User Study Report

Refining the Prototype for the Smart Home Plant Pot

Ahmed Khilji - 13525643

Contents

Introduction

This report presents the analysis of the user study conducted for the prototype system of the Smart Home Plant Pot. It outlines the aims, objectives, research method, and protocol established in the previous group assignment. The report further explores the data analysis, user needs identified based on the evidence gathered, and proposes design alterations and refinements for the prototype based on user feedback.

Theoretical Foundation for the Prototype

The features we have put into our Smart Home Plant Pot prototype reflect the theoretical foundations of human-centred design. For instance, the capability for personalised plant profile considers the unique requirements of each plant species. Users can take advantage of the system's plant profiles by going through the profiles, such as the species and plant type, so that it can consider the needs of each plant. The human-centred design idea of considering user preferences and specific demands is adhered to by this feature.

The upgraded alert system of the Smart Home Plant Pot demonstrates the theoretical foundation's interaction design component. The technology notifies the user when it's time to water or move their plant and sends them reminders and warnings via the emotions shown on the dot matrix (happy or sad). These notifications are made to be clear, succinct, and unobtrusive so that consumers can receive the information they need without feeling overloaded or interrupted. The principles of interaction design direct us in developing an interface that promotes good communication between the user and the system and a fluid interaction experience.

Overall, the Smart Home Plant Pot prototype's design choices and feature implementations have been informed by the theoretical foundation of human-centred design, interface design, and physical interaction design. We seek to offer a user-centric and practical solution for plant care in a smart home setting by concentrating on user demands, designing user-friendly interfaces, and assuring a seamless physical interaction experience.

Aims and Objectives

To test the functionality and effectiveness of the proposed solution in its ability to achieve the desired objectives and purposes taken from the design brief, the user research study will consist of the user attempting to use the device, the Arduino Uno, preprogramed with set scenarios along with other components to complete certain goals attributed to solving the design problem. These may contain related sensor issues like moisture levels, or performing a specific task such as assessing plant profiles to ensure the task is achievable during the prototyping stage.

The aim of the user study is to justify and test the effectiveness of the design in completing certain small but necessary goals and how simple it is for the consumer to complete. Establishing a way to convey information that the goals were completed or other relevant information and how well this is communicated to the consumer is also another objective of the user study.

The developers, Team Rocket, will then conduct interviews and/or surveys and ask further questions to explore areas of improvement, productivity, and difficulties.

Method

This section will cover many aspects of the User study from Design, Participants, Sampling Approach, Materials used, Protocol and Analysis Methods.

Design

This user research design will assess the most important features that function as the core of the proposed solution. By interacting with these features via preprogramed scenarios for users to complete or users testing out how these features will function independently, we will be able to assess the functionality and effectiveness of the designed solution as if it were physically implemented, even without the need of a fully complete product. Once we have gained all the feedback from the user research design, we can construct a final product through the prototype design without the need of making major adjustments.

Scenarios 1: Device Setup

1. Ask the user to set up the smart home plant pot.
2. The user must observe and note the interactions they are having with the device.
3. After the task is completed, ask the user to rate the difficulty of setting up the smart home plant out of 10, 1 being easy, 10 being hard. Also ask the user to describe the experience and whether they found it user friendly.

Scenarios 2: Humidity, Temperature and Soil Moisture Check

1. Ask the user to check the humidity, temperature and soil moisture levels using the smart home plant pot. The LED dot matrix will display a pixel art image of a happy face if the conditions are sufficient to show the plant is “happy”. Conversely if the conditions are poor a sad face will be displayed.
2. The user must observe and note the interactions they are having with the device.
3. Ask the user to describe their experience with the living conditions feature, and whether they found it helpful.
4. Follow up with additional questions about how they might use this information to better care of the plants or other things they might do with it. This will be used to improve the product or make a better one.

Participants and Sampling Approach

To ensure variety in age, gender, and educational attainment, the suggested Participants and Sampling Approach for the smart home plant pot user study include recruiting people with plant care experience or interest through convenience sampling.

Participants

1. Experience: The participants should have experience in caring for plants or have been interested in doing so.
2. Age: 20-60 years old
3. Gender: Any
4. Education: High School Degree or Higher

During the sampling approach, developer/s and their desired sample demographic consumer will gather depending on convenience and will conduct a series of scenarios to ensure the sample has enough results to rely on for further improvement of the device. The number of individuals participating, which is 6, will also ensure that the culminated results from the sample pool are relevant and useful. Everyone will be approached separately for accurate enclosed tests and more ample time with the device. The developers will collect feedback through interviews and follow-up questions to identify areas of improvement, productivity, and any difficulties encountered by the users.

Sampling Approach

1. Convenience Sampling: The developers could approach consumers who frequent gardening shops, farmers markets, or internet advertisements to recruit participants.
2. They could also ask their friends and relatives who meet the requirements for participation to participate by getting in touch with them.
3. At least 6 people should be included in the sample size to collect enough data and feedback for analysis.
4. The sample should be diverse in terms of age, gender, and prior expertise with plant care, according to the developers.

Overall, the user study will help ensure the smart home plant pot is effective and user-friendly.

Materials

The materials we will be using for the user research prototype will be as follows:

- Arduino Uno
- Arduino Uno Grove Shield
- Tactile Button
- RGB LCD Display
- Dot Matrix Display
- Soil Moisture Sensor
- Humidity and Temperature Sensor
- 3D-Printed Plant Pot
- Rechargeable Battery Pack

Protocol

The Protocol Research method will collect data of participants' reactions and thoughts on completing tasks asked by the developers, we will simultaneously observe their progress in performing the tasks and document the disadvantages participants encounter during the research. The process is planted to be conducted as follow:

1. The developers will request that participants provide a brief description of their hobbies related to caring for indoor plants. Alternatively, the developers may ask participants to perform tasks that simulate common actions taken in caring for indoor plants.
2. The participants will then be asked a series of predetermined questions about their thoughts and reactions regarding the completion of the assigned tasks, as well as any drawbacks they may have experienced when manually monitoring their plants' conditions.
3. Finally, the developers will introduce their concept of a smart plant pot and gather feedback from participants on ways to improve the product to better meet the users' needs and preferences.

Analysis Method

The analysis method will gather qualitative data through participant post-study interviews and participant observations. To develop the product, it is intended to better understand how users interact with the smart home plant pot and to spot trends, patterns, and recurring themes.

1. To learn more about the participants' experiences with the smart home plant pot, as well as any comments or recommendations they may have, post-study interviews can be used.
2. Thematic analysis will be used to examine the data obtained to find trends, patterns, and common themes.
3. Each participant will also take part in a debriefing session with the developers to ensure they get the goal of the study and have the chance to ask any concerns or offer further information.
4. Understanding how the user used the smart home plant pot and how he found it more convenient or even explain the aspects that were found to be annoying.

Data Analysis and Design Alterations

This section will go over the analysis done on the data collected while describing the perceived user needs and showcasing how use used that to make design alterations and refinements to our final prototype. The evidence of the recorded interview answers can be found in the references section. The data analysis revealed several key findings regarding the user experience and perceived needs. Participants expressed a strong desire for clearer visual indicators of plant health, more intuitive controls, and personalised plant care recommendations. The analysis also highlighted the importance of timely notifications and the need for a seamless integration with other smart home devices.

Overall, the user feedback was found to be useful and gave us useful insight. There were only 3 main features that were implemented and gone through refinements that address most of the user feedback complaints and criticism.

Simplicity

Most customers are not computer literate, which is relevant given the target market for this product. Although it is intended for people of all ages, it will most likely benefit adults in their 50s. Simplifying the process was essential for the product to be utilised properly. In this instance, we chose not to use the programmes or outside sources and instead used buttons to flip between the plant profiles (another feature that was implemented). One of the modifications that was more widely embraced than the others was this idea. Some users really liked the idea of the inclusion of technology as it *"can play a major role in enhancing my ability to take care of plants.*" People that are busy with their studies, and jobs can benefit from this, however, older people would greatly appreciate this feature. One individual had stated that *"I enjoy feeling like I am closer to nature and the environment by doing all of my tasks and feel as though depending on technology. heavily to care for my plants takes away from that. Although, I'm sure there are lots. of individuals who would benefit from technology that indicates how and when to care for their plants."* So many ideas were thrown around from keeping the original idea, to make it still more connected to the IOT (internet of things) network. To target many audiences, we opted for a simple design solution where the pot has simple and intuitive controls. Simple button that switches between profiles, and not too many displays and distractions so that they can enjoy a activity that is more natured themed.

Plant Profiles

One user said *"I would like to have its care tailored for the plant that I buy. As I have no experience caring for plants, I have no idea in the differences in care that each type of plant would have"*. From this we realized that each plant requires a different and varied level of care, and users showed a great desire for the pot to give out alerts depending on the plant. For this solution we discussed manual time scheduling and automatic water systems. However, we addressed this by creating a thorough plant profile system that enables users to switch profiles in accordance with the type of plant they are working with. For instance, taking care of a cactus would require different procedures than taking care of a Calathea Makoyana plant. It is well recognised that different plants require varied environmental factors to grow well, including soil types, climates, and watering regimens. This was proved by comments like *"The types of plant category would be cool"*.

One user said, *"In the personalized plant profiling feature, I would like to include the species and types of plants"*. Our smart home plant pot gives consumers the option to choose the proper plant profile, allowing them to give their plant species specialised care. With this customised method, each plant is given the best possible conditions for growth, producing healthier and more colourful foliage. Additionally, the plant profile system accounts for the various watering needs of various plants, ensuring that each plant receives the proper amount and timing of watering.

Users can confidently nurture a wide variety of plant species in their smart home environment with the help of this flexible plant profile system. Our system adjusts to fit the unique requirements of each plant, whether they have succulents, flowering plants, or cactus, and creates an ideal atmosphere for their growth and wellbeing.

Enhanced Alert System

Initially, the main goal of our prototype design was to employ displays and external applications to give users a complete picture of their plants and to communicate specific information. The goal was to use aesthetically pleasing interfaces to display numerous parameters, such as soil moisture content, temperature, and humidity. By enabling users to change the location of the plant, and keep track of its general health, this method aims to give consumers the information they need to care for their plants intelligently.

On the other hand, we realised that the initial design approach would subject users to information overload based on insightful user input. Users emphasised the value of simplicity and the need for the system to concentrate on effectively communicating key information. We significantly improved our design in response to these revelations.

The improved prototype now has a more condensed display system that efficiently conveys the essential data from the sensors while still empowering users to make knowledgeable decisions about their plants. We simplified the display to highlight important metrics, such as soil moisture levels, temperature, and humidity, which play critical roles in plant care, rather than overloading consumers with a plethora of data. This makes sure that consumers can quickly obtain and understand the most important information. *"For the general condition of the plant I would prefer to see the data displayed on the pot so I can see it when I am around the house"* said one user.

"I find watering is often where I go wrong in taking care of my plants. It would be even better if there could be alerts for it." This was also a main issue user were reporting about. We included a Dot Matrix display to further tackle this problem while improving user experience. This user-friendly tool gives consumers fast feedback on the health of their plant using a basic visual indication system. The Dot Matrix display shows a pleased smile while the plant is flourishing and in a healthy state, giving the user encouragement. In contrast, the display displays a sad face to alert the user that something needs to be done if the plant needs attention or is under unfavourable conditions.

We strike a compromise between giving people the information they need and preventing information overload by using this straightforward and user-friendly display technology. *"Having visual representations of the plant's health is important to me because I might not be able to accurately judge its health by just looking at it".* This strategy guarantees that users can quickly understand the status of the plant, make wise choices, and take the necessary actions to ensure the best possible plant care in their smart home environment.

Conclusion

The user study analysis provided valuable insights into the strengths and weaknesses of the Smart Home Plant Pot prototype.

We had Incorporated:

1. clearer visual cues, such as colour-coded icons or animated graphics, to communicate plant health status effectively.
2. Intuitive controls: Simplify the user interface by streamlining navigation, grouping related functions, and ensuring consistent interaction patterns.
3. Personalised plant care recommendations: Implement a plant profiling feature where users can choose specific plant profiles to receive customised notifications based on plant species, growth stage, and environmental conditions.
4. Timely notifications and integration: Improve the alert system to provide contextual notifications for watering and other care needs. Explore seamless integration with other smart home devices to enhance the overall user experience.

This was done through, identified user needs and feedback which served as a foundation for design alterations and refinements to achieve a final, resolved design. By incorporating clearer visual indicators, intuitive controls, personalised plant care recommendations, and seamless integration, the refined prototype aims to deliver an enhanced user experience and meet user expectations. Further iterations and user testing will be conducted to ensure the continuous improvement of the Smart Home Plant Pot system.

References

1. Have you ever performed any gardening activities, or taken care of plants before?

Yes! I love all of my plants (20 currently) and will be starting a vegetable patch soon with seedlings that I am currently growing.
As an international student, I've tried taking care of plants before because it brings a bit of calm and joy to my otherwise hectic academic life. However, I found it challenging sometimes because I don't really know the best way to care for them, and I would forget to water them or water them at inappropriate times.
Never, my family has owned plants before at home but I have never been involved in their care
Yes, I have experience in gardening and have taken care of plants for several years. I enjoy tending to plants and watching them thrive.
Yes, I have some experience in gardening and have taken care of a few plants in the past. I'm interested in learning more about plant care and improving my skills.
I would prefer to receive reminders and alerts for watering and other care activities through a smartphone app. It would be convenient for me to have all the information in one place, and having notifications on my phone would ensure that I don't forget any important tasks.

2. How would you like to know about the status of your plant? Would you prefer to receive reminders and alerts for watering or moving your plants, and how? (on the plant pot, smartphone app, anything else?)

Receiving reminders that watering or moving my plants would be nice. I would like to receive notifications on my phone when the status of my plant’s health changes. A visual on the plant pot itself would be cool too, whether that be an icon or colour on a display screen or something like that.
I would appreciate a system that could alert me when my plants need attention, such as when to water them or when to move them to a more suitable spot. I think a smartphone app would be a great way to receive these alerts since I'm always on my phone and would see the reminders right away.
For the general condition of the plant I would prefer to see the data displayed on the pot so I can see it when I am around the house. If the condition is very severe however I would like to receive a notification on my phone. For reminders to water the plant I would also prefer phone notifications
I would prefer to receive reminders and alerts for watering and other care activities through a smartphone app. It would be convenient for me to have all the information and notifications in one place.

3. What additional plant information would you like to include in the personalised plant profiling feature? For example, species, types of plants, or any other specific details?

The type of plant category would be cool, and maybe adding the age of the plant, when it was re-potted last, etc. Even adding somewhere where you can name your plant, like you can with Google home devices, would be really nice.
For the personalized plant profiling feature, I'd like to see more information about the plant included, like the type of plant it is, the best environment for it, how much sunlight and water it needs, etc. This way, I could get a better understanding of how to take care of my plants.
I would like to have its care tailored for the plant that I buy. As I have no experience caring for plants I have no idea in the differences in care that each type of plant would have
In the personalized plant profiling feature, I would like to include the species and types of plants I own. Additionally, it would be great to have information about the ideal growing conditions, preferred lighting, and any specific care instructions.

4. In terms of the alert system, what specific reminders or alerts would be most helpful to you in maintaining the health of your plants?

Water level, humidity, and danger/pest alerts too? Fungus gnats or root rot etc. An overall weekly/monthly health status update would be nice and informative. A soil pH test would be an interesting and important feature too.
In terms of the alert system, I think reminders for when the plant is lacking or has too much water would be super helpful because I find watering is often where I go wrong in taking care of my plants. It would be even better if there could be alerts for it.
Watering alerts would be important for me as I feel that would be most easily forgotten. If the moisture of the soil could be monitored to make sure its receiving adequate water that would be great
Specific reminders or alerts that would be helpful to me include watering schedules tailored to each plant's needs, reminders for fertilization, pruning, and other maintenance tasks. It would also be beneficial to receive notifications about any potential pests or diseases that could affect my plants.
Specific reminders or alerts that would be helpful to me include watering reminders, reminders for fertilizing or repotting plants, and notifications about any potential issues like pest infestations or diseases. Having guidance on when and how to address these issues would greatly assist me in maintaining the health of my plants.

5. How important is it for you to have visual representations that showcase the health of the plant?

I think it is important and would be very helpful, but notifications and alerts via phone would be enough for me if there wasn't any visuals.
Having visual representations of the plant's health is important to me because I might not be able to accurately judge its health by just looking at it. For example, if the system could show different colors or patterns based on the health of the plant, I think that would be really helpful.
Visual representations showcasing the health of the plant are very important to me. Being able to see the plant's growth progress, monitor its overall health, and detect any signs of distress visually would greatly enhance my ability to care for the plants effectively.
Visual representations showcasing the health of the plant are somewhat important to me. While I may not be an expert in plant care, having some visual indicators or color-coded representations that show the overall health of the plant would make it easier for me to understand and take appropriate actions if needed.

6. Are there any specific data analysis features or functionalities you would like to see in the system to streamline the process of monitoring and understanding the data collected from your plants?

N/a
I'd love for the system to have some data analysis features, like tracking and comparing the growth rate of my plants, or predicting the future growth of the plant based on the current care I'm providing. This way, I can better understand the impact of my care and adjust my methods if necessary.
Not that I can think of
I would appreciate data analysis features that provide insights into the plant's growth patterns, water consumption, and overall health trends over time. It would be helpful to have charts or graphs that showcase the data in a visually understandable format, allowing me to make informed decisions about plant care.
I would appreciate data analysis features that provide basic insights into the plant's growth and health trends. For example, it would be helpful to see charts or graphs that show the plant's growth progress over time or indicate any changes in its health. However, I don't require overly complex functionalities since I'm still relatively new to plant care.

7. How do you envision technology playing a role in enhancing your ability to care for your plants?

Me, personally, wouldn't envision technology playing a large part in my gardening/plant care. I enjoy feeling like I am closer to nature and the environment by doing all of my tasks and feel as though depending on technology heavily to care for my plants takes away from that. Although, I'm sure there are lots of individuals who would benefit from technology that indicates how and when to care for their plants.
I think technology can play a major role in enhancing my ability to take care of plants. With smart technology, I can understand the needs of my plants more accurately and adjust my care accordingly. Plus, it helps prevent me from forgetting to water or take care of them, which is a big help for me.
I see technology being able to monitor my plant for me to make up for my lack of plant care knowledge. After some time I see myself becoming more familiar with plant care as I recognise patterns and the needs of my plant based on the alerts and notifications for the plant pot
I envision technology playing a significant role in enhancing my ability to care for my plants by providing real-time information, reminders, and alerts. With the help of a smartphone app and data analysis features, I can stay on top of my plant's needs and take proactive steps to ensure their well-being. Technology can simplify plant care routines and enable me to provide the best possible environment for my plants to thrive.
I envision technology playing a supportive role in enhancing my ability to care for my plants. With a smartphone app and reminders, I can stay organized and ensure that I'm providing the necessary care at the right times. Having access to basic plant information and simple data analysis features would help me learn and improve my plant care skills gradually.