December 27. 2024

What is an Arduino?

- A circuit board with a microcontroller on it
- Arduino is just a company, there are many microcontrollers that are Arduino-compatible, meaning that they can be coded the same way as an arduino
    - How is an arduino coded?
        - Through the Arduino IDE, which is an open source software
        - You can code on the Arduino IDE in a modified version of C++ and upload your code to the Arduino in order to have it control output devices

What is an Output/Input Device?

- An output device is a device that is affected by the code, like an LED or an LCD Display
- An input is a device that affects the output, like a Potentiometer or a Button.
- An output or intput device can be controlled by a GPIO (General Purpose Input Output) PIN. There are two types of these pins…
    - Analog Pins
        - Returns and reads in any number between 0 and 1023
        - Analog signals can be anything between 0 and 1023, meaning that they can be more varied than Digital Signals
        - Analog Signals can be sent via PWM (Pulse Width Modification) pins, which have the capability to send different amounts of current depending on the code.
    - Digital Pins
        - Returns and reads in true/false, high/low, yes/no, 0/1, etc
        - Digital signals are discreet and can be two opposite values
        - Digital signals can be sent through the digital pins
    - Example - Digital Pins can turn an LED on or off, but Analog pins can not only turn it on and off, but they can also adjust the brightness of the LED

December 28, 2024

How can I connect inputs and outputs to my Arduino?

- The Digital, Analog, PWM, 5v, 3.3v, and GND pins can be used to attach input and output pins to your Arduino.

December 30,2024

How does a plant begin to grow?

- The seed rapidly consumes water from the soil. This softens the seed coat

- The cotyledons in the seed are consumes by the embryo via enzymes to nourish it
- After some time, the root ruptures the seed coat. The root grows downward in search of more water.
- The seed cells become metabloic, and elongate as they break the soil and shed the seed coat in order to form a sprout. The cotyledon falls off and become part of the soil.

What does a plant need to grow
- A suitable level of moisture
- A suitable temperature
- A suitable level of sunlight
- A good quality of soil

How can I provide this

- I can provide moisture via a water pump and drip irrigation system
- I can control temperature via a heating mat and cooling fan
- I can control sunlight via strip grow lights
- I can provide a good quiality of soil by keeping it maintained and moist and making sure the soil is suitable for the plant

January 8, 2025 - Day 5 of experiment

8:45 p.m.
Observations - Manipulated Variable

- ⅝ have begun germination
- Soil is very wet, skip watering for tommorow
- Current Temperature is 31 degrees C
- Current Humidity is 43%
- Current Soil moisture is 843

Jan 20, 2025 - Research

What is a Greenhouse
- A structure to protect tender or out of season plants
- A modern greenhouse is made of glass and is used to cultivate out of season plants

Types of Greenhouses
- Span-type Greenhouse
    - A shaped roof
- Lean-To Greenhouse
    - Leaning against a wall

Common Components
- Polythene, Glass, Polyvinyl, or Acrylic Glass to insulate - Polythene

- Glazing to allow as much natural light as possible - Grow Lights
- Galvanized Steel or Wood frame - Wood
- Steam or Hot water cirulation for heating - Evaporation
- Roof openings and Electric Fans for cooling - PC fan
- To heat and boost heating - Heating mat and Mylar Film

January 8th and onwards

AHTMAS Experiment results

# Hypothesis

**If** I create an AI greenhouse and compare its skill in growing a basil plant against conventional methods, **then** the AI greenhouse will be able to grow a plant of a better quality **because** it will be able to control the environment inside the greenhouse on a different level than the conventional methods can. The AI greenhouse will be able to emulate the environment that the plant not only is used to, but also the one that it needs at that specific moment

# Variables

Controlled- The amount and type of seeds in each pot, the amount and type of soil in each pot

Dependent - The height and overall quality of the plants

Independent - Whether or not the plant is in the greenhouse and is being monitored by AI

# Materials

For the Plant and Physical structure

- 10 Basil Seeds
- 2 Pots with holes in the bottom
- 1 Bag of Potting Mix
- 6 planks of wood

- Duct Tape
- Nails
- Wood Glue
- Hole Saw

For the AI system

- 1 Arduino Uno R3
- 1 12v PC Fan
- 1 Heating Mat
- 2 Strips of LED Grow Lights
- 1-2 Sheets of Mylar Film
- 3 12v Power Supplies
- 1 9v Power Hub
- 1 USB Power Hub
- 1 USB type A-B cable
- 1 Bucket
- 1 12V Brushless Water Pump
- 3 LED lights
- 1 Passive Buzzer
- 1 DHT 22 Module
- 1 Soil Moisture Sensor
- DuPont Wires
- Jumper Wires
- Breadboards
- Fan Controller
- Surge Protector

# Procedure

1- Cut the wood into 22 peices of 22 inches, and 14 pieces of 15 inches

2- Construct 2 panels using 7 of the 22in pieces for one panel, and construct one more panel using 8 of the 22-inch pieces. The panels of 7 will be the floor and roof, and the panel of 8 will be the back

3- Contruct 2 panels using the 15in pieces, with 7 pieces making a panel. These will be the walls

4 - Cover the fronts of the panels in mylar film, and secure the entire back with duct tape.

5 - Using the hole saw, drill a hole into the left outside part of one of the walls. This will be where the fan will go

6 - Place the heating mat on one of the floor pieces and contstruct the greenhouse around it, using nails and wood glue to secure the pieces

7 - Using double-sided tape, secure the grow lights to the roof of the greenhouse and run the wires through the gap at the back

8 - Set up the drip irrigation system, and connect it to the water pump

9 - Place the water pump into a bucket of water, and do the required connections (see: Connections)

10 - Stick a breadboard to the inside of the back of the greenhouse, and place the DHT 22 in it. Do the required connections (see: Connections)

11 - Set up the Soil Moisture sensor and use DuPont wires to extend the connection (see: Connnections)

12 - Set up the PC fan (see: Connections) and mount it to the hole you made using nails

13 - On the roof, set up the Arduino (see: Connections) and ensure it has the code uploaded

(see: Code)

14 - Under the Arduino, place a breadbaord and cconnect the alarm system on it to the Arduino

(see: Connections)

15 - Connect the 12v Power supplies as well as the plug for the heating mat to the surge

protector.

16- Set up the Soil Moisture sensor and use DuPont wires to extend the connection (see:

Connnections)

17- Set up the PC fan (see: Connections) and mount it to the hole you made using nails

18- In the Jiffy Pot, put in a generous amount of potting mix. Place 5 seeds in the soil, and then

put in about 3mm of potting mix on top of them. Repeat twice.

19 - put the soil mositure sensor into one pot. Put that pot into the greenhouse. Your

manipulated variable is now ready

20- Place the other pot on a windowsill. Your controlled variable is now ready.

# Connections

DHT 22

VCC to 5v

GND to GND

OUT to Pin 12

Soil Moisture Sensor

VCC to 5v

GND to GND

OUT to Pin 8 or A0

Buzzer

GND to GND

+ to Pin 7

Fan

PWM to Pin 3

Positive to Positive Power Supply

Negative to Power Supply Sleeve

Temperature Warning LED

+ to Pin 9

- to GND via 220 ohm resistor

Humidity Warning LED

+ to Pin 10

- to GND via 220 ohm resistor

Soil Moisture Warning LED

+ to Pin 11

- to GND via 220 ohm resistor

Water Pump

Positive to NO on relay

Negative to Power Supply Barrel

Power Supply positive to COM on relay

IN1 on relay to pin 13 on arduino

# Code

```
#include <dht.h>



#define FAN_PWM_PIN 3
#define DHT22_PIN 12
#define BUZZER_PIN 7
#define LED_TEMP_PIN 9
#define LED_HUMIDITY_PIN 10
#define LED_SOIL_PIN 11
#define SOIL_MOISTURE_PIN A0
#define SOIL_POWER_PIN 8
#define NOTE_B0 31
#define NOTE_C1 33
#define NOTE_CS1 35
#define NOTE_D1 37
#define NOTE_DS1 39
#define NOTE_E1 41
#define NOTE_F1 44
#define NOTE_FS1 46
#define NOTE_G1 49
#define NOTE_GS1 52
#define NOTE_A1 55
#define NOTE_AS1 58
#define NOTE_B1 62
#define NOTE_C2 65
#define NOTE_CS2 69
#define NOTE_D2 73
#define NOTE_DS2 78
#define NOTE_E2 82
#define NOTE_F2 87
#define NOTE_FS2 93
#define NOTE_G2 98
#define NOTE_GS2 104
#define NOTE_A2 110
#define NOTE_AS2 117
```

```
#define NOTE_B2 123
#define NOTE_C3 131
#define NOTE_CS3 139
#define NOTE_D3 147
#define NOTE_DS3 156
#define NOTE_E3 165
#define NOTE_F3 175
#define NOTE_FS3 185
#define NOTE_G3 196
#define NOTE_GS3 208
#define NOTE_A3 220
#define NOTE_AS3 233
#define NOTE_B3 247
#define NOTE_C4 262
#define NOTE_CS4 277
#define NOTE_D4 294
#define NOTE_DS4 311
#define NOTE_E4 330
#define NOTE_F4 349
#define NOTE_FS4 370
#define NOTE_G4 392
#define NOTE_GS4 415
#define NOTE_A4 440
#define NOTE_AS4 466
#define NOTE_B4 494
#define NOTE_C5 523
#define NOTE_CS5 554
#define NOTE_D5 587
#define NOTE_DS5 622
#define NOTE_E5 659
#define NOTE_F5 698
#define NOTE_FS5 740
#define NOTE_G5 784
#define NOTE_GS5 831
#define NOTE_A5 880
#define NOTE_AS5 932
#define NOTE_B5 988
#define NOTE_C6 1047
#define NOTE_CS6 1109
#define NOTE_D6 1175
```

```
#define NOTE_DS6 1245
#define NOTE_E6 1319
#define NOTE_F6 1397
#define NOTE_FS6 1480
#define NOTE_G6 1568
#define NOTE_GS6 1661
#define NOTE_A6 1760
#define NOTE_AS6 1865
#define NOTE_B6 1976
#define NOTE_C7 2093
#define NOTE_CS7 2217
#define NOTE_D7 2349
#define NOTE_DS7 2489
#define NOTE_E7 2637
#define NOTE_F7 2794
#define NOTE_FS7 2960
#define NOTE_G7 3136
#define NOTE_GS7 3322
#define NOTE_A7 3520
#define NOTE_AS7 3729
#define NOTE_B7 3951
#define NOTE_C8 4186
#define NOTE_CS8 4435
#define NOTE_D8 4699
#define NOTE_DS8 4978


dht DHT;

unsigned long previousMillis = 0;
const long interval = 60000; // Interval at which to buzz (1 minute)

void setup() {
  pinMode(FAN_PWM_PIN, OUTPUT);
  pinMode(BUZZER_PIN, OUTPUT);
  pinMode(LED_TEMP_PIN, OUTPUT);
  pinMode(LED_HUMIDITY_PIN, OUTPUT);
  pinMode(LED_SOIL_PIN, OUTPUT);
  pinMode(SOIL_POWER_PIN, OUTPUT);
```

```
  Serial.begin(9600);
}

void loop() {
  // Read DHT22 sensor
  int chk = DHT.read22(DHT22_PIN);
  float temperatureC = DHT.temperature;
  float humidity = DHT.humidity;

  // Power the soil moisture sensor and read its value
  digitalWrite(SOIL_POWER_PIN, HIGH);
  delay(1000); // Wait for the sensor to stabilize
  int soilMoistureValue = analogRead(SOIL_MOISTURE_PIN);
  digitalWrite(SOIL_POWER_PIN, LOW);

  // Determine the status of temperature, humidity, and soil moisture
  bool isTempLow = (temperatureC < 10);
  bool isTempHigh = (temperatureC > 32);
  bool isHumidityLow = (humidity < 40);
  bool isHumidityHigh = (humidity > 60);
  bool isSoilDry = (soilMoistureValue > 400);
  bool isSoilWet = (soilMoistureValue < 200);

  // LED indicators
  digitalWrite(LED_TEMP_PIN, (isTempLow || isTempHigh) ? HIGH : LOW);
  digitalWrite(LED_HUMIDITY_PIN, (isHumidityLow || isHumidityHigh) ? HIGH
: LOW);
  digitalWrite(LED_SOIL_PIN, (isSoilDry || isSoilWet) ? HIGH : LOW);

  // Buzzer melodies
  if (isTempLow || isHumidityLow || isSoilWet) {
    playShaveAndHaircut();
  } else if (isTempHigh || isHumidityHigh || isSoilDry) {
    playMelody();
  }

  // Debugging output
  Serial.print("Temperature: ");
  Serial.print(temperatureC);
  Serial.print("C, Humidity: ");
```

```
  Serial.print(humidity);
  Serial.print("%, Soil Moisture: ");
  Serial.println(soilMoistureValue);

  delay(2000); // Loop delay
}

// Function to play "cddefgc"
void playMelody() {
  int melody[] = {NOTE_C4, NOTE_D4, NOTE_D4, NOTE_E4, NOTE_F4, NOTE_G4,
NOTE_C5};
  int noteDurations[] = {4, 4, 4, 4, 4, 4, 4};

  for (int thisNote = 0; thisNote < 7; thisNote++) {
    int noteDuration = 1000 / noteDurations[thisNote];
    tone(BUZZER_PIN, melody[thisNote], noteDuration);
    delay(noteDuration * 1.3);
    noTone(BUZZER_PIN);
  }
}

// Function to play "shave and a haircut"
void playShaveAndHaircut() {
  int melody[] = {NOTE_G4, NOTE_E4, NOTE_F4, NOTE_G4, NOTE_E4, NOTE_C4,
NOTE_D4, NOTE_G4};
  int noteDurations[] = {4, 4, 4, 4, 4, 4, 4, 4};

  for (int thisNote = 0; thisNote < 8; thisNote++) {
    int noteDuration = 1000 / noteDurations[thisNote];
    tone(BUZZER_PIN, melody[thisNote], noteDuration);
    delay(noteDuration * 1.3);
    noTone(BUZZER_PIN);
  }
}
```

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