IoT Based Oyster Output Management System

YEONG-YIL YANG
Department of Semiconductor Engineering & ERI
GyeongSang National University
JinJu Dae Ro 501, Jinju city, GyeongNam, 52828
KOREA
yyang@gnu.ac.kr
YOUNG-HO CHOI
Department of Semiconductor Engineering
GyeongSang National University
JinJu Dae Ro 501, Jinju city, GyeongNam, 52828
KOREA
choiyh4677@naver.com
YOUNG-SIK PARK
MBC(MunHwa Broadcasting Company)
JinJu, GgaHo street, Jinju city, GyeongNam, 52817
KOREA
bread6@naver.com
JONG-CHEOL LEE
Engineering Research Institute
GyeongSang National University
JinJu Dae Ro 501, Jinju city, GyeongNam, 52828
KOREA
jongfe@naver.com

Abstract: - In this paper, we propose oyster output management system based on IoT(Internet of Things) through multi-channels, the internet or the 3G/4G mobile communication for managing and monitoring the amount of the oyster product. We designed and developed the managing program and the smart scale. The environment of the oyster workplace, such as temperature and humidity can be monitored to judge the degree of the freshness. The information acquired at the smart scale is transmitted to the management program running on the server in real time.

Key-Words: - Oyster Product, Management System, Smart Phone, IoT, Marine Product, Smart Scale

1 Introduction

Industry 4.0 in which computers and automation come together in an entirely new way is the current trend in various application area.[1] The idea of Industry 4.0 was the integration of Internet of Things (IoT) in the manufacturing process in the factory.[2] IoT becomes the smart component with various sensors, actuators and IoT devices are connected tightly to get the goal.[3][4]

The amount of the oyster produced in Korea is 40,000 tons every year and 22,000 workers are engaged in oyster production. In the conventional oyster workplace, the worker crushes oyster shells and takes oyster shells away. The weight of the oyster produced by each worker is measured by the scale and it is written on the note by hand. Therefore, it takes time to total up the amount of the produced oyster for each worker. Moreover the oyster cooperative union wants to total up the amount of the produced oyster for all oyster workplaces in real time. Therefore we developed oyster output management system using IoT technology. In our system, the amount of the oyster produced in all the oyster workplaces is totaled up in real time. Since the developed system monitors the environment of the oyster workplace, i.e. temperature and humidity, the degree of the

freshness of the produced oyster could be checked indirectly.

The diversification of communication channels between the server and the remote system is inevitable trend of the development for managing and monitoring remote systems, home appliances, robot control [5], [6], [7]. As in Ref. [4] and [5], traditional remote control system is mainly focused on multi communication channels between the control center and the user, not between the control center and the remote system. In Ref [8] and [9], the framework which uses multi communication channels between the server and remote system is proposed.

In this paper, we propose the oyster output management program using different channels, the internet or the 3G/4G mobile communication according to the circumstances of oyster workplaces.

The framework of IoT based oyster output management system is explained in section 2. In section 3, the implementation of the proposed system is described. Testing and conclusion are given in Section 4.

2 Framework of Oyster Management System

Fig. 1 shows the overview of proposed oyster output management system. Oyster workplaces are classified into two types which are represented as Type A and Type B in Fig. 1. The oyster workplace of Type A is the workplace where the intranet is constructed and the internet is accessible. The oyster workplace of Type B is the workplace where the intranet doesn't be constructed. In the oyster workplace of Type A, the oyster output management program which runs on the computer at the oyster workplace communicates with smart scales represented as *S1*, *S2*, ⋯, and *Sn* in Fig. 1. The smart scale identifies the worker and measures the weight of the oyster on it. The oyster output management program at the oyster workplace communicates with smart scales through wireless internet (Wi-Fi). The information acquired at the smart scale such as the worker and the measured weight is saved on the computer at the oyster workplace. Also the information is transmitted to the oyster output management program running on the computer at the center, i.e. oyster cooperative union. In the oyster workplace of Type B, the oyster output management app running on the smart phone at the oyster workplace communicates with the smart scale through Bluetooth. The information of the oyster workplace is saved on the phone which oyster output management app runs on. Also the information is also transmitted to the oyster output management program running on the server at the center. We designed and implemented the smart scale and the embedded system included in the smart scale.

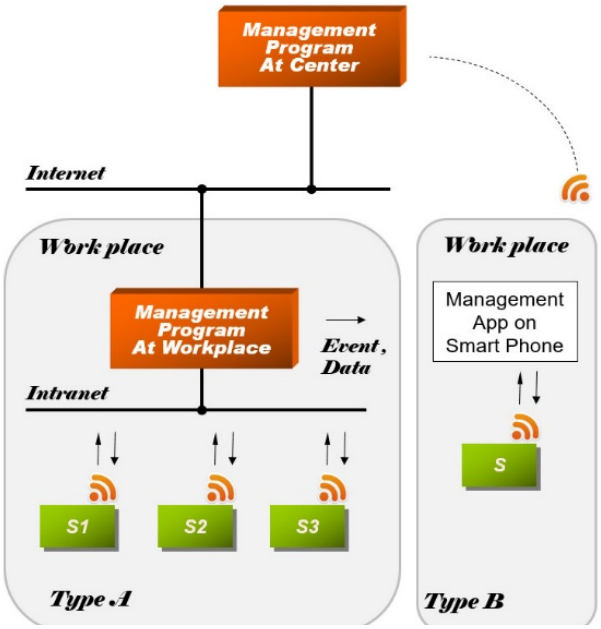

Fig. 1 The overview of oyster output management system

Fig. 2 shows the dataflow of the oyster output management system. As shown in Fig. 2, the oyster output management program running on the server at the center communicates through the internet or the 3G/4G mobile communication channel. The embedded system in the smart scale has two communication ports, the Wi-Fi port and the Bluetooth port. In the oyster workplace of Type A in Fig. 1, the embedded system in the smart scale accesses the intranet through Wi-Fi communication channel. Therefore the embedded system can transmit the data to the oyster output management program running on the computer at the oyster workplace through the intranet and the data is transmitted to the oyster output management program running on the server at the center through the internet. In the oyster workplace of Type B in Fig. 1, the embedded system communicates with the smart phone at the oyster workplace. The app running on the smart phone called the oyster output management app communicates with the embedded system through the Bluetooth communication channel. Also, the oyster output management app running on the smart phone communicates with the app server through the 3G/4G mobile

communication represented with the dotted line between the smart phone and the app server in Fig. 2.

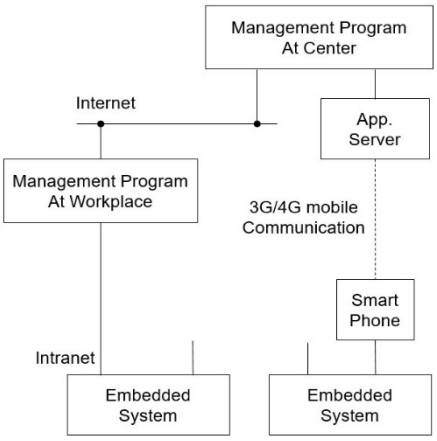

Fig. 2 The dataflow of the oyster output management system

3 Implementation of Oyster Output Management System

To implement the oyster output management system, we designed and developed the oyster output management program running on the computer at the oyster workplace and the oyster output management program running on the computer at the center, the embedded system in the smart scale, the oyster output management app running on the smart phone and the app server.

3.1 Oyster output management program at workplace

The oyster output management program running on the computer at the oyster workplace manages the output of the oyster produced at that workplace automatically in real time. The main functions of the oyster output management program at the oyster workplace are as follows.

- Communicate with embedded systems in the smart scale through Wi-Fi.
- Communicate with the oyster output management program running on the server at the center through internet.
- Total up the output produced at the oyster workplace.
- Monitor the environments of the oyster workplace, such as temperature and humidity.
- Handle the events coming from the smart scale.
- Enroll, modify or delete the information of workers and smart scales.
- Send the data of the oyster workplace, i.e. the information of workers, smart scales and the output of the oyster at that workplace to update the information stored on the server at the center.

Fig. 3 shows the main window of the oyster output management program running on the computer at the oyster workplace. The icons which are listed on the upper side of the window provide various functions needed to set and show the information at the oyster workplace. As shown Fig. 3, the oyster output management program shows the list of the data received from smart scales.

Fig. 3 The main window of the oyster output management program at the oyster workplace

The dialog box shown in Fig. 4 is popped up when the *workers icon* which is the first icon on the upper side of the main window in Fig. 3. The list on the right side of the dialog box is unenrolled NFC cards. If an unenrolled NFC card is touched on the NFC card reader at the smart scale, the information of the NFC card appears in unenrolled list in Fig 4. The NFC card can be registered by writing the information of the worker who will use the new NFC card on the central part of the dialog box in Fig. 4. Also the information could be modified in the dialog box in Fig. 4.

Fig. 4 The dialog box to enroll/modify workers

Fig. 5 is the dialog box to enroll and modify smart scales in the oyster workplace.

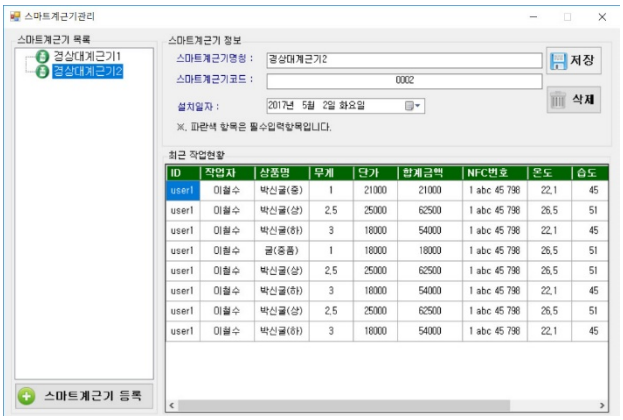

Fig. 5 The dialog box to enroll/modify smart scales at the oyster workplace

The oyster output management program is developed with Eclipse IDE for Java Developers [10]-[12]. The database is designed with SQLite.

3.2 Oyster output management program at center

The oyster output management program running on the computer at the center (oyster cooperative union) monitors the output of the oyster produced at all the oyster workplaces in real time. The main functions of the oyster output management program at the center are as follows.

- Communicate with the oyster output management program running on the computer at the workplace through the internet or the oyster output management app through the 3G/4G mobile communication, respectively.
- Total up the output of the oyster produced at all the oyster workplaces.
- Display/Update the information of oyster workplaces.
- Enroll, modify or delete the information of oyster workplaces.
- Display the statistical information of the oyster output for each oyster workplace during the certain period.

Fig. 6 shows the main window of the oyster output management program at the center. The icons which are listed on the upper side of the window provide various functions needed to set and show the information. The data received from workplaces is listed on the central part of the oyster output management program in Fig. 6.

Fig. 6 The main window of the oyster output management program at the center

The dialog box shown in Fig. 7 displays the information of the oyster workplace. The oyster workplaces are listed on the left side of the windows in Fig. 7. If one of oyster workplaces is selected, the information of the selected oyster workplace is displayed with the location of the selected oyster workplace on the map. We can enroll or modify the information of the selected oyster workplace using the dialog box shown in Fig. 7.

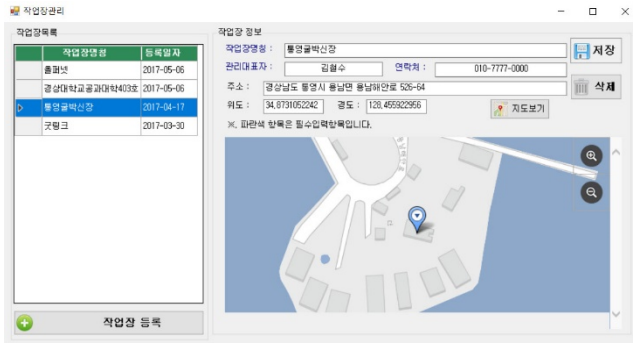

Fig. 7 The dialog box to enroll/modify oyster workplaces

The dialog box shown in Fig. 8 is the window to display the statistical information.

Fig. 8 The dialog box to display the statistical information

3.3 Embedded system in smart scale

The embedded system acquires the data from the weight sensor and NFC card reader. The main functions of the embedded system are as follows.

- Communicate with the oyster output management program/app through Wi-Fi and Bluetooth, respectively.
- Acquire the data from the temperature and humidity sensor and send the data to the oyster output management program/app.
- Measure the weight of the oyster on the smart scale and send it to the oyster output management program/app.
- Identify the worker by reading the data from the NFC card.

Fig. 9 shows the block diagram of the embedded system. As shown in Fig. 9, it consists of four modules.

- *Processing module*: Control the embedded system.
- *Sensor module*: Acquire the data from the sensors such as the weight sensor (load cell), the temperature sensor, the humidity sensor and read the data from NFC card reader.
- *Display Module*: Display the information such as the identified worker and the weight on the LCD window of the smart scale.
- *Communication module*: Send and receive data through communication ports, Wi-Fi port or Bluetooth port.

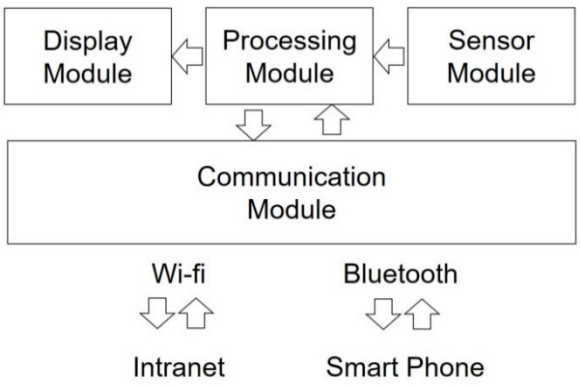

Fig. 9 The block diagram of the embedded system

Fig. 10 shows PCB(Printed Circuit Board) of the developed embedded system. Atmega2560 is used as the CPU. The firmware is developed with Arduino.

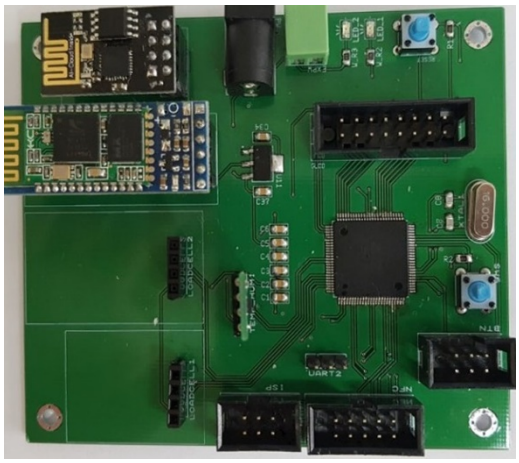

Fig. 10 Developed PCB of the embedded system

3.4 Oyster output management app running on the smart phone

Fig. 11 shows the window of the oyster output management app running on the smart phone. The main functions of the app running on the smart phone can be classified into two.

- Communicate with the embedded system and the app server as shown in Fig. 2.
- Provide same functions with the oyster output management program at the oyster workplace.

Fig. 11 The main window of the oyster output management app.

3.5 App Server

As shown in Fig. 2, the app server communicates with the oyster output management app running on the smart phone. The app server program runs on

the server which the oyster output management program runs on.

4 Conclusion

We implemented the overall system for the oyster output management and tested our system. It works well with no problem.

We developed oyster output management system based on IoT(Internet of Things) through multi-channels, the internet or the 3G/4G mobile communication for monitoring the amount of the produced oyster and managing workplaces. The output of the oyster produced at all the workplaces is updated in real time. The environment of the workplace, such as temperature and humidity can be monitored to judge the degree of the freshness of the oyster being produced.

We are improving our system to expand the application area for various kinds of marine products.

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