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Meteorological Data Visualization Application for Mandarin Farmers Support

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***Abstract*—Currently, agricultural population is decreasing year by year in Japan. It is a cause of the collapse of the domestic crop of market balance because of import liberalization of agricultural products. Income of Japanese farmers becomes unstable, and as a result, because of a lack of successors, the growing number of cases to be going out of business. In addition, the cultivation of the crop is required retention of long-term weather information and experience. However, its information and experience is lost if farmers go out of business. In this paper, we reduce costs for acquiring meteorological data and develop the android application for data visualization in order to solve the above problem.**

I. Introduction

Currently, agricultural population is decreasing year by year in Japan. It is a cause of the collapse of the domestic crop of market balance because of import liberalization of agricultural products. Income of Japanese farmers becomes unstable, and as a result, because of a lack of successors, the growing number of cases to be going out of business [1], [2], [3]. Cultivation of fruits in Japan, there is a need for own rule of thumb and a sense of seniors over the years. Therefore, its information and experience is lost when the farmers go out of business. Data of the growing environment of crops such as temperature, humidity and soil of the state does not exist or have not been opened with the exception of the official period such as Agricultural Experiment Station. To obtain the data on their own, it is necessary to mass installed weather sensor because farmland vast. However, it is difficult to purchase a large number of sensors in the financial condition of the current situation of farmers because commercially available sensors [4] are still a high price.

We are developing a low-cost weather data acquisition system that is running on only solar power by using a single-board computer in order to support the orchard farmers. In cooperation with mandarin farmers, we are doing the installation of the system in mandarin field [5], [6], [7]. In this paper, we describe our weather data acquisition system. In addition, we describe the application to view the weather data using the smart phone such as Android.

II. Equipment and creating cost

The cooperation of mandarin farmers in Ama Town (Shimane Prefecture), we are actually the installation of weather sensors. To reduce the creation cost, we used a single-board computer and single-board computer, such as Raspberry Pi (Figure 1, right) and the Arduino (Figure 1, left). We attach sensors for measuring the temperatures, the humidity and the status of the soil in these computers. And we have created a system for uploading weather data obtained sensor to a server automatically. Further, the power supply using solar power.

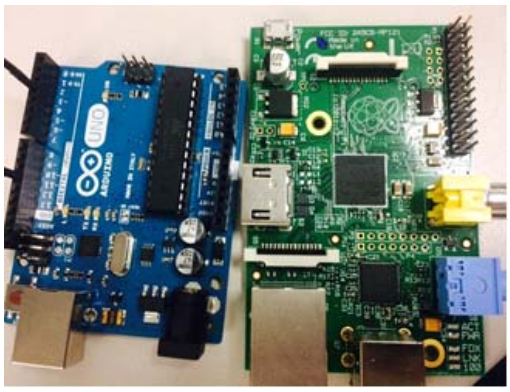

Fig. 1. Raspberry Pi Model B Revision2.0 and Arduino UNO

About the cost of the system, creating cost of the machine to get the sensor data is approximately $90 per one. The cost of the solar system is approximately $180 per one set, it is possible to run three or four single board computers in one set. The transfer cost of the data is approximately $0.09 per one day because we use the cheap SIM.

III. Weather data acquisition system

The flow of weather data acquisition system is shown below.

1) Power supply of the entire system utilizes the solar power because there is no power in the mandarin fields and it leads to running cost reduction.
2) In order to get more detailed data, to install a weather sensor in many places.
3) Acquired meteorological data is uploaded to the server through a Wi-Fi router with a cheap SIM.
4) Meteorological data uploaded to the server are processed into available for viewing from the Web and Android application.

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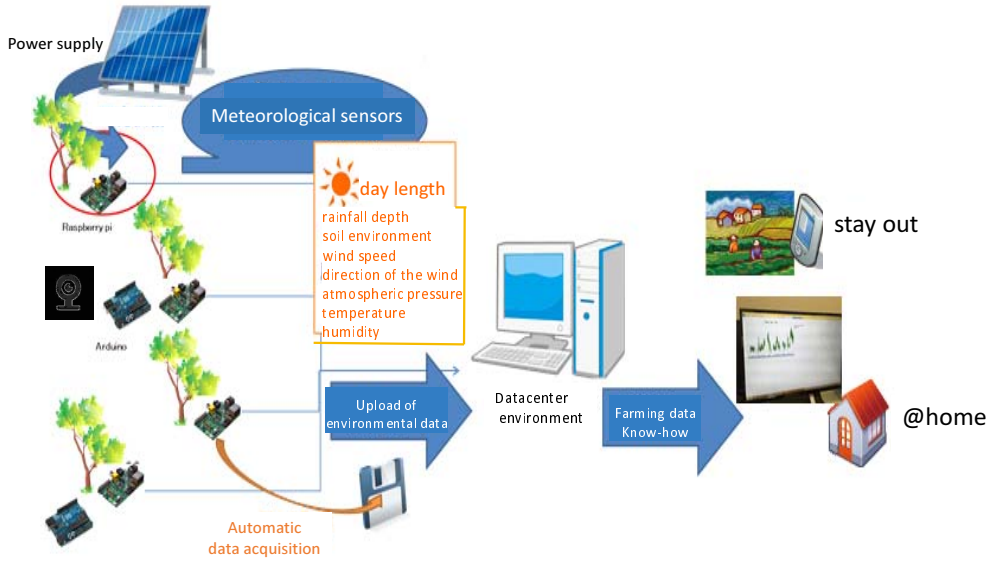

Fig. 2. System configuration

Data obtained from the weather sensor are transferred to the server every 10 minutes. Therefore, it is possible to know the weather information of the field by simply connecting to the network without actually going to the mandarin fields.

IV. Visualization System using the Android Application

The mechanism from the acquisition of weather data until the user to view shown in Figure 2. We create the Android application to understand the weather situation of mandarin fields using the Android Studio. Data accumulation in the Android is problematic because there are many failure such as 'the problem of recording capacity', 'the failure of the terminal' and 'data loss caused by the loss'. Therefore, the user accesses the HTML that is dynamically created based on the meteorological data stored in an external server In our Android application, it is possible to browse weather data, image of the camera installed in mandarin fields and the Facebook page of mandarin farmers. Figure 3 shows the operation flowchart of the Android application.

V. Prototype System

We are doing the verification of the proposed system from March, 2015 in mandarin fields of Ama Town. The screen of the Android application is shown in Figure 4. The user select the display period and the type of data in order to display the weather data as shown in Figure 5 There are two types of specification of the display period. One is a method to specify the number of days from today such as 'one day ago', 'three days ago', etc. The other is a method to directly specify the period of date you want to view. The users can select three types of data such as air temperature, air pressure and illuminance. The future is increasing the types of available display sensor.

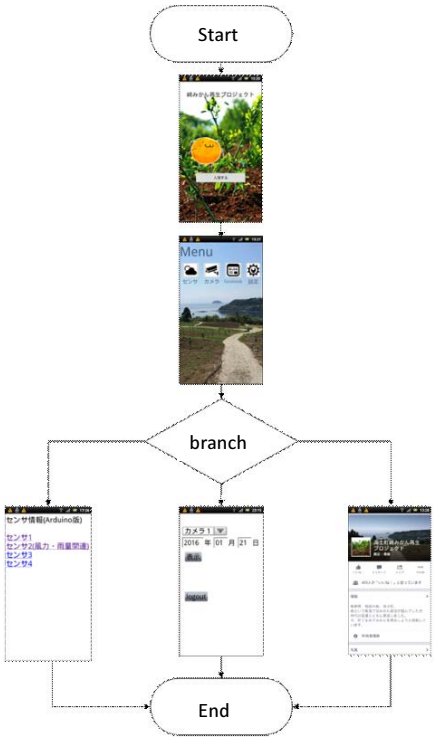

Fig. 3. Screen transition of Android

The display examples from Oct. 2, 2015 to Oct. 5, 2015 shown in Figure 6, 7, 8. Each figure shows air temperature, air pressure and illuminance and it is confirmed that can continuously get the weather data. We confirm that it is possible to acquire the weather data continuously. Figure 9 is an example of displaying air temperature data during two

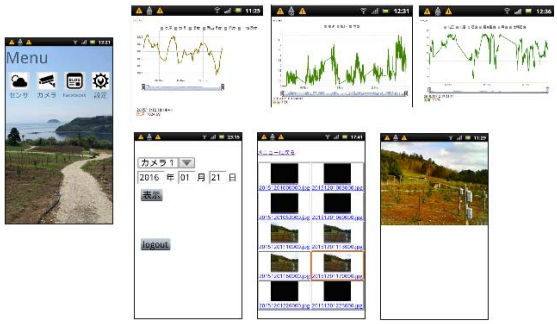

Fig. 4. Application practice screen

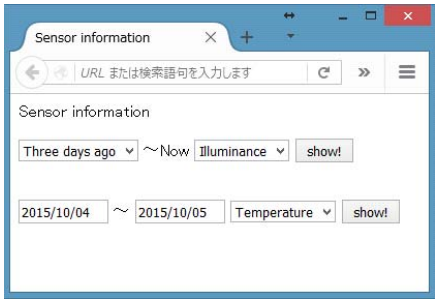

Fig. 5. Webpage of the weather data

months period from Jul. 1 to Sep. 1, 2015. Data transfer can be operated using the solar system only although loss of some data can be seen. In addition, we can confirm that it is the high air temperature during period from late Jul. to early Aug. 2015 in Figure 9. We cannot specific of actual cause of data loss. However, we conjecture that a failure has occurred in the temporary data communication network for some reason because the transmission of the data is restored automatically.

Further, we confirm that it is possible to identify when the typhoon approaches from air pressure data. Typhoon No.15 has passed through the vicinity of the Ama Town on Aug. 25, 2015. From air pressure data in Figure 10, it can be seen that had been re-close the evening on Aug. 25.

VI. Conclusion

In this paper, we propose the method of gathering the weather data using solar paper and inexpensive hardware such Raspberry Pi and Arduino. Thus, we succeeded in suppressing the introduction cost and the running cost. In addition, we have implemented an Android application to view weather data. In the experimental results in mandarin orange fields of Shimane Prefecture Ama Town, our system showed that it is possible continuously transferring weather data. In addition, producers have also confirmed that easy to browse the weather data using the Android.

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Fig. 6. Temperature graph

Fig. 7. Atmospheric pressure graph

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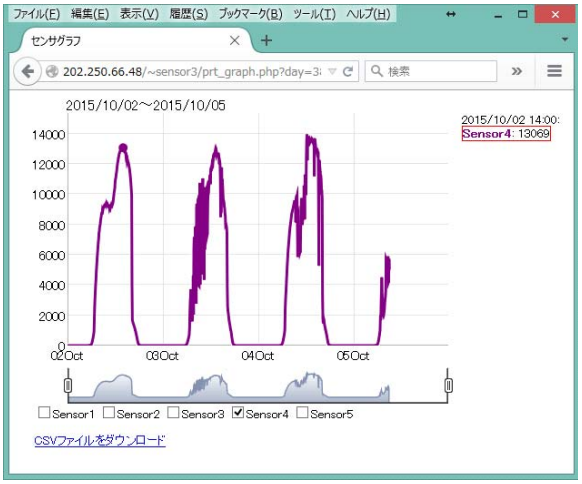

Fig. 8. Illuminance graph

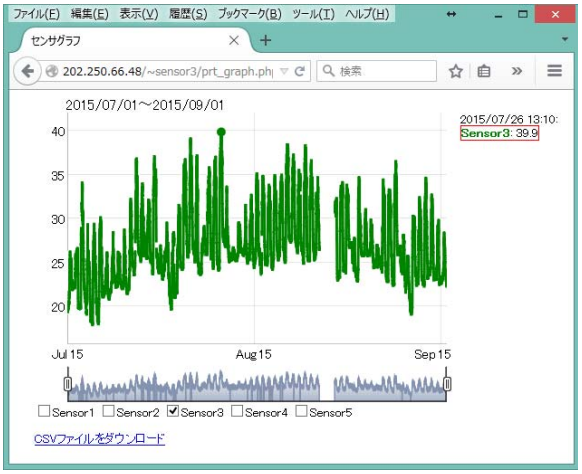

Fig. 9. Change of temperature (Two months)

Fig. 10. Change of atmospheric pressure (typhoon)