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Abstract

Having plants inside the home has positive effects on mental and physical health. [1] Taking care of plants can potentially reduce stress levels in young adults. [2] Moreover, some plants also have practical uses, and can be used for cooking or repelling insects. They are also a pleasant aesthetic addition to one's home. However, plant care is challenging for individuals with busy schedules, such as college students. The inability to properly care for plants leads to a waste of resources such as water and soil. HomeBud was created as a practical straightforward solution for automatic watering of indoor plants with the use of a beginner friendly app, and an Arduino powered circuit with a grow light, LED screen, and water pump all neatly placed in a simple plastic case.

Motivations and Objectives

Motivations

- Increase access to live plants for consumption and mental health benefits
- Reduce stress of plant care for individuals with busy lives or unfortunate living areas

Objectives

- Develop a compact, self-watering system which requires minimal human interference for plant maintenance
- Create a user-friendly app that is paired with said system, allowing the user to monitor the needs of their plant and learn about plant care
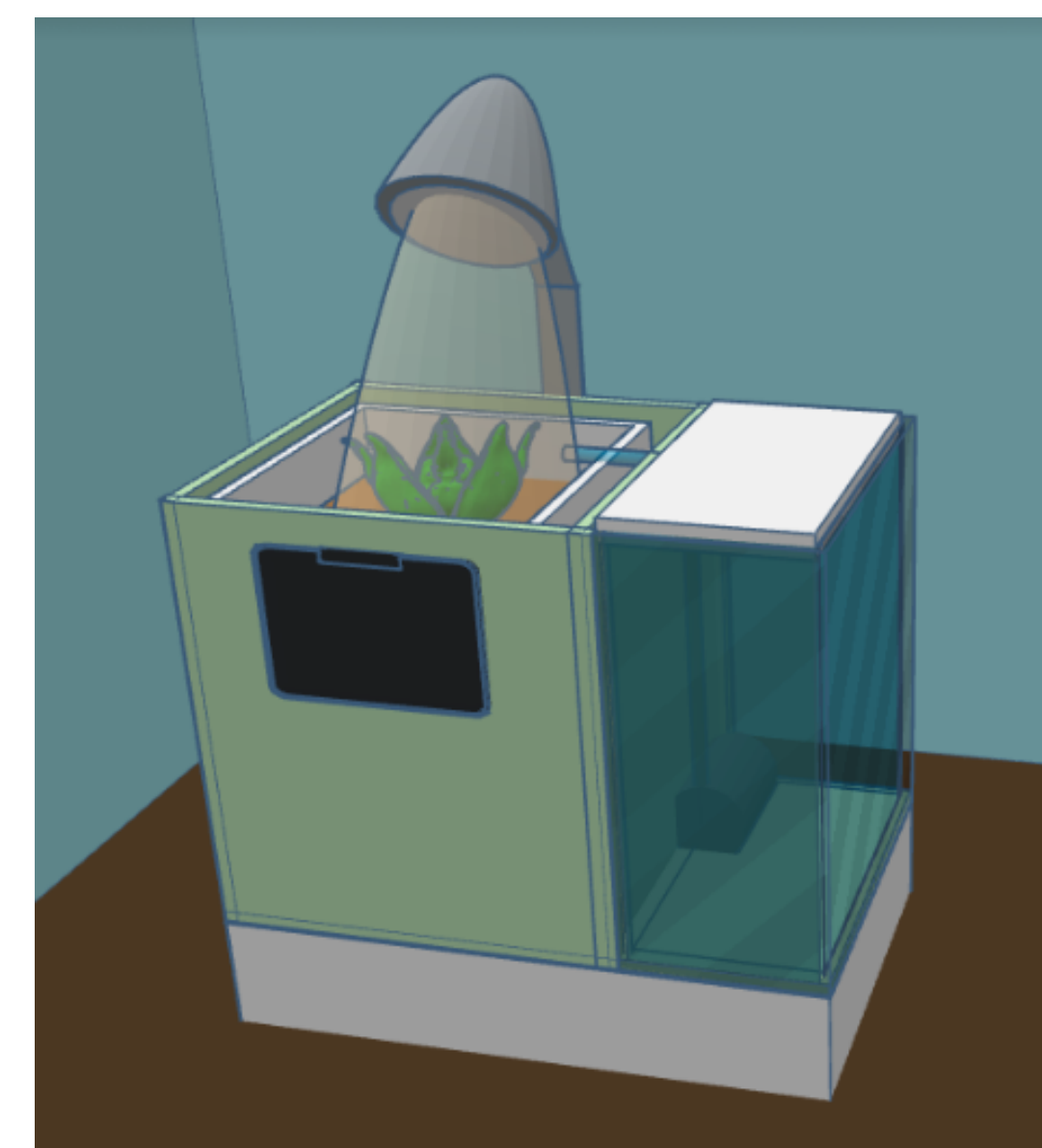- Ensure a compact design that does not take too much space in a small area

Fig 1. 3D Model Of Prototype

Project Challenges

Hardware/Case Development:

- High expenses associated with 3D printing and PCB manufacturing
- New software in PCB design
- Order Delays / Time Constraints

Software Development:

- Lack of documentation for relevant software development
- Connecting Android app to MongoDB backend for CRUD operations

Acknowledgement

We would like to thank Professor Sasan Haghani for being a great advisor to us throughout the duration of our project.

System Design

Hardware Design
- Specially designed circuit with a manufactured PCB for maximum space efficiency using KiCAD
- Custom built power supply to provide power outputs of 12V for the microcontroller (Arduino) as well as 5V for most individual components (speakers, lights, motors, and solenoid valve) using a wall adapter and a voltage regulator circuit.
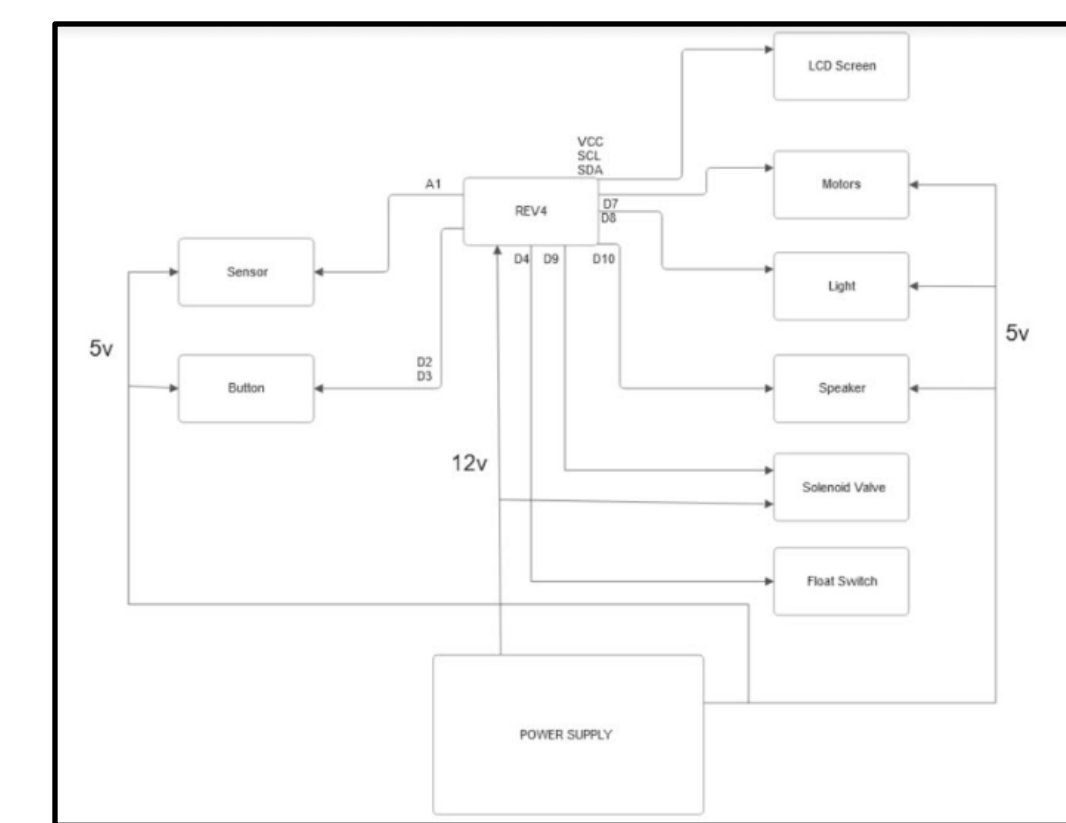
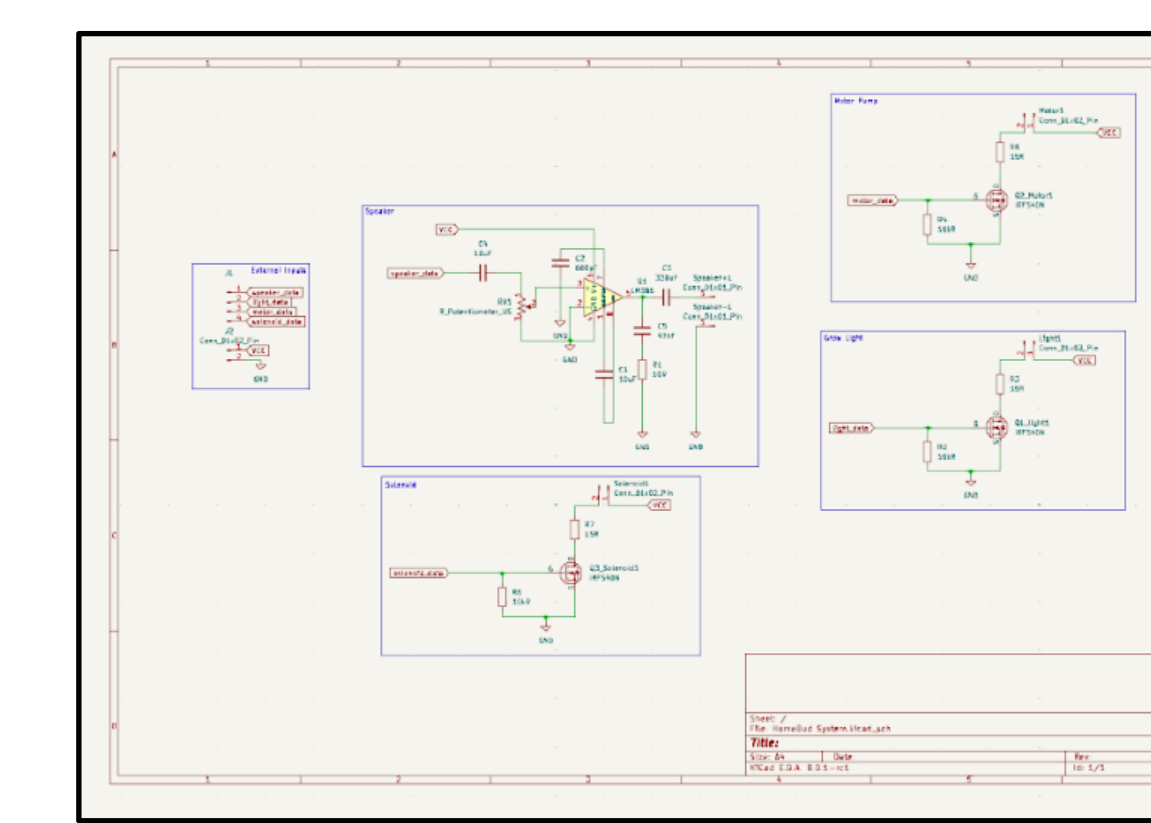**Fig 2.** Simplified Overall Circuit Design

Fig 3. Detailed Connections For Components (Speakers, Solenoid, Light, Motor)

Fig 4. HomeBud Prototype

Software Design
- Upon opening the app, the user will be faced with a welcome screen, then a list of all their linked plants and some statistics.
- The user can choose to add a plant or see an existing plant.
  - Adding a plant will guide the user to pair a new device.
  - Selecting an existing plant will guide the user to a page with information about the current plant's state (Humidity level of soil, watering cycle, amount of water used, etc.).
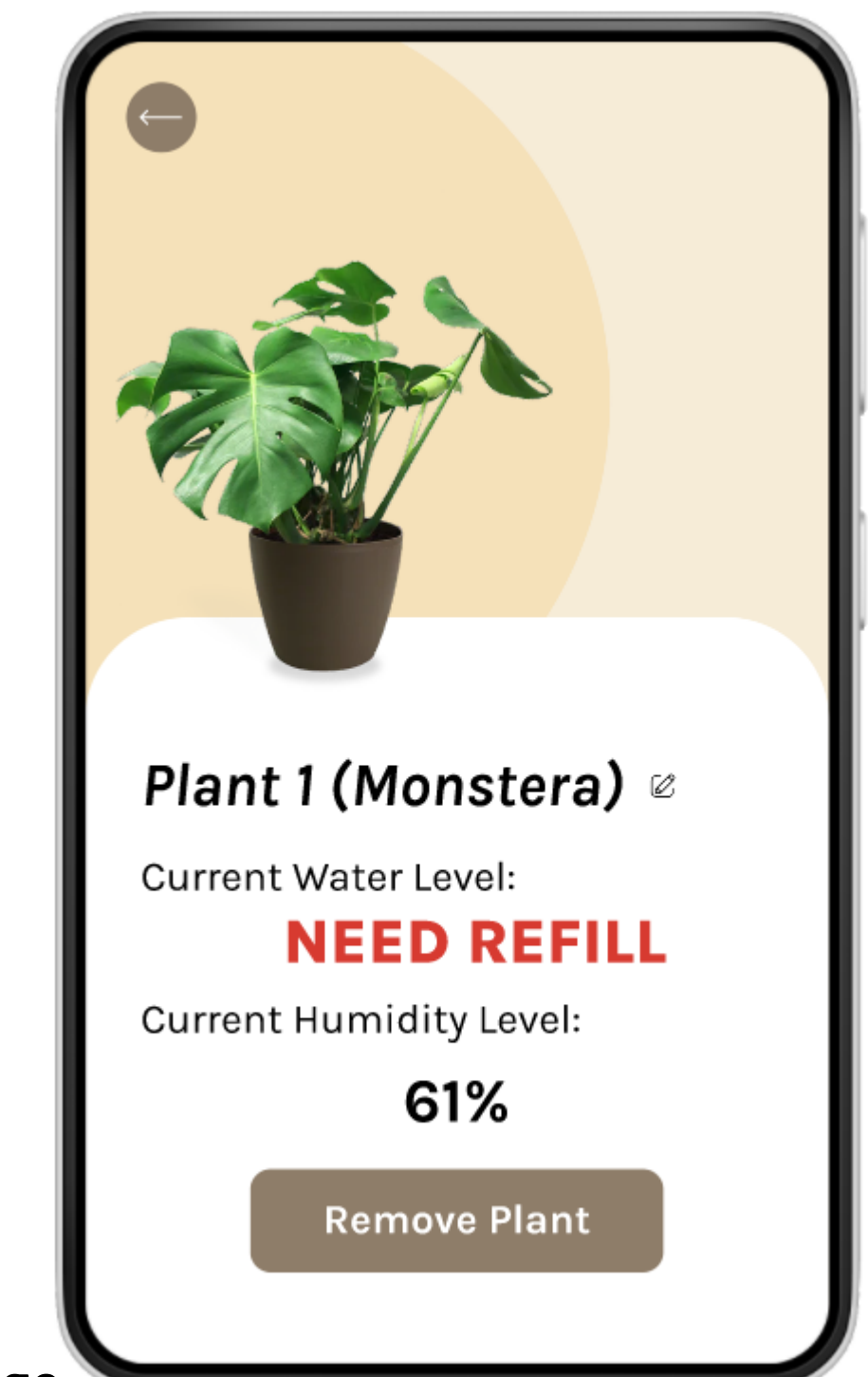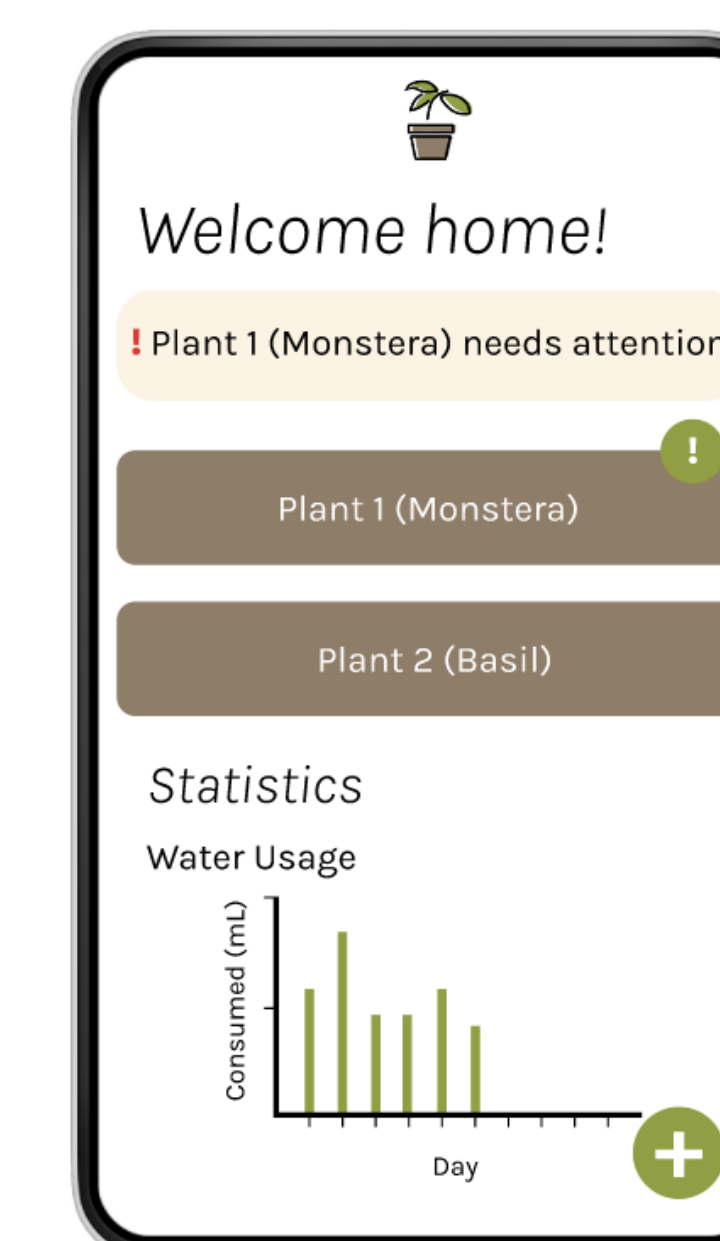
Fig 5. HomeBud Application Home Page (above) and Plant Summary (right)
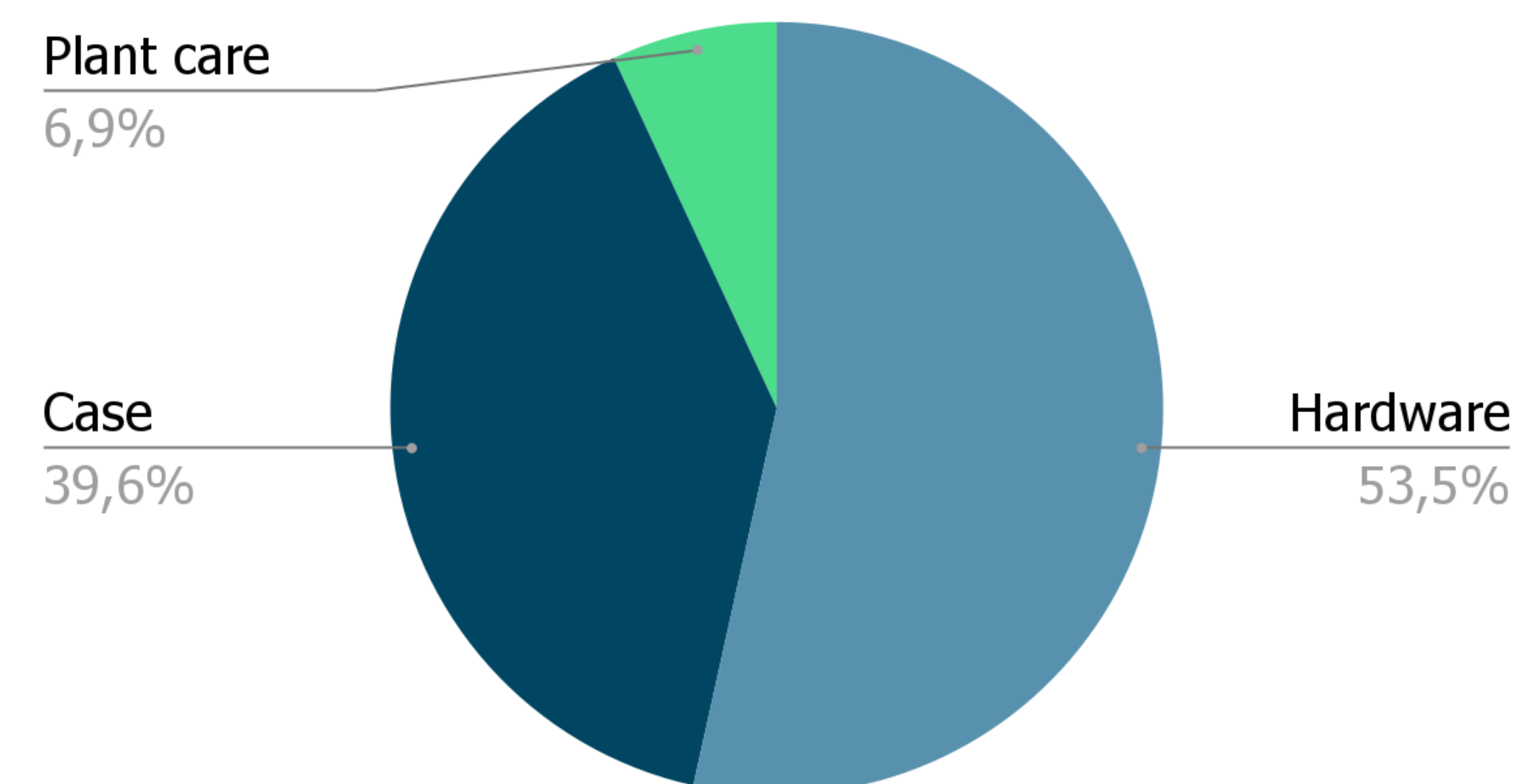
Overall Cost Analysis

Total cost allocation

Plant care 6,9%

Case 39,6%

Hardware 53,5%

Fig 6. Cost Allocations Graph

- Hardware: Arduino UNO R4 WiFi, Soil Moisture Sensor, LED Grow Light, LCD display module, 2 speakers, audio amp, float switch, solenoid valve, water pump, PCB, voltage regulator, AC adapter, potentiometer, MOSFETs
- Case: Container encasing arduino and wiring, water container with lid, watering tubes, square 6" pot with plastic mesh filters for excess water drainage, PVC sheets for hiding the wiring along the walls of the case
- Plant care: Plant, soil, water
- Software: Arduino Studio - no costs

Project Impact

The HomeBud makes plant care easy and straightforward, making it more widely accessible to users of all skill levels. Easily accessible plant care can help boost the users' mental health, grow their knowledge of plant care, reduce stress associated with it, and encourage purchase of plants with practical uses such as for cooking, air-purifying, insect repelling and more.

References

[1] K.-T. Han, L.-W. Ruan, and L.-S. Liao, "Effects of Indoor Plants on Human Functions: A Systematic Review with Meta-Analyses," Int. J. Environ. Res. Public Health, 19(12):7454, Jun. 2022, doi: 10.3390/ijerph19127454.
[2] Lee, Ms., Lee, J., Park, BJ. *et al.* Interaction with indoor plants may reduce psychological and physiological stress by suppressing autonomic nervous system activity in young adults: a randomized crossover study. *J Physiol Anthropol* 34, 21 (2015). https://doi.org/10.1186/s40101-015-0060-8