode the signal, listing an array of characters which could look like a message.

Morse Code Installation

How it will link to the features?

The text input, the output from the Arduino, will be used as the input that the user generates in order to carry out the challenges that are on the interface.

We could send the tweets directly from the Arduino with the use of a LAN shield, however as we are already linking it to a computer, we can send the twitter messages through the interface.

In order for the user to match their input text to the words on on the time challenges we will have to use a code that recognises what is coming in.

Arduino - Designing and Implementing

After deciding that the Morse code idea was the most viable and realistic concept to integrate into the “A Soldiers Life” exhibition, the next stage was to design the hardware that would interpret the Morse signals as standard alphabet characters.

The hardware would have to recognise the analogue signals that are made when tapping out the dots and dashes on the morse code telegraph. When the hardware understands the analogue input, it will need to convert it to digital output in the form of characters from the English language.

Having previously grasped the basics of Arduino in another project, where audio input was adapted into actions that executed iTunes controls, using Arduino seemed like a natural movement for creating the input device.

The plan was to wire an authentic Morse telegraph, which would be used as the controller for the user to tap out the signal sequences, to an Arduino Uno board. The Arduino Uno board has six digital and six analogue pins which can be configured to give an input signal or output signal so we will be inputting an analogue signal and converting it to a digital action.

The reason that the Arduino board can perform this action is because of the hardware-coding combination. The micro-processing chips allow the Arduino to execute custom code that the user writes. Following the Arduino language, the code can be anything, and as long as the peripheral components can do what the code is asking, the user can create just about anything.

Before writing any code, we needed to create a circuit with the components to create a Morse code oscillator. Although the oscillator wouldn’t be communicating with the computer, it would be able to create the analogue signals needed for the Arduino to convert to digital output.

Arduino - Designing and Implementing

This is a standard telegraph device that will have been used to create the Morse signal sequences that are needed to translate over radio communications. In figure 1, the circuit is open so by pressing down on the lever it closes, creating a signal. The type of signal, which is also represented by a high frequency tone, depends on the length of time the user has the lever pressed down for. A quick tap represents a dot and a dash signal is made when the lever is held down.

figure 1

Arduino - Designing and Implementing

At the early prototyping stage we didn't have access to an authentic telegraph, so with a bit of creativity and the use of some household items, we designed an alternative morse code oscillator.

Because we didn't want to spend money on a real telegraph because the risk of the prototype not working, we created a telegraph with standard garden pegs, and since the circuit needs to be closed for the signals to be made, the leverage of the pegs made it a suitable choice.

By drilling screws through the peg and wiring each end to the Arduino, it creates the conductibility needed for the circuit to be completed when the peg is pressed down.

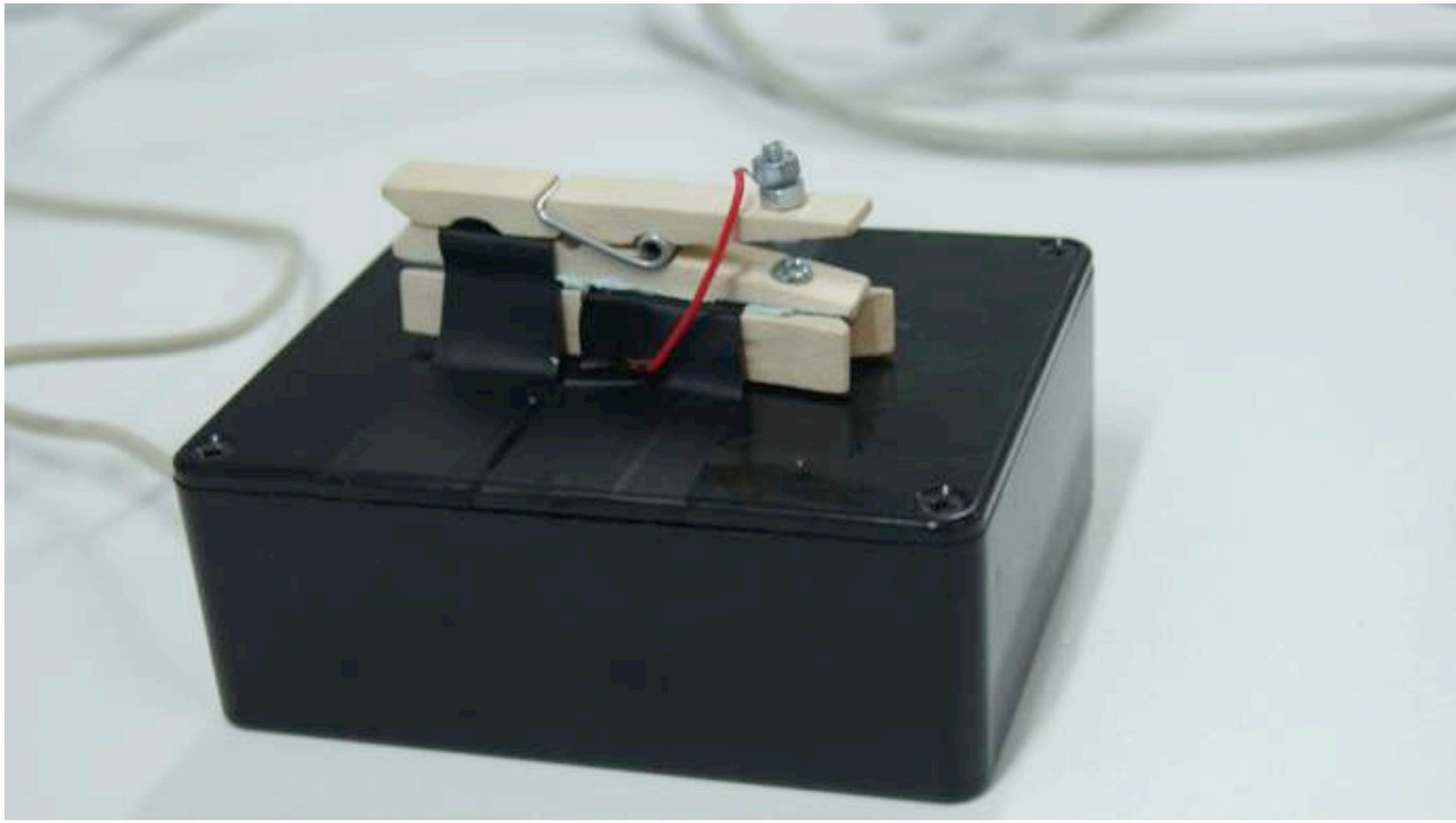


Figure 2: Homemade telegraph key

Arduino - Designing and Implementing

In terms of the manual set up of the circuit, we needed to wire the telegraph to the Arduino.

As the telegraph is a switch, the two ends needed to be connected to the board.

By using the breadboard we could create a custom circuit for it to do what we wanted.

We connected the wiring to the breadboard and connected one end to the analogue input and the other to the digital output using wires and a 10ohm resistor, and this would make sure that the signal from the telegraph can go through the Arduino to the computer.

Another digital output on the circuit is the speaker seen in figure 3. Along with the switch, the speaker is connected to one of the six digital output ports, allowing for a tone to be played when the switch is closed, however this will need to be written into the code for this action to work.

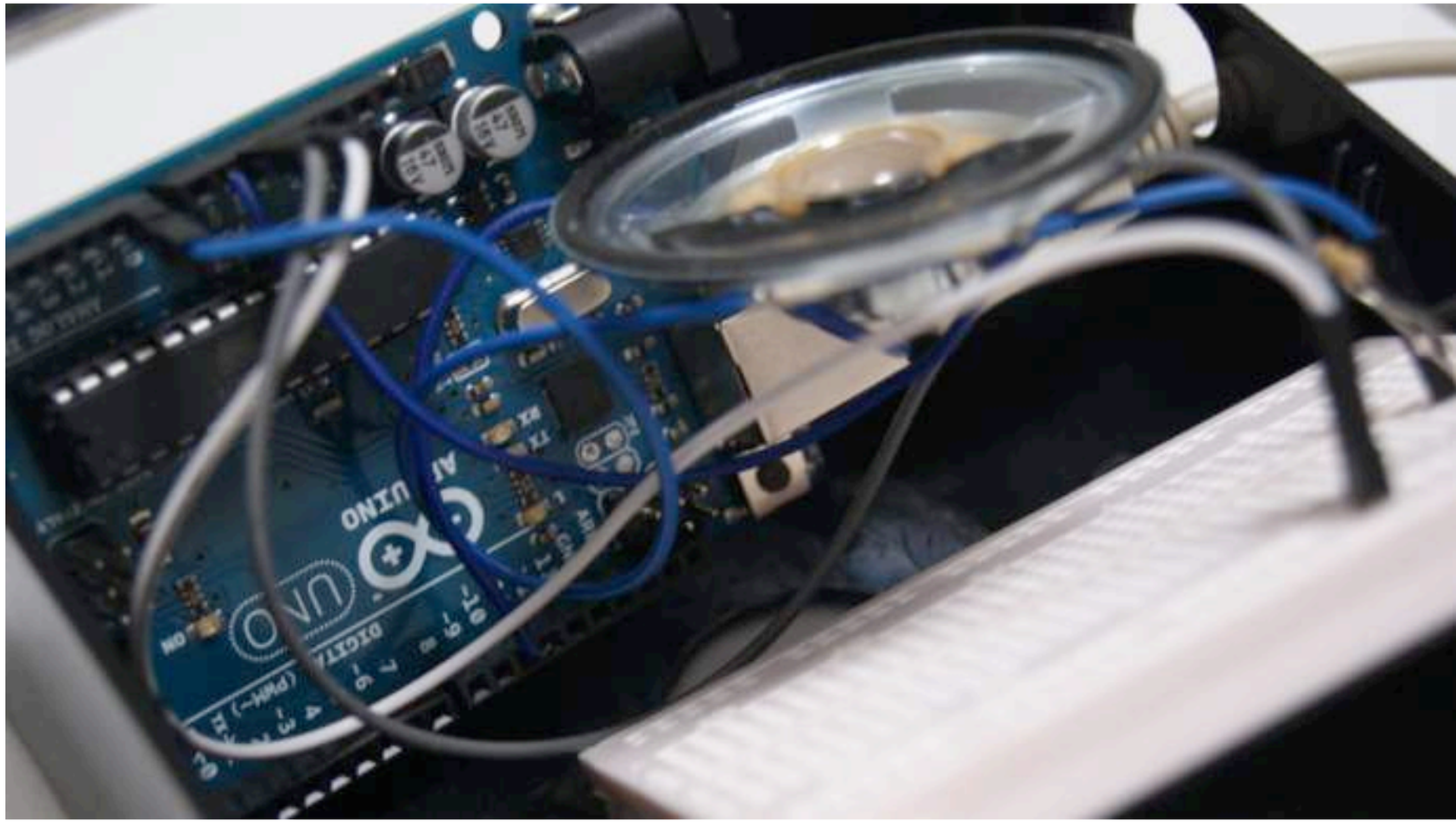


figure 3

Arduino - Designing and Implementing

This code is telling the Arduino board to play the morse code tone of 440hz when the telegraph key closes the circuit. It is telling the Arduino to read whether the key is open or closed and if the value representing that the circuit is closed is 0, then it is to play the sound, if not then it doesn't.

At this stage the telegraph key was making an authentic Morse code sound every time the nuts on peg touched, however for the computer to display the sequences of signals as specific characters, the coding needed to be developed.

MorseCodeSound

```
int myKey=14;    // We are borrowing Analog Pin 0 and using it as digital
int speaker=11;  // Speaker will be hooked between pin 11 and ground


int val=0;       // A value for key up and down
int myTone=440;  // Freq. of our tone



void setup() {
  pinMode(myKey, INPUT);
  pinMode(speaker,OUTPUT);
}



void loop() {
  val=digitalRead(myKey);          // Read the state of the key
  if (val) tone(speaker,myTone);   // If it is down play the tone
  if (!val) noTone(speaker);       // If it is not down stop the tone
}
```

Figure 4: Sound code

Arduino - Designing and Implementing

```
int myKey=14;    // We are borrowing Analog Pin 0 and using it as digital
int speaker=11;  // Speaker will be hooked between pin 11 and ground

int val=0;                  // A value for key up and down
int myTone=440;             // Frequency of our tone

boolean ditOrDah=true;      // We have a full dit or a full dah
int dit=100;                // If we loop less than this with keydown it's a dit else a dah
int averageDah=101;         // Start with this value we will adjusted it each time he sends a dah


boolean characterDone=true;  // A full character has been sent
int myBounce=2;              // Handles normal keybounce but we needed to do more later
int downTime=0;              // We are going to count the cycles we loop while key is down

long FullWait=200000;     // This value will be set by the sender's speed - the gap between letters
long WaitWait=FullWait;  // WaitWait is for the gap between dits and dahs
long newWord=0;          // For the gap between words

int nearLineEnd=60;      // How far do you want to type across your monitor window?
int letterCount=0;       // To keep track of how many characters have been printed on the line

int myNum=0;  // We will turn the dits and dahs into a data stream and parse
              // a value that we will store here
```

Figure 5.1: Coding developed

Arduino - Designing and Implementing

With guidance from several YouTube tutorials and Arduino forum answers, we were able to code the Arduino to return a character based on a sequence of dots and dashes. Members of the Arduino forum recommended that we should comment our way through the coding so we knew exactly what was going on at each stage of the coding.

Gaining quite a lot of information from the web tutorials, we were able to devise a bunch of code that needed to be adapted and fused together to create the code we needed.

For example, we could return the letters of the alphabet through the code that the tutorials had provided but because one of the ideas of the concept is to incorporate the social media aspect, to be able to tag users on the networks, we needed to be able to display punctuation with the device.

Figure 5.2 basically shows that when there isn't enough detection of a signal to create a full tap, which would display an "E", a "#" is displayed.

To display an "@" sign, which would tag people, the user would have to press down on the key for a specific time, which is unreliable at the moment. This would need to be changed in the future if the museum was to install the exhibit.
This process took a couple of weeks to get working because of the amount of errors that were present when compiling the code.

```
void printPunctuation() {
  byte pMark='#'; // Just in case nothing matches
  if (myNum==71) pMark=':';
  if (myNum==76) pMark=',';
  if (myNum==84) pMark='!';
  if (myNum==94) pMark='-';
  if (myNum==101) pMark='@';
  if (myNum==106) pMark='.';
  if (myNum==115) pMark='?';
  Serial.print(pMark);   // print the punctuation mark
}

void shiftBits() {
ditOrDah=true;         // we will know which one in two lines
if (downTime<dit/3) return;  // ignore my keybounce
if (downTime<dit) {
  // We got a dit
  myNum = myNum << 1;  // shift bits left
  myNum++;             // add one because it is a dit
}
else {
  // We got a dah
  myNum = myNum << 1; // shift bits left

  // The next three lines handle the automatic speed adjustment:
  averageDah=(downTime+averageDah)/2;  // running average of dahs
  dit=averageDah/3;                    // normal dit would be this
```

Figure 5.2: Coding developed

Arduino - Designing and Implementing

After purchasing a telegraph key from the Internet, we wired it up to the breadboard of the arduino to replace the rough pegged prototype. This key is much more reliable when tapping out the signals because it the screw closest to the handle can be altered to the users preference and speed. Also, the prototype now looks more professional than it did before.

At the moment the code allows the computer to display the characters through the serial monitor on the Mac's arduino software. By possibly changing the code to keyboard print and keyboard press, instead of serial print, the characters could then be displayed in any kind of text field or text editing software because the telegraph would then take over the controls of the keyboard, emulating the input that the keyboard performs.
This would make the process of linking the input to the interface a lot easier and wouldn't require any peripheral equipment to make the connection, which would save on costing.

Another improvement would be the connection to the Mac from the Arduino board. At the moment the device is linked up via a USB cable. However, if the Arduino board was carrying a Bluetooth shield, which only costs around £5, the connection could become wireless through the bluetooth connectivity. This would give the museum installation more flexibility because there would be less of a limited area in which to locate the device.

Please refer to 'Device Prototype Demonstration' on the disc

Finalising the Morse game

After a lot of debate, as a pair we decided to make the game a one player game throughout.

After keep on receiving feedback about immersing a user beyond we were proposing, we added in a storytelling aspect to the game. Combining multiple features we research and analysed earlier in this document.

There is only going to be one game mode in the Installation.

A user selects at random a time period during World War 2. According to the scenario they're given. They must type out a warning message to their allies before time runs out. The idea allows the user to gain an insight into how fidgety morse code is as opposed to current methods of communication. I.e, smartphones, talking to people via phonecalls, instant real time communication.

We combined multiple aspects of what can engage a user in an interaction. It was importPlease refer to Final Prototype video on the discant that any media used throughout the game was 100% contributing to the alteration of the users emotion.

Once the authentic telegraph arrived, we realised the alphabet was actually on the telegraph which massively benefited the on screen experience. It eliminated the need to have the on screen guide.

We made a bold move to make the minimal and simple animation with the planes moving towards the Hawaii islands visual timer. Not having an actual timer on screen created more suspense and also erases any aspect of digital on screen. It's just the user and the telegraph.

Please refer to Final Prototype video on the disc

Collaborative reflection

We as a pair believe we answered the brief the way we set out to and owe a lot of the success of the project to the Arduino prototype. It took a bulk of the project creating the Arduino, with many issues regarding the code and programming, particular letters not working and working out accurate measurements of time between dots and dashes. One we got the prototype working the rest of the final design work fell into place perfectly.

We received a very positive response to our final prototype video, which we couldn't have been any happier with as all of the hard work crafting the style of the experience and the development of the Arduino really paid off.

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