DESIGN DIALOGUES IMD11112

Coursework Two

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Introduction

The Lion's Gate is a project situated on the Merchiston campus of Edinburgh Napier University which seeks to realise a concrete implementation of the principles of permaculture through the use of interactive digital systems (Edinburgh Napier University, 2018). These systems seek to create a blended space in which permaculture can be introduced to a wide audience using user experience design principles for more effective engagement (Benyon & Egan, 2017).

In this vein of wider participation, it has been found that low ethnic diversity is exhibited amongst permaculture practitioners as a group despite a variety of ages being well represented (Evans & Thomas, 2013). Given that the university's student body has a sizeable number of international students, use of the Lion's Gate represents a prime opportunity to expose permaculture to a more varied demographic (Complete University Guide, 2018).

Indeed, Egan has indicated in lectures that the level of engagement with the project is very high, with no shortage of enthusiastic volunteers but there has been difficulty in defining tasks for all of them. Thus, it is proposed that an interactive system be designed to automate the allocation of labour on the Lion's Gate, specifically focusing on the food productivity crops within the area. While productivity in itself is not the primary metric for success for the project, "Obtain a yield" is the third principle of permaculture so it is important that volunteer effort is applied as efficiently as possible (Permaculture Association, 2018).

The main interactive component of this system will consist of garden tools, such as rakes, spades and forks, with a computerised integrated component displaying pertinent information on a screen. Working in concert with the smart tools, planters and small plots containing crops within the Lion's Gate will be bordered with low power LED lights, changing hue to indicate the status of the task in progress. This is in keeping with the idea of zoning laid out in the permaculture approach of land management (Whitefield, 2016).

The automation of labour allocation ensures correct and consistent care of the relevant crops even across multiple volunteers. A collaborator of Egan's, Dr Emilia Sobolewska, has stated that her houseplants expired due to the difficulty in remembering to maintain a steady regime of care. This illustrates the potential for a system to schedule necessary tasks and ensure that the establishment and consistent upkeep of crops even across multiple volunteers.

This report seeks to apply the design principles laid out in User Experience Design (Benyon, 2017) to create the system described above.

Design Approach

The design approach used in the current system was the Iterative Design process.

Iterative Design shares many features of the Agile Methodology that is used the information technology industry and was developed for use in the software development sector. The principles of the Agile methodology demand delivery of a working product “frequently” and emphasise regular contact between the developers, product owners and end users (Agile Alliance, 2018).

Design is not the same as software development, but the principle that an idea is conceptualised before being repeatedly tested in multiple iterations to gradually improve it will be the concept carried forward in this report. A similar process of developing a prototype (usually low fidelity) in a short period of time before being tested whether with the client, end user or subject matter experts will be used for all the advantages previously mentioned.

Given that access to potential volunteers (primarily students and staff at the university) for the Lion’s Gate project was readily available, this allowed the high level of engagement required for the Iterative Design approach.

However, an initial investigation consisting of researching technologies and user conceptions was required before any iterations were completed and did not form part of any further design cycles so it can be said that the design approach was not purely iterative but in fact blended with the traditional waterfall method even if only in a small part.

[PHOTO OF ITERATIONS FROM SKETCHES TO PAPER PROTOTYPE TO FUTURE DESIGN]

Understanding

Two techniques from chapter seven (Understanding) of Designing User Experience (Benyon, 2017) were chosen in order to gain preliminary data before the preliminary concepts were developed further.

Interviews

The use of interviews was selected due both to the ease of access to the primary target demographic (students and staff of the university) and the fact that user centred design is often best served by speaking directly to the users. As with all interaction with human users, there was a certain vagueness to the responses given but the deliberate narrow scope of the questions was designed to focus interviewee attention on the system rather than the application of permaculture in general.

A cross section of potential users primarily in their twenties and thirties were asked three questions in a semi-open format. The interviewer engaged with the interviewee to expand upon the answers.

The interview questions are listed below with a selection of answers:

What do you think of a system that would keep track of the tasks needed to be done in a garden and automatically tell you what to do?

"I think it's a great idea. I don't really know much about gardening so anything that would keep me on the right track would be great."

"There are loads of people who want to volunteer on the Lion's Gate but nothing for them to do. Organising them all would be a headache so a computer system that would channel all that energy into the right direction would be really useful."

"I take it that this is a computer system? You could use the university's system to run it but someone would have to maintain it over the long term. In principle it sounds good but you have to plan for the future where it might be years in the future and people are still using it. It sounds like a lot of effort."

What do you think of a system based on lights that inform you of the status of a task being done in a particular part of the garden?

"What kind of lights? Do you mean lightbulbs? [Interviewer makes interjection about LEDs] Oh, in that case I think it would be useful to show where you need to work in the garden but how visible would they be on a sunny day?"

"It would be really cool if you used neon bars for a retro 80s theme but you're probably going to go for LEDs because they're cheap and don't need much power. You still need to power them though so you need to find some kind of solution for that."

"The colours would be important. Red for not yet started, orange for in progress and green for done sounds good but maybe some people would think that red means danger."

Interviews (continued)

What do you think of smart tools that would work with the other two systems to track the progress of a task in the garden?

"As I said before I don't know too much about gardening so if these tools told me exactly how to do what I needed to do, it would be really cool. For instance, I remember my mum telling me that you can't water potatoes with too much water so a smart watering could tell me exactly how much to put in it for potatoes."

"Are you going to use batteries to power these tools? What kind of feedback will we get from them? Without a screen of some sort aren't they just fancy normal tools?"

"Um sounds like a reasonable idea but how are the tools going to connect to the system to track progress as you say. Will they need to use Bluetooth or wifi?"

From the data collected in the interviews, it was clear that the benefits of a system that automatically manages garden tasks had potential value to the intended end users but they were somewhat confused since the concept was not yet well formed.

However, the quotes listed show that a number of suggestions were made and these were absorbed into the design process and taken forward onto the next iteration.

Observation

The other method of understanding selected was observation. The logic behind the use of observation is to glean the useful practical habits used during gardening for incorporation into the system being designed.

An expert (an experienced gardener) in the field of small scale agriculture was observed conducting routine maintenance of a small plot of land across the course of a day. While not specifically a permaculturalist, the expert in question has indirectly practised permaculture principles for decades while sustainably growing crops with a modest yield.

It was noted that the expert worked on several sections of the garden all at once. The garden is divided into distinct parts categorised by crop such as potato, pea or strawberry. Such an advanced method of working is not feasible for the novice volunteers working in the Lion's Gate. Curiously, different crops required different tools which were placed next to the relevant section for easy access at the time.

Additionally, when planting was taking place, a long thin piece of wood with markings was used to measure the depth required before seeds were placed inside the resulting hole.

Finally, crushed egg shells were used as fertiliser but it was unknown as to how this could be implemented within the system.

Overall, several useful methods were indeed discovered during the observation and were included into the next iteration of the product.

Envisionment

As set out in chapter eight of Designing User Experience (Benyon, 2017), envisionment is the process of forming the information collated during understanding into a prototype with which a user is able to interact.

Sketching and paper prototype techniques were selected for use in this case. Design is often best conveyed through a visual medium and as both methods are highly visual, they fulfil this criterion well.

Sketches

For speed and impact, sketching is perhaps the most efficient envisionment method for conveying a concept. The prototype is kept low fidelity for speed but recognisable enough for interaction.

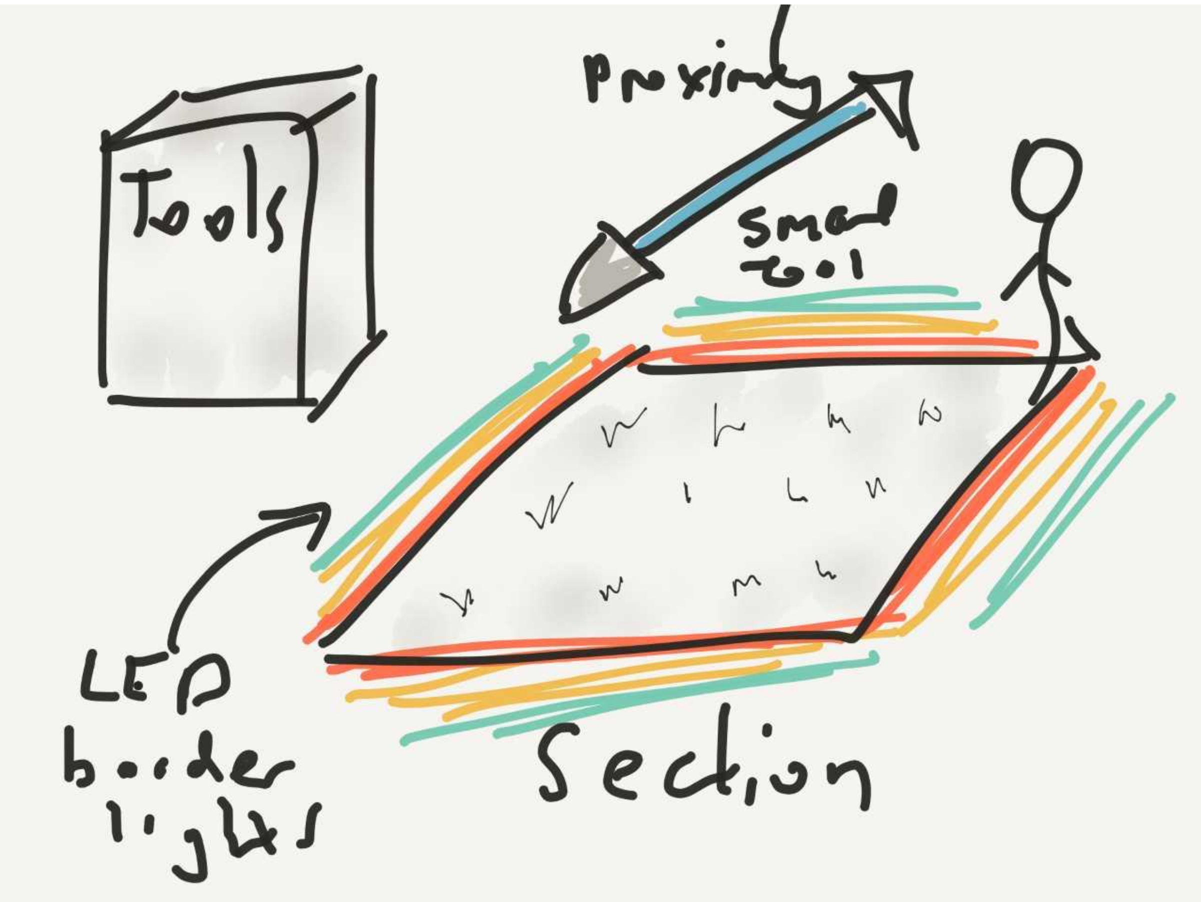

Figure 1: Initial Sketch of smart tools and garden

In this instance, a simple sketch was created in using digital imaging software on a tablet and shown to a potential user. A brief discussion was conducted and feedback recorded.

Paper prototypes

The creation of a paper prototype naturally occurred after sketching of the concept. This is due to the fact that the paper prototype was somewhat higher fidelity than the sketches so it was logical to include the feedback gained from the sketches into improvements for the paper prototype.

Due to the difficulty in creating a real working prototype of smart tools, an intermediate prototype was created using foamboard and felt, referring to the design outlined in the sketch and the feedback gained. This was used as the primary system representation for testing and evaluation.

Models were hand made to represent the smart tools, a section of the garden and a small placeholder to represent the tool storage location.

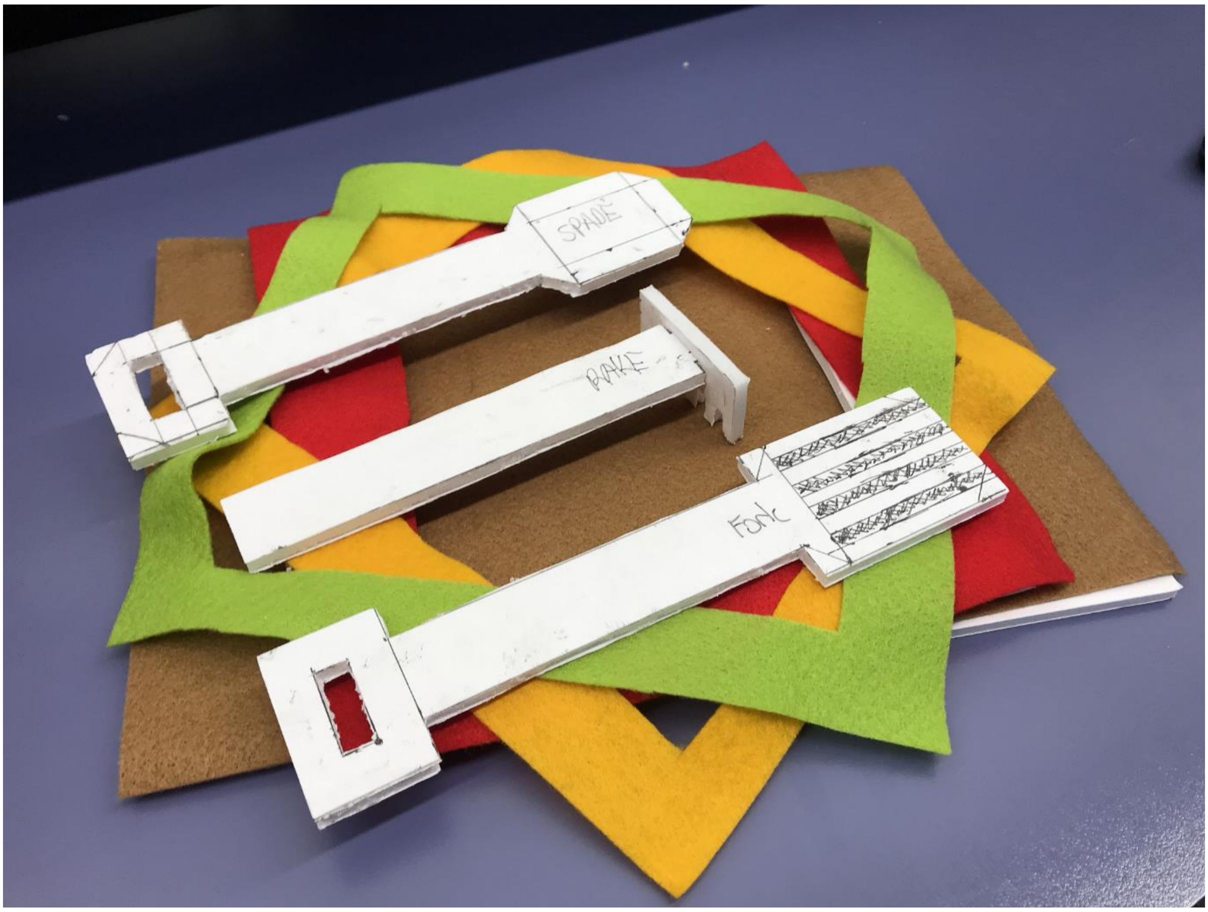

Figure 2: Paper protype of system

Testing

Testing of the idea was implemented using two techniques found in chapter 10 on evaluation in Designing User Experience (Benyon, 2017). Despite being labelled as evaluation, the techniques detailed in this chapter are also used for in process testing.

Participant Evaluation

As mentioned previously, students were readily available to be used to test the product and as user centred design typically involves direct interaction with the users, participant evaluation was selected as an appropriate method for gathering feedback for design improvement.

A potential user, a university student in their twenties, was given the paper prototype (model tools and garden) and a task to complete. Since the prototype was not completely interactive, the designer supervised the user and prompted them on interactions triggered from the app.

The requested task to be carried out began with signing into the system by means of the user's university card, which would open a cupboard where the tools were stored. The user would then take the necessary tools from the cupboard and proceed to the section of the garden lit up by an LED border and perform the required task. Upon finishing this task, the tools would be returned to the cupboard for use by the next volunteer.

The participant did not face particular difficulty in achieving the task set despite the somewhat limited interactivity provided by the paper prototype which indicates an easy to follow concept. They were particularly intrigued by the idea of smart tools and interaction with the garden section border but was unclear about how the tools would relay information back to them since no display on the tool as yet existed on the concept.

Additionally, concerns were raised about the colours of the lights of the border and their implications. In the version that was demonstrated, the border would initially glow red, then orange when the tools and therefore user were detected inside the area to be worked on and finally green once the task was completed. The user's chief concern was that red usually indicates danger or that an error has occurred so a reaction to a problem that does not exist may be provoked.

As a result, these concerns were noted and implemented in the form of a screen that would display information relevant to the task at hand on the tools themselves. The colour of the lights however, was kept the same (red, orange then green) due to the ubiquity of the traffic light system in design and the decision that a solid red light does not typically indicate an error.

Conceptual Walkthrough

Given the problems faced during the participant evaluation due to the still somewhat abstract nature of the paper prototype, it was decided that a conceptual walkthrough would be a more effective technique to gain more information for the improvement of the system by explicitly telling the participant what happens at each stage of interaction.

A different user, also a university student in their thirties, was shown the paper prototype but walked through the process as indicated above. A similar but not identical task was used as a framework for the technique, taking into account the improvements suggested above.

Once again the user signed into the system using their university card and opened the cupboard. The relevant tools were taken from the cupboard and carried to the location lit up by the same LED lights and the required task carried out with the task status being indicated by the border changing colour from red, to orange and finally green which indicated completion. After this, the tools were returned to the cupboard for use by the next volunteer.

With this technique, the ambiguity of the feedback given by the system was somewhat reduced by telling the participant what would happen at each stage but the difficulty of conveying an interaction and reaction through conversation still represented a barrier. The participant did not have any specific difficulty with following the progress of the interaction although certain concerns were raised at the end of the process.

The user stated that during initial interaction in retrieving the tools, it was not possible to know exactly which ones to use and that this would be a problem especially for novice users. This was remedied by adding an indicator light to the storage bins for the smart tools which would only flash for those required for the current task.

Another concern was raised about the task required again for novice users who may not know what to do. It was decided that a screen on the inside of the cupboard would display all necessary information on the current task as well as a short video indicating the path to the location of the garden sector as well as another short instructional video on the task to be accomplished.

The final concern was that the LED borders would not be bright enough to be seen in bright sunlight. It was decided that this could not be remedied at this particular time.

All in all, the rigid nature of the conceptual walkthrough meant that any ambiguity of interaction was eliminated although this meant that the potential to pinpoint these problems was lost.

Evaluation

Evaluation of the concept was implemented using two techniques found in chapter 10 on evaluation in Designing User Experience (Benyon, 2017). This was performed upon finalisation of the system although in this case the design was not yet brought to a working stage. However, several stages of improvement were completed and integrated into the system.

Expert Evaluation

Expert evaluation was chosen as a technique for evaluation of the completed system due to the effectiveness of the user evaluation in identifying problems during testing and the use of an expert in the field to gain an alternative point of view. Again due to the lack of interactivity of the paper prototype, the designer had to narrate and explain the responses of the system.

In this case, an expert in the field of gardening in their forties, not a member of the university but interested in participating in the project, was given the paper prototype and asked to complete a simple task with the improved system in a similar fashion to the process carried out with the user evaluation. The interaction with the final system was detailed as followed:

The user was to sign into the system using their university card and open the cupboard. The storage bins of the tools required would flash and the display on the smart tools would flash green. In addition, an instruction video indicating the task to be carried out (in this case digging and planting potatoes) was played out on a screen inside the cupboard long with a short video showing the path to the garden section to be worked. The tools were taken from the cupboard and carried to the location lit up by the LED lights and the required task carried out with the task status being indicated by the border changing colour from red, to orange and finally green which indicated completion. After this, the tools were returned to the cupboard for use by the next volunteer.

The expert did not have any particular difficulty in competing the task although a few concerns were raised:

Only a few tools, namely a rake, fork and spade were represented in the paper prototype but of course a wide variety are required for gardening work. The recommendations suggested involved the use of a smart watering can which would display the exact volume of water required to prevent over or under watering of the crop. This was especially important due to the fact that the crop in the example (potatoes) is especially vulnerable to rotting if left in waterlogged soil.

In the same vein, it was also suggested that an active indicator of depth be show on the tools that involved digging into the ground to achieve the optimum planting conditions.

Both these suggestions would be especially effective given the likely novice nature of the volunteer body mostly made up of students typically unfamiliar with even basic agricultural techniques. The addition of somewhat familiar visual cues would be especially effective with a population familiar with interactive technology.

However, both these suggestions, especially the depth indicator involve significant further work to be carried out in a future iteration. Both ideas could be implemented using LEDs within the tools themselves to indicate water level and digging depth or even lighting up the whole tool itself although no current technology could be identified for this purpose. The screens on the tools could also be used to indicate depth in conjunction with a simple ruler etched or printed on the blade or forks.

Co-discovery

Co-discovery was used for final evaluation due to the varied opinions that could be gained in a single testing session from multiple users. Again, the designer had to explain the initial concepts and function of the smart tool system as well as indicate system responses but this was kept to a minimum to avoid influencing user feedback.

A group of three students in their thirties were used for this research technique due to their similarity to the target demographic. Unlike in previous techniques, no particular tasks were set for the users to carry out and they were simply allowed to explore the system with the designer responding to interactions.

The group tried a variety of scenarios including planting different crops with different tools and had no great difficulty in understanding the function of the system and were particularly pleased with the interactive nature of the LED borders on the garden sections.

However, as with all other methods used, the evaluation yielded a number of suggestions:

Given their enjoyment of the interactivity of the LED lights, the group were keen to expand upon the features. Improvements included flashing the lights to increase visibility and changing the colour from amber to red if a volunteer left with the tools from working on the garden section without completing the task.

In conjunction, it was suggested that sound feedback be added to increase interactivity although the precise nature of the sound would have to be in concert with the natural environment of the Lion's Gate since there would be a danger of increasing noise pollution which is the opposite of what the project as a whole is seeking to achieve.

The most interesting suggestion mooted was that of what occurs with more than one volunteer using the system at once. This could not be implemented currently but one possibility involves assigning tasks that do not overlap in terms of tools and perhaps displaying a different pattern on the border lights for each volunteer.

Conclusion

While it can be said that the concept of a smart garden automated volunteer labour management system was enthusiastically received by both volunteers and experts, much work is still required to realise the concept into a working prototype. However, due to the limited time and tools available, valuable feedback was still gained.

The iterative design process was found to be highly effective in its ability to segment development into short sections in which one or two features were changed with each version produced. However, the readily available access to the user group may have made this design approach particularly suited to the project and it may not be entirely appropriate for every project.

Due to the lack of a working prototype, the system cannot be said to be truly complete and the fact that the designer had to act out the system responses somewhat broke immersion and most probably affected the user reactions. This could be remedied with a more advanced paper prototype or more probably a computer simulation although both would require significantly more work.

Mission, or function creep was significant problem conspicuously present throughout all stages of the project. Strict application of the MoSCoW process as detailed in Designing User Experience (Benyon, 2017) in order to prioritise system feature is necessary in order to suppress superfluous functionality consuming limited project time.

Comparing this process (iterative) with that carried out in the first assignment (scenario based), it was found that iterative design yielded a concrete concept with significantly less effort and therefore more quickly than scenario based design. Scenario based design involves basing the design heavily on use cases of the product so may be more appropriate if given more information about function at the beginning of the project. However, iterative design is an approach that would usually be appropriate given the flexibility and high level of contact with users for adjustment and feedback.

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