CS-200 2019 Coursework Report

GROUP 30

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Contents

Introduction

In order to investigate how interactive design processes work in the real world, we designed and evaluated a product that helps visually impaired people control their TV. For these people, we created a remote controller which allows users to better interact with a TV through the use of a large visual aid with accompanying audio. This remote controller works by using a variety of sensors to detect user hand placement, along with a number of other sensors described later. This idea came to us when we realised that we all had some form of older relative who were either visually impaired, unfamiliar with general technology, or both. While thinking of common tasks performed or objects interacted with on a daily basis, we settled on tackling TV interaction. We wanted to improve aspects of this interaction that this group of people struggle with.

In order to better understand this problem, we conducted research. We carried out a questionnaire and an in-person interview. By asking useful questions as specified in the module, we managed to gain useful insight into issues surrounding TV usage. We were able to narrow down our target audience's age as well as better understand the main complaints they had with a standard TV remote. Overall, this stage helped us create a solid foundation in order to produce a design that would help us achieve our goal of improving accessibility.

The next stage in our process was making suitable prototypes to further refine the product specification and find any limitations we might come across. One prototype was a paper-based sketch which illustrated the idea clearly to all team members, allowing us to all be on the same page moving forward. The next prototype we made was a low-fidelity prototype. This prototype allowed us to not only further cement the functionalities of our product but allowed us to see some limitations of our design. For instance, the more complex we would make our remote, the greater the cost and size of it would get. We then used the previous two prototypes to create a Wizard of Oz prototype in order to test the functionality of our product. By creating a PowerPoint and using its animations to simulate the various stages our pop-up image of our remote could be in, we gained more insight into the functionality of our product in the real world. Overall, this stage of the process led to a more refined design of our product that conformed to our original goal of making TV interaction easier for visually impaired people, or people unfamiliar with certain aspects of technology.

Ultimately, as a group, we managed to design a product that augmented an already existing product to help accommodate a certain category of people. By conducting research and making prototypes, we pinned down our design to be suitable for our target audience.

Establishing requirements

Data Gathering

As part of our approach to establishing requirements, we used an interview as one of our data gathering methods. One of our group members, Christopher Barker, has grandparents local in the Swansea area. They were perfect candidates to discuss our ideas with. Christopher had many informal conversations with them about how they interact with their TV and their experience with varying remote controllers. In the interview Christopher asked them if they struggled interacting with their TV, and if so, what aspects were troubling. The answer received was that they commonly have trouble. The main issues were seeing the small buttons on the remote controller which often led to mis-clicking buttons causing other actions to occur which in turn confused them further. Another issue was understanding certain buttons. While they had a good understanding of all key buttons and features (they explicitly mentioned their fondness of the red R button for recording shows), they didn't understand some of the less common (although still useful) buttons on a remote controller. Common confusion was with the switch input button, along with other TV menu buttons. Upon being asked if a large on-screen prompt would be useful the answer was a resounding yes – the idea of the button and it's function being read out was well-received, however they specifically stated that the volume of this voice feature should be user controllable so they can turn it off if desired. Adding to this, the placement of their chairs in relation to their TV made it clear to us that the pop-up would have to also be large, otherwise they would face the exact same problem of illegible text/diagrams just on a larger scale.

This highlighted an important aspect to us. We decided that the audio feedback should be an option in some way. Having a voice constantly reading out every button on the remote would, admittedly, become frustrating especially when completing menial tasks such as adjust the volume. Because of this we adapted our design so that the audio feedback required an extra step – in this case, an extended hover over the button causing the audio feedback. This is similar to a long key press on a smartphone.

[insert survey stuff here]

Personas

Our first persona is a 48-year-old white British male by the name of George Smith. George is a software engineer, committed husband and father of two residing in central Birmingham. George usually fills his spare time with side projects to continue to learn and improve his programming skills, however his mother, Julia Smith, has unfortunately had a stroke of poor health. Due to this, Julia has temporarily moved in with George so he can keep an eye on her and look after her. George's mother is unfamiliar with technology due to her age and struggles with her TV. Basic tasks are a struggle that often take much longer than needed, and many features are completely unknown to her. George is currently attempting to explain to Julia how his TV works so she can be more confident when using her own TV once she recovers. They goal is to explain to Julia the functions of different buttons and the affects they have on the TV.

Our second persona is an 87-year-old retiree. Since the death of her husband, Alisa Jenkins lives alone in a single flat in London. Previously being a bank teller, Alisa has found new hobbies such as reading to fulfil her retirement time. While Alisa has always had poor eyesight, it has certainly

worsened with age. Alisa struggles to see the small buttons on her remote controller and some of the smaller diagrams are too complex and hard to see. Thanks to her son, she has a good grasp on technology and does not have trouble with navigation or general television use. However, the size of the buttons combined with her poor eyesight leave Alisa struggling to operate her remote. Having a large pop-up on the TV will allow Alisa to see all the buttons on her remote which will make interaction much easier and faster.

Scenario

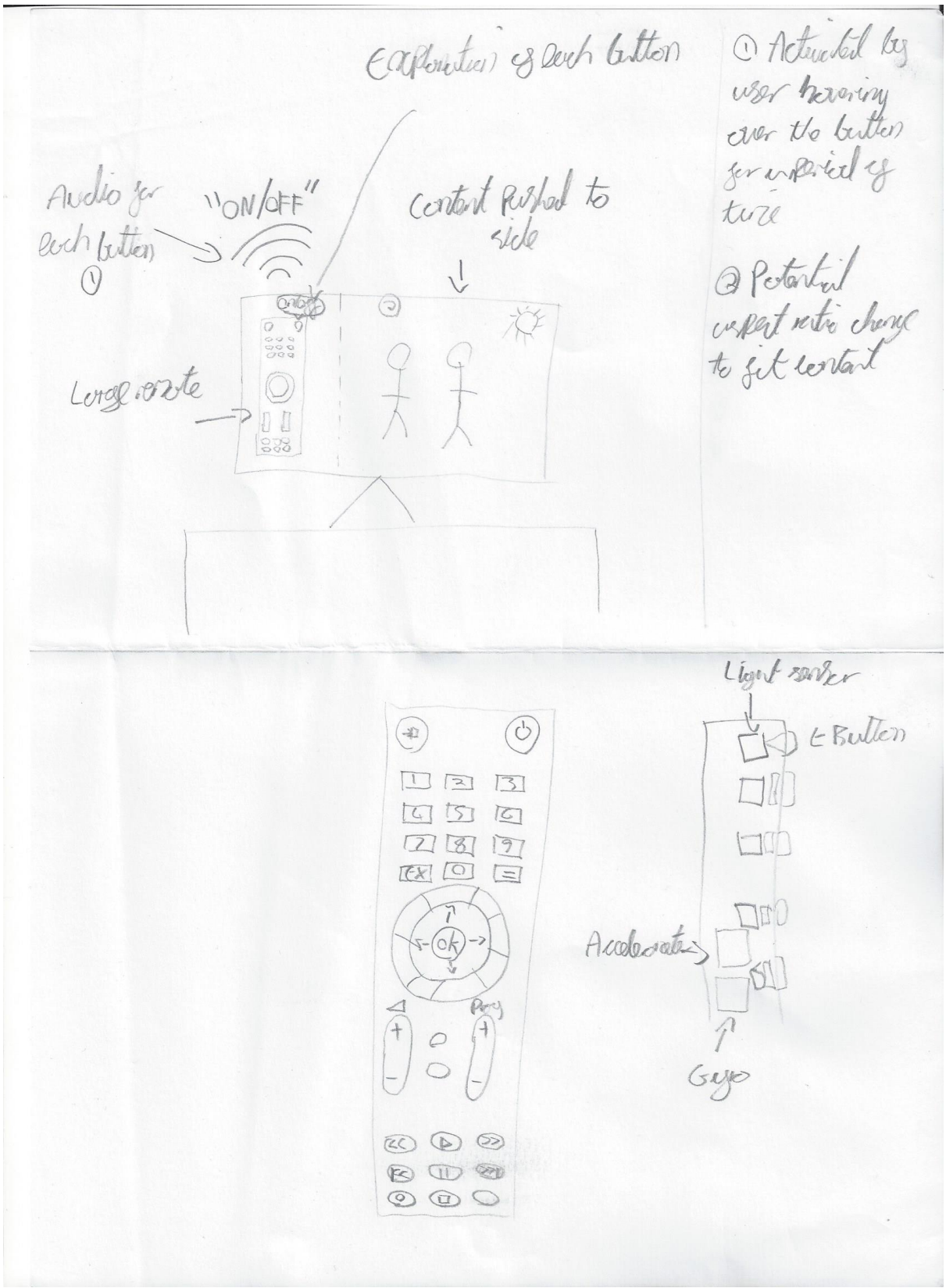
As mentioned in the above persona brief, George Smith is now looking after this mother, Julia Smith, due to a downturn in health. Julia has expressed to George that she doesn't know what she is doing with her TV and often can not use it as desired. She doesn't understand what many of the buttons do, and as a result simple tasks such as switching channels is a trial and error situation that causes much confusion, frustration, and takes up lots of time clicking random buttons until the desired effect is reached. George has decided to teach her how TVs work so that while he is at work she can watch entertainment on TV. To do this, George has decided to purchase our remote controller. George hopes that this remote controller will help her learn to independently control her TV, so that when she recovers and moves back into her own home she will be confident in her skills and ability to interact with her own TV. George explains the basic functionalities of the remote control. He gives her the remote and asks her to change channel. As soon as Julia picks up the remote and points it at the TV, the overlay pops up with an enlarged view of the remote. Julia then precedes to hover over different buttons on the remote and read the text on the screen explaining what each button does. Through constantly interacting with the TV, she begins to learn what certain buttons do due to the text explanation. Furthermore, key buttons being colour coded (for example the 'On/Off' button and 'Record' button) means she can associate different colours with different actions. She continues practicing on her own while George is at work. When George gets home, he uses the remote and explain his steps so she learns from both the remote itself, and her son. Julia doesn't have any visual impairments and as such does not find use for the voice reading out buttons when she hovers over the button for an extended period. As such, she asks George to turn this feature off. George shows her how to access the options page and writes the steps taken down on a piece of paper for her to use when she is on her own. Julia slowly but surely learns how to control her TV through visual feedback from the text and prompt on screen. She likes the coloured buttons as she can remember the colour and then the result of clicking that colour.

Similarly, our remote can be used for people with visual impairments. Alisa is very comfortable with technology and has no problems with understanding her TV. However, her eyesight has degraded over the years and now has trouble seeing small things such as the text and diagrams on the buttons on her remote. She dislikes the large-button remotes you can purchase as they often remove key features such as a 'Record' button. She decides to purchase our product in an attempt to interact with her TV easily. Alisa can then use her remote as normal but benefit from the large overlay with the on-screen buttons. Depending on which chair she is sitting in she can use the extra zoom functionality to zoom in on a part of the remote for an even larger view. For example, the number buttons are often small so Alisa can zoom in on the buttons in order to see which number she is on, so she can type in a certain channel number.

Prototype

Paper-based sketch

Below is the paper-based sketch.

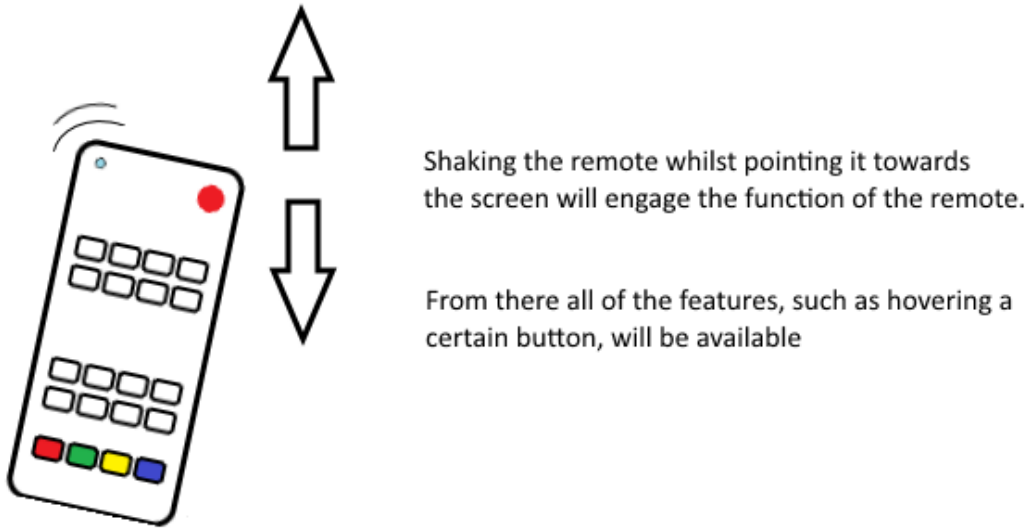


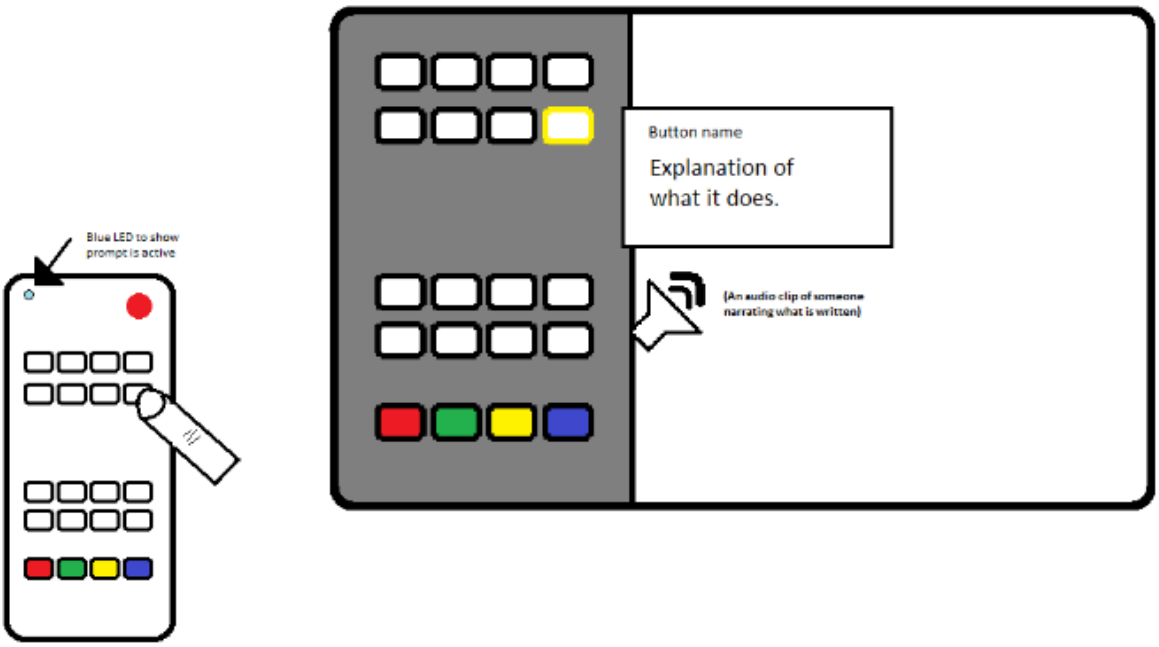
For this product we didn't want to spend time focusing on the exact layout for the remote controller as we were more worried about the functionality. Shown here is a generic remote controller similar to one found in one of our homes. However, the key differences are the internals. Our design uses light sensors under each button to determine if the user is hovering over or touching a button. This allows us to show the button selected on the on-screen prompt. Furthermore, the controller contains a combination of an accelerometer and a gyroscope to determine when it has been picked up and pointed at the TV. This allows the on-screen prompt to appear when the device is in use by the user, and the combination of the 2 sensors should mean that the remote getting moved between people (an action described in our interview) shouldn't active the prompt needlessly. The paper-based sketch also shows the audio prompt in action. An extended hover or touch of the button will cause that button to get read out to the user. This sketch also shows a possible implementation for the pop-up display. To avoid covering the content currently on screen we had the idea to change the aspect ratio of the show which will then leave us a reasonably sized gap to show the pop-up in. Alternatively, the pop-up could be displayed as an overlay if required.

Later on after having completed the sketch the idea to include touch sensors came up. This is because a finger hovering over a button could potentially block light for several buttons at a time. This was a design challenge for us. The light sensors could still be included as they would allow the remote to know all possible buttons that the user is about to press, and only turn the touch sensors on for those buttons. This would drastically lower power use as then the sensors are only on for a small period of time, for a few buttons at a time. Battery life is an important aspect of a remote, so we were conscious of this fact. Adding a larger battery is an option, but we were also aware that the weight of the remote might become an issue if it got too heavy.

Low-fidelity physical prototype

Below is the low-fidelity prototype.





[insert connor paragraph here]

Wizard-of-Oz prototype

In order to further investigate our product's functionalities, we created a Wizard-Of-Oz system for the purpose of testing our features. This mock-up system was a PowerPoint design consisting of slides to represent the various states the product would be in. Initially, there was no on-screen pop-up. Upon lifting the remote up pointing it at the screen, the pop-up appeared. At any point when the TV is on, any interaction of the buttons by the user's finger would change the state of the program. This would be represented in our system via a 3rd party 'Wizard' swapping slides to the current state. We did this via custom PowerPoint animations and manually changing slides with the arrow keys.

Here, our prototype allows us to see that when you press the 'on' button, the pop up would highlight the 'on' button on the screen.

We gained a valuable insight into our product. Firstly, we now understood the scale of our product. For instance, we had a greater understanding of how to program the software part of our product. Having seen the correct outputs for all various combinations of button inputs, we clearly had an idea on how we should tackle the implementation of our features. By all being on the same page, it would make further prototypes or even the final product implementation process much smoother.

Another useful insight is the fact that our design could be adjusted to better conform to our target audience. For instance, considering our product is designed for people who have difficulty seeing buttons on the remote, our buttons on-screen could be much bigger, or allow the user to select from a few size pre-sets. Also, a range of easy-to-see colours should be used in the final product in order to better distinguish key buttons, especially if the symbols on each button still cannot be seen. Colour coordination is an important aspect of our system to allow users to recognise rather than recall, which is a golden rule of interface design. Additionally, we considered the idea of a further zoom if the user needed it. If a user needed to see a more detailed image of the remote - like the top

right section – they could use a zoom feature that would enlarge that specific section of the remote. This would help make our product even more accessible for our target audience.

Finally, our prototype system allowed us to evaluate our hardware features and goals. After seeing our product in use we had to think about the cost of the device. Including sensors such as a gyroscope, accelerometer and a combination of touch and light sensors would push the price of our product up due to the increased complexity. Nevertheless, we felt that these features would be vital to ensuring our product would be appropriate for our target audience.

Evaluation

Due to the current global climate we were not able to do a user study. Instead, we completed a heuristic evaluation of our product.

Heuristic	Pass? (Y/N)	Justification
Visibility of system status	Y	Whenever our remote's feature is activated by the user, the overlay will always appear. This way the user always knows when they will be able to hover over buttons to activate the visual and audio prompts.
Match between system and the real world	Y	Only the information relevant to the selected button will be visible/heard. The text that appears is also written to be as easy to follow for the user as possible, and in as much detail as needed for the user to grasp the full functionality of the button they have selected.
User control and freedom	Y	For some users the narration feature will become an annoyance as indicated in our interview. Therefore, the remote will have settings to allow the user to adjust the speed and volume of the narration, or to turn it off completely.
Consistency and standards	Y	The way the user engages with the buttons is consistent - all buttons have the hover feature and the pop ups appear in the same place each time with the same format. This helps to eliminate confusion as the user knows what to expect after using the product for a brief period.
Error prevention	Y	Having the hover feature of the button already helps to reduce user error, along with the additional narration. However, error could occur when the remote activates the popup even when the user doesn't want it to. For example if the remote is

		dropped, the user wouldn't want the popup to appear. This is somewhat circumvented by mandating that the remote is also facing the TV (determined by the gyroscope). The combination of sensors should stop most of these cases from happening.
Recognition rather than recall	Y	The remote is deliberately very as the user only needs to hover or touch a button which is a simple action that can be remembered easily. This is the primary way for users to interact with the system. Furthermore, our use of colour for certain key buttons will allow recognition of their functionalities.
Flexibility and efficiency of use	N	Aside from changing the speed of the narration, or removing it altogether, there aren't any features for experienced users such as shortcuts. However, with our design there isn't any feature that exists that needs a shortcut due to the nature of the device.
Aesthetic and minimalist design	Y	Our specialist remote is very similar to standard TV remotes, so there is already that familiarity inherent in our product.
Help users recognise, diagnose and recover from errors		
Help and documentation	N	

Conclusion

[x]

Appendix

[x]