POSTER 01

Development of Growth Information Monitoring and Remote Control System based on ICT

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I. Introduction

Making use of ICT (Information & Communication Technology), it is being used as the Internet of Things (IOT) at common households or offices.

The use of ICT in the field of agriculture has been much in the aspect of labor saving, convenience pursuit, profit increase, health improvement or securing stability, etc., and R&D investment has been expanded (Lee *et al.*, 2014; IPET, 2012). The developed countries in agriculture such as USA, Japan or Netherlands, et cetera are making efforts in R&D over ICT Converging Technology, and even in Korea, agricultural ICT model projects and R&Ds are under progress centered upon its government. The level of converging technology of agricultural ICT in Korea is evaluated to be in the mid-60%3), and the infrastructures such as the small scale of agricultural ICT converging-related enterprises, insufficient recognition of farmers, and lack of manpower that can support the field have been in unsatisfactory degree (Korea Rural Economic Institute, 2013).

Supply of water at orchards or farms is a very important factor in the growth of crops. In general, any decision of irrigation period or quantity of water for each growing period of crops is done by ordinary custom of the farmers or farming households. Additionally, control devices for irrigation cost a lot, and it is difficult to manipulate them, so farmers face difficulty to a greater extent when using the device. Furthermore, the supply of water required for irrigation depends mainly on the underground water, and it is difficult to supply water at a proper period unless water storage devices such as water tank, etc. are not prepared in advance. Even after installing the devices, farmers want to control them at the field where they are installed, but the reliability of controlling them in the farms at remote areas is not that high. Even if the device malfunctions only one time at the farm, it will ruin the growth of crop.

Therefore, it should be able to check whether the control device of the farm operates normally or not at a remote place, monitor the status of the farm at present as occasion demands, and remote-control real time through the web or app of a smart device. Moreover, it needs irrigation control using a timer the farmer used in the past, automatic control by the environment-measured value, and above all, a device low-priced which the farmer can easily buy and use.

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II. Materials and Methods

The control device this study develops was researched to control two control facilities at a time (irrigation facilities, frost-proof fan, etc.) There are 3 control modes: one-week timer control sold at the market, control by the sensor value measured, and user manual control. Ways of communication are as follow: LTE modem, way by accessing wireless sharer through WiFi.

A developed remote control device was installed at Daegu Apple Research Institute to evaluate whether it operates or not, and the convenience, stability, etc. of the remote control.

The overall system block diagram is depicted as Fig. 1. The farmer can access the farm's control device with web or app of the smart device at a remote area. The control device of the farm must be always connected to the server so that it can respond any time to the order of the farmer. However, the amount of communication must be minimum packet to reduce communication charge. So, the server requests status information every minute so that the connection may not be down and the control device responds to the status information. It costs a lot to compose a system at which the control device operates as a server. Thus, the main server was made to deputize as the server of each equipment. In most cases of control devices, Public IP Service or DNS service are beyond the realms of possibility, and if possible, their set-up is complicated, so it is hard for the farmer to use them.

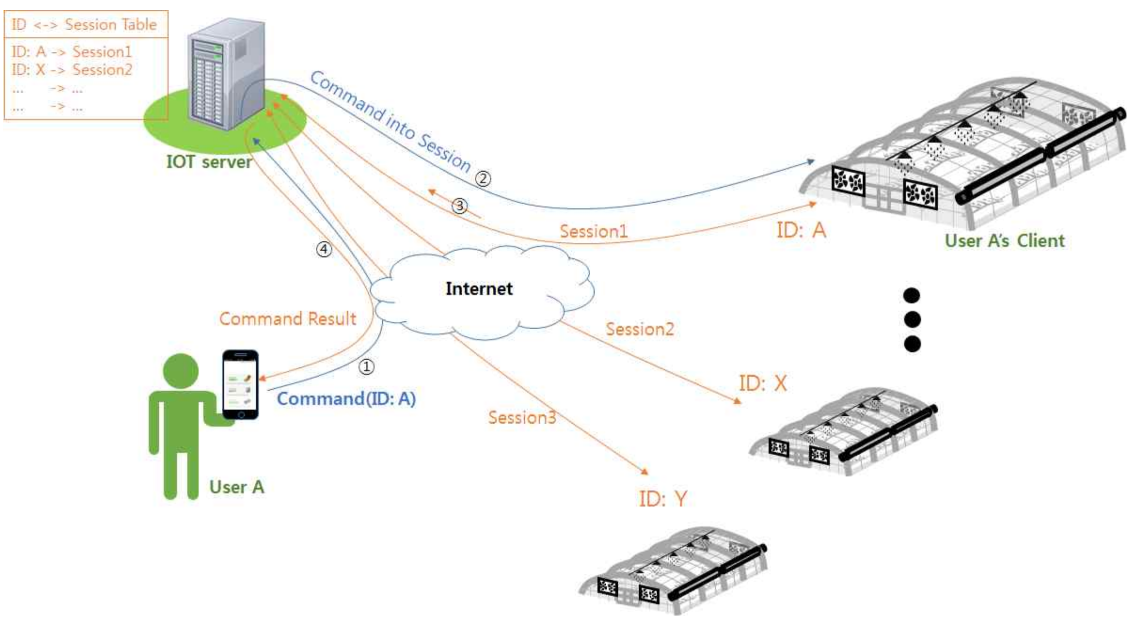

Fig. 1. Overall System Block Diagram.

As for the development environment used for system development, the server program is Visual Studio 2005, Machine configuration UI is Visual Studio 2005, Firmware is MPLAB IDE (ANSI C base C compile, Assembler), Smart device UI is Android Studio (Java), and the circuit design is OrCad 16.6.

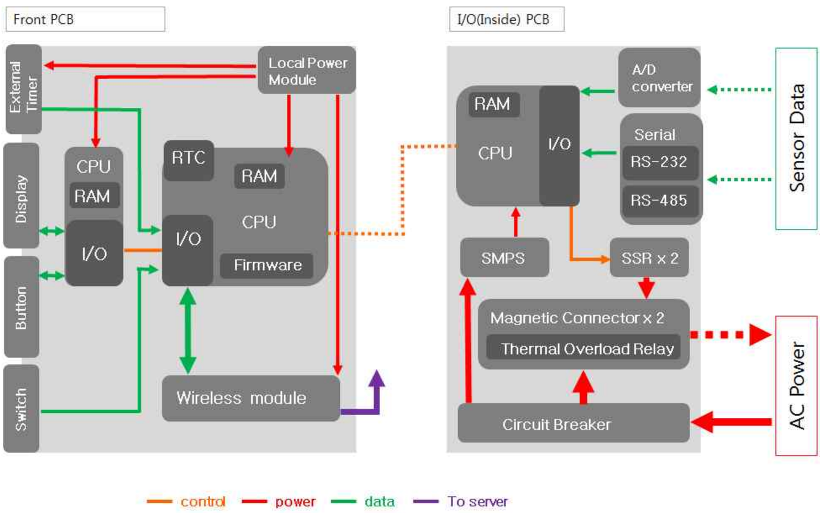

Fig. 2. Hardware Interior Composition.

Fig. 2 and Fig. 3 are the roles of hardware interior composition and exterior composition. They are composed of two parts: The left side(Front PCB) controls timer power supply, monitors if the timer operates or not, control user input/output of the sensor set-up, and monitor the selecting switch of operation mode. And, they handle and control the overall algorithm. The right side (I/O PCB) receives and calculates the input of sensor, gets the order of CPU (Front PCB) to control the output.

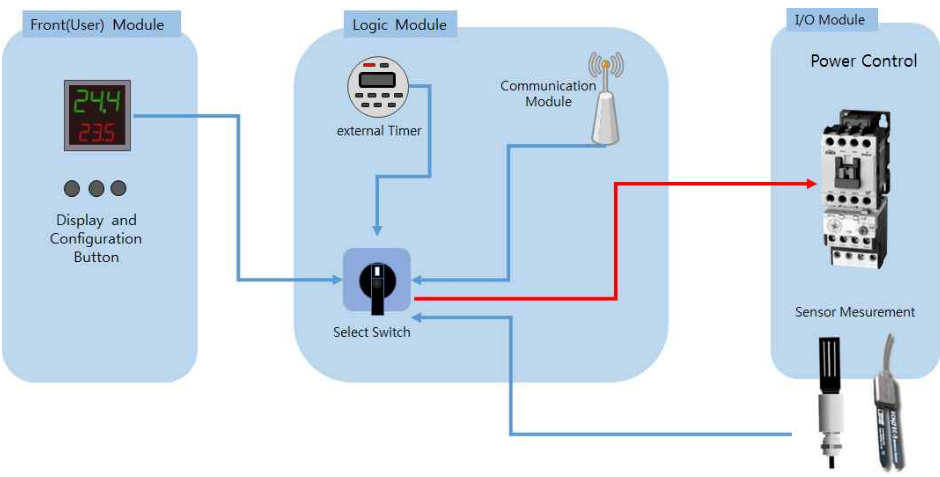

Fig. 3. The Role of Hardware Exterior Composition.

Fig. 4 is the interior and exterior of the control device. The exteriors consist of two one-week timers, two display liquid crystals, and two selecting switches. The interior receives by two control devices, and the sensor value inputted receives by voltage, RS232 or RS485.

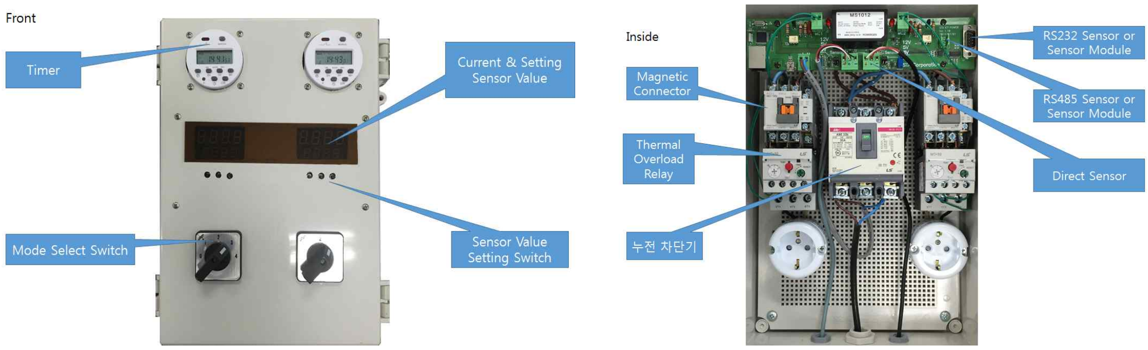

Fig. 4. Interior and Exterior of the Control Device.

Fig. 5. Irrigation Facilities of Apple Testing Ground (Gutta irrigation).

Fig. 5 is the photo of Irrigation Facilities of Daegu Apple Research Institute equipped with a remote device. The remote control made a progress of seed weight experiment in two ways: one operating irrigation system manually and the other operating remote control automatically through measured value of soil water sensor.

III. Results

When accessing the server through modem at a control device, the irrigation facilities were operated by accepting the values set up at the smart phone (Fig. 6).

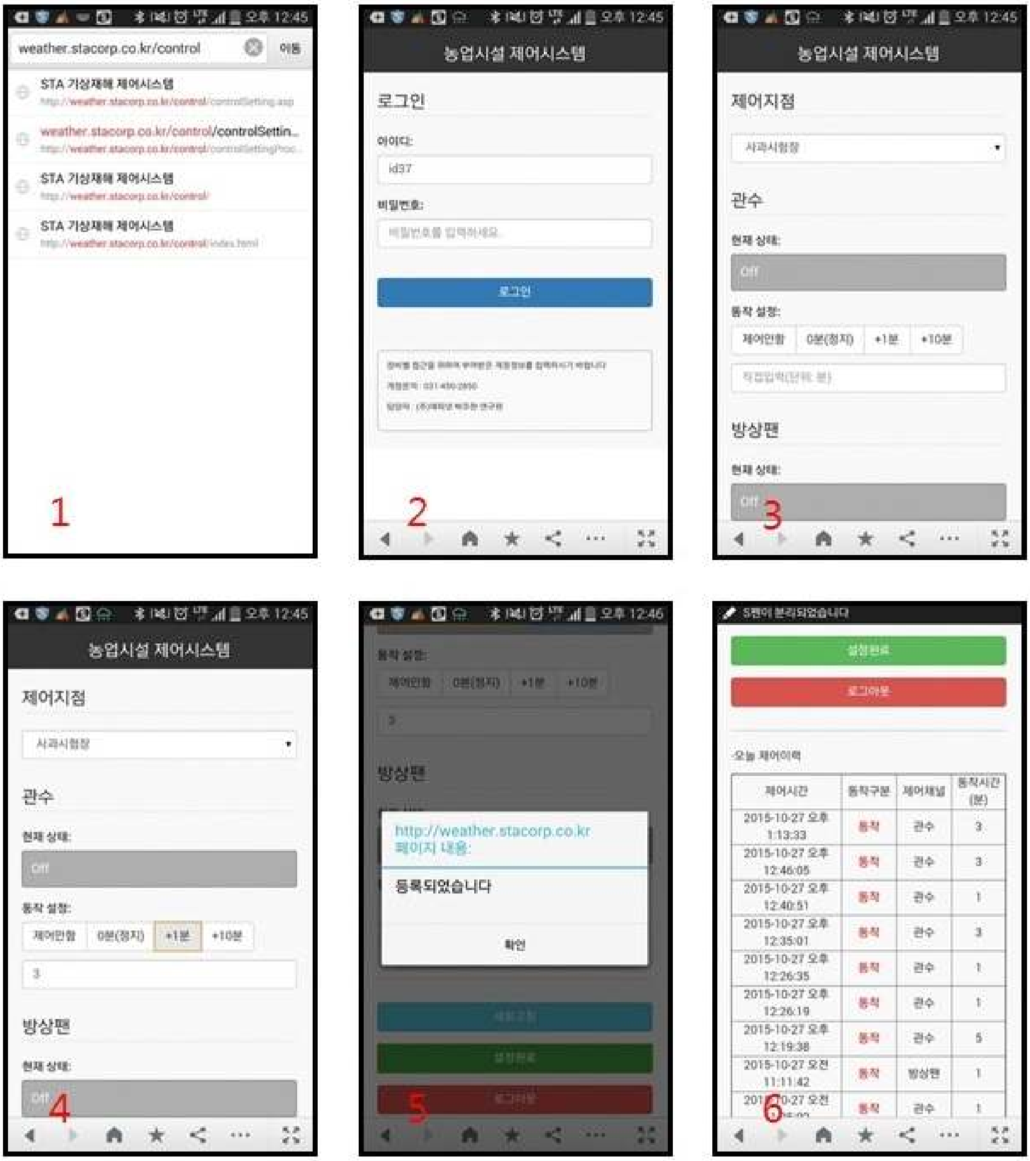

Fig. 6. Remote Control Screen of the Smart Device (1. Access a Screen on the Web-site, 2. Log-in after entering ID/PW, 3. Select a Controlling Point, 4. Set up an Operation Time, 5. Register Set-up on the Server, 6. Control History)

Seed weight experiment used a smart device to access the control device to operate a irrigation device. Tests whether it operated normally or not were carried out 6 times in total, 3 times respectively by setting up the operation time of irrigation facilities in 1 minute, 3 minutes respectively. First, enter ID and password at the smart device to access the control device that can control irrigation. Select a point to control and set up operation time of irrigation for some time at irrigation to set up the control. Finally, click the button that completes set-up that pops up a window saying 'Registered' which will complete the set-up (Fig. 6).

Fig. 7. Figure of Manual Irrigation Facilities Operation by Using Smart Device at the Experiment Pave.

At the experiment repeated for 1 minute, 3 minutes respectively, all the irrigation operation time operated normally, and the operation was ceased to the operation stop signal (Table 1).

Table 1. Results of Setup and Operation of Irrigation System of Remote Control Using Smart Device

Set-up Time for Operation (min.)	**Set-up Time for Control**	**Whether it operates or not**	**Operating time (min.)**
1	11:11:42	○	1
1	12:26:35	○	1
1	12:40:51	○	1
3	12:35:01	○	3
3	12:46:05	○	3
3	13:13:33	○	3

Acknowledgements

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