Easy Garden

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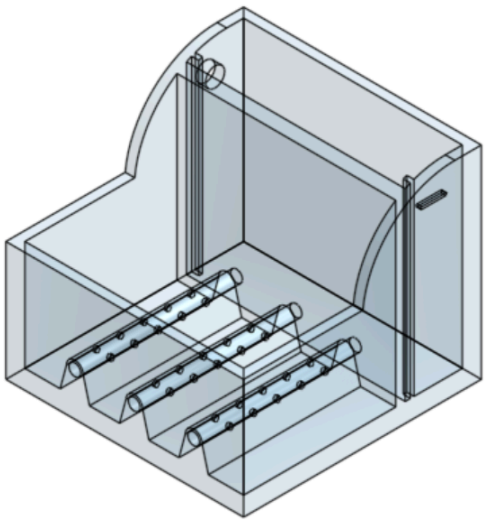
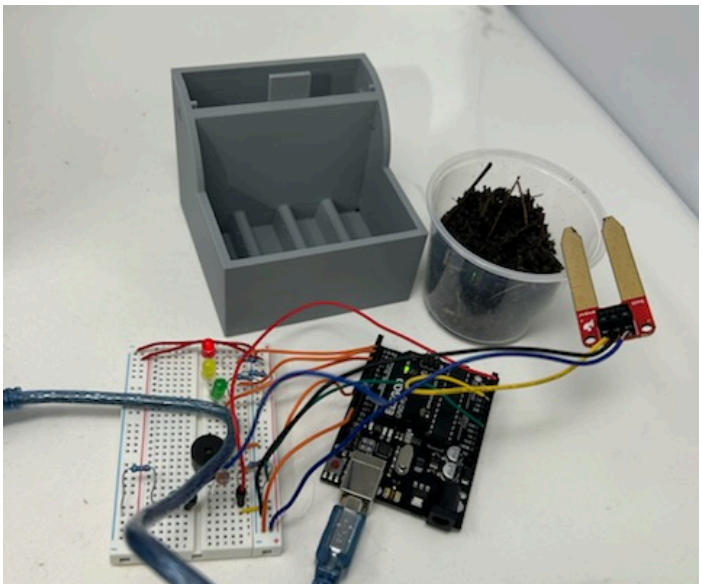
EGN2020C
Fall Semester
#18887





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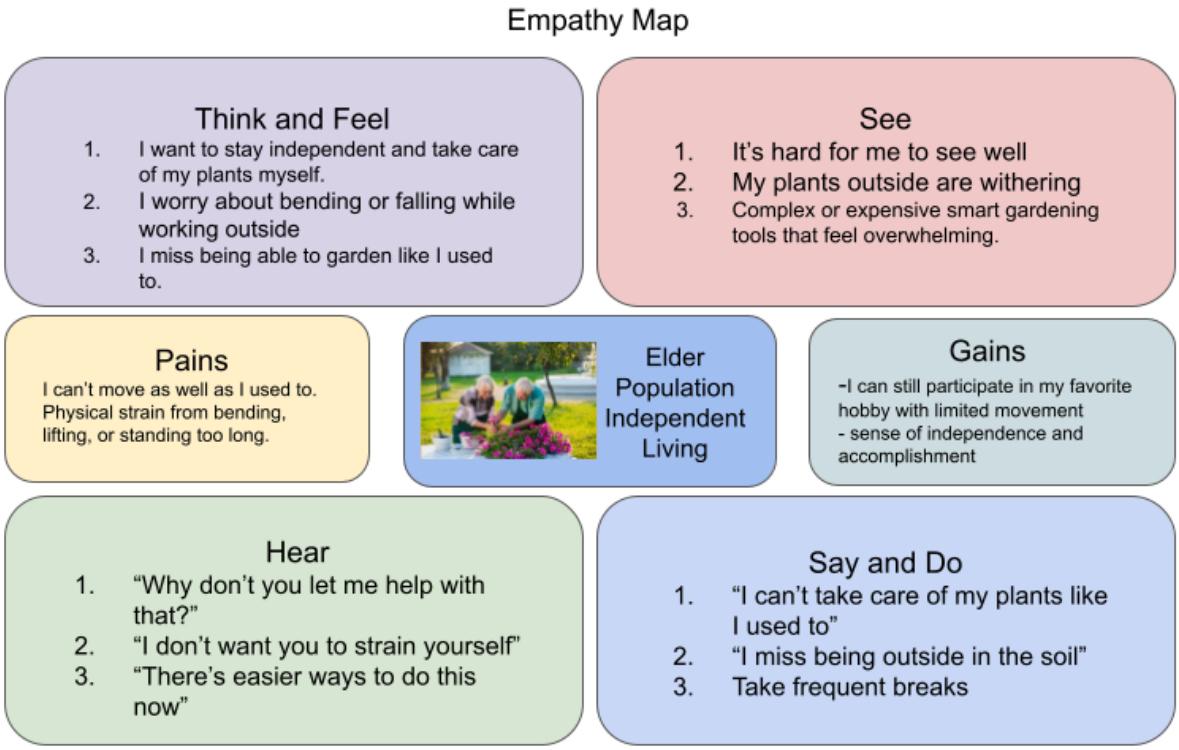
Human-Centered User Needs

Our human-centered user is an elderly individual living independently, who enjoys gardening but faces age-related limitations that make the activity more difficult. Many older adults experience reduced mobility, strength, eyesight, hearing, and memory, which can turn a once-relaxing hobby into a challenging or even unsafe task. Despite these limitations, gardening remains a meaningful part of many elderly individuals' lives, like promoting mental wellness, providing light physical activity, and giving a sense of purpose and independence. Our design, the *Easy Garden*, was inspired by the desire to help elderly users continue gardening safely and independently while minimizing physical strain and cognitive load.

Traditional gardening often requires repetitive bending, lifting, and watering, which can be difficult for those with arthritis, balance issues, or limited mobility. To reduce these barriers, our system uses an integrated watering mechanism where the user fills a basin occasionally instead of watering plants daily. By simply pulling up a small lever, water flows through tubes into the soil so it minimizes effort and movement.

To further support users with sensory or cognitive impairments, the Easy Garden includes soil moisture sensors connected to LED indicators and a buzzer. The LEDs provide clear visual cues for users who are hard of hearing, while the buzzer ensures feedback for those with impaired sight. Additionally, a photoresistor measures light exposure and uses another LED to indicate if the plants are receiving enough sunlight.

By combining these features, the Easy Garden allows elderly individuals to enjoy gardening without constant physical exertion or confusion. It supports independence, enhances safety, and promotes mental well-being, all while being easy to maintain and sustainable.



Design Justification

1. Decision Matrix

ATTRIBUTE (OR FACTOR)	List each attribute (or factor) you need to consider when deciding on the best overall solution or design.	Accessibility	Cost (cheaper is higher score)	Safety	Innovation	Sustainability		SUMS
FACTOR (OR ATTRIBUTE) PRIORITY MULTIPLIER	On a scale of 1 to 10, where ten is highest and one is lowest, rate the priority you should give for the factor (or attribute) above.	10	5	10	3	8		
Design	Design Ideas	DESIGN IDEA WEIGHT: On a scale of 1 to 10, where ten is the highest and one is the lowest, rate your design idea.						
A	Easy Garden	10	1	10	3	6		262
B	Distance Sensor Bracelet	10	3	8	3	6		252
C	Door/Hallway lighting system	10	4	10	2	4		258
D	3							0
E								0
F								0

Based on your TOP 3 SCORES, list the main considerations needed in your design:

Score	Design Ideas	Attribute	Describe some potential approaches to the proposed DESIGN IDEAS and ATTRIBUTE of the design
1-	Easy Garden	larger, more expens	Uses moisture sensors to detect soil moisture, LEDs to indicate when it needs to be watered, a button to activate water pump to water the plants. All of these ideas would make the design larger and more expensive
2-	Door/Hallway lighting system	small and many	would use buzzers and LEDs, would have multiple placed around house, would be relatively small, would rely heavily on motion sensor/buttons
3-	distance sensor bracele	accessibility	Uses an ultrasonic distance sensor to detect nearby objects and provide LED and buzzer feedback. The bracelet would be lightweight, rechargeable, and simple to use with one button, helping prevent collisions and promote independence.

2. Description

After much deliberation over the decision matrix and results, we ultimately decided to go with the Easy Garden. Not only did the Easy Garden score the highest, but we also agreed that the Easy Garden offered stronger alignment to our goals for human-centered design. It focuses on the accessibility, safety, and sustainability that is required when creating a product tailored towards the elderly community, specifically with those in the elderly community with a hobby in gardening. Many elders have limitations, such as sight, movement, and hearing, and this Easy Garden is tailored for that in order for many to enjoy what they love even in the later stages of life. In the matrix, we gave higher weight to certain subjects like usability, impact on independence, and sustainability. We did this because we felt that these subjects are essential for the elderly community, and the Easy Garden scored high in all these aspects. It enables the elderly to continue gardening, which is known for its promotion of mental health as well as physical well-being. By adding systems like ease of watering, soil moisture sensors, LED indicators, and a buzzer, the users of our prototype will be able to care for plants without the

physical strain while still remaining independent. The watering allows one to use limited motion to get the soil moisturized, and the moisture sensors, LEDs, and buzzer notify the user about the conditions of the plants in a more obvious way. The Easy Garden stood out as the solution that best aligned with our ideas for what our human-centered design should work towards, while also accumulating the most points in our decision matrix, which lead in every category except for cost. This decision shows our commitment to create a product that is inclusive and empowering to the elderly community.

Ethical & Environmental Considerations

When creating the Easy Garden, our group wanted to think beyond just function and focus on the ethical and environmental impact of our prototype. Since it is made using 3D-printed parts and Arduino-based electronics, we looked at how each part affects the environment and what happens when the product reaches the end of its life.

Our 3D-printed parts were made from standard filament because it was affordable, easy to use, and available in our lab. We understand that most filaments are plastic-based and not biodegradable, which means they can contribute to waste if not reused properly. To reduce this impact, we designed the Easy Garden to be modular. If one section breaks, only that piece can be reprinted instead of making the entire product again. This helps reduce plastic waste and makes the design more sustainable overall. In the future, we could use recycled or plant-based filament to make the prototype more eco-friendly.

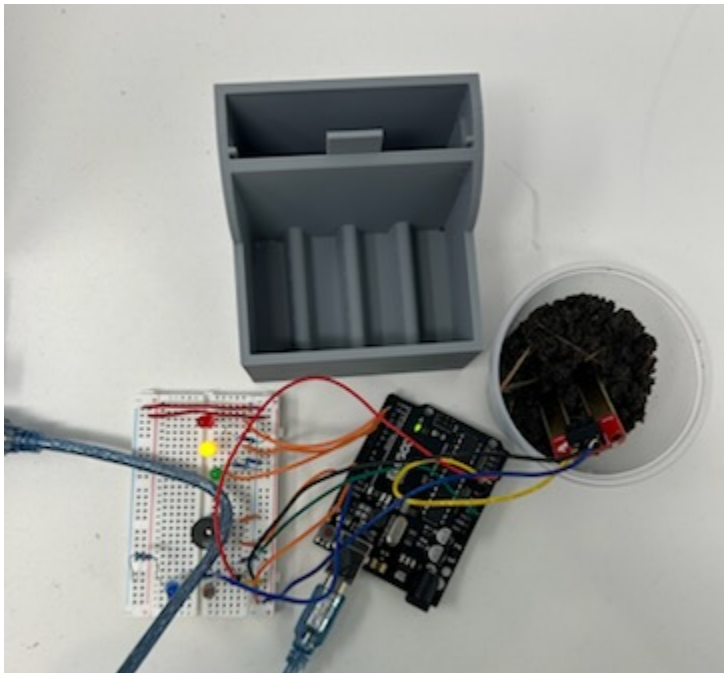
The electronic components such as the Arduino, sensors, LEDs, and buzzer can all be removed and reused for other projects. If something breaks, the parts can be replaced individually

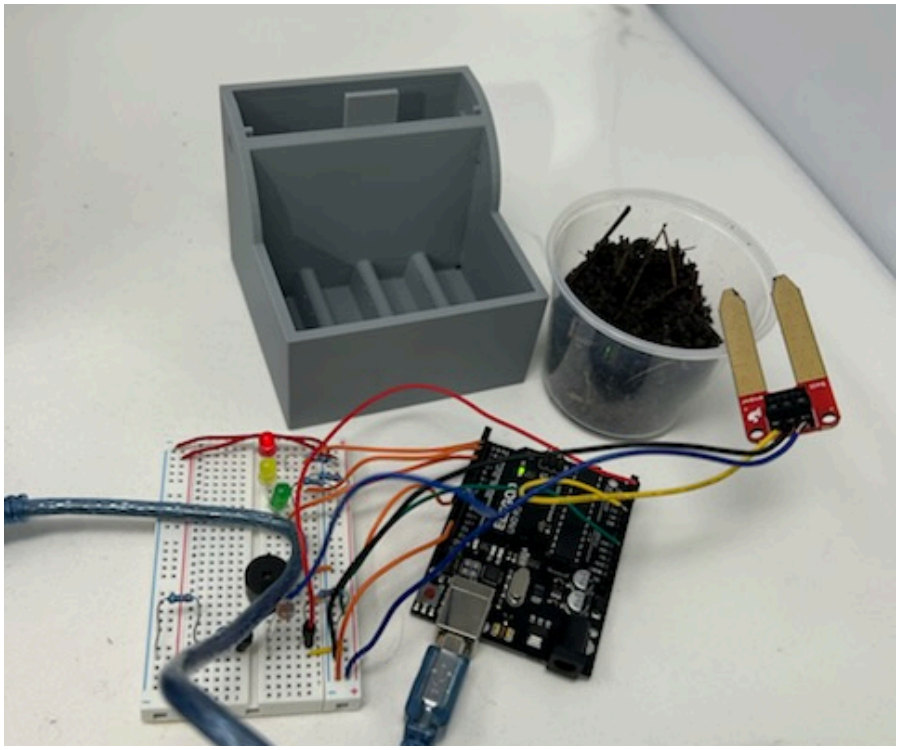
instead of throwing away the entire system. This makes the design easier to repair and keeps electronic waste to a minimum.

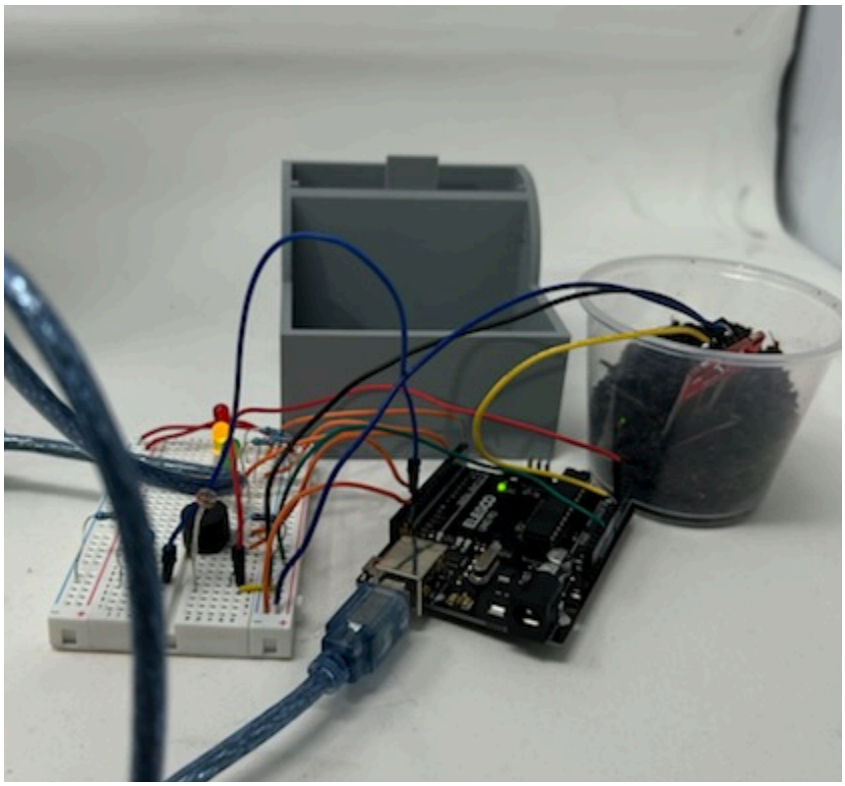
From an ethical standpoint, we recognize that many electronic components are manufactured in factories where workers may face unsafe conditions or low pay. While we used common components that were easily available, in future versions of the product we would aim to source materials and parts from suppliers with more transparent and fair labor practices.

The Easy Garden is designed with long-term sustainability in mind. It focuses on reuse, repairability, and reducing waste while still meeting the needs of elderly users in an ethical and responsible way.

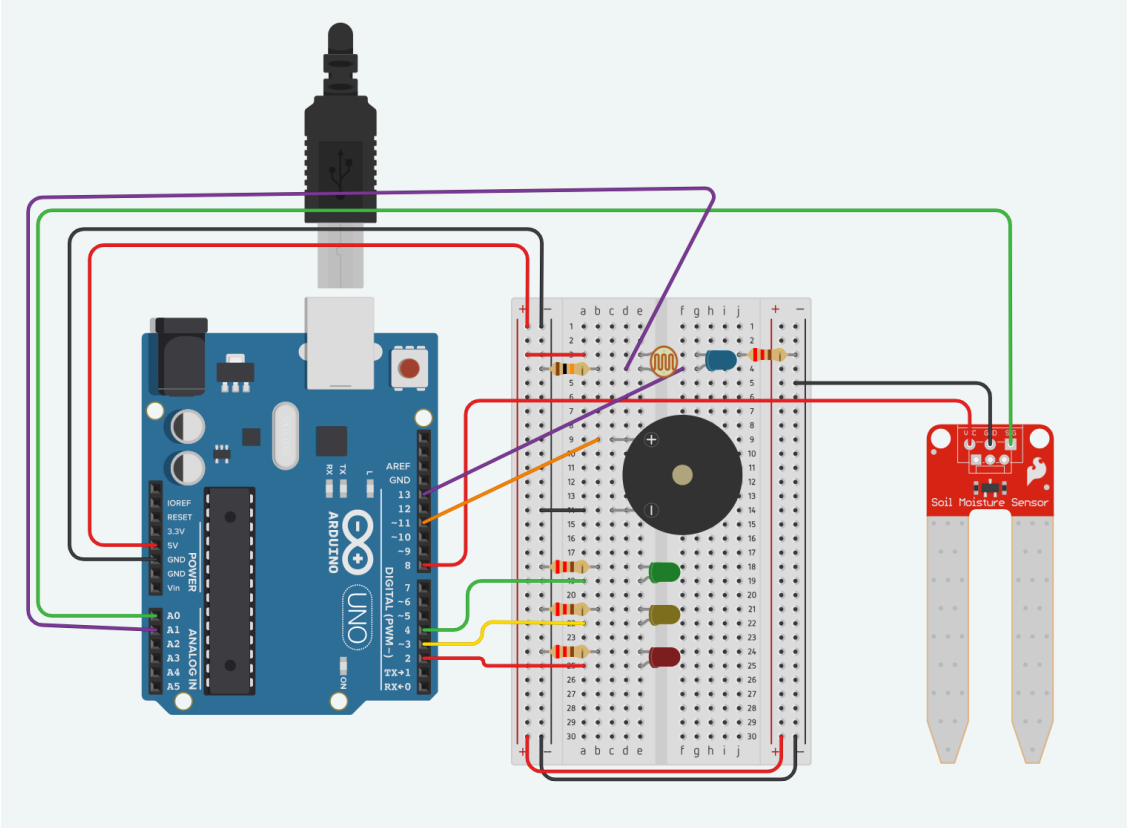
Light Booth Pictures of Your Final Prototype: using the light boxes in class take at least 3 different angled pictures of your final assembled prototype with the photobooth plain background







Tinkercad Images with List of Parts/Functions



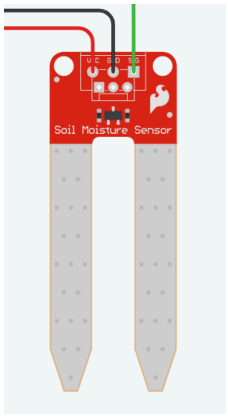
Photoresistor:

- 
- Must be positioned where the plants get sunlight to accurately read the amount of sunlight

Blue LED:

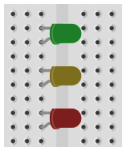
- 
- turns on when there is not enough light read
- turns off when there is enough, and the **buzzer** goes off.

Soil Moisture Sensor:

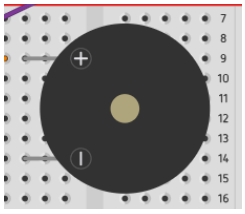
- 

- Must be well-placed in the soil to accurately read the moisture level.
- When the moisture level changes and the sensor reads enough moisture, the **buzzer** beeps 3 times.

Green, Yellow, and Red LEDs:

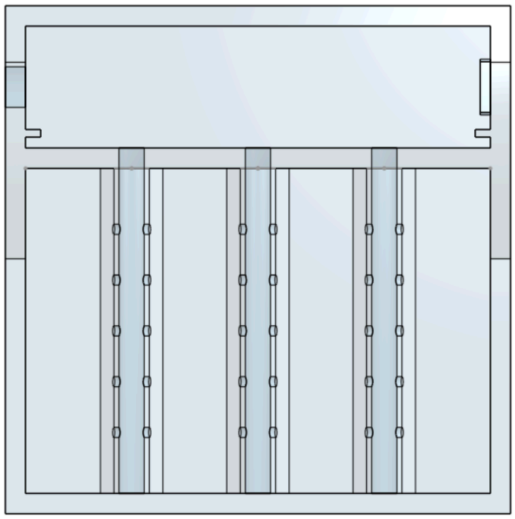
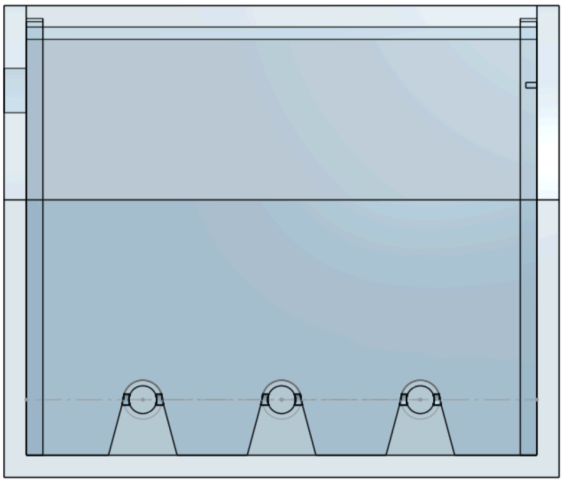
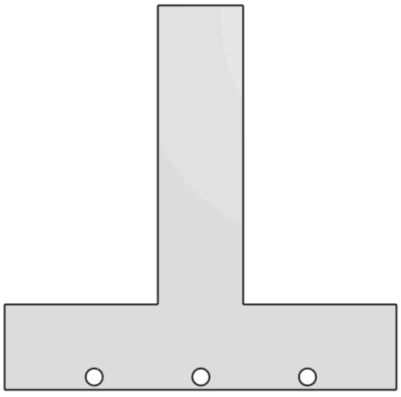
- 
- Red: not enough moisture
- Yellow: Slightly dry, running out of moisture
- Green: Has an ample amount of moisture

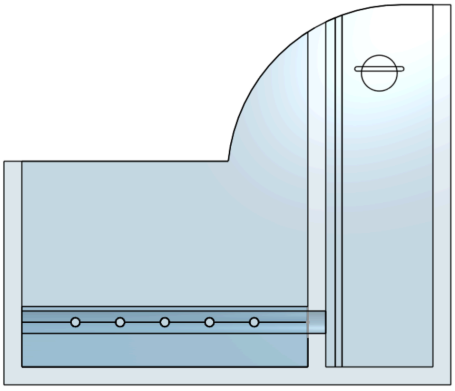
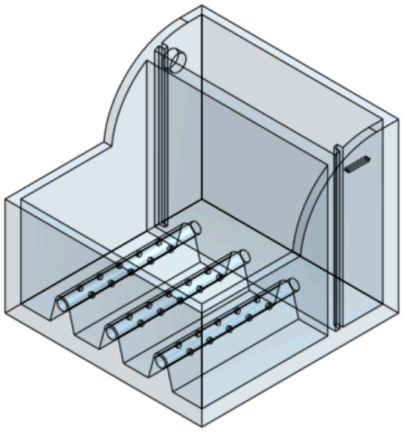
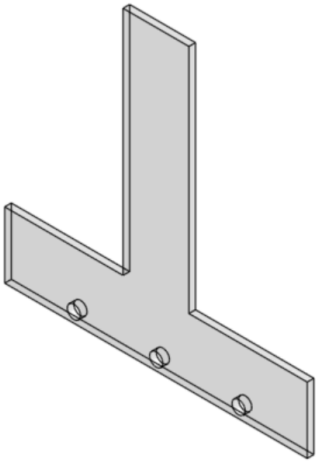
Buzzer:

- 

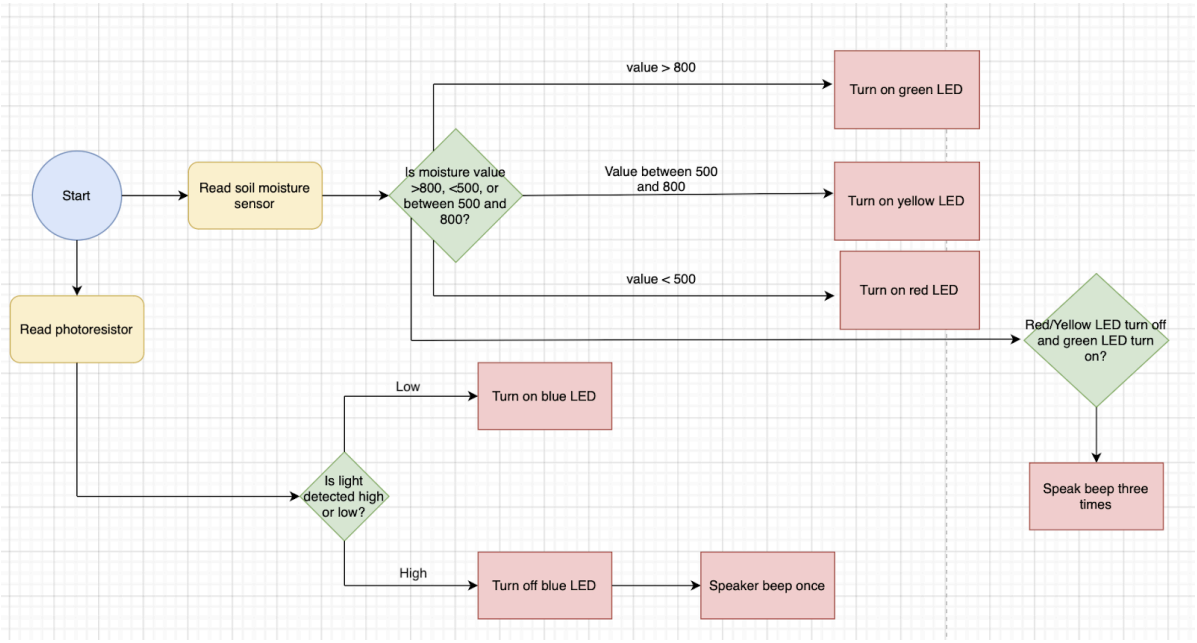
Engineering Drawings and Onshape Link to Parts

https://cad.onshape.com/documents/b6ff23c896145e18abe7f22a/w/c8635c3d53f563af2d2d86bb/e/d6a5d8baa8ffe92e739ead01?renderMode=6&uiState=69163d0b1f191bfae69664d2

PART 1	**Part 2**
Top	**Top**
	
Front	**Front**
	

Right	**Right**
	
ISO	**ISO**
	

Flowchart



When the device is powered on, it will simultaneously monitor the soil moisture sensor and photoresistor. Once it reads the moisture level from the moisture sensor, it will determine which range it falls in (above 800, between 500 and 800, or under 500). Based on the determined range, the corresponding LED will light up green, yellow, or red respectively. If the moisture level rises to the above 800 range (green LED is lit) from any value less than 800, the speaker will beep three times at a high frequency. Additionally, it will read the photoresistor and detect incoming light from its surroundings. If the light detected is low, the blue LED will turn on. If the light was previously low and then goes to high, the blue LED will turn off and the speaker will beep once at a low frequency.

Commented Code

```
// declare variables for pins
const int sensorpin = A0;
const int sensorpower = 8;
const int LED1 = 2;
const int LED2 = 3;
const int LED3 = 4;
const int buzzerPin = 11;

// Light sensor pins
const int lightSensorPin = A1;
const int lightLED = 13;

// Light threshold (can calibrate later)
int lightGood = 600;

// variable for sensor reading
int sensor;

// Track whether the soil was previously NOT green
bool wasNotGreen = false;
bool lightWasLow = false;

// delay time between sensor readings
const int delayTime = 1000;
```

```
// "wet" and "dry" thresholds - these require calibration
int wet = 800;
int dry = 500;

void setup(){ // code that only runs once
  // set pins as outputs
  pinMode(LED1,OUTPUT);
  pinMode(LED2,OUTPUT);
  pinMode(LED3,OUTPUT);
  pinMode(sensorpower,OUTPUT);
  pinMode(buzzerPin, OUTPUT);
  pinMode(lightLED, OUTPUT);

  // initialize serial communication
  Serial.begin(9600);
}

void loop(){ // code that loops forever
  // power on sensor and wait briefly
  digitalWrite(sensorpower,HIGH);
  delay(10);
  // take reading from sensor
  sensor = analogRead(sensorpin);
  // turn sensor off to help prevent corrosion
  digitalWrite(sensorpower,LOW);
```

```
// print sensor reading
Serial.print("Moisture: ");
Serial.println(sensor);

// If sensor reading is greater than "wet" threshold,
// turn on the green LED. If it is less than the "dry"
// threshold, turn on the red LED. If it is in between
// the two values, turn on the yellow LED.
if(sensor>wet){
  digitalWrite(LED1,LOW);
  digitalWrite(LED2,LOW);
  digitalWrite(LED3,HIGH);

  // If soil was previously dry or medium,
  // and now becomes green then beep
  if (wasNotGreen) {
    beepWhenGreen();
    wasNotGreen = false;
  }

}
else if(sensor<dry){
  digitalWrite(LED1,HIGH);
  digitalWrite(LED2,LOW);
  digitalWrite(LED3,LOW);
```

```
    wasNotGreen = true;
  }
  else{
    digitalWrite(LED1,LOW);
    digitalWrite(LED2,HIGH);
    digitalWrite(LED3,LOW);
    wasNotGreen = true;
  }

int lightValue = analogRead(lightSensorPin);
Serial.print("Light: ");
Serial.println(lightValue);
if (lightValue > lightGood) {
  // Bright enough
  digitalWrite(lightLED, LOW);   // LED OFF in good light

  // If light was low and now recovers, beep
  if (lightWasLow) {
    beepLightRecovered();
    lightWasLow = false;
  }

} else {
  // Too dark
  digitalWrite(lightLED, HIGH);  // LED ON when it's dark
  lightWasLow = true;
```

```
}

  // wait before taking next reading
  delay(delayTime);
}

void beepWhenGreen() {
  // Three short beeps to indicate “stop watering”
  for (int i = 0; i < 3; i++) {
    tone(buzzerPin, 1200); // 1.2kHz tone
    delay(200);
    noTone(buzzerPin);
    delay(150);
  }
}
void beepLightRecovered() {
  tone(buzzerPin, 350, 300);  // deep, low-pitch tone
  delay(350);
  noTone(buzzerPin);
}
```

Design Limitations

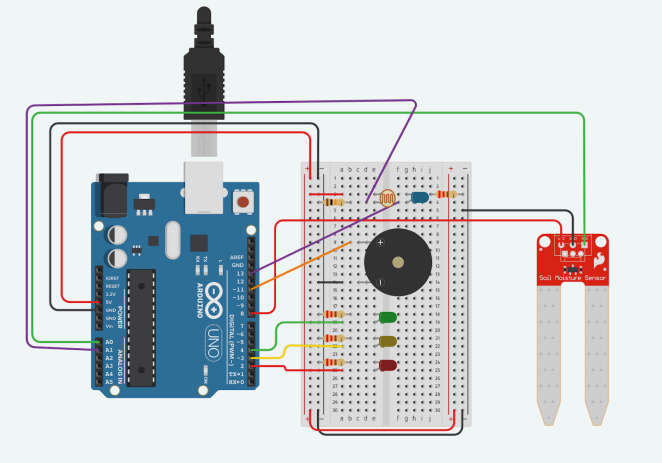
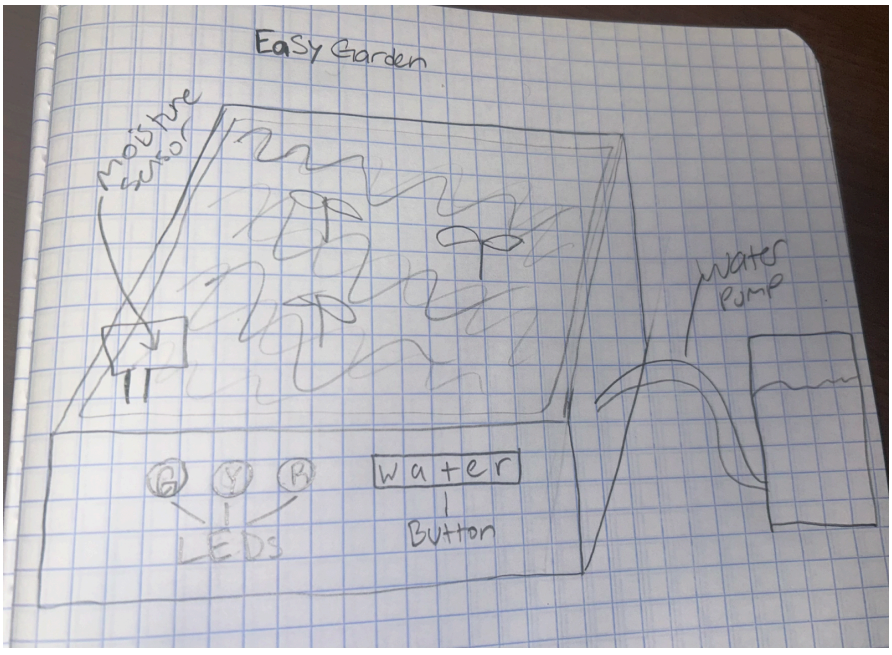
When we started our initial brainstorming progress, we had three great ideas that had benefits and downsides. Ultimately, we decided to go with a design that would assist elders in maintaining independence while gardening. The geometry of the prototype was originally an issue that required lots of edits. We originally wanted to include a water tank that poured from above the plant, but time constrictions and issues regarding sunlight prevented this. Instead, we opted for a mechanical compartment behind the soil that you can pour water in and lift up a tab to let water seep in. If the design was ever made on a larger scale, the tab may be too heavy for elders to lift depending on the materials used and water pressure. Another limitation of the design is that the electronics need to be placed somewhere they will not come in contact with water to prevent the electronics from being damaged. The water compartment heavily restricts where they can be placed, so this is something that should be considered if it were ever to be made on a larger scale. If we had more money and time, a prototype with a dedicated water pump would have been very useful and decrease the overall amount of labor required to utilize the design. In the original design, we planned to include a button that would activate a water pump and push water into the soil until the button was no longer being pressed. Based on our initial testing of the prototype, we would change the water release system. In our final design, the flap that holds the water is vertical, but we wanted to have the water release from the side. Because of concerns about water potentially leaking from the side, we chose not to do this. Overall, the design would be a great tool to aid elders in performing a hobby they love while also maintaining independence.

References

Geriatric diseases: Age-related medical conditions & illnesses. (2021, September 7). Keystone Health. https://keystone.health/geriatric-diseases

Human verification. (n.d.). Human Verification. https://www.nia.nih.gov/health/caregiving/services-older-adults-living-home

Appendix – Include the following information relevant to the project to document your design process:

- Tinkercad Circuits snapshots of the design
  - 
- Tinkercad file link to access the file (using the share tool in upper right corner of Tinkercad Circuits you can copy/paste the link)
  - https://www.tinkercad.com/things/fBGOToFqmDr-copy-of-arduino-soil-moisture-sensor/editel?returnTo=https%3A%2F%2Fwww.tinkercad.com%2Fdashboard&sharecode=cK_a42RgNPC9-ol9hVcl3UJ6hvLJoomlCXgRC8RrSbs
- Pictures of initial idea sketches from your design notebooks or classmarkerboards of your prototype
  - 

- Your Completed and Signed Team Charter https://docs.google.com/document/d/1sZJrotOTiujcVocj0gQipxvespOuqsy_WatUH6vwwWE/edit?usp=sharing
- A team picture with team member names labeled