8th Grade
Roberto Clemente
Middle School

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Germantown, Maryland

THE SMARTPOT

An Automated Home-Grown Solution to Encourage Healthy Diets

OBJECTIVES:

Primary Objectives:

1. Harvest food
2. Eat healthier to minimize obesity & Type 2 diabetes
3. Easy to set up tech and use

Secondary Objectives:

4. Require minimal input (refills only)
5. Not too expensive; price < $30

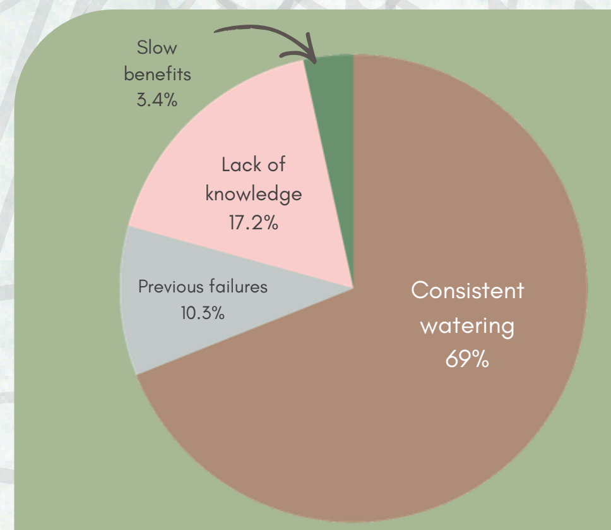
Factors:

1. Growth of fruits and vegetation
2. Fruits and vegetables as snacks
3. App (guide) for new gardeners
4. Refill < 20 seconds
5. Affordable pricing

USER REQUIREMENTS:

1. **Grow Food** – Successfully grow a producing plant
2. **Easy to Use** – Easy for everyone to understand, set up, and utilize
3. **Affordable** – Doesn't cost too much, accessible for all users

USER DATA:



SURVEY RESULTS:
If you don't grow a plant, why don't you grow one?

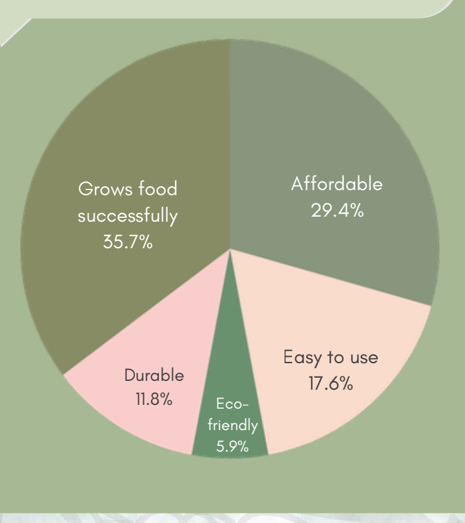
Main Reasons for Not Gardening:

- Consistent watering
- Lack of knowledge

User's Top Requirements:

- Successful care of plants
- Affordable
- Easy to use

SURVEY RESULTS:
If you have a SmartPot, what are some criteria it should meet?



TESTS AND RESULTS:

	Soil Moisture Sensor	Red LED	Green LED	Peristaltic Pump	HC-05 Module	Liquid level Sensor
Trial 1	✓	✗	✗	✓	✗	✓
Trial 2	✗	✗	✓	✗	✓	✗
Trial 3	✓	✗	✓	✓	✗	✗
Trial 4	✓	✓	✗	✓	✓	✓
Trial 5	✓	✓	✓	✓	✓	✓

✓ = meets test objectives ✗ = does not meet test objectives

TESTING PROCESS:

- **Soil Moisture Sensor Test** – readings appear in Serial Monitor & correspond to wetness
- **Red LED Test** – light up when the reservoir is empty
- **Green LED Test** – light up when the reservoir is full
- **Peristaltic Pump Test** – pump water only when the soil is dry
- **HC-05 Module Test** – connects to the app and displays all necessary functions
- **SST Liquid Level Sensor Test** – display whether refill is needed in Serial Monitor

CITATIONS:

- V, Dani. Personal interview with the author. 17 Jan. 2026.
- S, Dorian. Personal interview with the author. 13 May. 2026.
- NIH National Library of Medicine, Matthews, Emily D, and Emma L Kurnat-Thoma. "U.S. food policy to address diet-related chronic disease." Frontiers in public health vol. 12 1339859. 16 May. 2024.

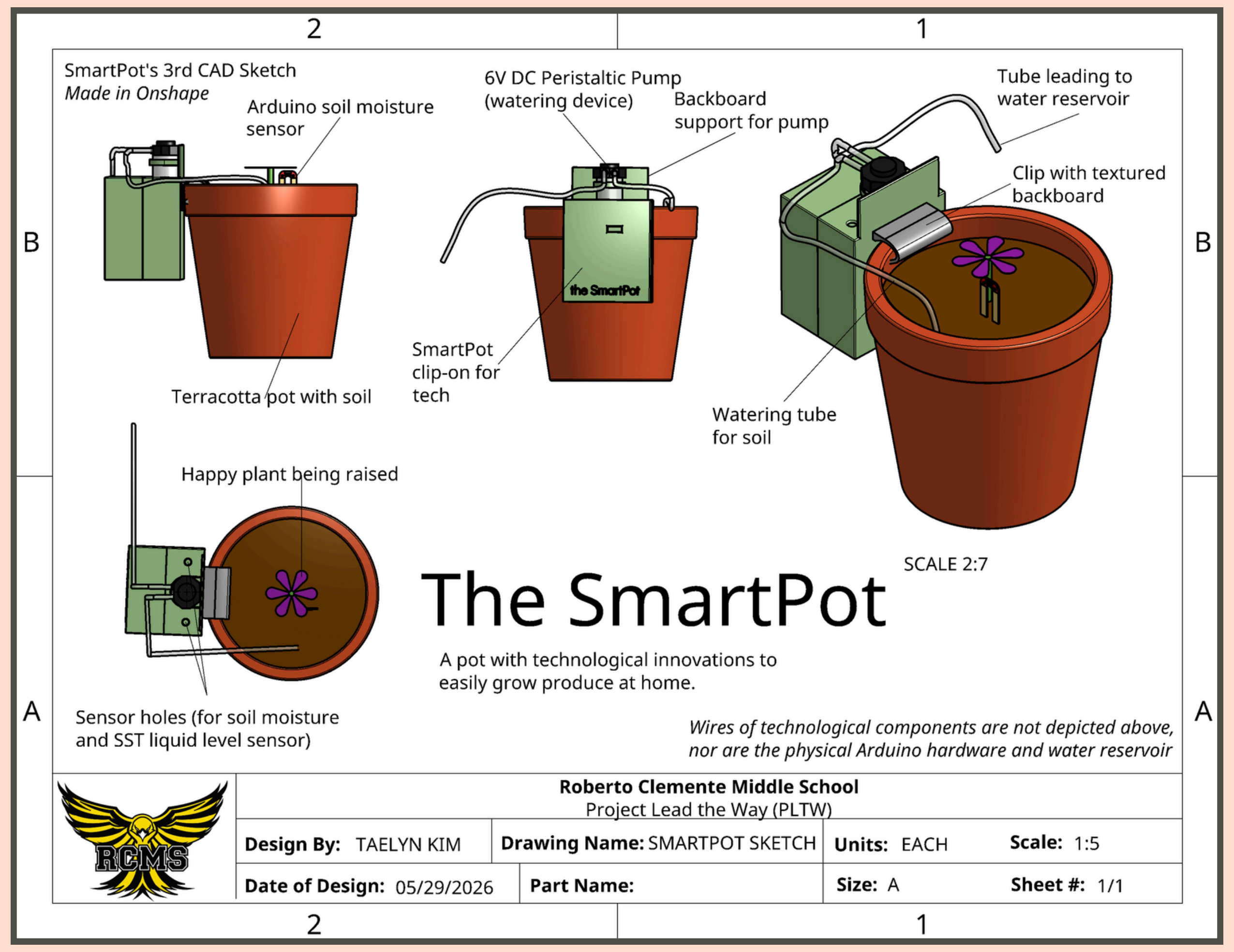
PROBLEM STATEMENT:

User: Families seeking healthy diets (inaccessible fruits & vegetables)

Issue: Unhealthy diets → obesity & Type 2 diabetes are common in the U.S.

The SmartPot: Home-grown food to encourage eating healthy

FINAL PROTOTYPE:



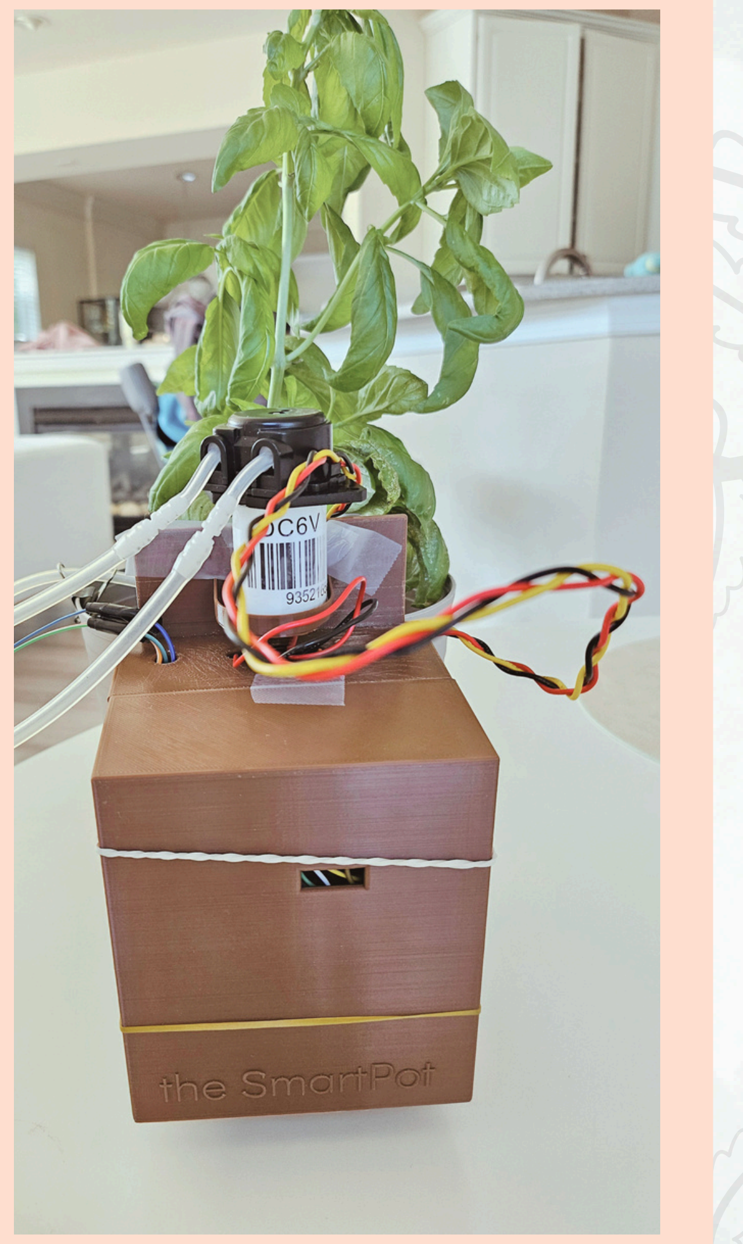
The SmartPot

A pot with technological innovations to easily grow produce at home.

Wires of technological components are not depicted above, nor are the physical Arduino hardware and water reservoir

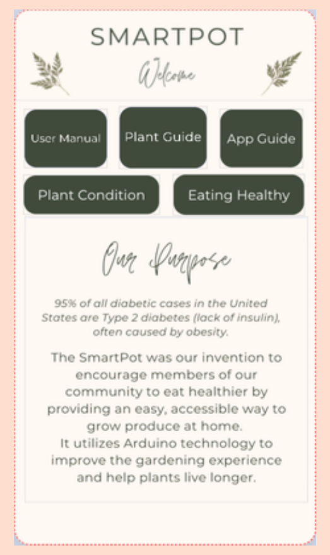
Roberto Clemente Middle School
Project Lead the Way (PLTW)

Design By: TAELYN KIM	**Drawing Name:** SMARTPOT SKETCH	**Units:** EACH	**Scale:** 1:5
Date of Design: 05/29/2026	**Part Name:**	**Size:** A	**Sheet #:** 1/1



Splash Screen

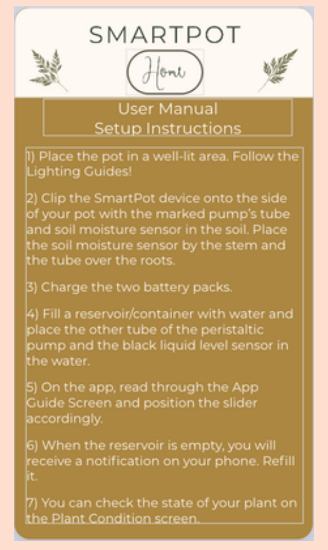
Main Menu



95% of all diabetic cases in the United States are Type 2 diabetes (lack of insulin), often caused by obesity.

The SmartPot was our invention to encourage members of our community to eat healthier by providing an easy, accessible way to grow produce at home. It utilizes Arduino technology to improve the gardening experience and help plants live longer.

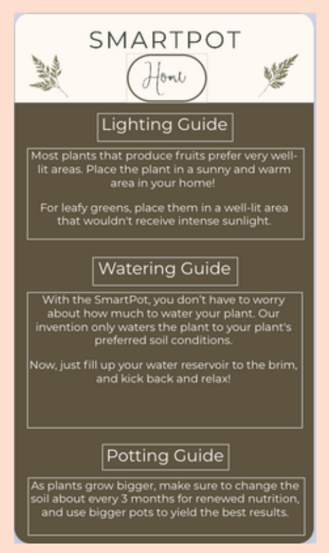
User Manual



User Manual
Setup Instructions

1) Place the pot in a well-lit area. Follow the Lighting Guides!
2) Clip the SmartPot device onto the side of your pot with the marked pump's tube and soil moisture sensor in the soil. Place the soil moisture sensor by the stem and the tube over the roots.
3) Charge the two battery packs.
4) Fill a reservoir/container with water and place the other tube of the peristaltic pump and the black liquid level sensor in the water.
5) On the app, read through the App Guide Screen and position the slider accordingly.
6) When the reservoir is empty, you will receive a notification on your phone. Refill it.
7) You can check the state of your plant on the Plant Condition screen.

Plant Guide



Lighting Guide

Most plants that produce fruits prefer very well-lit areas. Place the plant in a sunny and warm area in your home!

For leafy greens, place them in a well-lit area that wouldn't receive intense sunlight.

Watering Guide

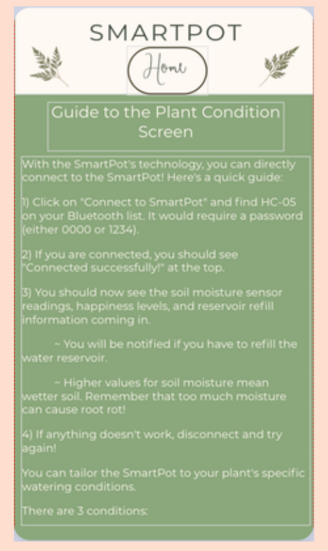
With the SmartPot, you don't have to worry about how much to water your plant. Our invention only waters the plant to your plant's preferred soil conditions.

Now, just fill up your water reservoir to the brim, and kick back and relax!

Potting Guide

As plants grow bigger, make sure to change the soil about every 3 months for renewed nutrition, and use bigger pots to yield the best results.

App Guide



Guide to the Plant Condition Screen

With the SmartPot's technology, you can directly connect to the SmartPot! Here's a quick guide:

1) Click on "Connect to SmartPot" and find HC-05 on your Bluetooth list. It would require a password (either 0000 or 1234).
2) If you are connected, you should see "Connected successfully!" at the top.
3) You should now see the soil moisture sensor readings, happiness levels, and reservoir refill information coming in.
 ~ You will be notified if you have to refill the water reservoir.
 ~ Higher values for soil moisture mean wetter soil. Remember that too much moisture can cause root rot!
4) If anything doesn't work, disconnect and try again!

You can tailor the SmartPot to your plant's specific watering conditions.

There are 3 conditions:

Eating Healthy

Tips on How to Eat Healthy

Here are some tips on how to eat healthy to help prevent diabetes and obesity!

~ Eat fruits and vegetables. They are high in nutrients, low-calorie, and filling.

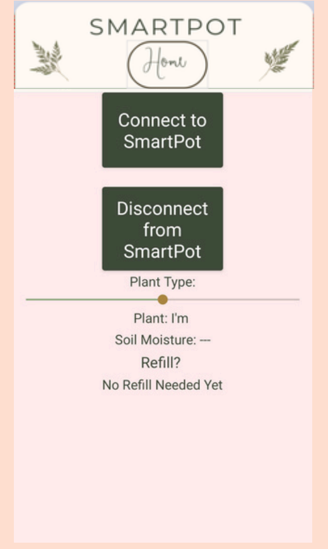
~ Try to avoid junk and fast foods. This includes McDonald's, Taki's, and Sour Patch Kids.

~ When preparing meats, try steaming, braising, and grilling instead of frying them. It uses less or no added oils, hence less fat.

~ Instead of white bread, try eating multi-grain! While it might not taste as good, white bread severely raises your blood sugar and isn't healthy.

Don't let these tips stop you from eating your favorite foods! Everything is okay in moderation, but make it a habit to eat healthy!

Plant Condition



Plant Type:
Plant: I'm
Soil Moisture: —
Refill?
No Refill Needed Yet

Our Painted Prototype

OUR APP SCREENS:

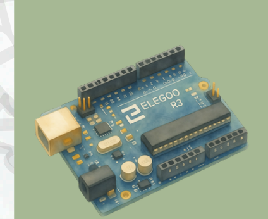
- Instruct users on how to use the SmartPot and how to take care of their plant
- Inform users on how the plant is doing

Real-Time Info
From Your Plant

MATERIALS USED:

- Pot + Soil + Strawberry Plant
  - Test subject

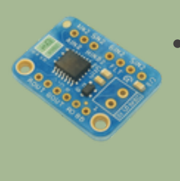
- Rechargeable Battery Pack (8.4V)
  - Powers circuit & pump



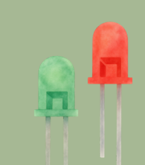
- Elegoo Uno R3 (circuit board)
  - Powers the circuit, runs the code

- Arduino Soil Moisture Sensor
  - Senses electric current in the soil to measure soil wetness

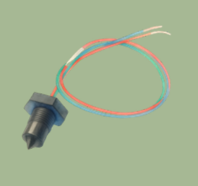
- Arduino 6V DC Peristaltic Pump
  - Pumps water from the reservoir to the plant



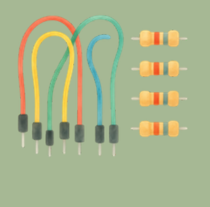
- Adafruit DRV8833 DC Motor Driver
  - Controls the voltage & transfers power



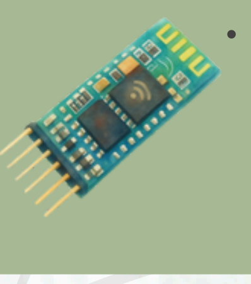
- Arduino LEDs (green & red)
  - Informs the user if the reservoir needs refilling



- SST Liquid Level Sensor
  - Senses how much water is in the reservoir
  - Uses infrared optical tech



- Arduino Essentials (wires, resistors, etc.)
  - Connects the circuit together



- Arduino HC-05 Bluetooth Module
  - Communicates with Arduino & app
  - Use Classic Bluetooth

USER FEEDBACK:

Glows:

- Compact & easy to use
- Grew produce fast
- More inclined to snack on greens & fruits

Grows:

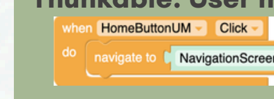
- Wanted more variety
- Expand to multiple pots

OUR CONCLUSION:

- **Met** the requirements of creating a self-watering pot based on the requirements and goals we set
- **Positive** results from testers (peers & neighbors)

CODE:

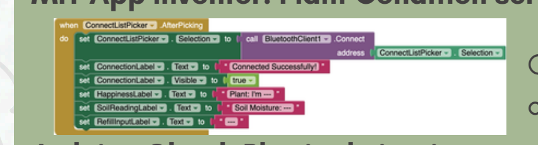
Thunkable: User manuals and guides



```
when HomeButtonUM Click
do navigate to NavigationScreen
```

Navigation to diffent screen

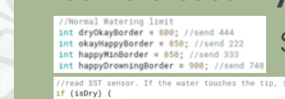
MIT App Inventor: Plant Condition screen



```
when ConnectListPicker .AfterPicking
do set ConnectListPicker . Selection to call BluetoothClient1 .Connect
                                             address ConnectListPicker . Selection
   set ConnectionLabel . Text to "Connected Successfully!"
   set ConnectionLabel . Visible to true
   set HappinessLabel . Text to "Plant: I'm --"
   set SoilReadingLabel . Text to "Soil Moisture: --"
   set RefillInputLabel . Text to "--"
```

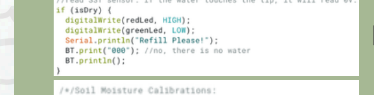
Classic Bluetooth connection to HC-05

Arduino Cloud: Physical circuit



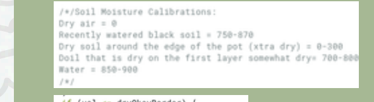
```
//Normal Watering limit
int dryOkayBorder = 800; //send 444
int okayHappyBorder = 850; //send 222
int happyMinBorder = 850; //send 333
int happyDrowningBorder = 900; //send 748
```

Standard soil moisture level benchmarks



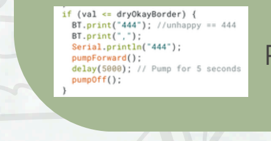
```
//read SST sensor. If the water touches the tip, it will read 0V.
if (isDry) {
  digitalWrite(redLed, HIGH);
  digitalWrite(greenLed, LOW);
  Serial.println("Refill Please!");
  BT.print("000"); //no, there is no water
  BT.println();
}
```

Detecting an empty water reservoir



```
/*/Soil Moisture Calibrations:
Dry air = 0
Recently watered black soil = 750-870
Dry soil around the edge of the pot (xtra dry) = 0-300
Doil that is dry on the first layer somewhat dry= 700-800
Water = 850-900
/*/
```

How we chose our threshold values for watering



```
if (val <= dryOkayBorder) {
  BT.print("444"); //unhappy == 444
  BT.print(",");
  Serial.println("444");
  pumpForward();
  delay(5000); // Pump for 5 seconds
  pumpOff();
}
```

Pump water when soil is dry

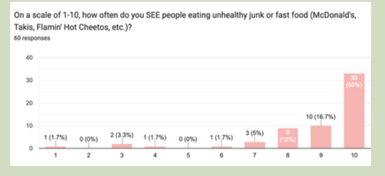
FUTURE:

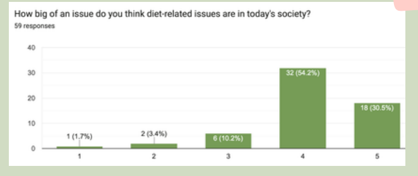
- **Extend battery** life
- Implement **solar power**
- Expand capabilities to include watering for **multiple plants**

DESIGN PROCESS & ITERATIONS:

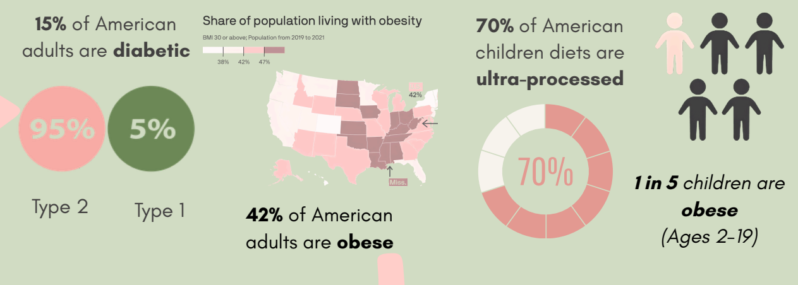
IDENTIFY PROBLEM

- Noticed students **consuming** a lot of **junk food**
- Opened a **survey**
  - Discovered **concern** about **eating habits**





RESEARCH



15% of American adults are **diabetic**

42% of American adults are **obese**

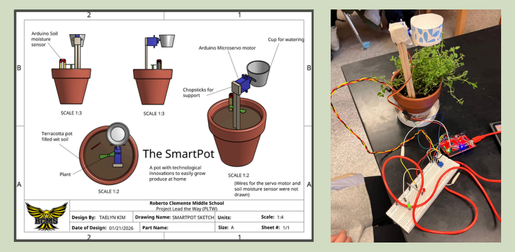
70% of American children diets are **ultra-processed**

1 in 5** children are **obese
(Ages 2-19)

BRAINSTORM SOLUTIONS

- **Fresh produce** from grocery stores is **inaccessible**
- Fast/junk food is available
  - People eat unhealthily → obesity & diabetes
- **Gardening** at home
  - Makes produce **accessible**
  - Cost-effective

BUILD PROTOTYPE



1st Prototype

- **Servo motor + paper cup** = watering device
  - 1 week to build
- App
  - Basic with navigation screen, **user manual**, **planting guide**

TEST & EVALUATE

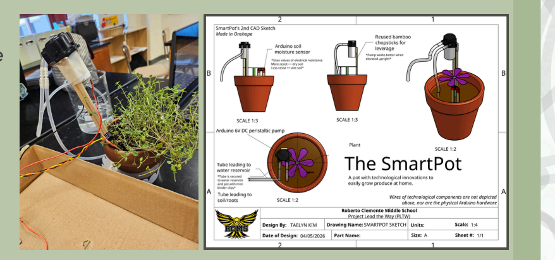
- Water kept **splashing out** of the pot
- Watering cup empties every time the plant is watered
  - **Frequent refills**
    - Required a lot of user input
    - Not efficient

Switched to: PERISTALTIC PUMP!

A displacement pump to move fluids through flexible tubing

BUILD PROTOTYPE

- **Peristaltic pump** = watering device
- HC-05 Bluetooth module for **app connection**
  - 1 month to build
- App
  - Added a **plant condition screen** (connect to SmartPot)

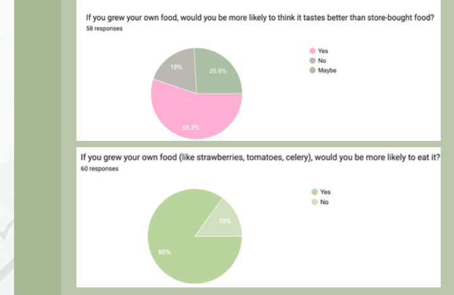


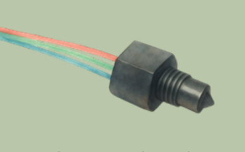
2nd Prototype

TEST & EVALUATE

- Only made for **one** type of plant
  - Keeps soil consistently moist; **doesn't adapt** to dry or wet conditions
- **Inaccurate** when detecting an empty water reservoir
  - Causes app connection errors
- Not **practical** or visually appealing (casing = shoebox)

RESEARCH





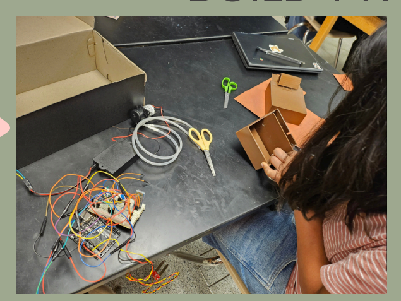
Best type of water level sensor?

SST liquid level sensor

BRAINSTORM SOLUTIONS

- Add SST liquid level sensor and edit the code
- Use a slider component to **customize** SmartPot to different plants
  - Extra wet, normal, extra dry
- Create a **clip-on** to contain tech and clip onto the side of pots
- Implement screens for **eating healthy** and **app guides** (user request)

BUILD PROTOTYPE



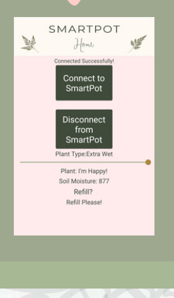
- 3rd prototype
  - 3D printed **clip-on**
  - SST liquid level sensor
  - **Rechargeable** battery
- App
  - Made the SmartPot **adaptable** to different types of plants

TEST & EVALUATE

Made minor fixes in the code and finalized the prototype:

Additional **"Normal"** plant type test subject:

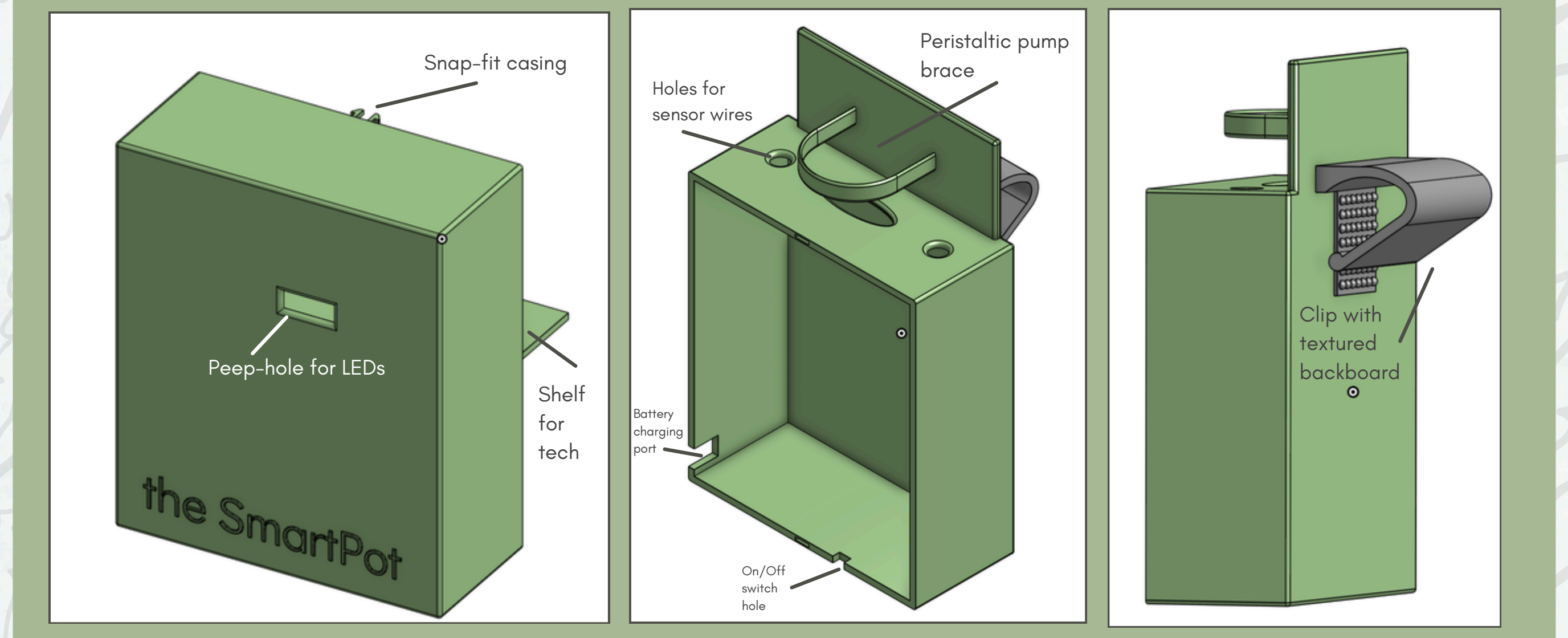
Basil plant



Plant Type:Extra Wet
Plant: I'm Happy!
Soil Moisture: 877
Refill?
Refill Please!

(App screen to customize slider and show readings)

CAD DESIGN OF CLIP-ON:



- CAD sketch of a clip to put the SmartPot tech and attach to the rim of pots (PLA 3D-printed)