DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
THE UNIVERSITY OF TEXAS AT ARLINGTON

PROJECT CHARTER
CSE 4317: SENIOR DESIGN II
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PLANT WAYS
SMART PLANTER

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Revision History

Revision	Date	Author(s)	Description
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1 Problem Statement

Plant maintenance is a common issue in today's households. Most people do not have the time to water their plants and some often forget. Modern plant pots have added features like moisture sensors, temperature sensors and even displays that indicate when the plant needs to be watered. However, there has not been a single pot that combines all these features with home automation.

2 Methodology

We are going to build a self-watering plant pot, removing the consistent maintenance required in watering a house plant on your own. This pot is called the Smart Planter. The Smart Planter will measure humidity, temperature, and light exposure. We will also build an application to interface with the planter, to customize the settings for the individual plant.

3 Value Proposition

Having a SmartPlanter will help homeowners decorate their homes with plants without worrying about the maintenance or pots with no loose wiring like related home projects. SmartPlanter can also be used as a learning tool for beginners as our application would display information about a particular plant someone would want to know about.

4 Development Milestones

- Project charter first draft: September 26, 2022
- SRS: October 17, 2022
- ADS: November 7, 2022
- DDS: February 13, 2023
- Demonstration of Water Pump and Moisture Sensor: End of Sprint 3
- Demonstration of Humidity and Temperature Sensor: End of Sprint 4
- Demonstration of Light Sensor: Beginning of Spring Semester
- Demonstration of Application: End of Sprint 6 (March)
- Demonstration of LCD Screen: Beginning of Sprint 7
- Demonstration of Bluetooth Connectivity: Beginning of Sprint 8
- Demonstration of Wi-Fi Connectivity: End of Sprint 8
- Demonstration of 3D Design Pot: End of Sprint 8
- COE Innovation Day Poster: April 18, 2023
- Final Project Demonstration: May 5, 2023

5 Background

The smart planter will solve many of the problems when it comes to doing maintenance on plants. People who have plants sitting in their house tend to forget or have a busy work schedule to take care of the plant. Therefore, the plant ends up dying, so the smart planter could be used by people who like having plants around them but do not like to take care of the plant often.

The smart planter application can also be used as a learning tool for people who do not know anything about taking care of plants and want to learn how to take care of their plant by utilizing a cloud database which obtains information about the plant. For instance, some might not know how often to water a plant, so they sometimes over-water or under-water a plant, causing harmful deficiencies, which can lead to the death of the plant. Additionally, new plant caretakers could unknowingly keep their plant in an environment that's too warm or cold for that specific species, or too dark/bright for the plant, which can also be harmful. The smart planter's automation would remove these issues and ensure the longevity of the users plant. The smart planter cloud database will have information about different plants, the user can pick the type of plant they are planting in the smart planter, and they can send a request to the site for new plants to add to the list. The smart planter is designed to be used in a regular household, but can also be retooled to use in a small commercial setting to grow plants on a small scale in a green house.

The purpose of the smart planter is to be affordable and decorative to the public. There are some IoT planters out there, but they are expensive or have a self-watering system outside of the pot. The smart planter is supposed to combine the self-watering and IoT pot in one for ease of use.

6 Related Work

- Indoor Herb Garden Kit and Refills [1] The Click Grow is a commercially available smart planter where a device grows plants by watering them automatically its cheapest device is about $100. The difference between this product and our smart planter is that we will implement an LCD screen and the user will be able to interface with the pot via a phone through an application.

- Lua, the smart planter with feelings! [4]

  The Lua smart planter is a campaign, that is now closed, on Indiegogo which is a crowdfunding platform. The Lua smart planter will not work the same as our planter for customers because the Lua planter just tells you how the plant is âfeelingâ through an animated screen while ours will be watered automatically, the user only needs to refill the tank. Also, the Lua doesnât have an application so there is no way to interface with the pot that displays specific information.

- Smart Garden with IoT Plant Monitoring System [5]

  Bolt IoT gives instructions to people for them to create their own IoT devices and they specify how people can create a smart planter. Even though people creating their own project may be cheaper this project is not as aesthetically pleasing as our planter since there are wires everywhere. Lastly, it has a text messaging system to send information about the plant instead of an application.

- Smart Garden Planter 1-Unit Pot [2]

  LetPot sells a self-watering pot but the difference between theirs and ours is that they do not use a motor to administer water to the plant but have the bottom of the pot touching the water tank to soak the water in. Also, the pot doesnât come with any sensors or an application, so the user has no way to monitor information about the plant.

- Amazon.com : Self Watering Pots for Indoor Plants [3]

  This self-watering pot by ETGLCOZY that is commercially available through Amazon is somewhat related to what we want to create but it is missing a couple of features. This pot may be cheaper, but we will have an LCD screen on our pot and have the pot connected to our mobile application for customers to be able to monitor and learn more about their plant.

7 System Overview

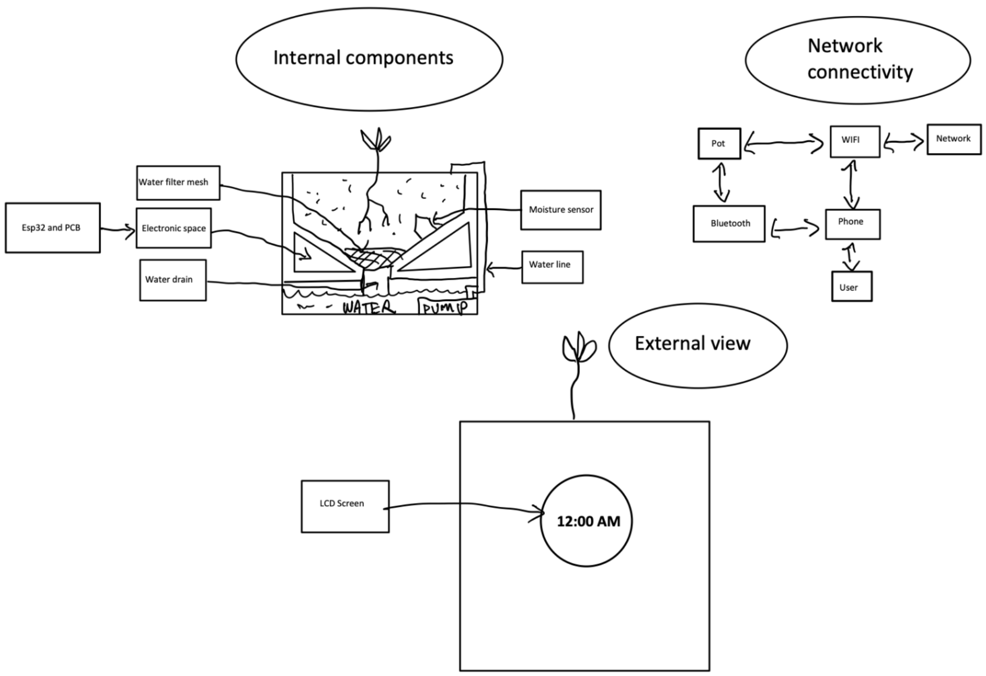

Figure 1: Components for hardware and software

The Smart Planter's physical build includes a tank filled with water which will be used to water the soil, a pump which will water the soil automatically (depending on the instructions how it receives the data), and It will also have an LCD screen attached which will showcase a clock with the current time. There will also be a metal mesh between the bottom of the plant's soil and the drainage water channel, which is leading directly toward the water tank. Additionally, the cable systems and sensitive electronic modules will be insulated and protected within separate layer section inside the pot.

The Smart Planter will be monitored and controlled by an app with the following functionalities: searching for the desired plant's information from the cloud database, which includes the humidity percentage, required temperature, and light exposure needed, along with the plants actual picture and its name, sending the specific plant's data over to the pot's local memory storage, and monitoring the current status of the plantâs humidity, temperature, and light exposure.

The app will initially connect with the Smart Planter via Bluetooth. Then the Bluetooth connection will be disconnected and then overridden by a WIFI connection between the mobile/website app and Smart Planter. The app should request the required data as well as the instructions from a cloud-based server, then send it over to the Smart Planter. The Smart Planter will then follow the instructions and water the plant accordingly. The Smart Planter mobile/website application is capable of monitoring multiple smart pots from a single user account.

8 Roles & Responsibilities

The stakeholders for this project are everyone on our team, Professor Gieser, and the University of Texas at Arlington for sponsoring our project.

There is currently no contact for the customer side since this is a student pitched project. The team will contact Professor Gieser in the case that anything is needed from the University and all documentation will be submitted to him.

Everyone on the team will act as a product owner and agree to any changes made to the project scope.

The responsibilities of each team member are as follows:

- Samuel J. Ruiz Hardware Development and Embedded Systems Programming

  Printed Circuit Board Design
- Kevin Eduardo Flores Hardware development and programming
- Luis Guillermo Jaen

  Android application development and UX/UI design
- Don Dui

  Hardware development and programming
- Samrat Baral

  Hardware development and programming

9 Cost Proposal

The project will have require the hardware mentioned in the system overviews. The project estimate is about $100.00 for each prototype on actuators and sensors and other required hardware if we make gallon size without any software cost.
An Arduino Uno will also be purchased for learning purposes along with a breadboard. The estimated cost will be $28.50 for the Arduino Uno and $9.99 for the breadboard kit.
Once the first prototype is complete, the team will research a variety of plants and soil to test the product with. The cost analysis for this section will be updated in a future project charter revision.

9.1 Preliminary Budget

9.2 Current & Pending Support

The only funding for this project is the $800 budget given to the team from the University of Texas at Arlington CSE department. All items purchased from this budget will be returned to the UTA CSE department.

Component Name	Quantity	Cost
Humidity and Temperature Sensor x5	1	$10.29
Photo-resistor Pack of 20pcs	1	$6.68
Soil Moisture Sensor Module x5	1	$9.99
IRLB8721 MOSFET Transistors x10	1	$10.99
Micro Submersible Mini Water Pump x 4	2	$22.78
ESP32 ESP-WROOM-32 Development Board x3	2	$37.76

Table 1: Overview of hardware component parts and cost

Any team member who wishes to keep a prototype for themselves will have to build it out of parts purchased from their own budget.

10 Facilities & Equipment

For the documentation of this project, the team will be meeting in the 2nd floor of the UTA library. This workspace contains whiteboards and open spaces good for discussing ideas and changes to the project scope.

For the software elements, the team will meet in the designated spot assigned by the professor in room 208 of the Engineering Research Building.

For the hardware elements,the team will request access to the Nedderman Hall Computer Engineering lab. This lab contains majority of the following necessary equipment:

Soldering Station
3D Printer
Workstations

The team will also get together with Professor Gieser next semester to discuss ways of outsourcing the construction of the Printed Circuit Boards and find potential software applications we can use to 3D design our smart planter.

Some other equipment we will require are multi-meters to read voltages and currents in our setup. Sam and Kevin own multi-meters which those can be used during our meetings. We also require an Arduino kit that contains an Arduino micro-controller, jumper cables and breadboards. Sam and Don own a kit which they can use when working on the hardware aspect of the project, anyone wanting to participate in hardware tasks can purchase a kit online. In order to program our hardware we need to use the Arduino IDE which is open source. We will require the Flutter framework for our mobile application which is also open source. Additional equipment that we will purchase personally for our pot are temperature, humidity, light, moisture and water level sensors. Additionally we will acquire a LCD screen, a water pump motor and a regular pot for our prototype. Any additional hardware needed such as resistors, diodes, relays, etc. will be purchased as needed since we may or may not require them.

11 Assumptions

The following list contains critical assumptions related to the implementation and testing of the project.

- The purchased hardware will not arrive damaged and will not fail when testing prototype
- The team will have a suitable lab area to begin working on the electronic components by sprint 3
- UTA network will allow for the ESP-32 to connect through WIFI
- All necessary components will be available on Amazon and should arrive by sprint 3
- Software application will be available to install from GitHub or Android app-store by final demonstration

12 Constraints

The following list contains key constraints related to the implementation and testing of the project.

- Final Prototype demonstration will be complete by May 1st, 2023
- Total development cost must not exceed $800.
- The final prototype must keep the plant alive in a healthy environment
- Final prototype must follow the National Electrical code for wiring
- Software applications must protect the userâs private information.

13 Risks

This section should contain a list of at least 5 of the most critical risks related to your project. Additionally, the probability of occurrence, size of loss, and risk exposure should be listed. For size of loss, express units as the number of days by which the project schedule would be delayed. For risk exposure, multiply the size of loss by the probability of occurrence to obtain the exposure in days. For example:

The following high-level risk census contains identified project risks with the highest exposure. Mitigation strategies will be discussed in future planning sessions.

Risk description	Probability	Loss (days)	Exposure (days)
Delays in shipping from overseas vendors	0.10	15	1.5
Availability of affordable LCD screens due to shortages	0.20	10	2
Receiving faulty parts and needing to reorder more	0.10	7	0.7
Failure to connect device through UTA network	0.30	14	2
Failed acquisition of special 3D printing filament, due to low supply	0.10	10	1

Table 2: Overview of highest exposure project risks

14 Documentation & Reporting

14.1 Major Documentation Deliverables

14.1.1 Project Charter

This document will be maintained using overleaf and will need to be updated if any changes are needed. The initial version will be delivered September 26th and the final version is estimated to be released in the Spring 2023 semester once all changes are finalized.

14.1.2 System Requirements Specification

The System Requirements Specification document will also be maintained using overleaf. The initial version will be released October 17th, 2022, and all changes will be finalized around the Spring 2023 semester.

14.1.3 Architectural Design Specification

The Architecture Design Specification document will also be maintained using overleaf. The initial version will be released November 7th, 2022 and all changes finalized around the Spring 2023 semester.

14.1.4 Detailed Design Specification

The Architecture Design Specification document will also be maintained using overleaf. The initial version will be released and finalized on February 13th, 2023 semester.

14.2 Recurring Sprint Items

14.2.1 Product Backlog

The items added to the backlog will be decided upon a group vote. The group will decide the priority of the items depending on the level of difficulty and time consumption. We will be using Trello software to share the product backlog.

14.2.2 Sprint Planning

Sprint planning meetings will be held every other Friday to determine the requirements of the next sprint. There will be a total of 4 sprints this semester.

14.2.3 Sprint Goal

The group will decide what the sprint goal is by vote. There are currently no customers involved as this is a student pitch project by Sam Ruiz.

14.2.4 Sprint Backlog

The group will decide on the sprint backlog by considering the time constraints and dependencies of other backlog items.

14.2.5 Task Breakdown

Backlog tasks will be decided by each team member volunteering to take on the task of their choosing. Time spent on those tasks will be recorded in the team members' engineering notebook and then on the sprint breakdown.

14.2.6 Sprint Burn Down Charts

Kevin will be in charge of generating the burndown charts for each sprint. The amount of effort expended by each individual team member will be discussed during the weekly meetings. The burndown chart will follow the format created in Excel.

14.2.7 Sprint Retrospective

Sprint Retrospective meetings will be held every other Friday. The team will determine the status of the previous sprints and discuss any changes that need to be considered before the next sprint planning meeting.

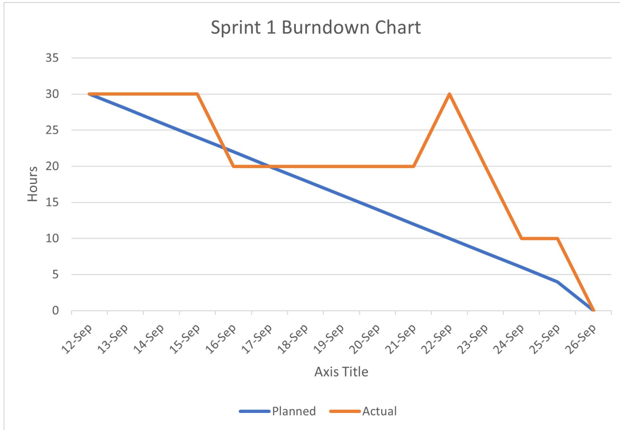

Figure 2: Example sprint burn down chart

14.2.8 Individual Status Reports

Each team member will complete tasks that are assigned to them, contributing to the teamâs burnout chart. The individual status reports will be completed by the individual team members and submitted to Professor Gieser.

14.2.9 Engineering Notebooks

Each team member will be required to complete at least one page of the engineering notebook every sprint. They will keep a detailed account of their progress along with details of how long they spent working that sprint.

14.3 Closeout Materials

14.3.1 System Prototype

The system prototype will be a 3D printed plant pot. It will be demonstrated during the senior design demo by using the prototype and a demo video.

14.3.2 Project Poster

The project poster will be a 3x5 poster board. It will be delivered during the senior design demo.

14.3.3 Web Page

The project poster will be a 3x5 poster board. It will be delivered during the senior design demo.

14.3.4 Demo Video

The demo video will be about a minute long video showcasing the SmartPlanter along with instructions on the initial setup.

14.3.5 Source Code

The source code will be maintained on a GitHub repository. New branches will be created for each section of the software and will be merged during a group code review.

14.3.6 Source Code Documentation

GitHub repository will include a README file for documentation.

14.3.7 Hardware Schematics

The project will include a custom PCB layout. The wiring diagram will be added in the future semester once the layout has been designed.

14.3.8 CAD files

The SmartPlanter pot will use a custom 3D design. The CAD files will be provided in a GitHub repository at the end of the Spring 2023 semester.

14.3.9 Installation Scripts

The planter will include the code necessary to run. The phone application will be included in GitHub for Android phones to install.

References

[1] Indoor herb garden kit and refills.

[2] Self-watering pot with 21 days watering-freeï¼1-unit potï¼letpot self-watering smart planter.

[3] self watering pots for indoor plants.

[4] Vivien Muller. Lua, the smart planter with feelings!, Jun 2019.

[5] Pranav Pai Vernekar. Smart garden with iot plant monitoring system.