Automated Gardening System

Garden Gnome Kit

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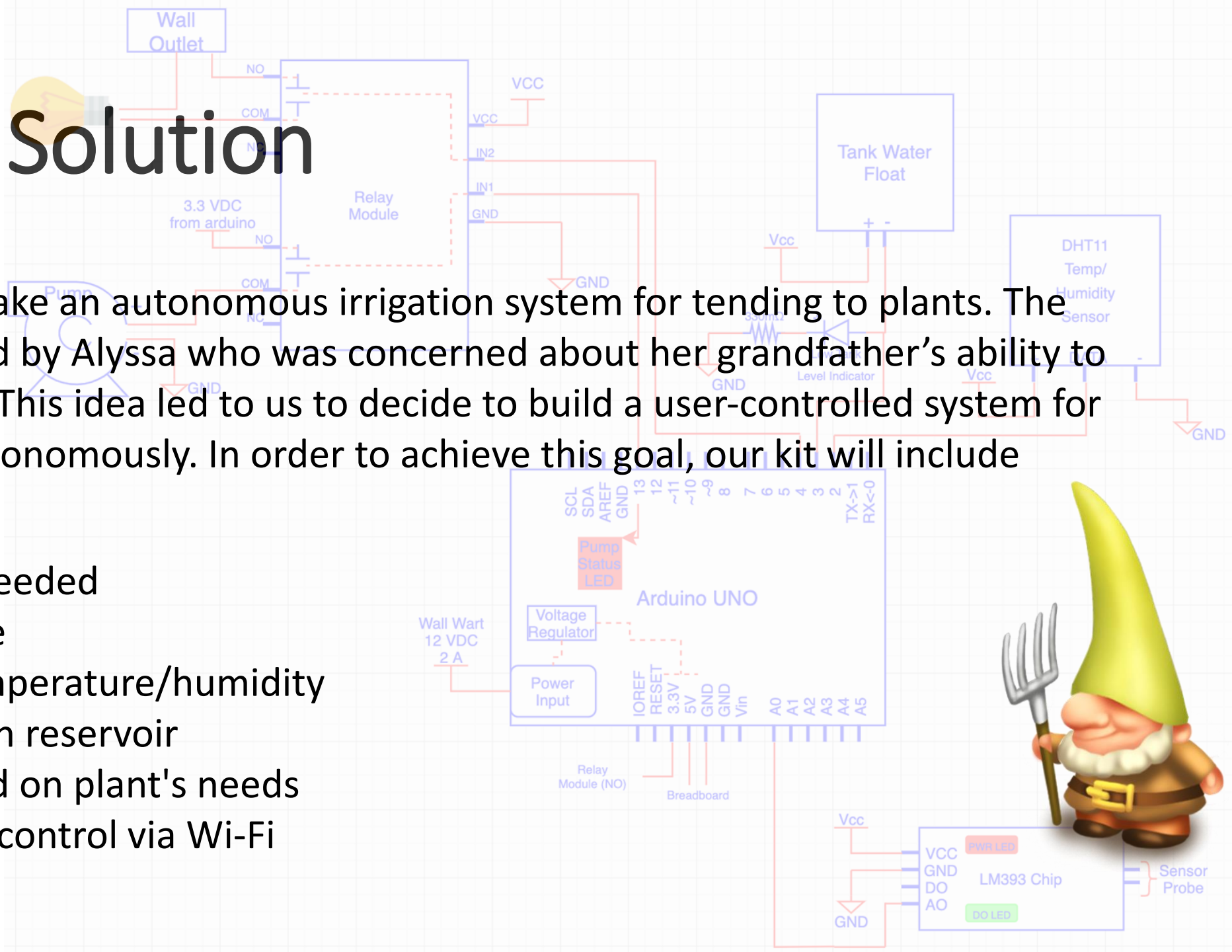
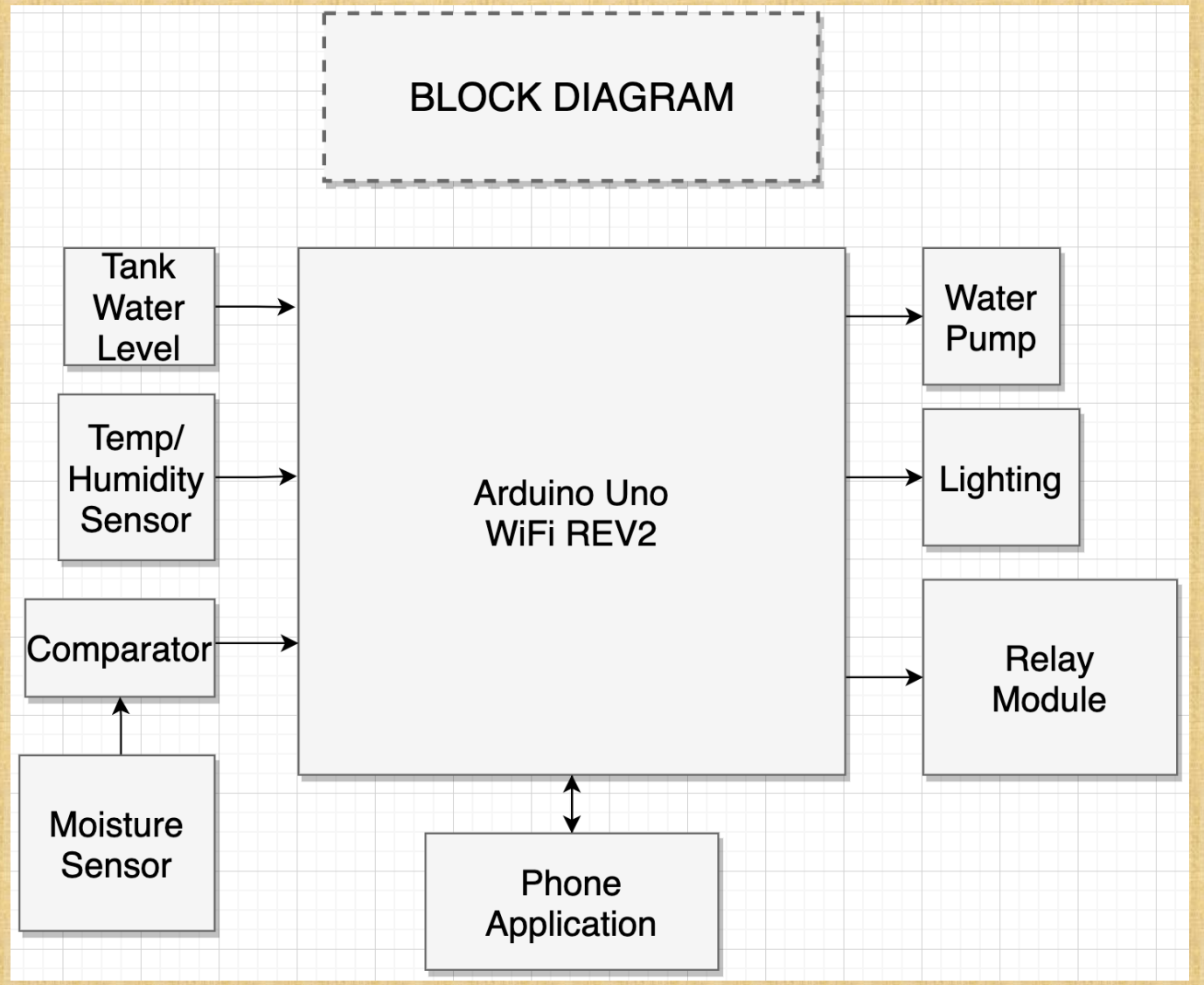
Problem & Solution

Our group wanted to make an autonomous irrigation system for tending to plants. The idea was first introduced by Alyssa who was concerned about her grandfather's ability to take care of his garden. This idea led to us to decide to build a user-controlled system for taking care of plants autonomously. In order to achieve this goal, our kit will include

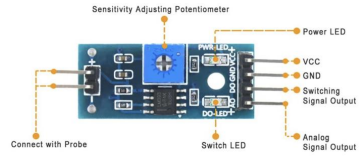
- Water plants when needed
- Monitor soil moisture
- Monitor ambient temperature/humidity
- Monitor water level in reservoir
- Control lighting based on plant's needs
- An app to allow user control via Wi-Fi

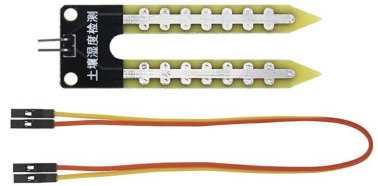


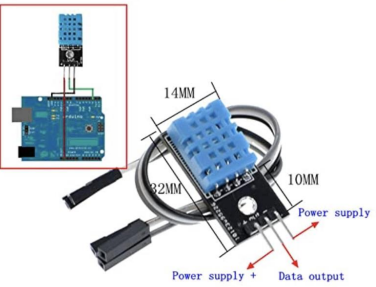
Automated Irrigation System

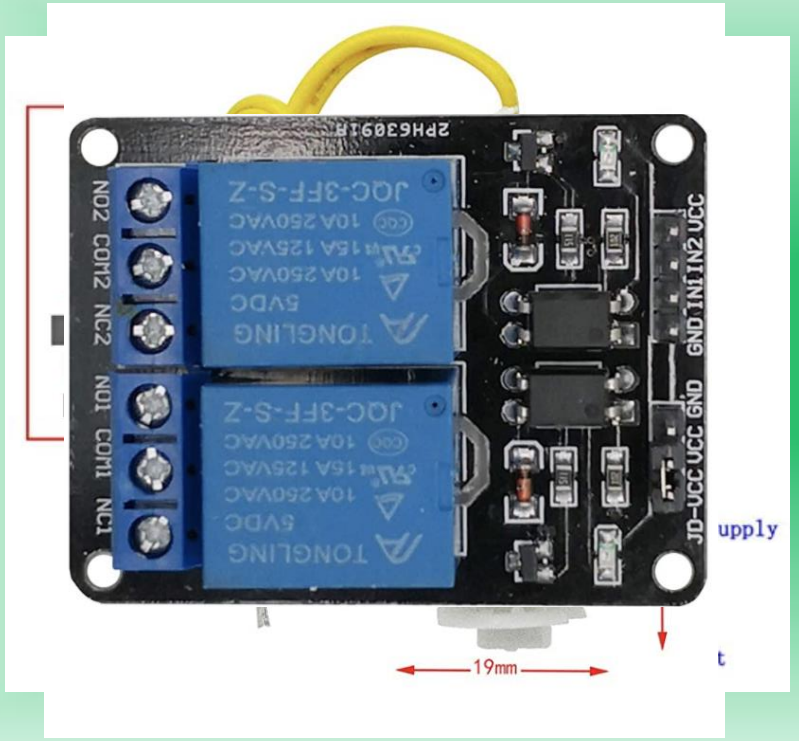


Components





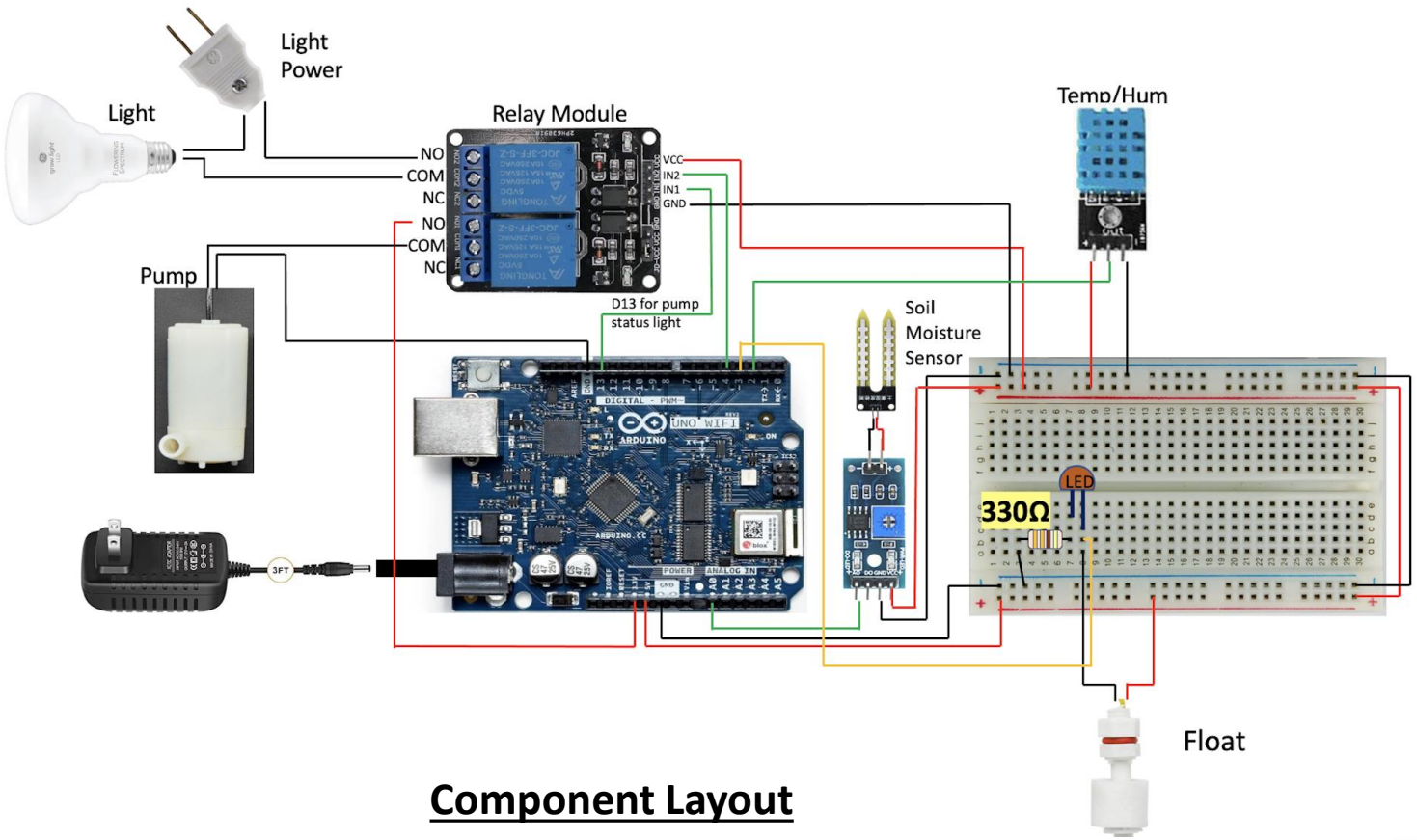




Sensor:

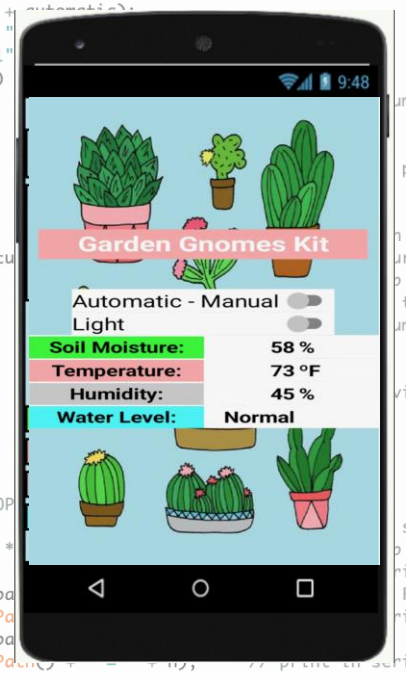
- ~1 $\frac{gal}{min}$/resistance)

Developmental Designs

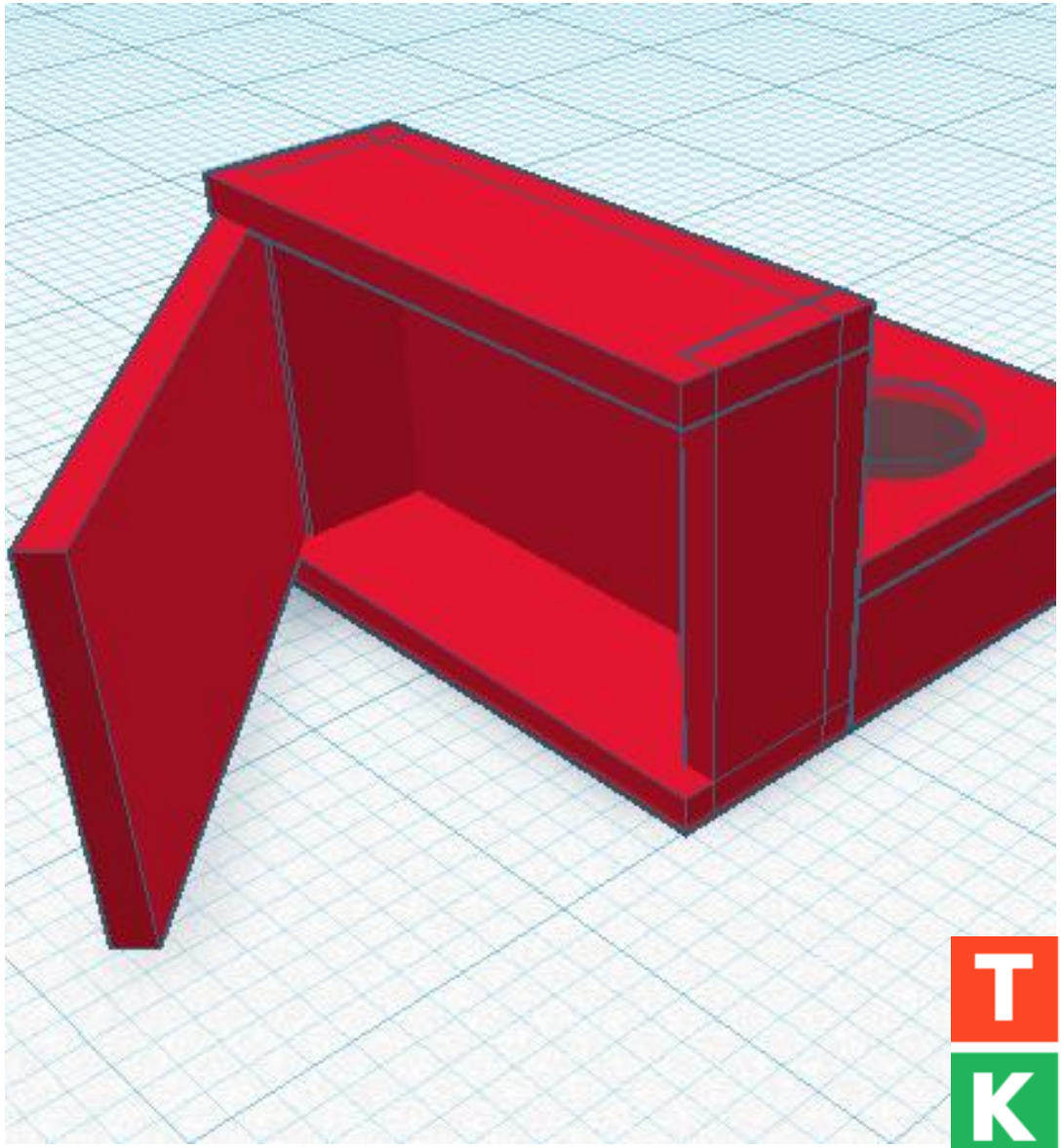


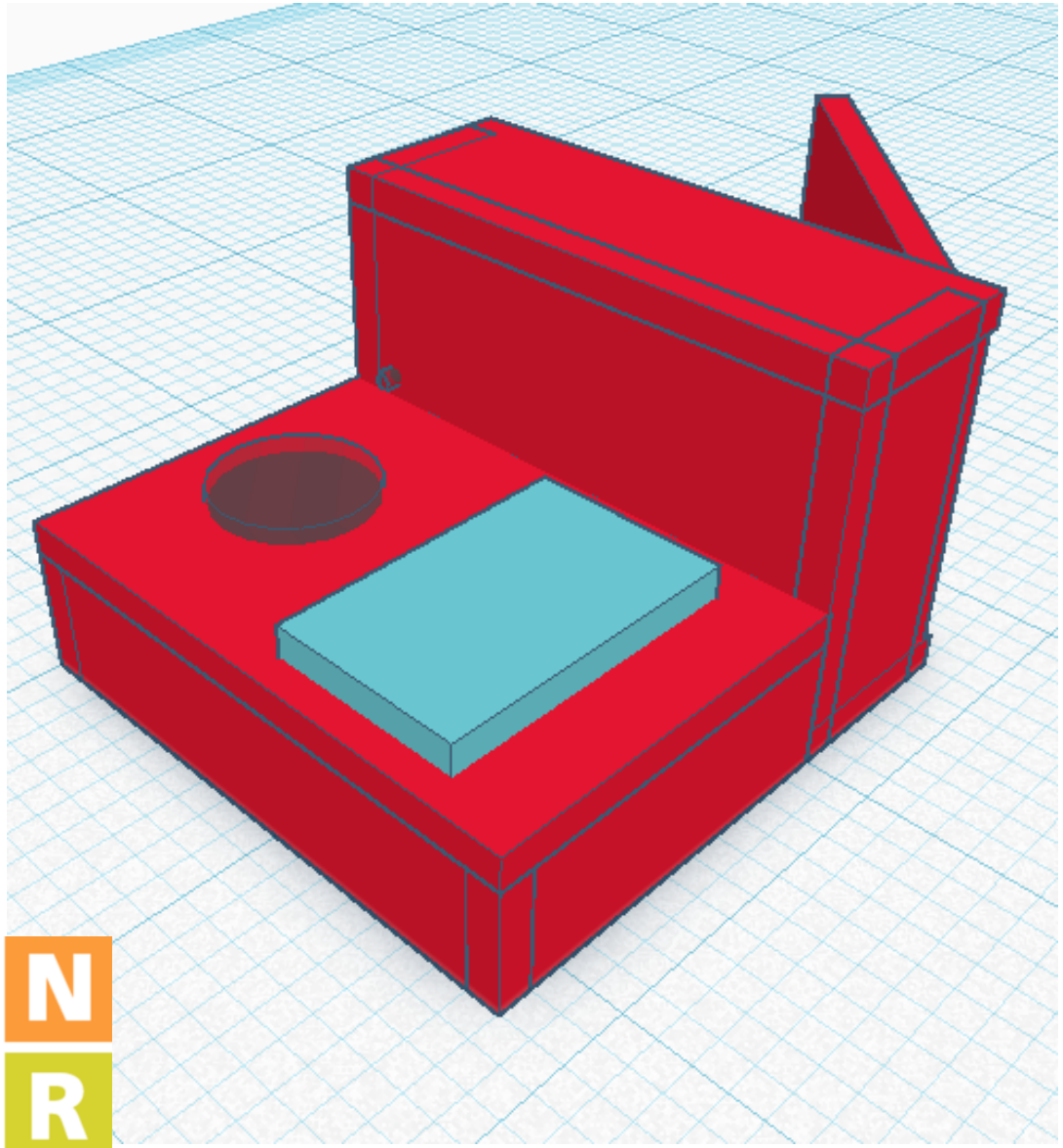
Component Layout

```
void loop() {
  ////////// MOISTURE SENSOR AND PUMP OPERATION
  moisture = analogRead(A0);                                  // assigns variable to read moisture
  int percentMoisture = map(moisture, wet, dry, 100, 0);      // Convert to %
  Firebase.setFloat(firebaseData, path_M, percentMoisture); // set moisture on FB
  Serial.println(firebaseData.dataPath() + " = " + percentMoisture); // print to serial link
  if (Firebase.getString(firebaseData, path_A)) {
    automatic = firebaseData.stringData();                    // check if pumpRun is ON
    if (Firebase.getString(firebaseData, path_MR)) {
      manualRun = firebaseData.stringData();                  // check if in Auto or Man
      Serial.println("auto is in " + automatic);
      Serial.println("manRun is in "
      if (automatic.indexOf("Manual"
        if (manualRun.indexOf("On")
          digitalWrite(13, LOW);
        }
        else {
          digitalWrite(13, HIGH);
        }
      }
      else {
        if (percentMoisture < moistu
          digitalWrite(13, LOW);
          delay(pumpRunTime);
          digitalWrite(13, HIGH);
        }
        else {
          digitalWrite(13, HIGH);
        }
      }
    }
  }
  ////////// TEMP/HUMIDITY SENSOR OP
  int chk = DHT11.read(DHT11_PIN);
  float tempF = (DHT11.temperature *
  float h = DHT11.humidity;
  Firebase.setFloat(firebaseData, pa
  Serial.println(firebaseData.dataPa
  Firebase.setFloat(firebaseData, pa
  Serial.println(firebaseData.dataPa
  ////////// TANK WATER LEVEL SENSOR OPERATION
  lowWater = digitalRead(3);
  if (lowWater == HIGH) {
    Firebase.setString(firebaseDat
    Serial.println("LOW TANK LEVEL.
  }
  else {
    Firebase.setString(firebaseData, path_W, "Normal");    // send data to FB
  }
  ////////// LIGHT OPERATION
  if (Firebase.getString(firebaseData, path_L)) {
    light = firebaseData.stringData();
    Serial.println("light is in " + light);
    if (light.indexOf("On") != -1) {                                  // if On
      digitalWrite(4, HIGH);                                  // turns light on
      Serial.println("Grow light is On.");                    // print in serial link
    }
    else {
      digitalWrite(4, LOW);                                   // send data to FB
    }
  }
  Serial.println("");
  delay(500);
}
```



Garden Gnome App

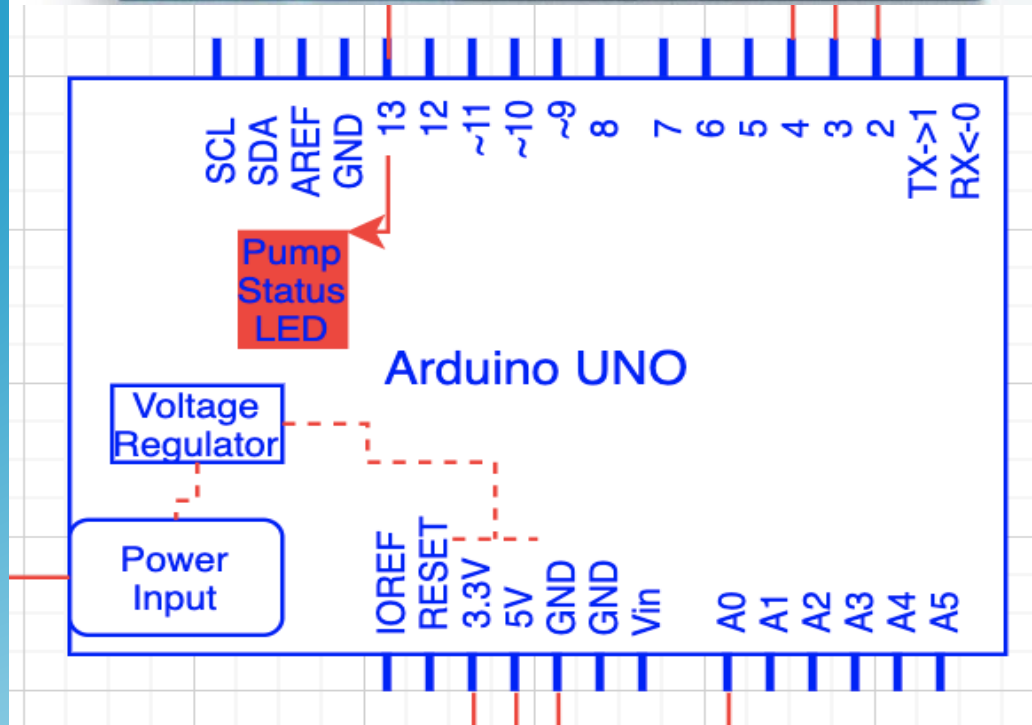




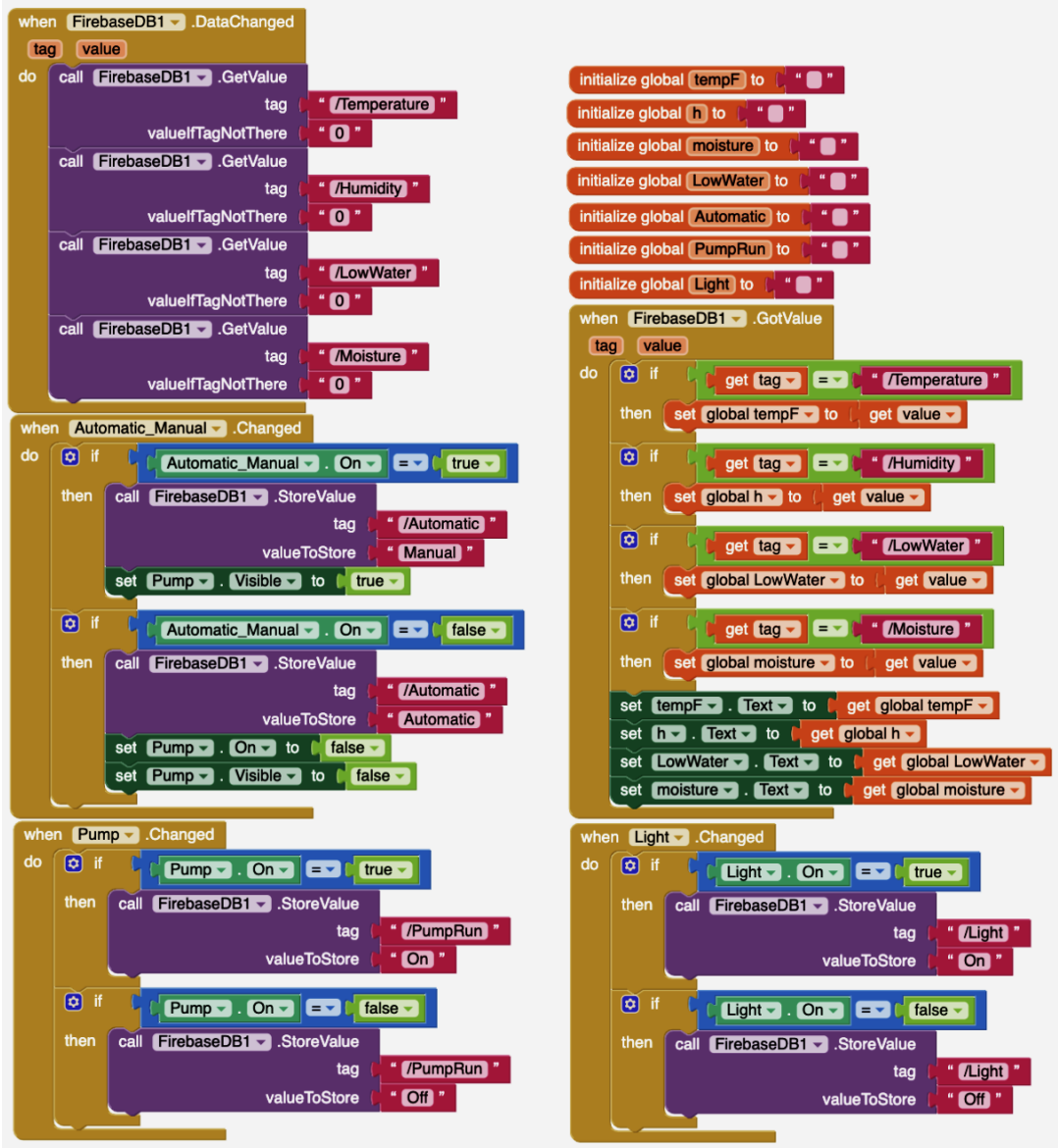
TINKERCAD

Arduino UNO Wi-Fi Rev 2

- Very compatible open-source microcomputer
- Offers 20 separate input/output pins (digital and analog)
- New ATmega4809 microchip to perform high speed analog to digital conversions
- Built-in Wi-Fi and Bluetooth connectivity thanks to the NINA-W10 chip
- Includes the ECC608 crypto chip creating secure wireless communication because of its cryptographic processor



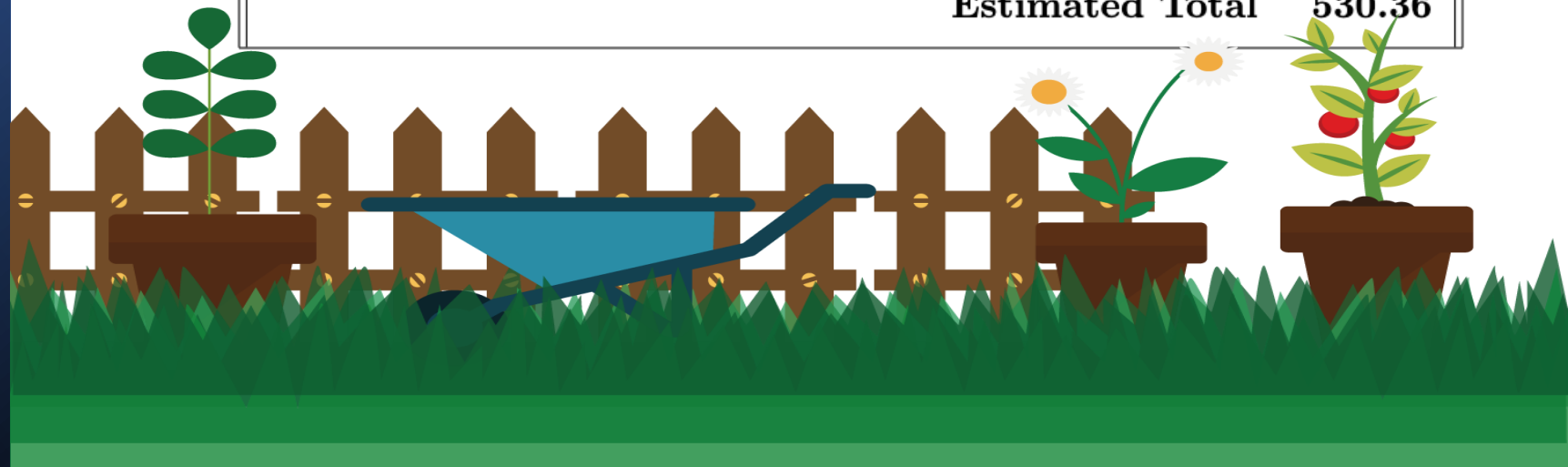
Garden Gnome App



After using the water pump, our water reservoir is low and now the Garden Gnome App is warning us that the water reservoir needs to be refilled. Thanks to the built-in float sensor incorporated into the reservoir lid, the user will be warned if the water level runs low. By simply filling up the reservoir with water, the float sensor will inform the user that the water reservoir is full.

Budget

Quantity	Name	Description	Cost
1	Housing Structure	Wooden Frame	200.00
3	Arduino Board	UNO Wi-Fi Rev2	124.17
3	Power Supply Adapter	9V Power Supply	28.50
1	Extension Cable	6 ft	6.50
3	Water Level Sensor	Gikfun M8	26.04
3	Relay Module	5V, 2-Channel	19.77
5	Water Flow Tubing	PVC 1meter, 6mm	7.50
3	Submersible Water Pump	3V, 80oz/min	8.85
2	Temp./Hum. Sensor(2pk)	DHT11	12.78
1	Soil Moisture Sensor(5pk)	YeeKees	7.99
3	Digi-Key LED(Red)	630nm (Vd=2V)	8.85
3	Digi-Key 330ohm Resistor	+/-5 (0.25W)	0.30
3	Light Socket	Generic	13.98
3	LED Grow Light	GE 9W, 120V, Red	29.13
3	Water Tank	6.3 QT	6.00
misc	Wires/Jumpers	-	30.00
		Estimated Total	**530.36**



Possible Extensions

If the “Garden Gnome” project is granted the CSUB Student Research Scholars Program, we can expand our project by:

- controlling more plants or ideally an entire garden of various types of plants
- including a more sophisticated system that would specify each plants needs without the use of programming
- potential Bluetooth capability for local operation control
- using a cloud-based system for user control anywhere there is an internet connection
- allowing the user to control multiple facilities at one type

Acknowledgments

- Special thanks Professor Mostafa Abdelrehim for guiding our group through our project and providing insightful ideas to this build.
- Special thanks to Cal-State Bakersfield and their incredible staff and faculty for giving us the resources to achieve our goals.
- Special thanks to *Best Cabinets* for building our Garden Gnome Kit housing.