Project Phase 4

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Executive summary

The initial problem that we wanted to address with *The Control Freak* was that sometimes people leave appliances or electronics on in their home that can create an unsafe environment. For example, if a homeowner left the stove on or if the dishwasher malfunctioned and started to flood the home. These are unsafe and costly situations that can be avoided. The other problem that could be solved with this application is efficiency. Too many times homeowners leave their residences and forget to turn off lights which consume unneeded energy. Our motivation for *The Control Freak* stemmed from the problems above and lead us to create an application that can maintain a safe and efficient environment in the home.

We decided to make a web application as our medium for *The Control Freak*. This application could be accessed from any desktop or mobile device. The homeowner would be given a login where they can sign in and access the devices in their home. From this application, homeowners could view the status of home appliances and electronic devices in the home as well as control and automate them remotely.

As part of our analysis we conducted interviews with peers and homeowners to determine what type of home monitoring and automation systems there are already out there and what specific features they would want in a system like *The Control Freak*. From this information we obtained work activity notes and were able to construct a work activity affinity diagram (WAAD) and a flow model of how the system would interact with other devices. Using the WAAD we came up with the system requirements.

Entering the design phase we drew sketches to represent the different screens of the application. After getting feedback from our peers we decided which screens to focus on and what details needed work. From there we created a wireframe that would encompass the main functions of *The Control Freak*. We then were able to create a high-fidelity wireframe as the prototype for our application that had a horizontal view of the system's features with a vertical focus on viewing and controlling devices while away from home.

As part of our evaluation we obtained several participants to perform two tasks using the prototype and fill out a NASA Task Load Index survey where we recorded observations and feedback. The key findings across all of the participants were that

they thought the home map was very intuitive and a great idea, but the location of the favorites page was confusing.

Problem domain

The problem that *The Control Freak* addresses is the inability to monitor and automate the home. In most cases the home is unable to automate itself with current technology. With *The Control Freak*, homeowners will now have the ability not only to automate specific tasks in the home but to also be able to check the status of electronic devices. For example, let's say a homeowner has a tough time remembering to turn off all of the lights in the home. Then that person can now create an automation setting that will automatically turn off all of the lights in the home when they leave, or they can go into the application and turn off all of the lights manually. This interface really caters to homeowners that are traveling or aren't always there so they can monitor and automate tasks in the home.

System concept statement

The *Control Freak* (CF) will allow residents to remotely monitor and control electronic features of their home with a powerful, dynamic web application that can be accessed from any location or device. The user will be able to control features of their home including, but not limited to, alarms, door locks, lights, television, thermostat, washer, dryer, dishwasher, oven, garage door, and coffee maker. A focus on the simple, intuitive interface will give users information about their home while they are away, leaving them with a sense of security and ease. It will also allow certain devices to turn on or off when the user performs a specific action, such as leaving the house. CF will secure the users home and reduce the time it takes to perform everyday chores.

Analysis

We conducted interviews with a variety of subjects, from our peers to homeowners. We observed the way they currently use their electronics, and how often they conduct repetitive tasks. From the observations we made and the feedback we got from our interviewees, we created a collection of work activity notes. As a team, we sorted these work activity notes into a Work Activity Affinity Diagram (WAAD). The WAAD gave us a very helpful visual representation of the data collected from interviews. We were able to get a sense for what actions the product would need to complete, and which features potential users would care about most.

From our completed WAAD, we extracted key requirements from the work activity notes taken from interviews. There were some clear requirements we had from the beginning, such as the fact that the app had to be able to control devices remotely. The WAAD also allowed us to see other features we would need to add.

One of the biggest findings our team discovered was that users want to be able to quickly check the status of a device while away from the home. Here is a specific example: an interviewee uses a straightener every morning. After leaving the house for the day, she wonders whether or not the straightener has been left on. However, she has no way of knowing if the device has been left on or off, short of going home or getting in touch with someone who may still be at home. This lead us to pursue the goal of being able to quickly check if a device is turned on or off, and easily change its status. This manifested itself in a “Favorites” menu item with a list of constantly used devices. This is just one example of what the app would need to quickly enable a user to do.

Another significant finding of the Contextual Inquiry was that potential users wanted to be able to automate devices. A specific example would be lights turning on or off as the user left or arrived at the home. Since there may be multiple users, the app would also need to know how many users were in the house at once.

Additionally, our Contextual Analysis led us to think about other issues arising from multiple people living in one house or apartment. The app would need to be able to distinguish between different users. Some users would need control over every device in the house, while others would need to be locked out of certain devices. For example, a parent may not want to give control of the stove to a child, and two tenants of an apartment would not want to give the other control over devices in their respective rooms.

Design

We started out the design with ideation and sketching. Moving quickly in ideation, we came up with many ideas in a group. Some obscure ones such as having a fully automated robot came in during this ideation process, but was ultimately discarded in later design processes. Once we had our ideas for the design we started sketching

rough designs of Control Freak on paper focusing on the concepts of the design that we came up with in the ideation process.

Once we were finished with the ideation and sketching process, we moved on to the conceptual design. One of our goals was to make a design that felt familiar with the user. This was important, because we expect that the user will use the app on a daily basis, and needed to feel comfortable using the application, and is primarily why we chose the Human-Information Processing (HIP) Paradigm when designing our application. Following the HIP Paradigm, we established various metaphors to help the user such as having the Home Screen actually be a customizable layout of the users home. In the end we came up with multiple conceptual designs that we reduced into one intermediate design.

The intermediate design of our project consisted of a storyboard of how a user may go through and use the application. We used a tool, moqups, to create a low-fidelity wireframe that consisted of enough features to tell an illustrated scenario of our persona using the application. Moqups has various tools that allowed our informational objects to easily be represented.

Our detailed design evolved from a low-fidelity wireframe. We evolved our initial low-fidelity design and shaped it into our vision for the Control Freak app. It allowed us to start a conversation on how the app should be laid out as we designed it. We caught several errors in how our app was laid out in terms of how the elements were positioned. This allowed us to fix this issue and lay out the application in a logical informational hierarchy. Other concerns came up during the detailed design phase such as supporting multiple devices (web, tablets, etc); however, our focus was on a mobile interface so we did not consider other layouts of the design for devices with larger screens.

The detailed design was complete, but some aspects of it were not really refined. We chose some features to really focus in on with the design to make them better than their current state. We chose to look at the favorites menu and how a user might go about interacting with devices that they use frequently. This was chosen as we thought it would be something that a user would use the most often once familiar with the application.

In the process of refining the favorite device list, we added in a high level overview of the device status, and an easy toggle for devices to reduce the number of actions needed to perform actions on favorite devices. This was our vertical part for our T-prototype as we focused on this feature the most in our high-fidelity wireframe.

Evaluation

To evaluate our design we interviewed 8 people with various lifestyles to gain valuable feedback on our design. Participants included ages 19 to 30, 3 females, 5 males, from areas from Blacksburg, VA to Baltimore, MD. We asked participants to perform two tasks with the prototype of our application, in which we would record observations and the metrics and goals of each task, as well as participant feedback following the completion of the tasks. Each session lasted about 30-60 minutes, and following the sessions we had each participant complete a NASA Task Load Index (TLX) form. The two tasks we asked participants to do were the following:

1. **Task 1**
   Scenario: You are going on a drive in the countryside and you aren't sure if you left your wife's hair straightener on. Your wife is going to be home soon, and you don't want her to know that you were using it. So, you go to *Control Freak* and check if the straightener is on.
   Task: Check if the hair straightener is on. If so, turn it off.
2. **Task 2**
   Scenario: You are up late working on the GIS system and once you finally finish you get to bed. You stayed up late and don't want to miss class in the morning, so you want the lava lamp to turn on automatically next morning to make sure you wake up.
   Task: Automate your lava lamp to turn on tomorrow morning at 7:00am.

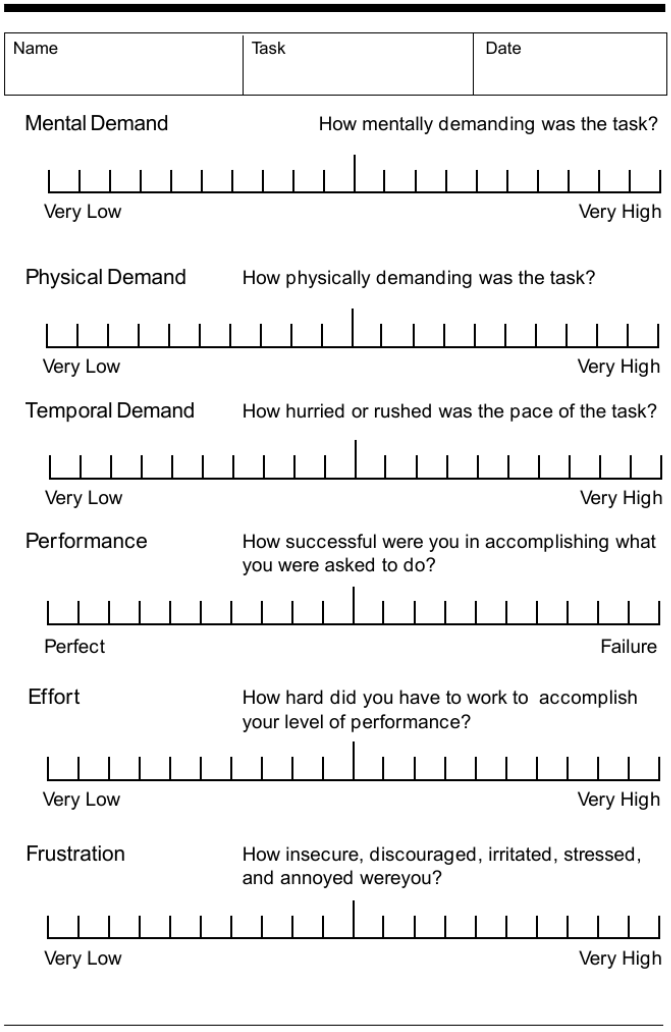
National Aeronautics and Space Administration Task Load Index (NASA-TLX)

For evaluation, we used NASA TLX. We gathered great information via observations and feedback. We each collected information from people that we interviewed.

Figure 8.6

NASA Task Load Index

Hart and Staveland's NASA Task Load Index (TLX) method assesses work load on five 7-point scales. Increments of high, medium and low estimates for each point result in 21 gradations on the scales.



Survey Questions:

How many steps did it take to complete the task?
Did it take more steps than you expected?
Were any of the layouts confusing?
Was the definition of the task straightforward?
Do you think the location of the favorites page is conventional?
Would you utilize the admin settings?
Was it easy to complete the task? If not, why?
At any point did you get frustrated trying to complete the task?

Raw Information

Kyle's

Person 1:

- observations / feedback:
    - Home screen is a great idea.
    - Plus sign for the Favorites List doesn't make sense/Minus for the logout. Make it appear as sub options for an option above
    - For bigger homes would make more sense to have tabs for different floors.
    - Easy to complete the tasks after understanding the favorites list and what was implemented.

- TLX scores:
    - Mental Demand: 5
    - Physical Demand: 2
    - Temporal Demand: 10
    - Performance: 6
    - Effort: 4
    - Frustration: 5

Person 2:

- observations / feedback:
    - Wished the home screen had worked
    - Had to go out of the way to access devices in the favorites list

    - Wanted a more central favorites list
    - Confused by user management tab
- TLX scores:
    - Mental Demand: 6
    - Physical Demand: 1
    - Temporal Demand: 7
    - Performance: 5
    - Effort: 3
    - Frustration: 6

Ben's

Person 1:

- observations / feedback:
    - Home screen looks good.
    - Likes the users' profiles at the bottom.
    - The plus sign by the Favorite Device List doesn't really make sense.
    - Thought you should be able to actually change values in evaluation.
- TLX scores:
    - Mental Demand: 5
    - Physical Demand: 1
    - Temporal Demand: 4
    - Performance: 5
    - Effort: 3
    - Frustration: 5

Person 2:

- observations / feedback:
    - Would like to see more details on the home map
    - Did not go to the menu very quickly
- TLX scores:
    - Mental Demand: 9

    - Physical Demand: 2
    - Temporal Demand: 12
    - Performance: 4
    - Effort: 11
    - Frustration: 6

Trevor's

Person 1:

- observations / feedback:
    - Did not like how many steps it took to get to a device.
    - Wanted favorite devices accessible from home screen.
- TLX scores:
    - Mental Demand: 3
    - Physical Demand: 3
    - Temporal Demand: 4
    - Performance: 4
    - Effort: 5
    - Frustration: 8

Person 2:

- observations / feedback:
    - Disliked the colors. Wanted icons vs. using green and red to indicate that devices were on and off.
    - Liked that the home screen could be customized to match users home.
    - Figured out the menu almost instantly.
- TLX scores:
    - Mental Demand: 1
    - Physical Demand: 1
    - Temporal Demand: 5
    - Performance: 9
    - Effort: 4
    - Frustration: 3

Christina's

Person 1:

- observations / feedback:
    - Kept on getting stuck on the home screen / "Not Implemented" pages.
    - Once they figured out the navigation, it was easy.
    - Wished there was a "tutorial" to help them learn how to use the app.
- TLX scores:

    - Mental Demand: 2
    - Physical Demand: 4
    - Temporal Demand: 6
    - Performance: 5
    - Effort: 3
    - Frustration: 4

Person 2:

- observations / feedback:
    - Home screen was confusing and cluttered. Would prefer a list of rooms.
    - Found the global menu easily.
    - Was able to find the device list, but the button did not open properly for them (misclicks were common) and caused some frustration.
- TLX scores:
    - Mental Demand: 3
    - Physical Demand: 2
    - Temporal Demand: 8
    - Performance: 5
    - Effort: 4
    - Frustration: 4

Compiled NASA-TLX Averages

- Mental Demand: (5+6+5+9+3+1+2+3) / 8 = 4.25
- Physical Demand: (2+1+1+2+3+1+4+2) / 8 = 2
- Temporal Demand: (10+7+4+12+4+5+6+8) / 8 = 7
- Performance: (6+5+5+4+4+9+5+5) / 8 = 5.375
- Effort: (4+3+3+11+5+4+3+4) / 8 = 4.625
- Frustration: (5+6+5+6+8+3+4+4) / 8 = 5.125

Key Observations

- The plus button on the home screen was confusing for most users.
- Overall, the design was frustrating for a prototype. Users kept on hitting the “Not Implemented” screens vs. following the intended T-prototype of clicking on the global menu *first*.
- Once they learned how to use the system, they were able to complete the tasks quickly.

Key Feedback

- The home screen map was an intuitive way to represent the layout of devices in the home.
- Accessing devices should take less steps.
- Liked the customization. Makes it feel more personal.

Reflection on the product

Overall, our final system design we produced throughout the semester evolved tremendously due to the process of the Design Wheel, in which we designed, prototyped, evaluated, and analyzed *Control Freak*.

Our original intentions for making this application was for the pure act of controlling electronic devices from away from the house to increase house safety when residents are away from home. We wanted to solve the problem of turning the stove on to cook dinner and leaving the house afterwards, while forgetting to turn it off, causing a serious hazard. The original system concept had the majority of focus on controlling various devices from anywhere inside, or outside a home, for conveniency and safety. The main idea we had in our head was a “universal remote” for households.

As we continued through the design wheel, we gathered information during each stage to develop a more desired, robust system. In our first client interaction, Bobby gave us great input on how we can make our system more unique and more useful than other simple universal, home automation ideas. Bobby suggested that we focus more on the automation aspect of controlling a home, rather than simply notifications and basic on/off settings. From this feedback we decided to focus more on the automation and personable aspects of such an application. After changing our design to include easy-to-use calendar automations and permissions so anyone in the household can enjoy *Control Freak*, we continued to gather feedback from classmates, participants, and our client for more improvements. From all the input from observations and input, we implemented some new features in our design. We created an interactive map which users can create themselves to make the application more individualized and easier to use.

Through all the various ideas and improvements, we created a design that was usable, useful, and emotionally impactful in the real-world. Our application can significantly reduce stress and increase happiness by allowing users to more easily manage time and by reducing safety hazards. This will be done by the features such as automation of appliances and notifications. The application will be very useful in getting

every day tasks done, such as household chores, from any location. It will provide safety, convenience, and efficiency to users through an easy-to-use design.

Although this system has many great implications for the real world, there are some major barriers for adopting this system. The main barrier would be setting up all of the appliances in each household. A third party would need to install the new appliances to work with the application or adapt existing appliances to work with the application. This can be both time consuming and expensive.

Reflection on the process

The overall process was very eye-opening and constructive for this project. Dividing the project into separate parts for contextual analysis, design, prototyping, and evaluation was effective in learning many new concepts as well as creating a well designed, usable product that could be a great value in society. There were various aspects of the overall process that worked well, as well as other methods that were more challenging and we could improve on.

One of the strength that we felt we learned a lot from and really came together was the contextual analysis section. We differentiated between asking about the current situation versus future situations and how asking questions based on the current situation gave us insight to how to make a project and improve it. One specific section we felt we really collaborated well on was making the WAAD and designing the initial requirements.

More struggling aspects of the process involved determining work roles, sub roles, and machine roles in the contextual analysis phase. This aspect was challenging due to lack of understanding of the roles; however, over time we came to understand the role. Also, although our initial wireframe prototype was great, we needed to elaborate more on the aspects of the vertical aspects of the prototype. Our client suggested a paper prototype, since it is easy to discard afterwards and is most efficient. However, we already had a pretty good wireframe set up and our client agreed. If we could do this portion differently, we would most likely use paper to more easily represent our intended actions.

Appendices

Final Persona

Steve Shufflebottom is a 30 something year old astronaut who works for NASA in Pensacola, Florida. He has a wife and two kids, Tommy and Sarah, and likes to use his iPad in his free time. On his weekends he likes to bike and go out on his boat. Steve drives to work and drops his kids off at school on the way while his wife leaves for work (he would like to be able to check on his home while no one is home). He is often away from his house and family for work at conferences that usually last 2-3 days at a time (this gives him the perfect opportunity to monitor and automate his home). Steve loves taking vacations with his family too.

Final Prototype

https://moqups.com/controlfreak/CLtQ07fR