Food Distribution Management System with the Smart RFID-PH Sensor Tag

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Abstract. As customer's interest is increased about quality and safety of food, in this paper, we are proposes system which prevent change of food through monitoring and predict food quality between production, distribution, storage. Proposed system is designed to smart RFID PH sensor tag using 900Mhz tag and ISFET to measure PH value. As PH sensor can be checked acid changes that may arise in the course of changes in food, degree of alteration of food state is confirmed. Confirmed information saves server. When consumers purchased food, system confirms food status based on the stored information is proposed. The proposed system conducts experiment using kimchi. System indicates three-step (non-fermented, moderate fermented, over-fermented).

Keywords: RFID tag, PH sensor, ISFET, food quality, Food distribution management.

1 Introduction

Recently, customer's interest is increased about safety and quality of food. So we are interested in that developed to predict changes that may arise in the course of distribution. The fermented food happen a large change in the distribution process than other food. The food state of fermented foods affects PH degradation rate, acidity increase speed, microbial growth rate [1]. It will determine the status of the food. In this paper, the monitoring system is proposed to expected changes in the quality of food during distribution and storage by measuring the change in the PH of fermented Foods. Proposed system is designed by smart RFID PH sensor tag using ISFET. Because PH sensor measures acid of changes, the tag is able to confirming the change of food PH. Confirmed information is stored on the server. System using saved information shows the state of the food when you purchased food. We propose system that can confirm the state of food. The proposed system conducts experiment using kimchi. System indicates three-step (non-fermented, moderate fermented, over-fermented).

2 Proposed system

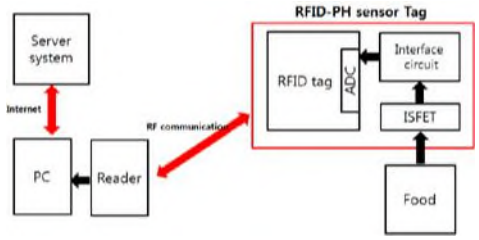
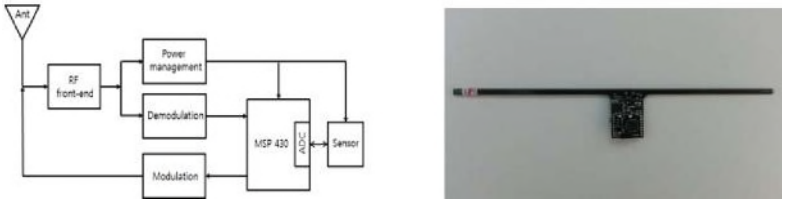


Fig .1 Block diagram of proposed system

Proposed system is composed of PH sensor tag which measures the state of food and server system which can be processed measured information. This system is provided with status information of the food quality using measured data from smart RFID-PH sensor. The food PH value is measured by ISFET sensor according to the around environment. After PH value outputs voltage via interface circuit, scalable voltage is changed into output voltage through amplifier. And digital signal is converted to Voltage through ADC. The digital data which is transmitted reader at RFID tag is stored at server. When consumers buy food, proposed system shows information that is stored at food status. Block diagram of proposed system is shown in Figure 1.

2.1 900 Mhz RFID tag



(a) Block diagram of 900Mhz RFID tag (b) 900Mhz RFID tag

Fig .2 Block diagram of 900Mhz RFID tag

Block diagram of the manufactured 900Mhz RFID tag is shown in Figure 2 (a). Tag is composed of 900 Mhz antenna, RF front-end, Power management, Demodulation, Modulation and micro-processor (MSP 430). RF front-end took impedance matching using the variable capacitor. Power management supplies DC power that is changed RF energy through step five doubling circuit. Demodulation changes digital signal through comparing the length of incoming signal of the antenna. Modulation is that digital signal sends on reader using backscatter method. Microprocessor is used to MSP430 that is able to operating low-power mode. Sensor tag is passive type tag that can operate power of RF signal, it shows in figure 2 (b).

2.2 PH sensor (ISFET)

ISFET sensor is used a commercial product. It has a structure similar to a MOSFET. Because operation of sensor responds to the H+ ions (solution exists) and an insulating layer (Ta2O5) surface, the electrochemical potential difference occurs. In this regard the potential difference is a function of the ion concentration, ISFET channel conductance can change. Therefore, the ion concentration in the solution appears as a change in the current flowing in the drain. PH sensor includes a temperature sensor that is necessary for temperature compensation.

2.3 Interface circuit

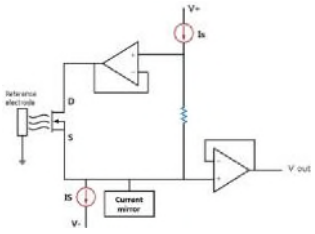
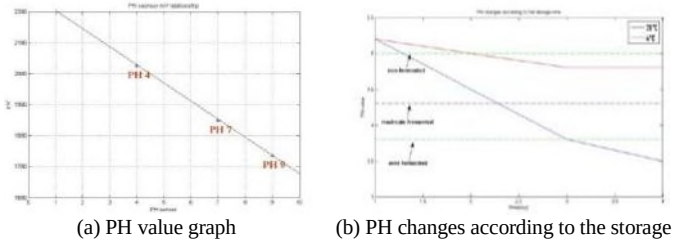


Fig .3 Interface circuit

ISFET is formed the gate region of the channel in response to changes in the hydrogen ion concentration. Channel formation in the area of the gate changes Ids. Because Rds keep uniformly voltage and current, Vs is changed through ISFET of the gate channel. Therefore, Vgs variation indicates directly changes in hydrogen ion concentration [2]. FET's input or output using the buffer circuit has remove noise. Because FET is influenced by the ambient temperature, we make a constant current bias using Miller circuit. Configured circuit is shown in Figure 3.

3 Experiment



(a) PH value graph (b) PH changes according to the storage

Fig .4 Experimental graph

PH sensor tags confirm accurately PH value through the experiment. PH of the comparison target like as figure 4 (a) is used to 4, 7 and 9 PH standard solution. Room temperature experiments were conducted at 25 degrees. Experimental result shows a linear change like as figure 4 (a). Consequently, the pH sensitivity of ISFET could be checks the change of 55mV/PH.

In this paper, the proposed system would experiment with using kimchi. Experiment temperature is composed of room temperature (28 ~ 29 ° C) and refrigerated temperature (4 ° C). Experimental temperature observes a change in PH during a four-day. The experimental result shows in figure 4 (b). Kimchi keeps a steady PH in refrigerated temperature, but it is able to confirming diminished PH in room temperature. In order that we divided food grade, sensory test had a survey of recruit graduate students of ten. The state of food is selected three different grades through sensory evaluation. We were able to confirm the changes that occur in the process of distribution of food through sensory evaluation applied system.

4 Conclusion

The fermented food happen a large change in the distribution process than other food. The food state of fermented foods affects PH degradation rate, acidity increase speed, microbial growth rate. In this paper, the monitoring system is proposed to expected changes in the quality of food during distribution and storage by measuring the change in the PH of Fermented Foods. Proposed system is composed of PH sensor tag which can measure a state food and server system which can be processed measured information. PH sensor tag is composed of 900 Mhz antenna, RF front-end, Power management, Demodulation, Modulation and micro-processor (MSP 430). And the server system is provided with status information of the food quality using measured data from smart RFID-PH sensor. the proposed system would experiment with using kimchi. The kimchi keeps a steady PH in refrigerated temperature, but it is able to confirming diminished PH in room temperature. So the state of food is selected three different grades through sensory evaluation. We were able to confirm the changes that occur in the process of distribution of food through sensory evaluation applied system. In conclusion, the state Information of fermented foods could be confirmed the supply of safe food to consumers. So customer will be increased reliability about fermented foods.

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