# Design of a Smart Phone Application Controlling Agricultural Watering System with a Drone

Kyung Mog Lee

***Abstract*—An android smart phone application of an agricultural watering system was designed using a drone. The drone was equipped with a smart phone. So the smart phone on the drone could gather the dry information from each of four soil humidity sensors buried in 4 different places. Then, returning of the drone to the water spraying device control site, the smart phone could send the information to the control device which analyzed and decided to spray water into a certain area. A smart phone installed on the drone was programed in polling process to check the humidity information.**

**The application could control the water spraying system at remote by a smart phone carried on a drone to setup the peripheral devices such as a water pump and four solenoid valves. And after analyzing the humidity of the four measured soil points, the system sprayed water around the dried area. The spraying system consisted of five parts: four humidity sensing modules, a drone, an android smart phone, a spraying device control module, four peripheral solenoid valves. The smart phone was programed to set up the peripheral devices. The device control module was built on an electric circuit board with an ATMEGA's 89C51 microcontrollers.**

***Index Terms*— android program application, auto watering system, Bluetooth communication, microcontroller, soil humidity sensor**

## I. Introduction

RECENTLY, the done technology was rapidly developed and widely used in variety application area, such as searching for the Ivory-Billed woodpecker[1], classification on Maize[2], etc.

Even though widely open farm area cannot be checked with the Bluetooth communication due to limited Bluetooth communication distance, a drone can fly over to the area to get necessary farm information.

The android operating system of an android smart phone can be used to be programmed. And, the database of the android can be used to store the gathered information.

The global warming causes serious weather problems around the world, such as sudden temperature rise and dry weather. So, monitoring the soil dried condition is important for the farmers to be able to produce good quality and quantity fruits.

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Explosive spread of the smart phone and the rapid development of the Information Technology have caused the smart phone's applications widely developed in variety fields, such as smart farming systems[2][3][4][5], games[6][7], and industry applications. The information technology is also applied in some applications of the farm protecting system from wild animals [8].

And, the Bluetooth communication was used in some researches on the connection of the phone and some environment devices[9][10][11][12].

In this paper an agriculture water spraying system was constructed with a drone carrying a data collector of an android smart phone and applied to the water melon farm.

This research consisted of four soil humidity sensing modules, a drone, a smart phone, a spraying device control module and peripheral devices. On the screen of the smartphone, the solenoid valve operation buttons were provide to be controllable.

## II. Body Of Paper

In this paper, an agricultural water spraying system was developed with a drone. An android smart phone was programmed to be used in an agriculture water spraying system, which could measure the soil dried condition and give order to spray water to the measured area if necessary.

The system consists of four sensing modules, a drone as the carrier of an information collector, a smart phone, a spraying device control module, and peripheral physical devices such as a water pump and four solenoid valves.

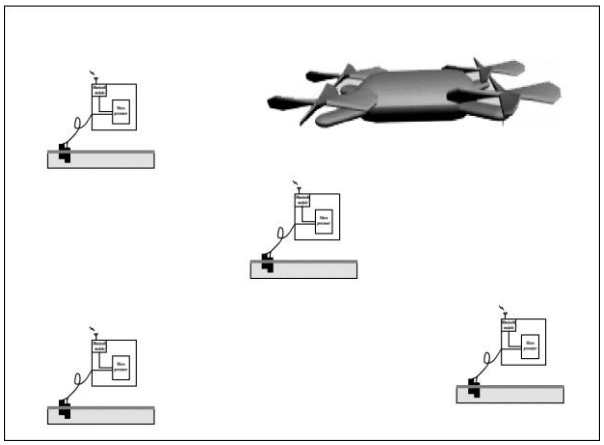

Fig. 1. An agricultural water spraying system using a drone carrying a smart phone as an information collector.

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Each sensor module was built with a microprocessor. The device control module was built with a microcontroller, too.

Fig. 1 shows an agricultural water spraying system using a drone carrying a smart phone as an information collector from sensor modules. Each sensor module was built with a Micro-processor and a Bluetooth communication module. The smart phone hovering over the sensor module collected the soil humidity data of that area.

Fig. 2 shows the system connection of a spraying device control module and a smart phone as an information collector. The device control module consisted of a Bluetooth module and a Micro-controller. This controller was built on an electric circuit board with ATMEGA's 89C51 microcontroller.

The spraying device control module was equipped with a Bluetooth communication module, a Micro-processor, a water pump, four solenoid valves. The communication specification between the Smart phone and the device control module was in 9600 bps Bluetooth communication. Due to the limited distance of the Bluetooth communication, the drone should fly over within at least 10 meter around the sensor modules and the spraying control device.

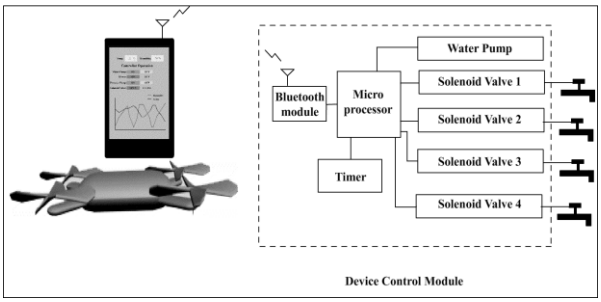


Fig. 2. System connection of a spraying device control module and a smart phone.

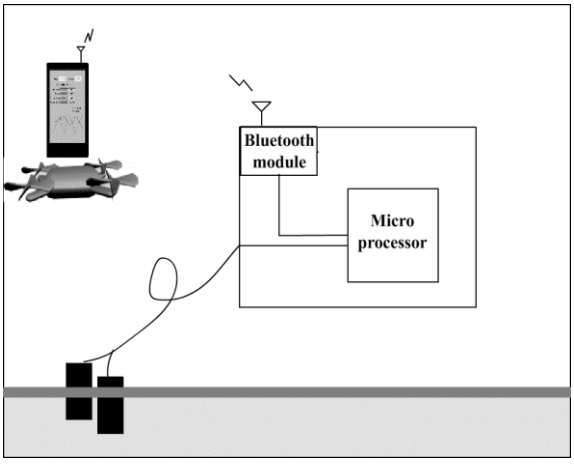


Fig. 3. Soil humidity sensing module with the conductivity sensor plugged into measuring area.

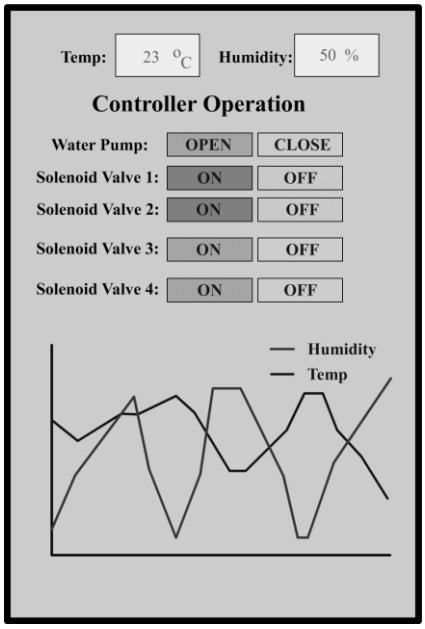


Fig. 4. The screen shot of a data collecting smart phone.

The distance between the phone and the spraying device control circuit board was within 10 m so that the phone and the control board could keep the connected state. The spraying device control module could power up four solenoid valves, and a water pump. The water pump pushed the water sprayed out into the field.

Fig. 3 shows the soil humidity sensing module with the conductivity sensor plugged into measuring area. When the smartphone asked the humidity data, the microprocessor of the module started to measure the conductivity of the soil and compared it with the reference resistance value, and converted it into true or false status signal. Then, the module sent the digital signal to the smart phone equipped on the drone.

Fig. 4 shows the screen shot of a data collecting smart phone. The screen showed all the status of the soil dried conditions. The operating schedule of peripheral devices was programmed into the smart phone.

Fig. 5 shows the configuration of an agricultural water spraying system controlled by a spraying control device. The control module controlled the time for the water spraying and selected the solenoid valve which induced the water into the field. The misty nozzle was used to spray out the water into the field. And the distance between two nozzles was about 1.5 m apart on a same hose. The inducing hoses were separated off about 2.5 meter in distance. The diameter of the inducing hose was 20 mm. The solenoid valve, the model of HPW2150, was used, which is made by Hyoshin Mechatronics company. The diameter and the operating voltage of the valve were 20 mm and 220 Volt each.

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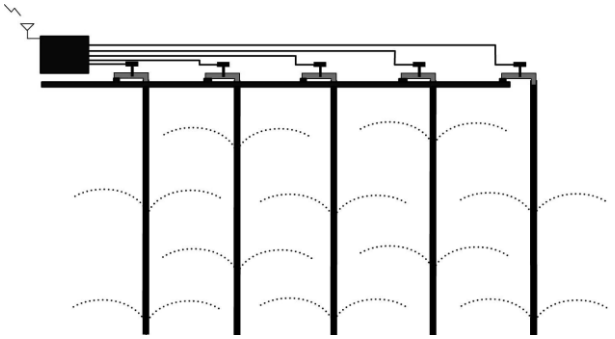

Fig. 5. The configuration of an agricultural water spraying system controlled by a water spraying control device.

Fig. 6 shows the diagram of the program blocks of the constructed system. The data collecting smart phone was a Samsung's Galaxy of which model Number was SHV-E210K. The android build number was KitKat, and Firmware version 4.4.4. The smart phone was programmed to send the measured area status to the spraying device control board. The spraying device control board started to operate the pressure pump and opened the necessary solenoid valve.

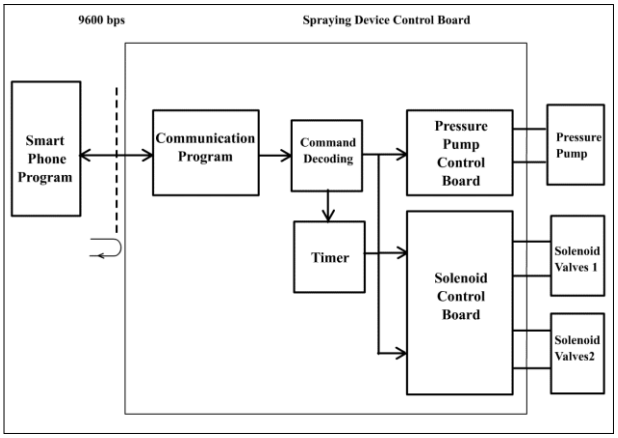


Fig. 6. Diagram of the program blocks of the constructed system.

## III. Conclusion

In this paper, an agricultural water spraying system was constructed to be controlled remotely by a drone carrying an android smart phone. The system consisted of four soil humidity sensing modules, a drone, an android smart phone, a spraying control module, and peripheral devices. The smart phone was programmed in Android to be connected each sensing module and gathered the humidity of measuring area, and sent the proper signal to the spraying device control module in Bluetooth communication of 9600 bps data rate. The device control module was built on an electrical circuit board with ATMEGA 89C51 microprocessor. The smart phone was programed to show on the screen all the setting statuses of the peripheral devices. As a remote control smart phone, Samsung Galaxy SHV-E210K model was used. And an android program was developed on the KitKat version for the phone to be able to be used as a remote data collector and a remote controlling device. It was much more convenient gathering soil conditions and controlling the peripheral devices by a drone carrying the remote control smart phone than by the human eye checking and controlling electronic switches in widely opened area of a huge farm.

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