ECE 445

Spring 2023

SENIOR DESIGN LABORATORY

PROJECT PROPOSAL

"Don't Kill My Plant" Habit Tracker

Team 28

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INTRODUCTION

Problem

We are trying to solve a problem that has plagued people for ages: breaking bad habits and adopting good ones. Even though humans may want to change these habits, they usually lack the willpower in order to do so. Common solutions on the market to help people change habits include smartphone tracking apps and physical devices that track physical habits. These solutions are great for tracking, but most of them can be circumvented easily and don't hold people accountable for their actions. In addition, any positive reinforcement methods that they provide are minor and are not effective enough.

Behavioral therapy has been promising in the field of medicine recently, and it is usually used to address traits in a person that might be self-detrimental or harmful for a person to have. Being able to understand what a person values and adapting their thought processes to fit what needs to change can benefit a person in the long term. Bringing behavioral therapy to fixing habits has been tried in the past, but not to as great of an extent as needed.

Solution

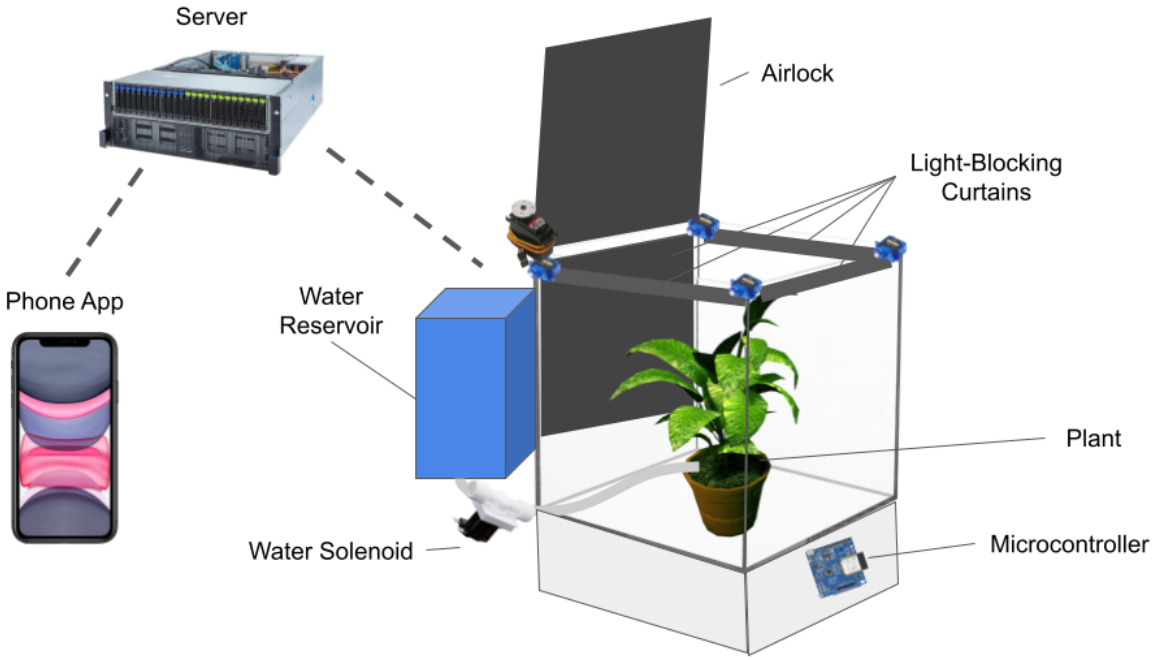
We want to change this by bringing in emotional attachment to tangible consequences to encourage people to keep up with their habits. While positive reinforcement may not be as effective, negative punishment has also shown promising results. "Don't Kill My Plant" is an application interface that will keep track of your habits through unforgeable data and will make the life of your plant dependent on it through hardware. The solution we are providing is innovative by causing people to emotionally attach themselves to keeping up with good habits as well as keeping a physical and visual reminder.

The concept around the project was to liken personal growth to the growth of a plant. Plants grow slowly, but over time they grow to be much bigger and stronger than when they started. The plant's steady journey is meant to mirror the journey of people on the path to starting better habits and breaking harmful ones. The ups and downs on the journey of habit change are slow, just like the change that our plant enclosure will provide. Because of this, we believe that a house plant is the best symbol for personal change as well as the best means to cause emotional attachment to your goals.

We aim to create a network-enabled plant enclosure that contains all the necessary mechanisms to facilitate or impede plant growth. This would include light-blocking curtains, an airlock, and an irrigation system. Along with the companion phone app, users can track their habits with real data from their phone such as screen time or location-based data. If habits are followed, the

enclosure will stay open, curtains will roll up, and the plant will be watered. As soon as good habits are broken, the airlock will seal tight, the watering will stop, and the curtains will roll down.

Visual Aid

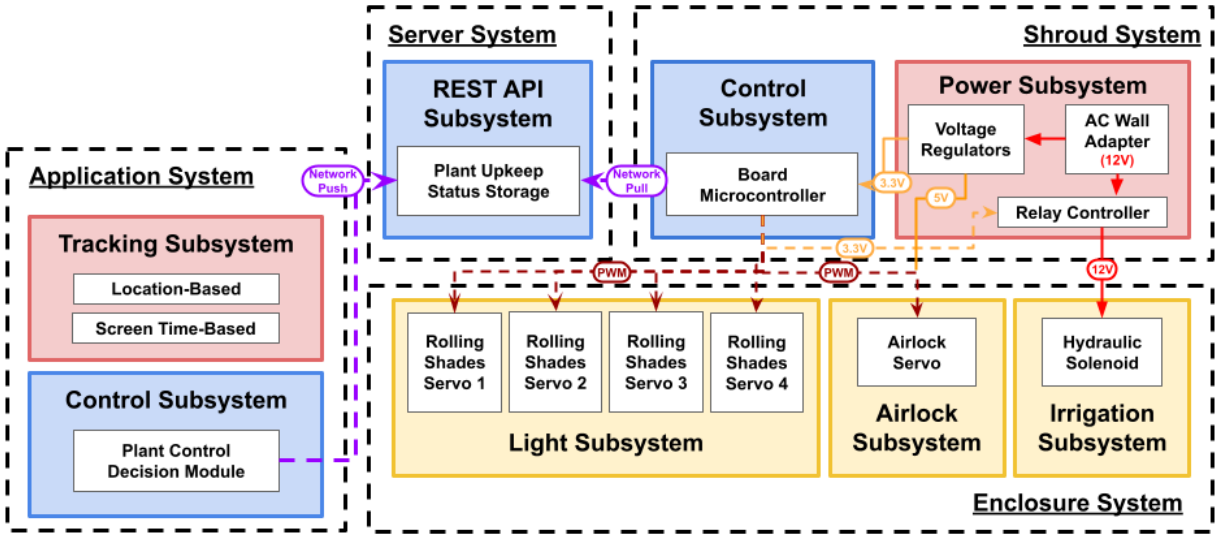


High-Level Requirements

- The created device system is capable of keeping a potted plant alive.
- The same device system also has the capability of killing a potted plant.
- The application interface is able to facilitate habit tracking for the user and send this information to the physical device

DESIGN

Block Diagram



Subsystem Overview

Power Subsystem

This module should interface between power from the wall input and each of the subsystems. It should provide each submodule with voltages and currents in ranges specified individually.

Requirements: The power subsystem should provide at least 12VDC to the irrigation system, 5VDC +/-4% to the light and airlock systems, and 3.3VDC +/-9% to the microcontroller subsystem.

Application Interface Subsystem

The application interface is a phone application that will offer multiple ways to track habit forming, including location, screentime, and message and call tracking. This allows the

application to pick up on habits such as going to the gym, avoiding a coffee shop, spending too much time on social media, or messaging your family.

Requirements: This subsystem should include basic user configurable habit tracking that leverages phone features such as location info. If habits are determined to be kept, this module communicates via WiFi (possibly as a web server) to the MC a signal of logical 0 (‘don't kill’). Otherwise, it sends a value of 1 (‘kill’).

Plant Enclosure Subsystem

The plant enclosure is a box with an airtight lid in order to create an isolated environment for a plant. The box itself will contain transparent walls with a method for blocking light out (either electronic tint or rolling window shades. The box will have an airtight lid that can be electronically opened and closed by the microcontroller. This lid and walls are implemented with servos.

Requirements: The light and airlock subsystems should expect 5VDC +/-4% to power servos. The servo ranges should accommodate ranges that fully ‘activate’ or ‘deactivate’ their corresponding function (light or air). The 3.3V control signals are driven by the microcontroller subsystem.

Microcontroller Subsystem

The microcontroller will be an ESP32 or ESP8266 that will pull from a server that the application interface is publishing to. This will determine the binary state of the plant enclosure system (killing or living). When the state on the server changes, then the microcontroller will control the plant enclosure subsystem to change the state of the box. The microcontroller will also allow routine watering of the plant through the irrigation system, which may be interrupted by not keeping up with habits.

Requirements: The microcontroller subsystem should expect 3.3VDC +/-9% from the power subsystem. This subsystem should fetch ‘kill’ (1) or ‘don’t kill’ (0) state from the app subsystem via WiFi. In ‘don’t kill’ state, this submodule regularly waters the plant via a control signal to the irrigation subsystem and sets servos to ‘de-active’ position. In ‘kill’ state, the regular watering is stopped and servos are set to ‘active’ position, blocking light and air.

Irrigation Subsystem

The irrigation subsystem will be controlled by the microcontroller in order to routinely water the plant through the included water solenoid. The reservoir outside the plant enclosure will allow the user to input water for irrigation, but the actual water delivery will be controlled through hydraulic tubing piping it inside the system.

Requirements: The irrigation subsystem expects at least 12VDC and 320 mA from the power submodule. Upon receiving a data signal from the microcontroller subsystem, this module actuates, assuming at least 2.25V for logical 1 and less than 0.9V for logical 0.

Tolerance Analysis

One of the most difficult sections of the project will be implementing the servo subsystems, specifically for the light subsystem. For its electronics, we need to implement voltage regulation in order to feed a higher voltage to the servos than the ESP32 can provide. In addition, connecting all four servos to receive the same signal will be challenging. This subsystem will be most difficult to design mechanically, since the servos will be driving curtains and suspended from a height. Mounting brackets and curtains need to be designed to be drivable by the servos we have and operate in unison.

We still believe that this design is feasible through simultaneous PWM control from the ESP32 board. In addition, by having the curtain roll up around a central shaft, we are minimizing the amount of torque required to lower and raise the light blockers. There are a large number of 3D printed brackets for the servo that we can use to help with assembly of the unit to the box, along with cyanoacrylate glue.

ETHICS & SAFETY

A potential safety concern that may arise in this project would be the exposure of certain parts of our system to water delivered through the irrigation subsystem. We can address this issue by ensuring that the plant enclosure system is properly sealed and can be properly drained to avoid leakage into other components. We plan to be mindful of the IEEE Code of Ethics 7.8.I.5 as we will be receiving continuous feedback through the development of this project and we will use this feedback to improve our project and continue producing honest data. Relating to the IEEE Code of Ethics 7.8.I.1, we also plan to be mindful of the safety of the public and the environment by ensuring that nothing other than a plant is placed into the airtight plant enclosure system because this system can cause harm to the object it encloses.