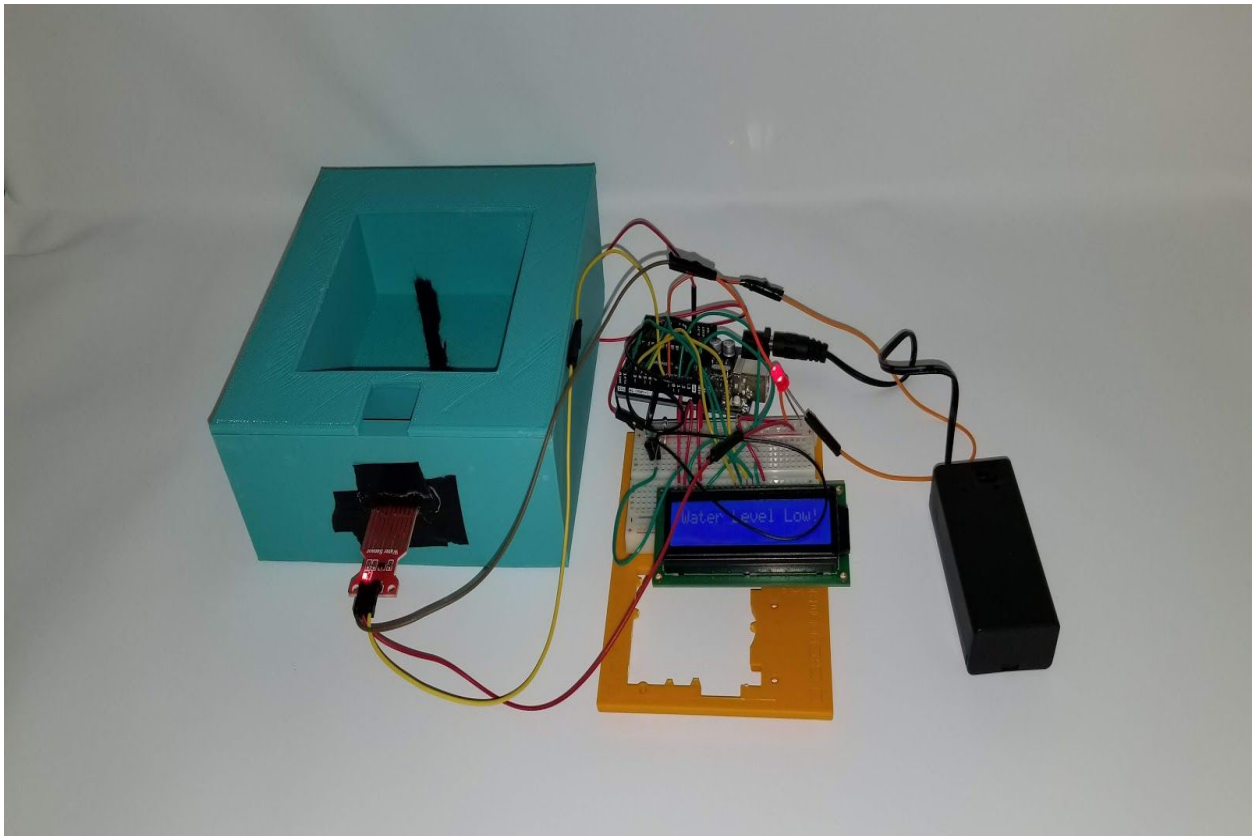
HydroTask

The Self Watering Planter



Natasha Polito, Matthew Cohen, Shayne Pollock, Chance Onyiorah
Dr. Pamela Dickrell
EGN2020C- Section 3E33
Fall 2019

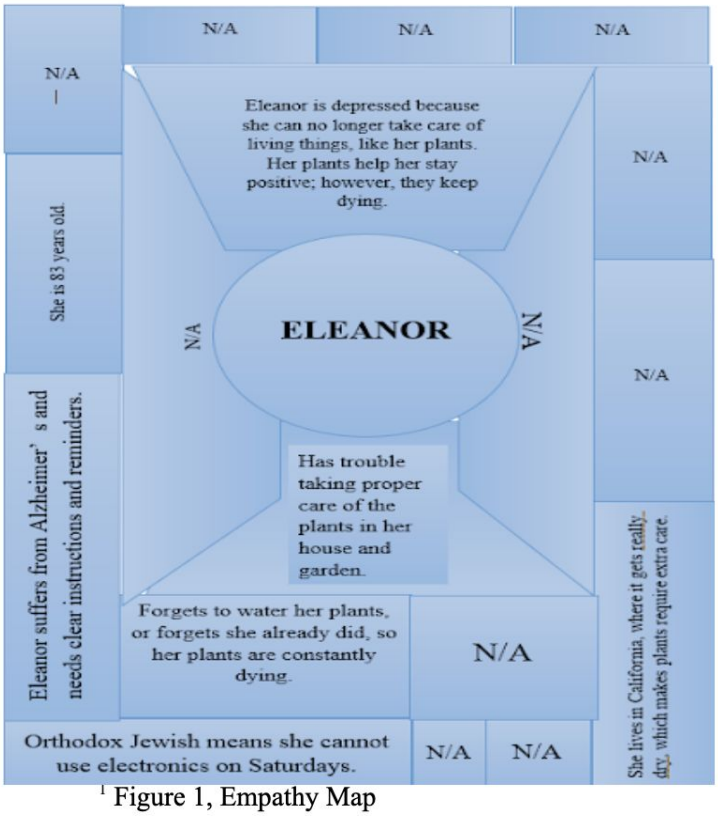
Table of Contents

A. Human-Centered User Needs

Eleanor is an 83-year-old woman that truly loves plants. Growing up in South Florida, she had a garden full of beautiful plants and flowers. Unfortunately, as she got older, she developed Alzheimers. Alzheimers is an incurable disease affecting more than three million Americans. It deteriorates memory and significant brain functions. For Eleanor, this proved to be detrimental to her health and well-being.

Eleanor moved to California after retirement and desperately wants to have plants in her home to serve as a reminder of her childhood. Unfortunately, her Alzheimers has caused many of her plants to die since she tends to forget to water her plants or overwaters them, forgetting she had already done so. The abundance of dead flowers and plants have caused her feelings of depression and disappointment. She wishes she could maintain plants in her home without worrying about killing them all. She worries she might not ever get the chance to wake up to the smell of flowers in her home again.

The design is meant to positively impact the elderly population, especially those with a tendency to forget, hopefully making a big difference in their state of mind and overall mental health. A self-watering planter that requires minimal care with built in reminders will resolve many issues with those suffering from an illness or those in the older population.



[1] Figure 1, Empathy Map

The empathy map simplifies Eleanor's story. As an elderly woman suffering from the tragic degenerative disease that is Alzhmeirs, it is easy to feel useless when even keeping a plant alive becomes difficult or impossible. Her religion, Orthodox Judaism, also prevents the use of electronics, such as motors to carry water to the plant, on Saturdays. She is limited for designs. Eleanor would need a design that has clear reminders and instructions, has reliable functions, and is easy to use. California's dry weather would require extra attention for the plants, and a self-watering planter that can be outdoors and indoors would be ideal for her.

B. Design Justifications

Our self-watering planter is based on the human-centered user needs. Essentially, the design priorities were easy to use, aesthetically pleasing, reliability, and short development time. The design was unfortunately time-consuming to 3-D print and design; however, we sacrificed development time to maximize simplicity and reliability. We created a design that would have a space in the center to hold the water and an opening to add water. This required the infill of the 3-D design of the outer layer of the planter to be at 100% to prevent spills and leaks to ensure that the user wouldn't have to worry about cleaning leaking water. Essentially, printing at 100% infill was decided for the sake of simplicity and ease of use for the user. This decision has the downside of significantly increasing the printing and development time. However, in the end we decided that the benefit to the user outweighs the disadvantage to the developer.

Since a water-level sensor was implemented into the self-watering planter, it facilitates the use for users like Eleanor. The water-level sensor detects when the water is out, and notifies the user with the LED light to refill the self-watering planter. The LCD screen also has a message for those users who are forgetful, saying "Add Water Please". By displaying a clear and simple message, the user doesn't have to worry about forgetting to water the plant. Furthermore, we have employed the use of an LED light tethered to the information received from the water-sensor. This LED light will light up when the water level is low to make it apparent to the user that the plant needs water, this furthers our simplistic design.

The aesthetics of the design come together with the modern look of sharp edges and the teal and purple polylite. It is also an ideal size, allowing more than one plant in the planter, but not big enough to be inconvenient. To increase reliability, we decided against the use of a motor since it would require more maintenance and could potentially be tedious to use and fix for the user. We created a gap in the planter for the user to add water manually, and to prevent potential malfunctions and reduce technical difficulties.

Attributes	Attributes Weight	Final Design	Final Design Weighted Scores
Development Time	0.1	3	0.3
Simplicity	0.5	9	4.5
Aesthetics	0.2	8	1.6
Reliability	0.2	9	1.8
Total			8.2

[1] Figure 2, Design Prototype Matrix

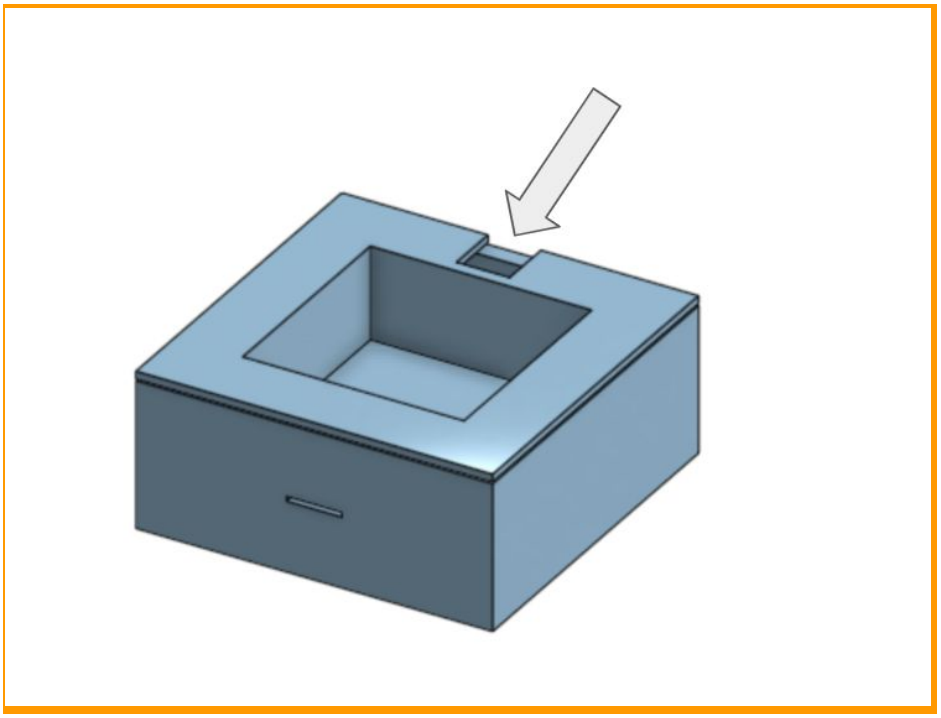
C. Ethical and Environmental Considerations

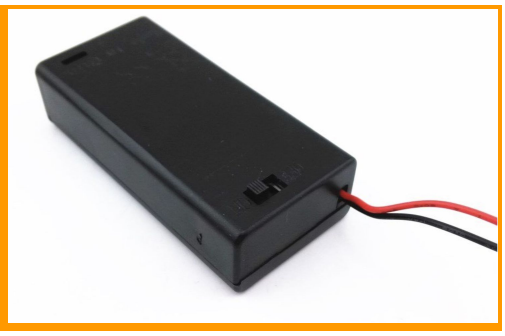
The main parts of the self watering planter are 3D printed using the Polylite PLA (Polymer) which is biodegradable and environmentally friendly. PLA also will last longer especially if kept at room temperature and pressure. PLA is easily recyclable but it does have limitations on what it can be recycled with. For example, Polylite PLA can not be recycled with other types of plastic because of its lower melting temperature. PLA is corn-based making it a renewable resource and is non toxic. One of the only contentions with PLA is that since it is made from corn, whether it will negatively impact the food supply and take away from the people who need it. However, only a very small amount of the corn supply (less than 0.05%) is used to create the material and it is not made with the corn itself but rather the sugar provided by the corn.

The Arduino UNO is a low cost circuit board and is used in the mechanics of the planter. The board can be used to build other circuits in the case that the planter breaks and is powered by a battery which can easily be replaced if the power runs out. It is also built with an on/off switch to conserve battery when not in use. In terms of manufacturing and selling the board, it is both locally distributed and sold by large companies. The board is manufactured in Italy where 100 to 3,000 boards are produced and tested daily in a facility. As of 2011, there were efforts being made to reach markets in China, India, and South America. This can cause ethical problems since these are countries known to exploit their workers and do little in providing them with fair working conditions. With these things in mind, we consider it a major benefit that the whole product can either be recycled or reused when it is done being used.

D. User Manual and List of Parts/Functions

If the screen says “Water Level Low!” the user should pour water through the square area on the top of the planter



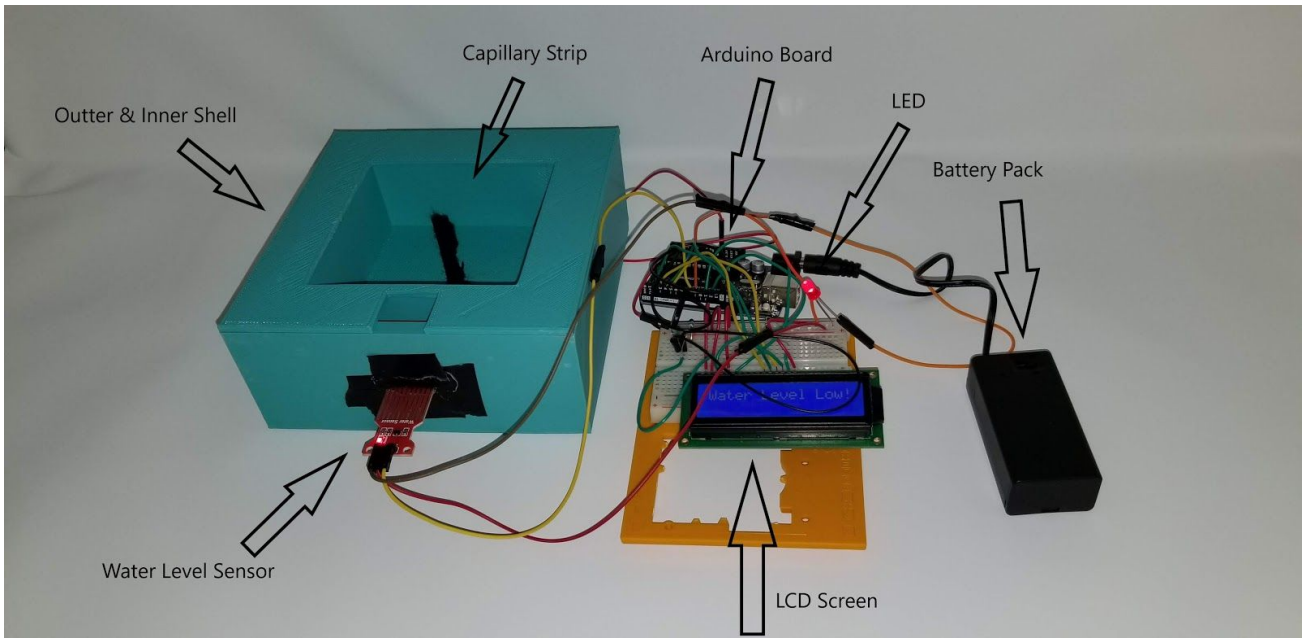


Insert one (1) 9V battery into the battery compartment to power the planter. Turn the planter on and off with the on and off switch located on the battery cover.

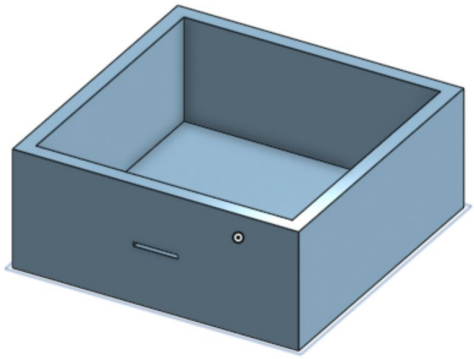
Place a capillary strip through the hole on the bottom of the inner compartment of the planter. This strip will carry water to the plant. Make sure part of the strip is submerged in the water and the other part is in the soil.

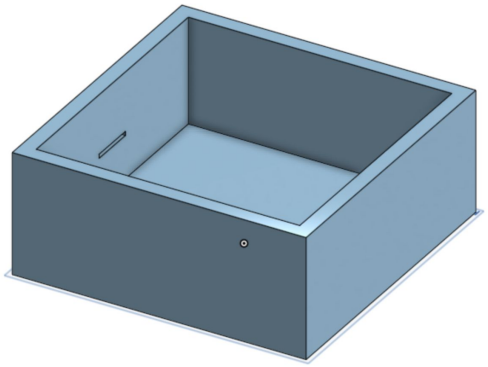
Parts

- Outer 3D printed layer
- Inner 3D printed layer
- Capillary Strip
- Water Level Sensor
- LED
- Arduino Board
- LCD Screen
- Battery Pack


Capillary Strip
Arduino Board
Outter & Inner Shell
LED
Battery Pack
Water Level Low!
Water Level Sensor
LCD Screen

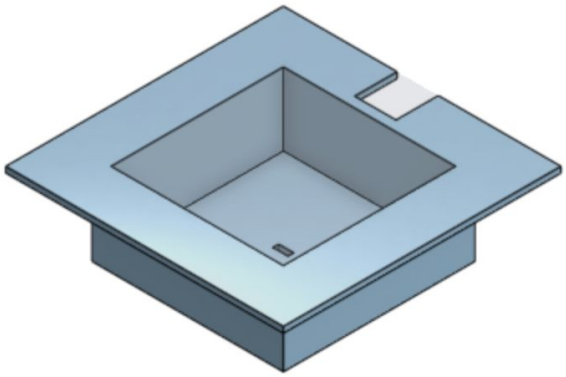
E. Engineering Drawings

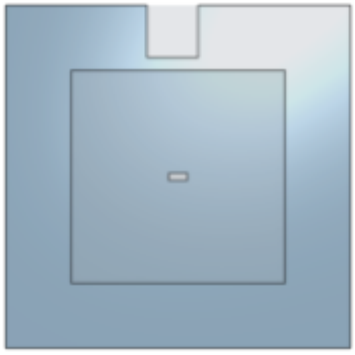




This part of the planter will hold the soil and plant. The small rectangle on the bottom is where the capillary strip will fit through. The ledges around the top face are so that this layer can fit perfectly on the outer layer.

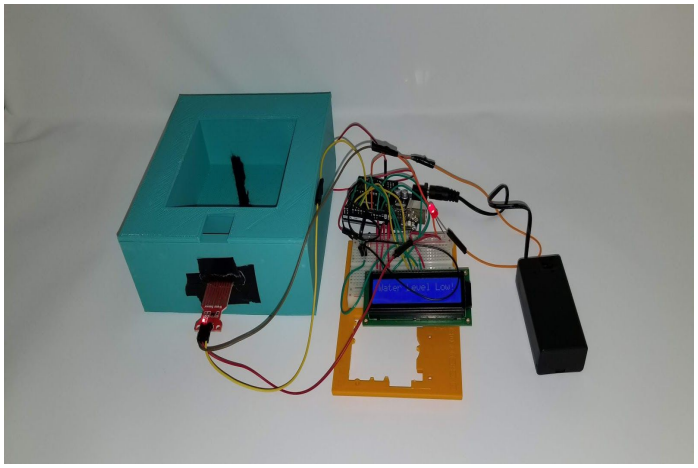
3D Printed Inner Layer





This part of the planter will hold the water. The small rectangle on the side is where the water sensor fits through to read the water level. The inner layer of the plant will sit inside this layer.

F. Final Prototype



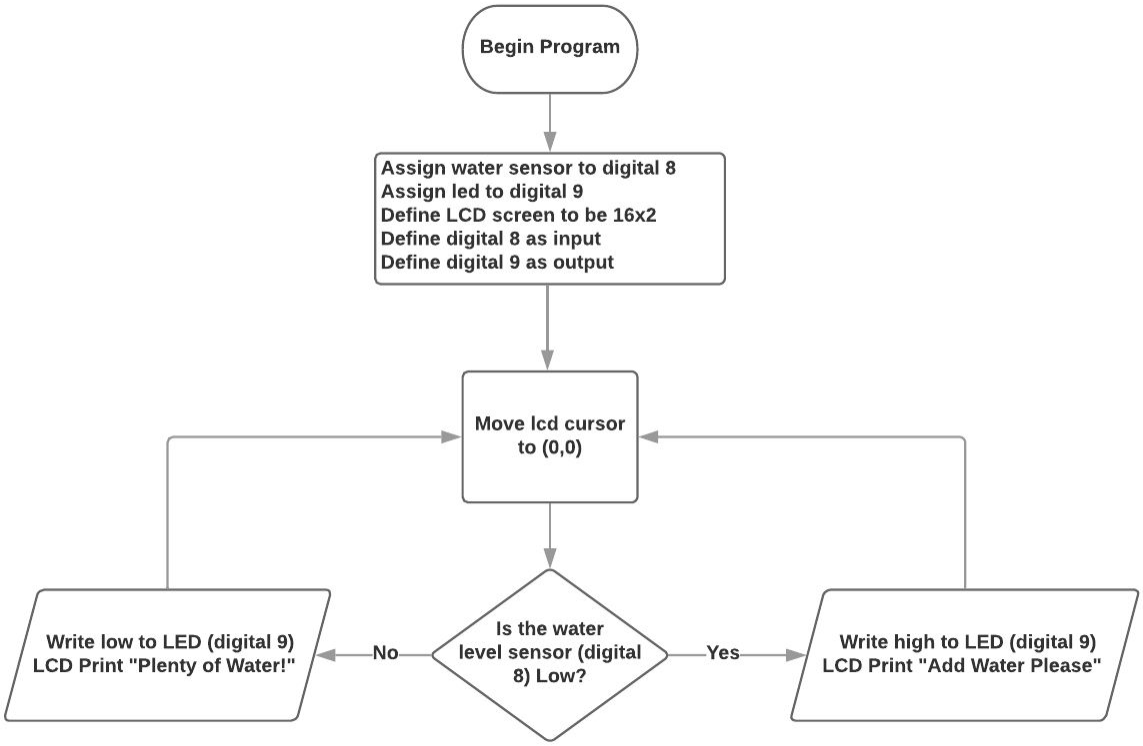
Full prototype

LCD screen when there is enough water

LCD screen when there is not enough water

Capillary strip opening where soil would be in planter

G. Flowchart (Figure 3)



[2]

[2] Figure 3, Flow Chart Diagram

H. Commented Code

```
// include the library code:
#include <LiquidCrystal.h>
//Setup inputs
#define Grove_Water_Sensor 8
#define LED 9

// initialize the library with the numbers of the interface pins
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);

void setup() {
  // set up the LCD's number of columns and rows:
  lcd.begin(16, 2);
  //Setup water sensor input
  pinMode(Grove_Water_Sensor, INPUT);
  //Setup LED output
  pinMode(LED, OUTPUT);
}

void loop() {
  // set the cursor to column 0, line 1
  // (line 1 is the second row, since counting begins with 0):
  lcd.setCursor(0, 0);
  if( digitalRead(Grove_Water_Sensor) == LOW) { //If there is no water on the sensor
    digitalWrite(LED,HIGH); //Turn the led on
    lcd.print("Add Water Please!");
  } else { //If there is water on the sensor
    digitalWrite(LED,LOW); //Turn the led off
lcd.print("Plenty of Water!");
  }
}
```

I. Design Limitations

There are some limitations with our self-watering planter. For one, with our initial design, we found that it used too much material and took too long to 3D print. The design included three shells: one to hold the plant, one to hold the water, and another to hold the electronics. We had to completely remove our third, outer shell for our design so that we could print the planter in a feasible amount of time. As such, the current design has the Arduino board laying on the outside, separate from the planter, rather than residing inside the third shell as imagined in our original design. The downside of allowing the Arduino to remain outside of the planter is that is takes away from one of our major design goals: simplicity. By allowing loose wires to be out in the open, it increases the likelihood of technical complications. These complications could easily arise from water being spilt on the Arduino or something as simple as a wire being disconnected. This may seem like a small issue, however, to someone with Alzeheimers, such as Eleanor, it could render our design unuseable. Our planter is just a prototype; with more time and money, we would include the third shell to make the overall design more aesthetically pleasing and secure.

Despite some complications, we did have many successes. We were able to put in a screen and a light to alert the user when more water was needed. We also have an inner shell that holds water so that when the person is alerted, the user can pour more water directly into the shell until the message on the screen goes away and the light turns off. The addition of water into the planter is facilitated by a cut out in the inner shell to ensure that the water compartment is easily accessible. The second shell is able to hold a large amount of water in relation to the size of the plant, allowing for a longer period of time before the user has to worry about refilling the water. Additionally, there is a capillary strip leading from the where the water is to where the soil would be so the water will only flow into the soil when the soil's moisture level is low. Lastly the design includes an on/off switch for the battery in order to conserve battery power.

Eleanor, our user that we designed for, has Alzheimer's and so her biggest problem is her memory and depression. We catered to our user's human-centered needs by giving visual cues to keep Eleanor from forgetting to water her plants as well as by making our design as simple as possible to minimize any potential errors. Our main flaw in our planter is the exposed electronics, something we would hope to change once we pass the prototype phase.

J. Appendix

TEAM CHARTER

The purpose of this document is to develop a charter for your team to establish many of the necessary ground rules for team meetings, interaction, and performance systematically. This charter should cover at the bare minimum the items listed subsequently. The expectation is that by establishing this document, the team will function more smoothly and efficiently.

Team Name and Logo
Team Name: The Dragons
Team Logo: A Dragon

Communication Plan

Last Name, First Name	UF Email	Other Contact Info
Cohen, Matthew	cohen.matthew@ufl.edu	(941) 893 7550
Polito, Natasha	natashapolito@ufl.edu	(954) 812-0994
Pollock, Shayne	shayne.pollock@ufl.edu	(954) 980-5068
Onyiorah, Chance	conyiorah@ufl.edu	(305) 298-7311

Mission Statement
The team's purpose is to develop and create an ideal design of a self-watering planter that will fit our human-centered user's needs.

Meeting management
Monday's at 1:30pm- Marston Library
Wednesday's at 5:00pm- Marston Library
Friday's at 2:00pm - Marston Library

Team Norms
Each meeting is an hour and a half long
Meeting #1 - Design parts on Onshape
Meeting #2 - Finish designs, start 3D printing, and begin working on report
Meeting #3 - Work on circuits, continue working on report
Meeting #4 - Finish circuits, continue working on report

Plan of Labor Division

Each person works on modeling a part on Onshape.

Matthew and Shayne work on the circuit and code.
Natasha and Chance write a large part of the design report.
Matthew and Shayne fill in whatever is left.

All team members sign the team charter agreement to certify their endorsement and commitment to uphold the team charter.

1. Natasha Polito — *Natasha Polito*
2. Chance Onyiorah — *Chance Onyiorah*
3. Matthew Cohen — *Matthew Cohen*
4. Shayne Pollock — *Shayne Pollock*