wificonnect
Design Process Journal

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In this project, we were asked to *'Design and Develop'* an output from a previous project and develop it further in order to create a package of information for that object to be manufactured. This project is aimed at the detailed design of the product.

Design Decisions

Concept Development

After understanding what was required of me in this project from the brief, it was a fairly straightforward decision to choose the NCR project as a starting point. My conclusion to that project, however, was a 'health card', and not something that obviously leant itself to this project. The technology that was used in that product was an NFC tag, a device capable of sharing small amounts of data between devices.

An initial idea was to develop this card, but in the form of a dongle, providing me with a physical object to design and develop. I wasn't keen on this idea however, due to the fact that you can buy NFC enabled dongles on the internet very easily, and I was more interested to develop a unique product.

I decided to stick with the technology of NFC tags, and find a unique function for them. This ended up being a device that would utilise the tag to provide users with an instant wifi connection. This would be a product aimed at the restaurant/cafe environment.

Initial User Research

I visited a few nearby restaurants and cafes, to gain some insight into the environment and the user requirements for a product like this. I visited *The Hengler's Circus*, a Wetherspoons pub on Sauchiehall Street, *Life restaurant, AntiPasti* and *Costa*. I also called on my own experience working at *Hotel Tarentaise* in France. I spoke to the woman at the counter in AntiPasti and asked her opinion on the concept.

"We wouldn't want anything extra on the table. We like it clear as it is."

"Our wifi is so slow, we don't want too many people on it"... "but it would be useful if we let everyone on the wifi."

Insights The concept is viable, but it must meet the user's needs. It must be sleek, unobtrusive, and fit naturally with the cafe or restaurants environment.

What is it?

An observation I had made from visiting these establishments was that there was not a single common thing that was on each table, counter, bar or reception. I was hoping to see a definitive single object that I could incorporate an NFC tag into.

I decided to focus on the tables, as creating something for every table would increase the potential for devices sold. These tables are uncluttered, and only had a couple of objects on the table at most, which relates back to what the staff at AntiPasti had said. Cafes and restaurants want to keep their table tops as simple as possible.

It was clear that the device could not be limited to a single form and should therefore offer a 'physical' function as well as allowing the user to access the wifi. I decided to create a table 'centre-piece', that provides this physical function.

Not all tables have numbers, menu stands, or salt and pepper holders, so I decided to provide these as options for what this physical function should be. These three options were the most commonly found table-top objects, and so the customer has the choice over which of these interchangeable components they use in their cafe or restaurant.

Reflections

In hindsight, after going through the process of this project, I can see that even if I had chosen to design the dongle, I would have run into very similar problems and challenges and would have learnt just as much.

Due to the focus of this project, I felt that I should not be wasting time on this part of the process, and so I forced my way through it, eager to get stuck in to the development of the product. It would have been worth my time exploring more options and possibilities at this stage.

I think the user research that I carried out was too heavily weighted toward the product rather than its function and the concept, especially during the early stages of the project, where they are arguably most important.

Technology

The main function of this device is dependent on the NFC tag. The tag is capable of storing small amounts of data, including information about your wifi and your password. This allows you to connect to a wifi signal with just a tap of your phone, provided that it is NFC enabled.
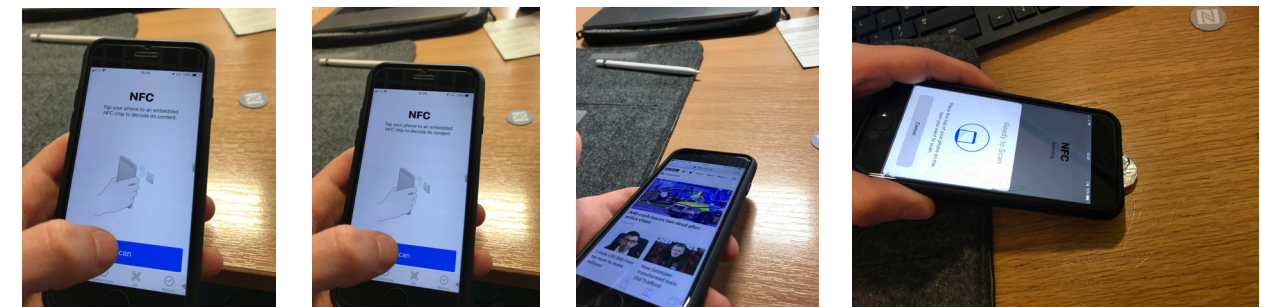
NFC tags
Key information

The tags are read-and-write, meaning anyone can encode data onto it, and anyone can read data from it. They can be re-encoded an unlimited number of times.

Provided they do not develop faults, they should last for 20 years.

The tags cannot be read by iPhones without an app and cannot be encoded by an iPhone. They can however be read and encoded by any enabled Android phone.

To read the data on my iPhone, I downloaded an NFC reading app to determine the user interaction. It requires three steps; opening the app, pressing scan, and holding over the tag. Your phone then performs the desired task.

The phone only scans when it is held a few millimetres from the tag, as the signal only travels a very small distance. The NFC tag within your phone is located in different areas depending on your model and make. The tag must be within reach of your phones NFC device. It was also apparent from this experimentation that NFC tags do not transmit through conductive materials.

You can 'lock' tags to be read only to stop any user from changing the data on it, however this cannot be undone. Therefore the tags must be able to be removed from the housing and swapped if the data ever needs to be changed, for example if the wifi password needs changing.

Reflections

I also chose not to focus on the problems that iPhones cause, but a further development would be to find a more efficient method for these users, for example encoding the wifi password itself, ready for a quick copy and paste.

Form

The device is constituted of two main parts; the base, and the lid. The different lids are interchangeable, allowing the customer to choose between the three physical functions offered by the device. Held in place within the centre-piece is the NFC tag.

The removal of the lid is an essential part of the design. Most importantly, it allows the user to change between lids. It also gives you access to the NFC chip, allowing you to change it in the case that data on it needs to be altered (presuming the customer locks the tag). Circular economy encourages you to extend the life of products through design, and reduce the material going to waste. The plastic inserts have a thread, allowing the lid to be screwed into place.
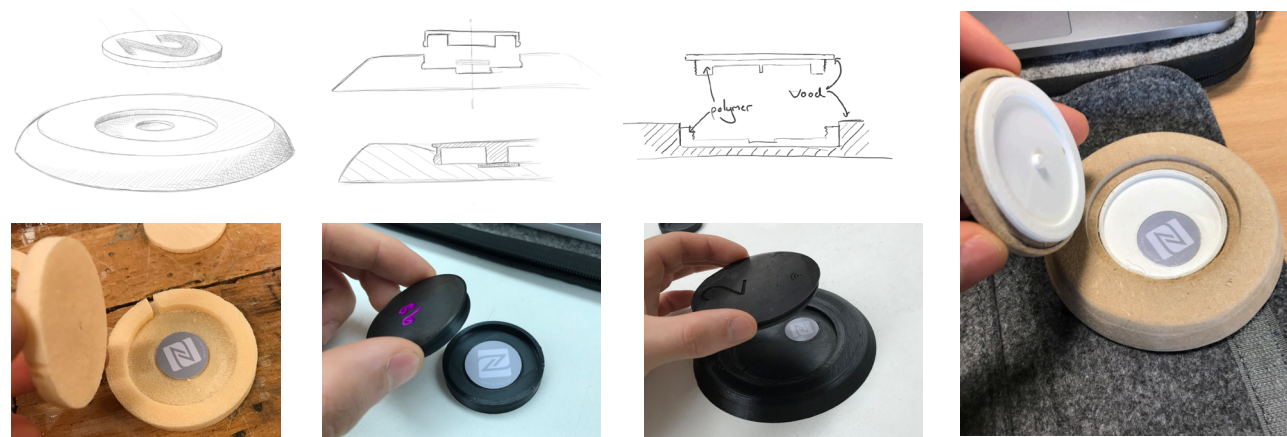
This development came from a series of issues that came about when prototyping this mechanism. The wide thread is awkward to manufacture from wood, so it made sense to introduce the plastic inserts. Plastic is easily shaped, cheap, and faster to prototype. This would also keep down the complexity of the wooden parts, simplifying the manufacturing process.

User feedback from these prototypes gave me further insights into what worked, and what needed improving. An example of this was that it was not immediately obvious to users where they had to put their phone in order to connect with the tag. I aimed to keep the shape as low profile as possible, in order keep it as unobtrusive, sleek, and so that the NFC tag was always within reach. The solution to this was to have a simple instruction on the lid, guiding the user on how to use the device.

The slot for the NFC tag is slightly off-centre. This was due to the location of the wifi signal on the lid not being in the centre of the device.

Another development due to user feedback is the small extrusion on the underside of the lid. In previous prototypes, the tag would sit in its dedicated slot, but free to move if the device was turned upside down. The extrusion holds the tag in place and stops any movement.

The product has three lid options; a table number, a salt and pepper holder, and a menu stand. I did not get an opportunity to prototype these lids and gain feedback on their forms, but they came from iterative concepts and my subjective preference.
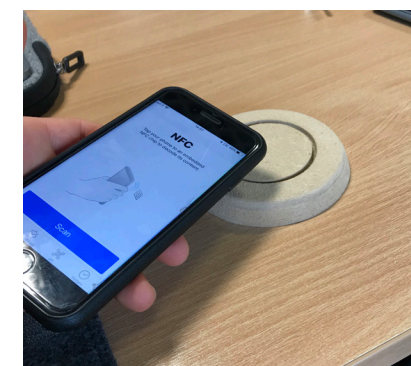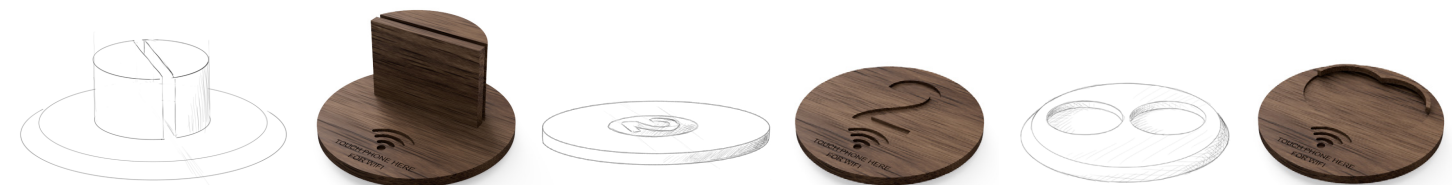
The lids are not intended to be taken off by the user, but by the owner or workers of the cafe or restaurant. When I put my final prototype in the hands of a user, the first thing that he tried to do was take off the lid, and by force rather than using the screw mechanism. I think that this is due to the gap between the lid and the base. In a further prototype, this gap must be smaller, or not there at all. The lid must not obviously be a lid, and yet remain easy to remove.

Reflections

I have accounted for the positioning of the wifi logo in where the NFC tag sits, but I have failed to actually ensure that the tag sits under the logo. The positioning of the tag was designed before the mechanism developed into a thread, so this needs to be resolved. Having made the final prototype, it is obvious that the lid is too small to accommodate the salt and pepper holder, so this will also have to be developed further.

Materials

My analysis of the user requirements for a product in a cafe or restaurant environment led me to determine a few technical specifications for the material of the device.

Technical Requirements

It must be resistant, and able to withstand kitchen standard cleaning products.

It must also be able to withstand boiling water, and durable enough to be washed many times.

It must be non-toxic, and therefore safe to be around food and drink.

It must not contain conductive materials, as these block the NFC signal.

These requirements caused my initial thoughts to head toward Polymers, due to their high durability, low cost and ease of manufacture.

One of the observations from the intended environment of use was that every single cafe table was made from wood, and as one of the user requirements specified that the device should be unobtrusive and natural, it seemed logical that the product should be also made of wood. Wood is also a much more environmentally responsible material and can be sourced from local, sustainable resources. I came to the realisation that the wood was primarily for aesthetics, and the durability could be achieved with a protective finish. As this is a cost-driven product, I settled on Pine as a cheap option, whilst still being aesthetic and easily manipulated. A wax coating can offer protection and provide a high-quality finish.

The inserts that hold the NFC tag and allow for the mechanism to attach the lid, are smaller parts, so I was more lenient about using a polymer. Polymers are more straightforward to manufacture complex shapes like a thread. I was able however to find a firm, MBApolymers, that sell high-grade post-consumer recycled plastics. The two most commonly sourced recycled polymers are Polypropylene and ABS. I decided on Polypropylene (specifically PP2131) due to its higher heat and corrosion resistance, and its price.

	ABS	PP
£/kg	2.22	1.18
Max service temp (°C)	76.9	115

Manufacture

The product is relatively simple, with only 4 components that need to be manufactured.

Firstly, the wooden parts. In order to mass produce these parts, you would need a more efficient, cost effective method of manufacture than forming them by hand.

I made the prototype by cutting 3 circular layers, each with a hole in the centre. I glued each layer together and then sanded to create the chamfered edge. This took me a couple of hours to produce and due to the thickness of some of the layers this was very difficult. Even with the use of a laser cutter, this process would be done predominantly by hand. A more efficient way of forming these wooden parts is through CNC milling.

CNC milling involves a high initial set up cost, but allows you to shape all kinds of materials to their exact shape, using a CAD file. All of the wooden parts could be formed this way, including the writing on the lids.

As with most parts made of wood, some of the process does need to be done by hand. In order to create the desired finish, the parts will need to be sanded, and then given a wax coating. This is likely to be the most time consuming, labour intensive, and therefore most expensive part of the process.

To prototype the polymer parts, I used a 3D printer. This is a very useful tool for prototyping small, quick parts like this, but not an efficient method of manufacturing parts at a larger scale.

The most cost-effective way to manufacture these parts is by injection moulding. There is a large tooling cost initially, but due to the large tooling lifetime, each unit that is produced only costs a few pence. Injection moulding allows you to produce very intricate shapes in a high quantity.

Reflections

CNC machining is a very effective method for manufacturing parts, but I am hesitant to believe that it is as cost effective as I have evaluated it to be. I costed these parts based on quotes from manufacturers, and from estimations based on advice found online, but I am still sceptical.

Final Reflections

The Product

The concept for this product came about in a backwards fashion. It did not start with a problem that I looked to solve, but with a technology that I aimed to find a unique use for. As a result, the concept is aimed at streamlining and improving a task, which in this case is connecting to a wifi in a cafe or restaurant environment. The concept does feel a bit of a gimmick, but one that I feel people would enjoy using, and would hopefully buy. Doing more stakeholder analysis at the start of this process to reassure this, would have definitely been worthwhile.

I decided on cafes and restaurants as the main stakeholders of this product, giving me an environment and situation to work with, but it seems a shame to be limiting this use of technology to only within this environment. The system in place is transferable to all establishments offering wifi, which is nearly everywhere in this day and age. If the product was suitable for use in the home, in museums and in shopping centres for example, the potential for sales would be much greater. I also decided early in the process that the unique use of the NFC tags would be for wifi connection, but the potential use for NFC tags is much broader than this. Within the restaurant environment, the tag could link you to a digital version of the menu. It would have been good to give customers a more flexible choice of the function and allow more freedom with what the product could be used for.

The Design

There are still a number of unresolved issues with the product. Firstly, there is the issue surrounding the compatibility of the NFC tag, depending on the model of your phone. At this present moment, you can only encode the tags with a single set of data. In this situation, you would have to choose between encoding the full wifi data, at the loss of iPhone users, or only encode the wifi password, losing the 'one tap connection' that is achievable with Android phones. This may change in the future of course, if Apple release the full capability of their technology.

Frustratingly, I only discovered in the past few days that the NFC tags I bought, and many that are available online, are in fact stickers. Having known this from the start of the project, the design of the device could have been very different. The tags would still need to be removed in case the wifi data needs to be altered and it has been 'locked', and of course the lids still need to be interchangeable, so it is likely that the design might have been similar, but removing a sticker is a great deal easier than designing a mechanism around removing a part. I might have been able to save on the intricacies of the details of the design, saving material resources, and manufacturing costs.

Design Process

During this project, I took on board from the previous design project, and kept a much more thorough account of my thoughts and actions in my folio. This meant that when it came to put together this reflective design journal, and the other deliverables, I could follow my process much more accurately, and realise where and when I could have made improvements.

Looking back at the initial stages of the project, I definitely should have spent more time analysing the needs and requirements of the users. I was able to find technical requirements to get my teeth stuck into, but more research into how customers actually go about connecting to the wifi now seems like a very important bit of analysis that I seemed to have missed. Storyboarding this would have proved useful.

The prototypes that I made were useful for gaining insight and gaining feedback about the technical form of the product and problems that needed to be solved, however it would have been very beneficial to take these forms to the stakeholders to get feedback from them. The form of the product and how it relates to the cafe environment is one of the stakeholder's most important interests, and therefore the most important aspects to get right.

What's Next?

Although I have made a prototype out of MDF and PLA (the 3D-printed part), the next step would be to make a prototype out of polypropylene and pine by using the intended manufacturing processes. Due to closure of the Reid workshop, I was not able to make this prototype until after I had put together the intended manufacturing process and due to the resources available I was not able to make it using these processes. Doing this would have given me further insight as to what is possible using these techniques, and whether they are viable. It would have also helped me to more accurately cost the product.