Development of Reclamation and Areas through the Use of

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PURPOSE

- Droughts and regional torrential rains resulted by abnormal temperatures
- Heterogeneous soil moisture –> difficulty of managing agricultural crops
- Necessity of efficient water supply
- Necessity of agricultural environmental data investigation by utilizing local area network and moisture sensors

OBJECTIVES

1. After installing soil moisture and temperature-humidity sensors in the management target area, we plan to collect data from communications with the drone through the use of a local area network, and use these figures to determine the amount of water supply for agricultural use needed.

2. Through continuously accumulating and monitoring collected data, we plan to use the results for the basis for future studies.

PROCEDURES & RESULTS

1 SYSTEM DESIGN UTILIZING ARDUINO

FIG. 1. ARDUINO, BLUETOOTH, SMARTPHONE, CONNECTOR, AND WIRES

- With Arduino as a basis, apply several sensors and modules to configure a system.
- External areas without internet connection –> Provide Wibro by drones

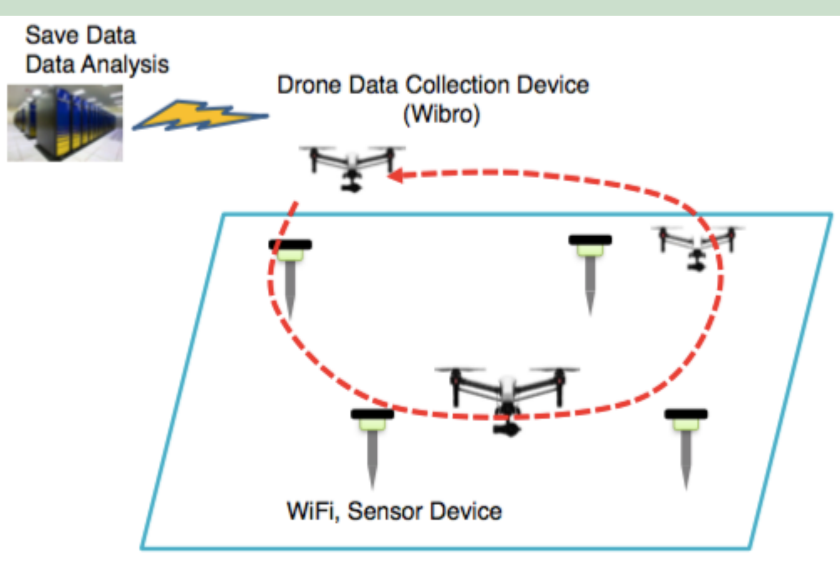

FIG. 2(A). MIMETIC DIAGRAM OF DRONE DATA COLLECTION

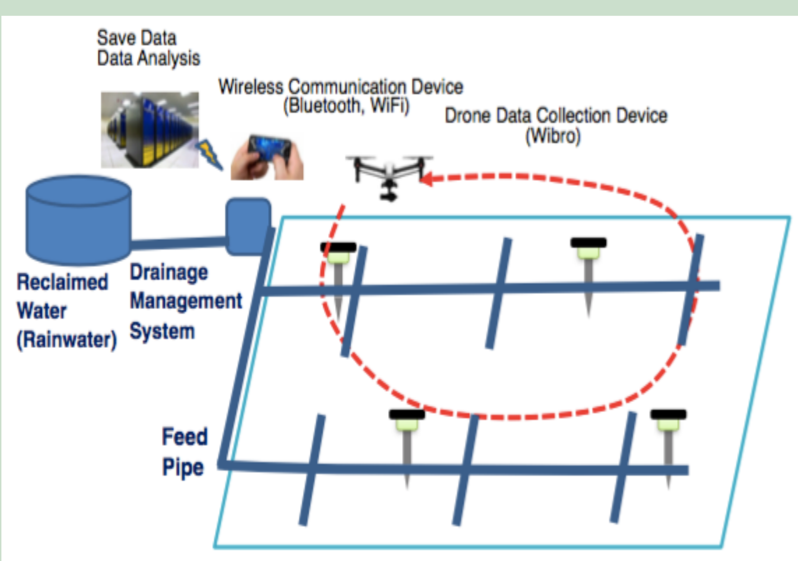

FIG. 2(B). MIMETIC DIAGRAM OF WATER MANAGEMENT USING RECLAIMED WATER

Measure –> WiFi –> Drone's Wibro–> Internet –> Save Data

Internet –> Analyze Data –> Smartphone –> Bluetooth –> Pump Operation

2 MEASURING DEVICE AND CONTROL PROGRAM

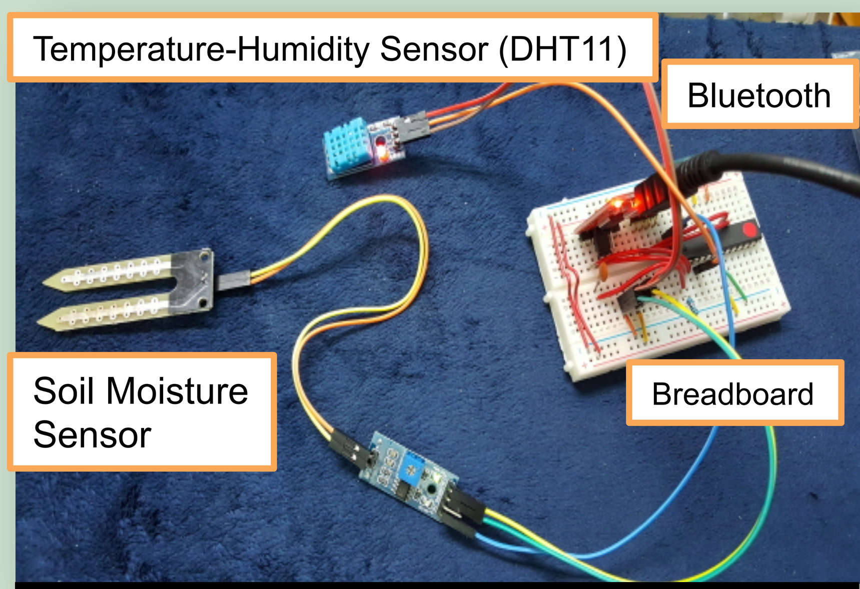

FIG. 3. CONNECTION BETWEEN BREADBOARD, BLUETOOTH, TEMPERATURE, HUMIDITY, AND SOIL MOISTURE SENSORS

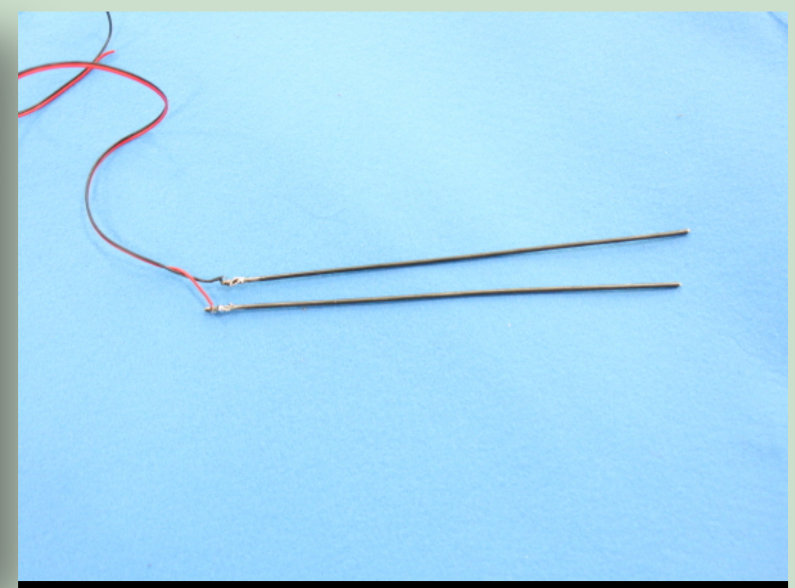

FIG. 4. SENSOR REFORM WITH 20 CM THICK WIRES

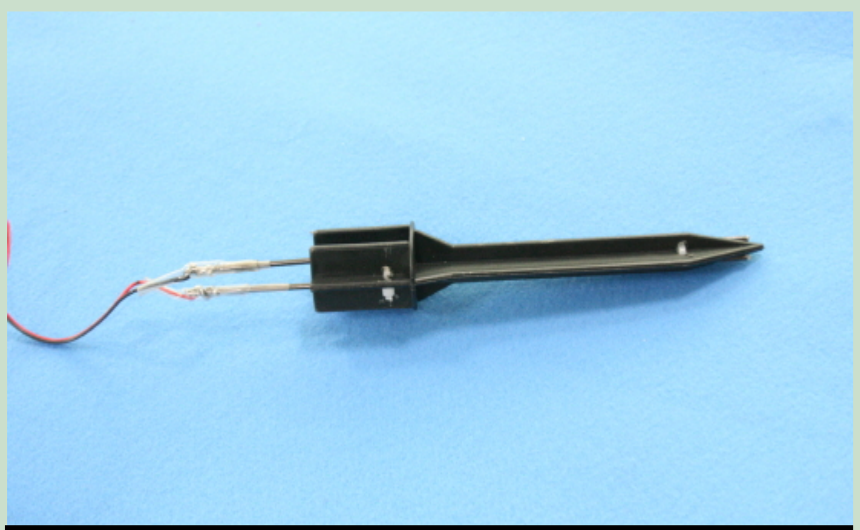

FIG. 5. ATTACHMENT OF SENSOR WIRES TO END OF CAST

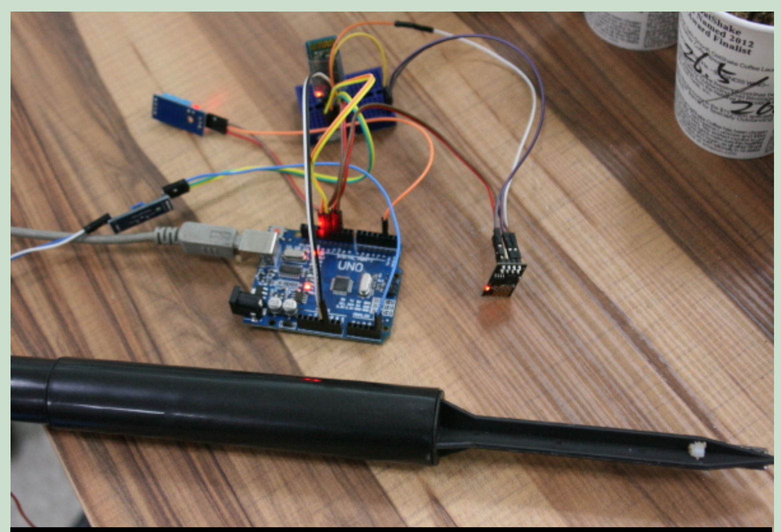

FIG. 6. CONNECTION BETWEEN ARDUINO, SENSORS, AND MODULE

FIG.7. INSERTION OF ARDUINO DATA MEASURING EQUIPMENT IN TRANSPARENT ACRYLIC CAST

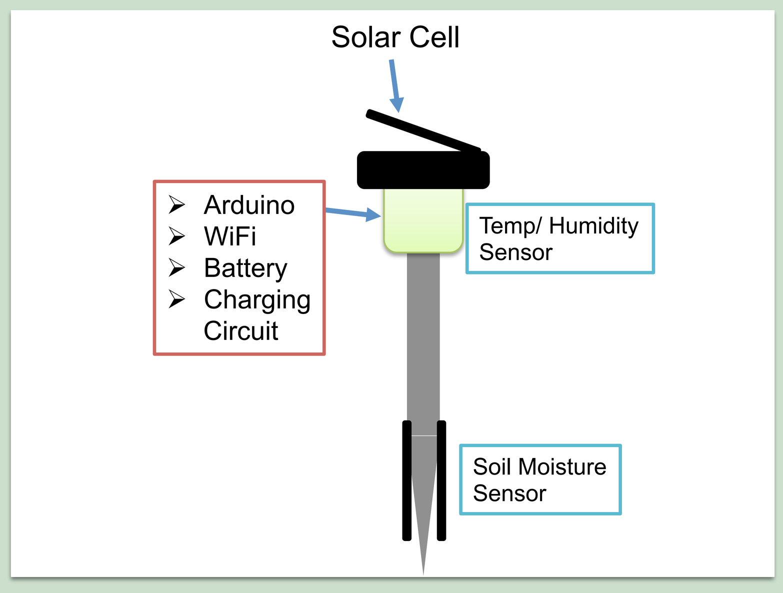

FIG. 8. USE OF SMARTPHONE APPLICATION TO SORT AND ANALYZE DATA BY FIELD

3 SOIL MOISTURE MEASUREMENT

- Mix 200g of sand and 150g agricultural soil in separate drainage basins –> Weigh undischarged water –> Calculate maximum packing quantity –> Moisture content 100%
- Make moisture content of sand & agricultural soil 100%, 75%, 50%, 25%, 0% –> Measure soil moisture with designed soil moisture measuring device

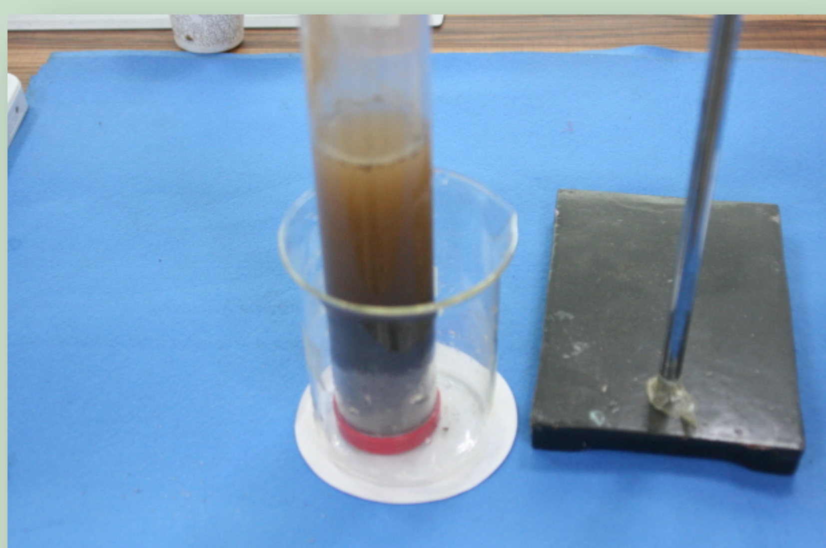

FIG. 9. MIX SAND AND AGRICULTURAL SOIL IN DRAINAGE BASINS

FIG. 10. WEIGH UNDISCHARGED WATER

Reuse System in Agricultural Drones and IoT Communication

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FIG. 11(A). SOIL MOISTURE LEVEL: 100%, 75%, 50%, 25%, 0%

FIG. 11(B). MEASUREMENT GATHERED THROUGH REFORMED SOIL MOISTURE SENSOR

These experiments were conducted to find the relationship between actual soil moisture level and corresponding measurement from the sensor. The experiment was conducted on sand and agricultural soil to confirm the sensor's correspondence in different types of soil. Based on field moisture capacity, representing 100% in soil moisture level, soil mixtures with 100%, 75%, 50%, 25%, and 0% soil moisture content were prepared for each soil mixture type, sand and agricultural soil.

FIG. 12. GRAPHS OF SOIL MOISTURE, TEMPERATURE, HUMIDITY ON SMARTPHONE APPLICATION

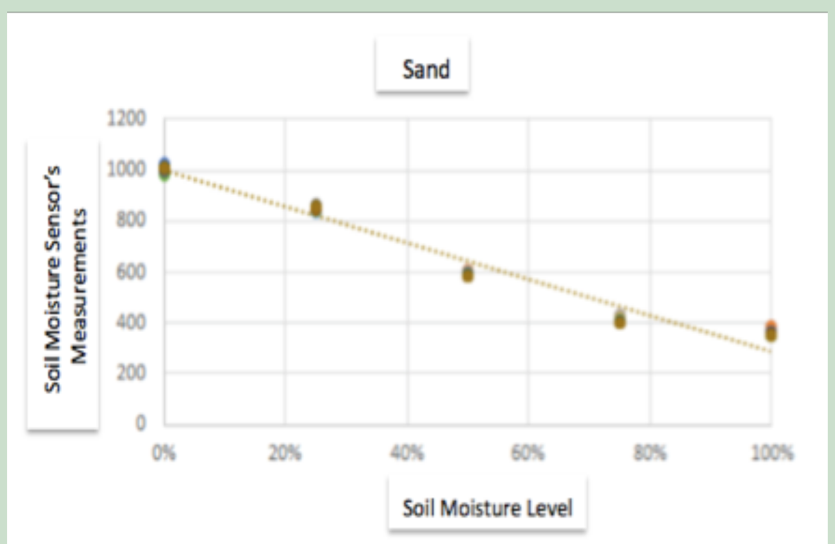

FIG. 13A). GRAPH OF SOIL MOISTURE LEVEL IN SAND VS. AVERAGE OF SOIL MOISTURE SENSOR'S MEASUREMENTS

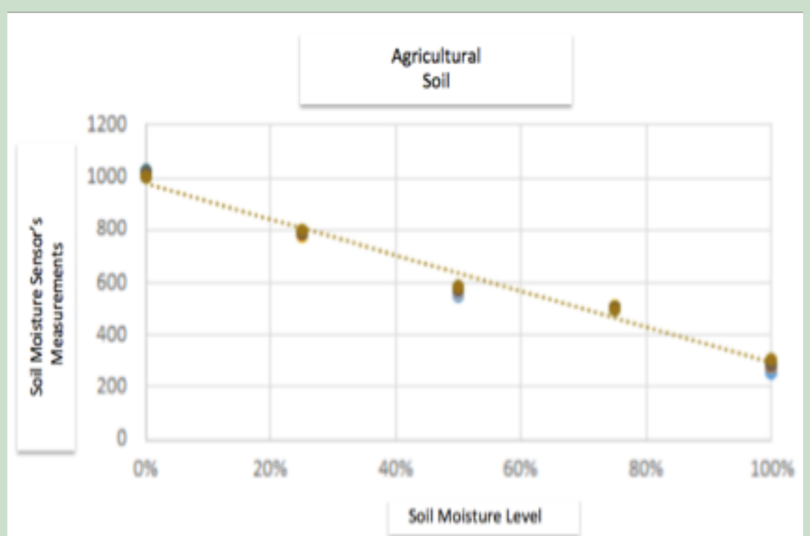

FIG. 13(B). GRAPH OF SOIL MOISTURE LEVEL IN AGRICULTURAL SOIL VS. AVERAGE OF SOIL MOISTURE SENSOR'S MEASUREMENTS

Both experiments with sand and agricultural soil portrayed inverse linear relationship between soil moisture sensor measurement and soil moisture level. The results confirmed that low moisture corresponded to high resistance and high moisture corresponded to low

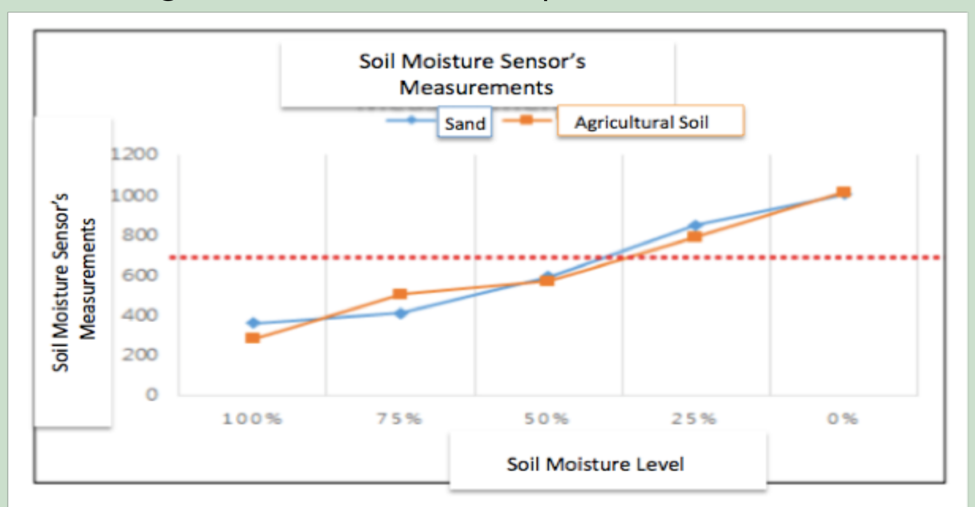

FIG. 14. GRAPH OF SOIL MOISTURE LEVEL IN SAND AND AGRICULTURAL SOIL VS. AVERAGE OF SOIL MOISTURE SENSOR'S MEASUREMENTS

The type of soil was determined to not significantly alter the measurement from the soil moisture sensor. Because agricultural crops grow best in soil moisture level of above 40%, an alarm system in Smartphone application was triggered at any measurement higher than 700.

4 WATER SUPPLY CONTROL

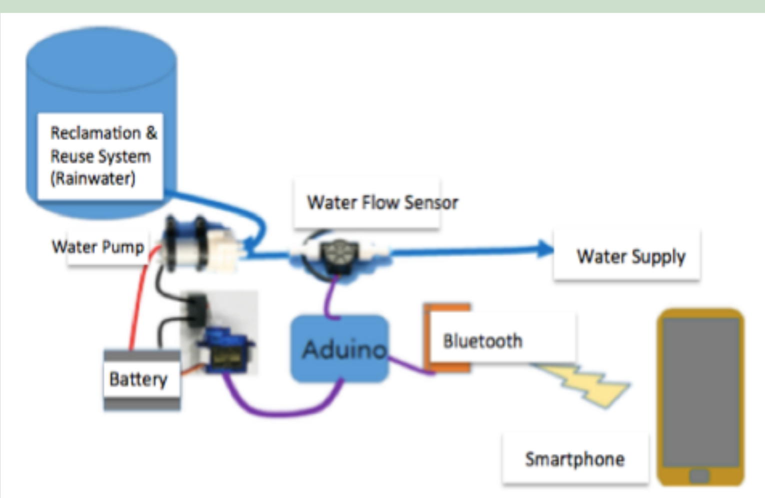

FIG. 15. CONNECTION THROUGHOUT WATER SUPPLY CONTROL

- Connect Arduino, water pump, flow meter, servomotor, and Bluetooth
- Use Micro Switch and Servomotor –> Design a reclaimed water pump operator device
- Water management through smartphone's Bluetooth

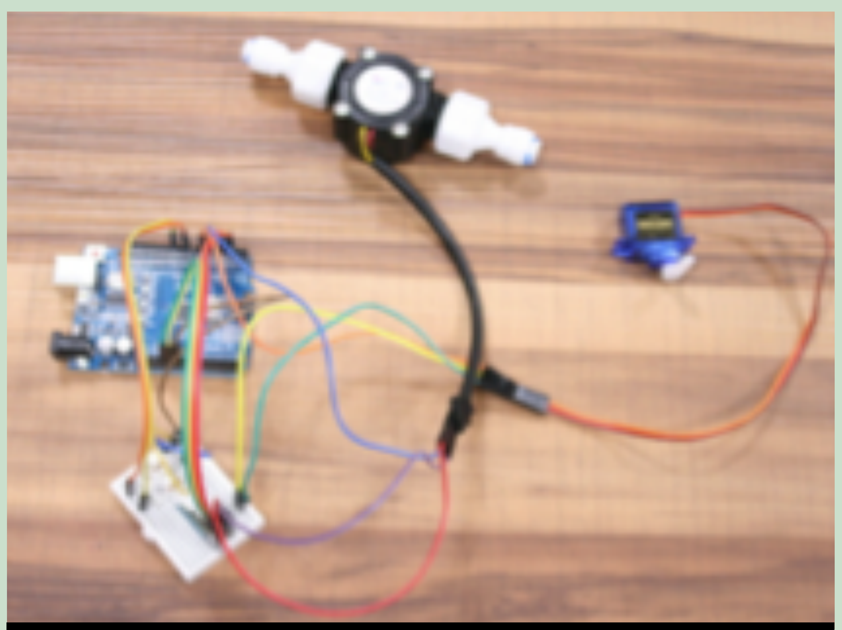

FIG. 16. CONNECTION BETWEEN ARDUINO AND BLUETOOTH, SERVOMOTER FOR WATER PUMP, AND WATER FLOW SENSOR

FIG. 17. SIMULATION OF WATER PUMP CONTROL

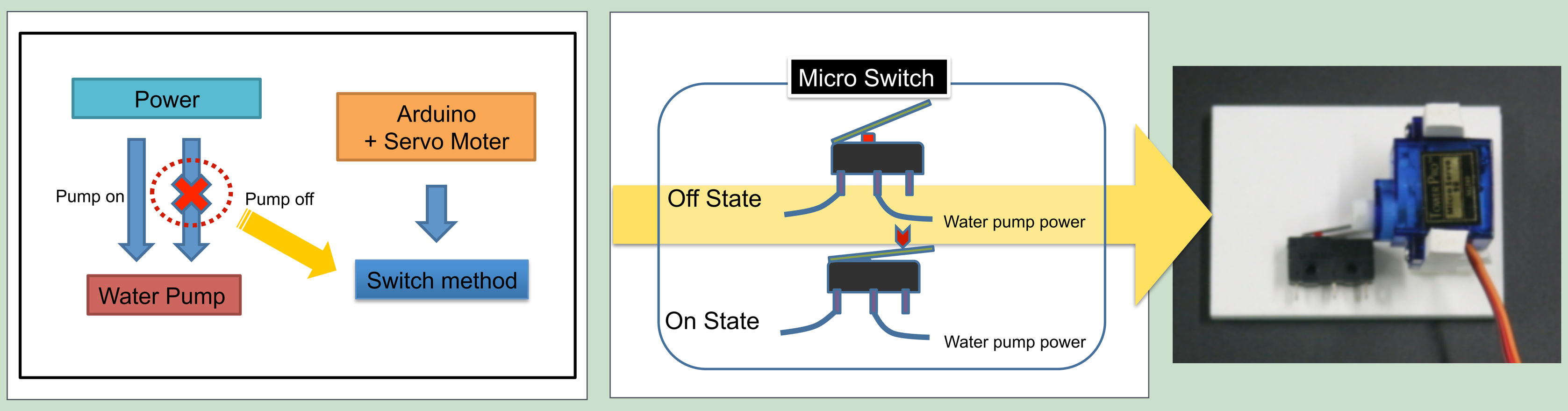

FIG. 18. DIAGRAM OF MICRO SWITCH WATER PUMP'S ON & OFF STATES –> ACTIVATE MICRO SWITCH USING SERVOMOTOR

Name of the Key	Corresponding Pump Activity
Start	Pump Activity Turned on with Continual Water Provision; Green LED Light
Start (10s)	Pump Activity Turned on with Water Provision for 10 seconds; Green LED Light
Start (20s)	Pump Activity Turned on with Water Provision for 20 seconds; Green LED Light
Stop	Pump Activity Turned off with Termination of Water Flow; Yellow LED Light

FIG. 19. SMARTPHONE BLUETOOTH CONTROLLER PROGRAM SETTING

CONCLUSION

1. It was possible to produce measuring devices applied with soil moisture and temperature-humidity sensors and use them independently through solar cells.
2. It was possible to apply Wibro to drone and collect/ save data on the Internet. It is more economical to apply Wibro to a drone because if attached to the measuring device, the data cost and energy consumption is very large.
3. From the measurements of soil moisture according to sand and upland soil's water content, figures decreased as soil moisture increased. We determined that for crops, to maintain a 40% or more water content, we have to set the sensor reading as 700 for the basis and if the number increases, it is good to activate water supply.
4. We can manage soil moisture and conserve water by supplying reclaimed rainwater according to soil moisture measurements. We believe that by using this data, we can also manage water according to climate, temperature, and humidity.

OUTLOOK and USABILITY

Measuring soil moisture will allow us to manage water supply that is essential to crop growth properly, decreasing the amount of unnecessary or wasted water. Also, even in areas without Internet, people will be able to use drones to collect data easily, accumulate and use them frequently, and use the data to operate soil moisture management such as the type of oil and crops, presence and absence of rain, and temperature. Furthermore, using GPS to set measurement gathering points in the application, drones could automatically be flown in a set path to gather data rather than stopping by every sensor in the field. Such method would save even more energy and resources in agricultural water management.We believe that by adding a sensor that can measure the soil, such as its pH, we can widen the areas of application.