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The Design of Smart RFID System with Gas Sensor for Meat Freshness Monitoring

LIN SEN[1], Kyo-Hwan Hyun[1],Joo-Woong Kim[1], Ji-Won Shin[1], Ki-Hwan Eom[1]

[1] Department of Electronics and Electrical Engineering
Dongguk University, Seoul, Korea,
kihwanum@dongguk.edu

Abstract. This paper proposed the monitoring system for meat freshness detection based on RFID(Radio Frequency Identification). Proposed system consists of RFID tag, temperature sensor, gas sensor, reader, and server. This monitoring system can show the meat freshness for four grades, High, Medium, Low, Spoilage. In order to confirm the usefulness of the proposed system, we performed experiments on the pork. With the smart RFID system, we estimated the freshness of meat successfully.

Keywords: Monitoring System, Meat Freshness, Smart RFID system, Temperature Sensor, Gas Sensor.

1 Introduction

People live in 21 century pay more attention for food safety than the price because of the improvement of living standard. Freshness is a main index when customers want to purchase meat. [1-2].

In this paper, we propose the monitoring system for meat freshness. The proposed system consists of RFID tag, temperature sensor, gas sensor, reader, and server. The smart RFID Tag in order to design a fast and convenient method that can make customers know pork freshness directly. The smart RFID Tag has temperature sensor and H_2S sensor. Through different time and different temperature detection, we can get the relation between sensor signal and pork freshness. In order to verify the effectiveness of the proposed smart RFID Tag, we performed experiments on the pork.

2 The proposed monitoring system for meat freshness

2.1 The smart RFID Tag

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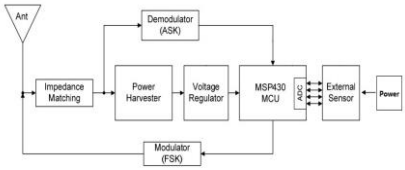
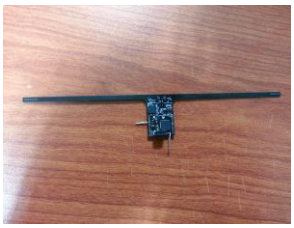


(a) The block diagram



(b) Smart RFID tag

Fig. 1 Smart RFID Tag

The block diagram of the smart RFID Tag is shown figure 1 (a). The Smart RFID tag consists of 950 MHz antenna, RF front-end, power harvester, demodulator, modulator, MSP 430, sensors and battery. Power harvester supplies power to MSP 430. Battery supplies power to H_2S sensor. MSP430 processes the sensor data and converts it to digital data. The manufactured smart RFID tag is Semi-Passive type tag worked by both RF signal power and battery. Figure 1 (b) is manufactured smart RFID tag .

2.2 Gas Sensor

We use MQ-136 as the main test sensor, which has a good sensitivity for H_2S.
Fig 2 shows MQ-136 and the typical sensitivity characteristics for several gases .

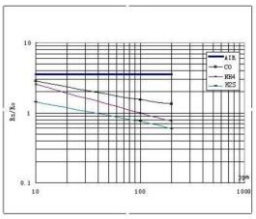


Fig. 2 Gas sensor and Sensitivity of gas sensor

2.3 The Reader

Reader is speedway revolution UHF RFID reader by IMPINJ. Fig 3 is reader and Table 1 is the specification of reader .

Fig. 3 RFID Reader

Table. 1 Specification of reader

Contents	Range
Interface	EPC global UHF Class 1 Gen
Protocol	2 / ISO 18000-6C
RF Frequency	900Mhz ~ 930Mhz
RF Range	10cm ~ 10m
Transmit Power	+10.0 ~ 30.0 dBm
Power Consumption	24V

From Figure 2 we know how to calculate the PPM of the test environment. Through sense of sight and nose we give a judgment for meat freshness.

Table 2. Grade of freshness

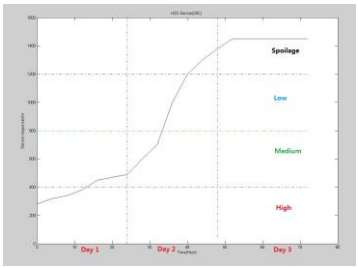
Freshness	Sensor(mv)
High	**<400**
Medium	**400-800**
Low	**800-1200**
Spoilage	**>1200**

Meat freshness can be divided into 4 grades: high, medium, low, spoilage. Consumers can see the grade of pork freshness on the display, then decide if buy the pork or not.

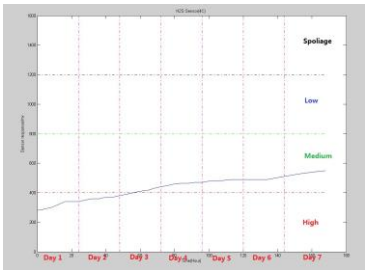
3 Experiment

In this paper, we perform experiments on the pork. Figure 4 is the experimental picture. Through the experiment, we measured the output of H_2S sensor. The result graph is figure 6.

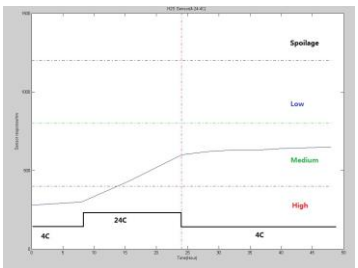
Fig. 4 Experimental picture



(a) Concentration of H_2S at 24 ºC



(b) Concentration of H_2S at 4ºC



(c)Concentration of H_2S between 4ºC and 24ºC

Fig. 5 Experiment result

In figure 5, Experiment (a) is at room temperature 24ºC within 72hours. Experiment (b) is at refrigerator temperature 4ºC within 7 days. Experiment (c) is

between 4ºC and 24ºC. In Experiment (a) we confirmed that the level of meat spoilage is almost linearly, at the end of Day2 the spoilage of meat is accelerated. At Day 3 it entirely corrupted and smelt bad. In Experiment (b), we can see the meat spoilage is very slow. In Experiment(c) we first put the pork at 4ºC and put it at 24ºC for several hours and then put it back to 4ºC.

In this experiment, we measured H_2S concentration of meat at different temperature and get a relation between H_2S and meat spoilage. The quality status of meat can be seen directly from the display program as fig 6.

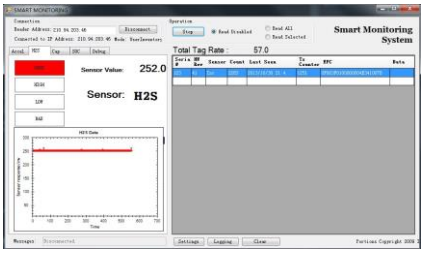


Fig. 6 Display program

4 Conclusion

In this paper, we proposed the monitoring system for meat freshness detection based on RFID. Through combining RFID and gas sensor, we get the relation between meat freshness and odor successfully. Proposed system consists of RFID tag, temperature sensor, H_2S sensor, reader, and server. The proposed RFID tag measured sulfide of environment during the transportation and storage. The measured information was calculated and divided into 4 degree such as high, medium, low and spoilage. In order to confirm the usefulness of the proposed system, we performed experiments on the pork. The experimental results show that was confirmed the performance of the monitoring system for meat freshness. Consumers can see the freshness of meat directly through the monitoring system.

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