

## Smart Environments Final Documentation

**Team: City Plant**

### **1.Challenge/Problem**

At first, when we were coming up with ideas, there were various ideas and after discussion, we decided to make a stuff which we can make a garden in the house and we finally determined to make a pot which is able to grow automatically.

During the process of making the pot, we faced a few problems. One of them was providing water to the pot and connection between water pump and pipes as well as the way to water. (direction, how much, etc) Next, we were faced with poor quality cabling which we then had to re-solder in order to get it to work. Moreover, because of the use of various sensors and actuators, the wiring and coding was a significant issue.

### **2.The Solution**

To make plants grow autonomously anywhere in home, we decided to make a smart pot which can water the plants spontaneously by detecting moisture level regularly. If moisture level of soil decreases under some level, it just gives plant water until moisture level of soil is enough.

### **3.Methods and tools (software/hardware used)**

In order to realize our prototype, we used a wide variety of (software and hardware tools). For the physical construction of the prototype, we purchased a watering kit online, water tubing, heat shrinks and fasteners from a hardware store and acquired the 2 plant pots, 3D printing filaments, and other tools from the school. After purchasing the arduino watering kit online, we performed a series of tests with the components such as the humidity, temperature, moisture, light, IR and UV sensors as well as the kit's OLED screen. We loaded software onto the arduino to test these sensors and actuators. Once we were finished testing and planning out where we want to place these components at, we cut 2 holes with a knife on the 1st pot: one at the center of the pot's base for the moisture sensor and one at the side of the pot for us to put the watering tube in and another 2 holes on the 2nd pot for the connecting the water tubing to the pump and the water container. After that, we drilled holes to place the cable fastener to fasten the tubes and components in place. In order to smooth the holes we drilled and cut, we used a chisel.

While we were working on the pump, we used a soldering iron to connect the power terminals to the relay and a screwdriver to secure the wires on the relay. The other components and sensors came with ports and an arduino shield so we could connect them to the arduino. We also borrowed 2 power cords rated at 12V from the SmartXp to power the pot. For

uploading programs onto the arduino, we used the standard USB cable that came with the Proto Kit (the arduino kit for CreaTe). In order to protect the arduino from water damage should the pump leak, we 3d printed a 'housing unit' modeled in Autodesk Fusion 360 for it, which is essentially a platform that keeps the arduino dry when the base floods. We even 3d printed a screen casing for the OLED screen to make it look professional.

For programming the Arduino and Processing side of the project, we used the Arduino and Processing IDE to achieve it. Some of the components such as the OLED screen, the moisture sensor, humidity and temperature sensor and the light sensor require libraries in order to function, so we installed them on the Arduino IDE. A screenshot of the libraries for the Arduino side we installed are shown below:

```
#include <Wire.h>
#include <SeeedOLED.h>
#include "DHT.h"
#include "SI114X.h"
#define DHTPIN A1
#define DHTTYPE DHT11
```

The processing side too, requires a library called "processing.serial" in order to communicate with the Arduino (receive serial data). A screenshot of said library is shown below:

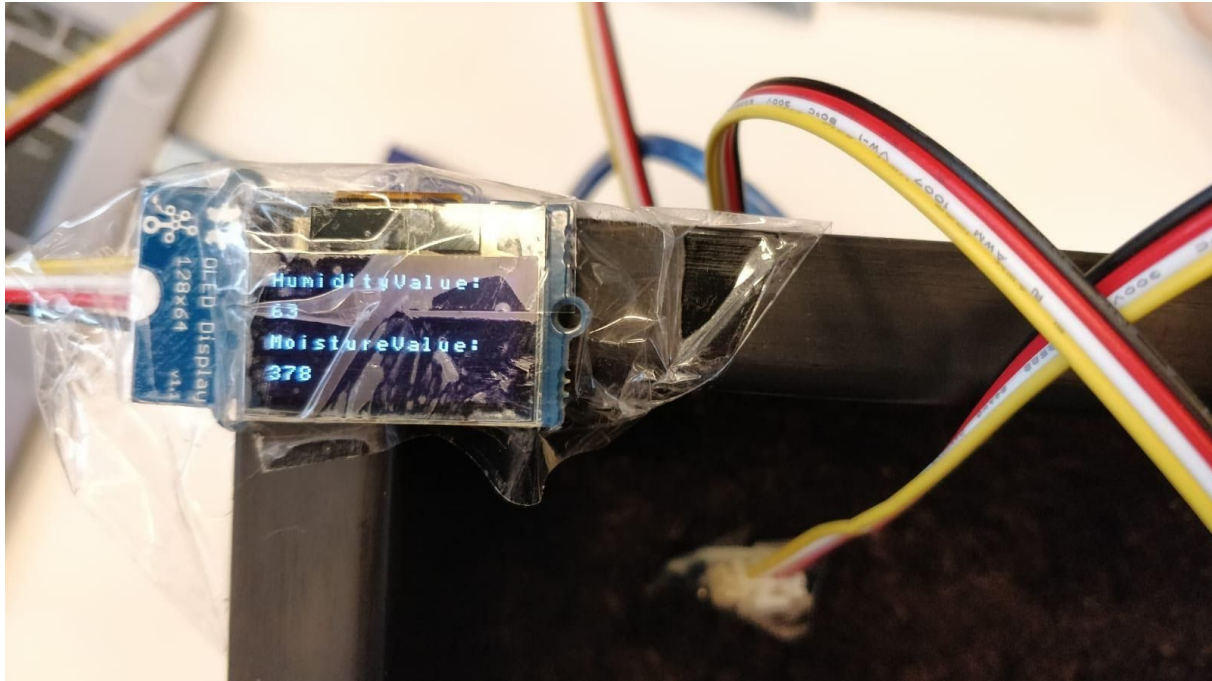
```
import processing.serial.*;
```

#### 4. Results

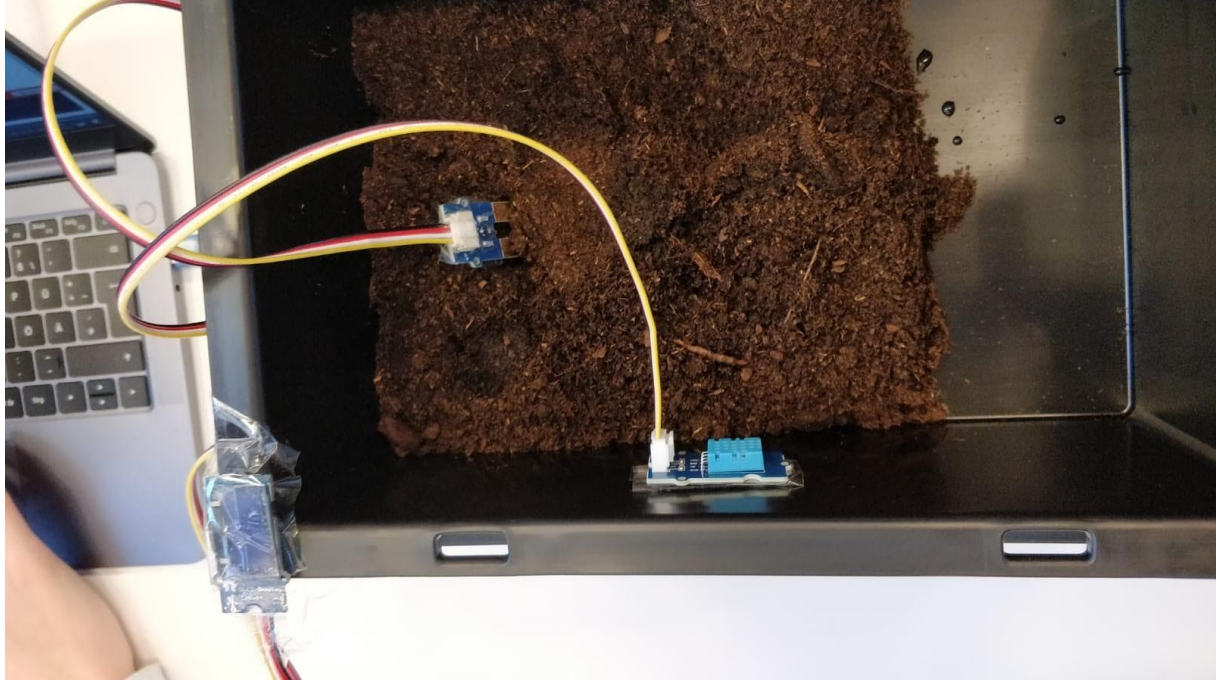
Every sensors and water pump works well as we expected and the codes of arduino and processing also work well. And the important point is that our pot works really well. We plant tomato seed and it really grows as we expect. There is a picture of plant below.

#### 5. Photos

First testing of the OLED screen

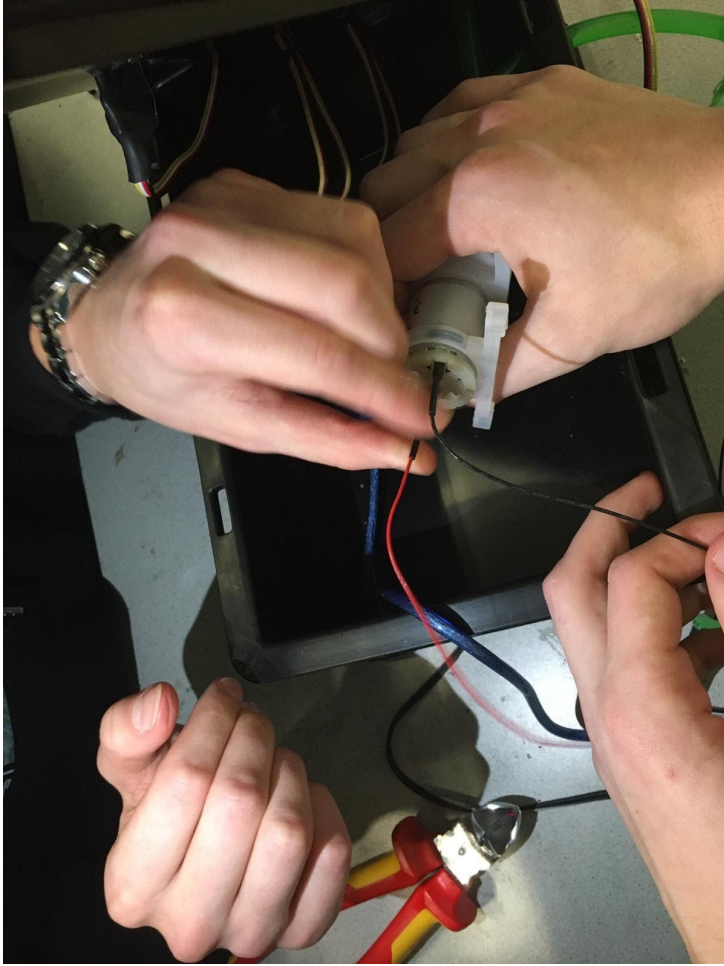


Drilling cable and tubing holes.



First testing of the sensors

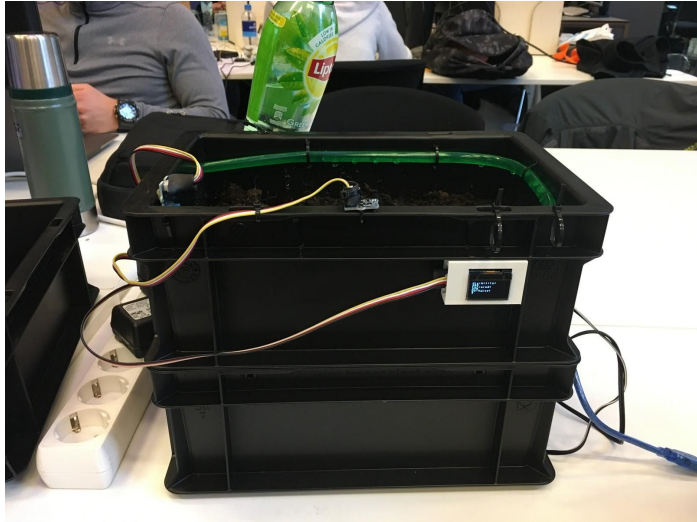




First pump testing/soldering



3D printed Arduino housing



side view



top view

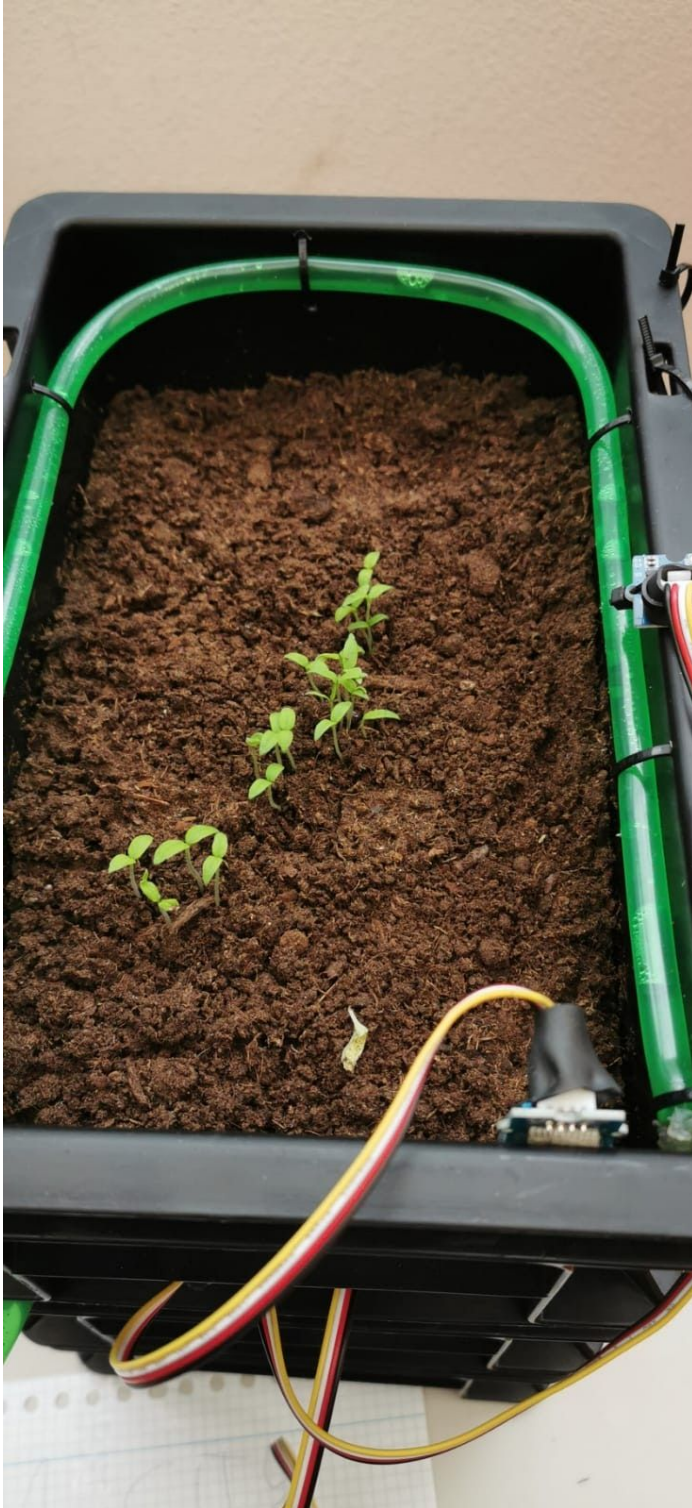


Photo which is growing from a real seed of tomato.

## 6. Codes

```

#include <Wire.h>
#include <SeeedOLED.h>
#include <DHT.h>
#include <SI114X.h>
#include <Arduino.h>

#define DHTPIN A1
#define DHTTYPE DHT11
SI114X SI1145 = SI114X();
DHT dht(DHTPIN, DHTTYPE);
int sensorPin = A0;
int sensorValue, vis, ir, uv;
int t, h;
void setup()
{
  Wire.begin();
  SeeedOled.init(); // initialize SEEED OLED display
  pinMode(4, OUTPUT);
  Serial.begin(9600);
}

void loop()
{
  vis = SI1145.ReadVisible(); //Read out Humidity value from Sensor
  ir = SI1145.ReadIR(); //Read out Temperature value from Sensor
  uv = SI1145.ReadUV(); //Read out Humidity value from Sensor
  sensorValue = analogRead(sensorPin); //read out the moisture value from sensor
  sensorValue = map(sensorValue, 0, 500, 0, 100); //map the moisture value to
percentage
  h = dht.readHumidity(); //Read out Humidity value from Sensor
  t = dht.readTemperature(); //Read out Temperature value from Sensor

  Serial.print("V");
  Serial.println(vis);
  Serial.print("I");
  Serial.println(ir);
  Serial.print("U");
  Serial.println(uv);
  Serial.print("M");
  Serial.println(sensorValue);
  Serial.print("T");
  Serial.println(t);
}

```



```
Serial.print("H");  
Serial.println(h);
```

```
if (Serial.read() == 'W')          //if processing sends a W water the plant  
{  
    digitalWrite(4, HIGH);        //the pump will turn on  
    SeeedOled.setPageMode(); // Set addressing mode to Page Mode  
    SeeedOled.clearDisplay();  
    SeeedOled.setTextXY(2, 0);  
    SeeedOled.putString("Watering in");  
    SeeedOled.setTextXY(3, 0);  
    SeeedOled.putString("progress ...");  
    delay(9000);  
    digitalWrite(4, LOW);  
}  
else  
{  
    digitalWrite(4, LOW);  
}
```

```
const unsigned long fiveMinutes = 5 * 60 * 1000UL; // variable initialization for  
watering loop  
static unsigned long lastSampleTime = 0 - fiveMinutes; // initialize such that a reading is  
due the first time through loop()  
unsigned long now = millis();
```

```
if (now - lastSampleTime >= fiveMinutes) //check the moisture value every 5 minutes  
{  
    lastSampleTime += fiveMinutes;  
    if (sensorValue <= 65) //if the moisture value falls below a certain threshold  
    {  
        digitalWrite(4, HIGH); //the pump will turn on  
        SeeedOled.setPageMode(); // Set addressing mode to Page Mode  
        SeeedOled.clearDisplay();  
        SeeedOled.setTextXY(2, 0);  
        SeeedOled.putString("Watering in");  
        SeeedOled.setTextXY(3, 0);  
        SeeedOled.putString("progress ...");  
        delay(9000);  
        digitalWrite(4, LOW);  
    }  
    else  
    {
```

```
    digitalWrite(4, LOW);
  }
}
oled();
}
```

```
void oled() //controls all the outputs for the oled screen
```

```
{
  SeeedOled.setPageMode(); // Set addressing mode to Page Mode
  SeeedOled.clearDisplay();
  SeeedOled.setTextXY(2, 0);
  SeeedOled.putString("MoistureValue:");
  SeeedOled.setTextXY(4, 0);
  SeeedOled.putNumber(sensorValue); //Read out Moisture value from Sensor and Show
it on the Screen
  SeeedOled.setTextXY(4, 2);
  SeeedOled.putString("%");
  delay(3000);
  SeeedOled.setPageMode(); // Set addressing mode to Page Mode
  SeeedOled.clearDisplay();
  SeeedOled.setTextXY(0, 0);
  SeeedOled.putString("Temperature:");
  SeeedOled.setTextXY(2, 0);
  SeeedOled.putNumber(t);
  SeeedOled.setTextXY(2, 2);
  SeeedOled.putString("°C");
  SeeedOled.setTextXY(4, 0);
  SeeedOled.putString("Humidity:");
  SeeedOled.setTextXY(6, 0);
  SeeedOled.putNumber(h);
  SeeedOled.setTextXY(6, 2);
  SeeedOled.putString("%");
  delay(3000);
  SeeedOled.setPageMode(); // Set addressing mode to Page Mode
  SeeedOled.clearDisplay();
  SeeedOled.setTextXY(0, 0);
  SeeedOled.putString("Visibility:");
  SeeedOled.setTextXY(1, 0);
  SeeedOled.putNumber(vis);
  SeeedOled.setTextXY(1, 2);
  SeeedOled.setTextXY(2, 0);
  SeeedOled.putString("Infrared:");
  SeeedOled.setTextXY(3, 0);
}
```

```
SeeedOled.putNumber(ir);  
SeeedOled.setTextXY(4, 0);  
SeeedOled.putString("UV-Value:");  
SeeedOled.setTextXY(5, 0);  
SeeedOled.putNumber(vis);  
delay(3000);  
}
```