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The Smart Hanger System based on the RFID

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Abstract

In this paper, we proposed the smart hanger system based on the RFID. Proposed smart hanger system consists of smart hanger, server, and wireless communication module. The smart hanger consists of LCD, LED, ring sensor, RFID tag, and RFID reader. In order to verify the usefulness of the proposed smart hanger system, we experiment the clothing store and laundry monitoring system. The shopping center server connects with the SNS server through the internet. When the clothes are sold, the information is transmitted to the hanger. Shopping center server read the "Purchase" and "Good" information and transmit it to the smart hanger through the wireless communication module. Then the LCD shows this information. This smart hanger system can be used for shopping mall to increase sales. Next laundry monitoring system, when customers come to the store to wash their clothes, washable tag is attached on the clothes. All the customer information is saved in database on server. It is very convenient for the customer to check their cloth status through web application. The laundry store can search customer's clothes by interface on computer, and collect it easily by indicated LCD on smart hanger.

Keywords: *Smart Hanger system, LCD, RFID Tag, RFID Reader, Clothing store, Laundry monitoring system*

1. Introduction

There is growing interest for various convergences in recent years. For convenience of the user, the convergence of one is the smart hanger using the RFID system [1-3]. Smart hangers can be applied to the store monitoring systems that can be used the clothing stores and laundry, and there are changed for customers convenience and buying increase [3-5]. The clothing store monitoring system uses the Social Networking Services (SNS). The SNS becomes an important social method, almost all the people use Facebook or twitter to make friends or share information. Therefore we can find great value from SNS. Social network site like Facebook and twitter have the function "Like" and "retweet", we can use these functions as the reference of purchasing (Figure 1) [6-7].

Figure 1. The Favorite Button of Facebook and Twitter

With these functions, smart hanger monitoring system can show the degree of satisfaction. The Laundry monitoring system can manage customer data, can give customers know where their clothes locate, which processes are done, and what time is appropriate to go to shop to take their washed clothes back. This monitoring system shows the customer number, full laundry, and current laundry [4-5].

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In this paper, we proposed the smart hanger system based on the RFID. Proposed smart hanger system consists of smart hanger, server, and wireless communication module. The smart hanger consists of LCD, LED, ring sensor, RFID tag, and RFID reader. In order to verify the usefulness of the proposed smart hanger system, we experiment the clothing store and laundry monitoring system. The shopping center server connects with the SNS server through the internet. When the clothes are sold, the information is transmitted to the hanger. Shopping center server read the "Purchase" and “Good" information and transmit it to the smart hanger through the wireless communication module. Then the LCD shows this information. This smart hanger system can be used for shopping mall to increase sales. Next laundry monitoring system, when customers come to the store to wash their clothes, washable tag is attached on the All the customer information is saved in database on server. It is very convenient for the customer to check their cloth status through web application. The laundry store can search customer’s clothes by interface on computer, and collect it easily by indicated LCD on smart hanger.

2. The Proposed Smart Hanger System

2.1. Smart Hanger System Overview

Figure 2 shows the processing flow of the smart hanger system. The smart hanger receives command and data from the server. The server periodically checks for status of smart hangers, the information is transmitted to the smart hanger. Then the LCD will show this information.

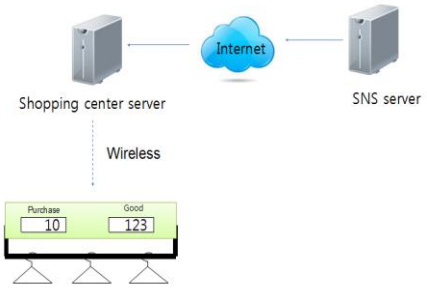

Figure 2. Processing Flow

2.2. The Smart Hanger

Figure 3 shows the block diagram of smart hanger, and they consist of LCD, LED, MCU, RF module, RF antenna, ring sensor and battery.

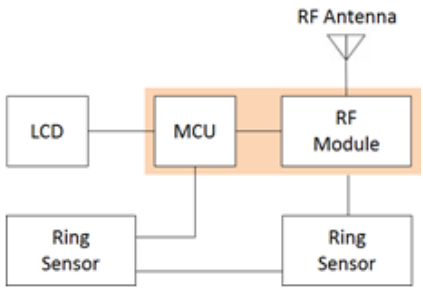

Figure 3. Block Diagram of Smart Hanger

Figure 4 shows the ring sensor. If the ring sensor is activated, the hanger is sent to the server reads the information of the RFID tags attached to the clothing. Figure 5 shows the structure of smart RFID hanger.

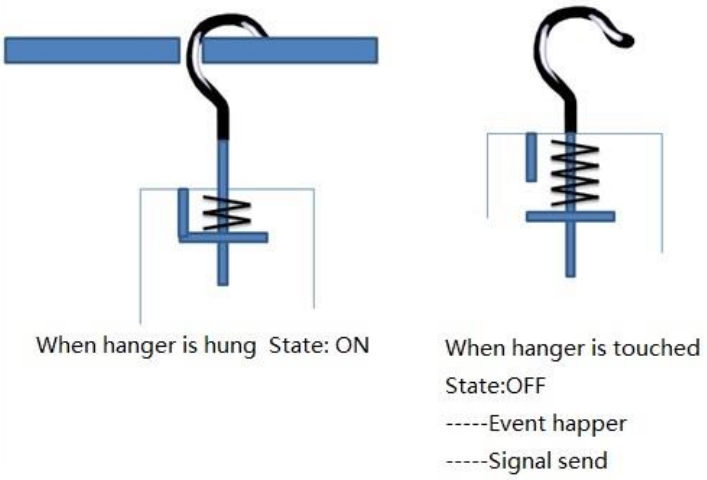

Figure 4. Ring Sensor of Smart RFID Hanger

This hanger combined RFID reader and wireless communication module [8]. Figure 5 and 6 shows the reader and antenna each. The reader reads tags at 13.56 MHz and read range are about 180mm. Figure 7 shows the PCB artwork

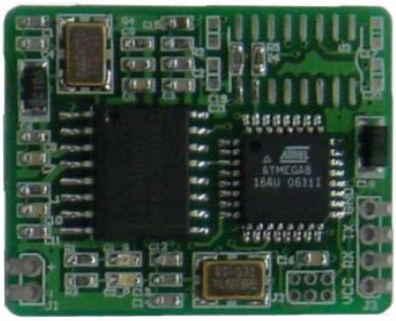

Figure 5. TRFID Reader

Figure 6. 13.56Mhz Antenna

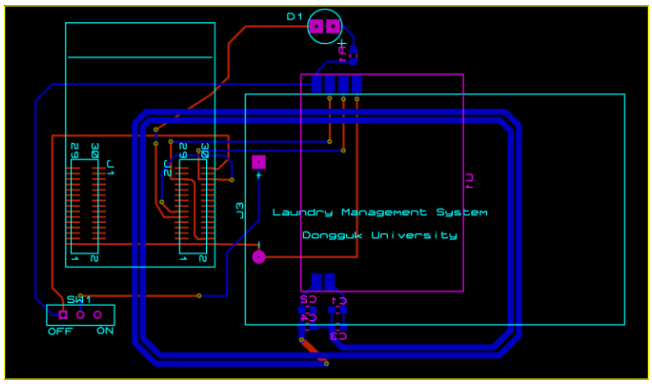

Figure 7. PCB Artwork

2.3. Electric Wave Absorber

When RFID reader read a tag, if multiple tags within range, the error is generated. Smart hanger is designed to prevent around the RFID tag via electric wave absorber, and used tape copper foil. Figure 8 shows the smart hanger with electric wave absorber and Figure 9 is manufactured smart hanger using the electric wave absorber.

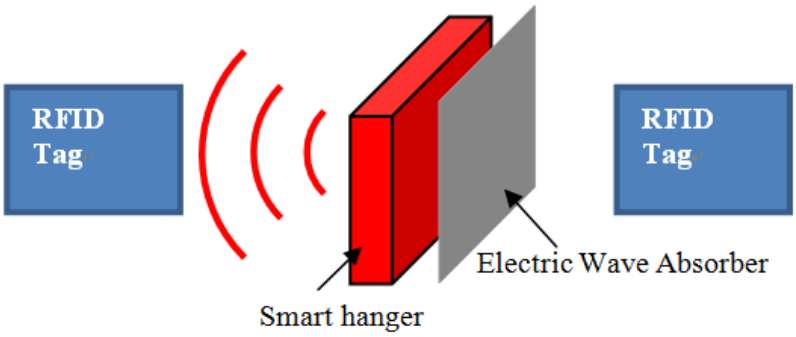

Figure 8. Smart Hanger with Electric Wave Absorber

Figure 9. Manufactured Smart Hanger using the Electric Wave Absorber

2.4. Wireless Communication Module

Figure 10 shows the wireless communication module of the proposed system. It is the bridge to collect tag ID from hanger to computer. The wireless communication module use Msp430 and CC2420 chip to keep a communication within 60m.We set one wireless

communication module at the server computer. It can read at least hundreds of tags at the same time.

Figure 10. Wireless Communication Module

Figure 11 shows the USB interface board, and it is connection board between the base module and USB.

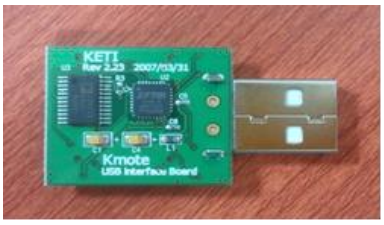

Figure 11. USB Interface Board

Table 1 shows the communication protocol of the RFID reader and tag. The reader can read a series of number from tag.0~1 is receiving module ID.2~3 is send module ID. 4~5 is action command. 6~13 is Tag UID. 14~15 is battery voltage. 16~17 is CRC code [9-11].

Table 1. Communication Protocol

	Name	Description
0 - 1	Destination	Receive module ID
2 - 3	Source	Send module ID
4 - 5	Command	Action demand
6 - 13	UID	RFID tag UID
14 - 15	Battery	Battery voltage
16 - 17	CRC	CRC

PC programs use the MFC (Microsoft foundation class), it is class library for Microsoft`s window application program development, included in the Visual C++, and use Win 32 programing [11].

2.5. PC Reader

Figure 12 shows the reader connected to PC and the clothing`s tag recognizes and store the information, and Table 2 is the characteristics of PC reader.

Figure 12. Reader Connected to PC

Table 2. Characteristics of PC Reader

Characteristics	Contents
Frequency	13.56Mhz
RF Data Rate	ISO 15693 26.6kbps
Read Range	180mm
Interface	RS-232
Power	DC 3.3V - 5V

3. Experiment

3.1. The Performance of Smart Hanger

3.1.1. Ring Sensor: In order to check the ring sensor`s operation status through the experiment was repeated 10 times. The experimental results through 100 cycles showed a 100% success rate. Figure 13 shows the experimental results of ring sensor.

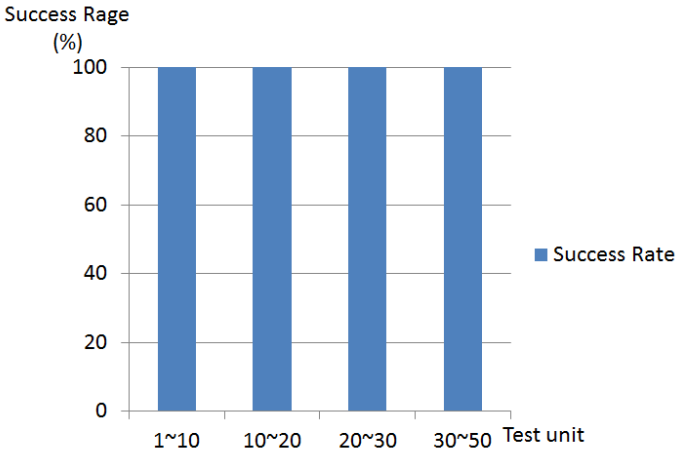

Figure 13. Experimental Results of Ring Sensor

3.1.2. RFID Tag: Manufactured smart hanger's reader for reading the time it takes for the experiments, and the average recognition time were calculated through repeated 10 times. Experiments for a total of 5 times were repeated 50 times. Experimental results of the average recognition time were 0.25 seconds, and figure 14 shows the experimental results of recognition time.

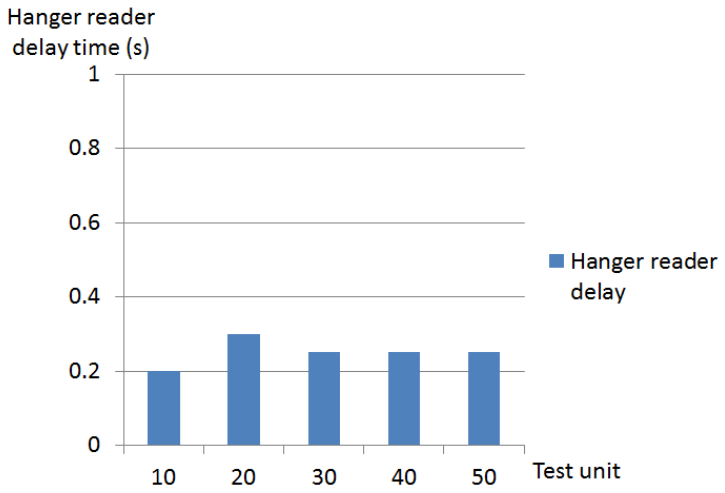

Figure 14. Experimental Results of Tag Recognition Time

3.1.3. Electric Wave Absorber: Experimental results in case of using the electric wave absorber was 100% success rate, and figure 15 shows the experimental results of electric wave absorber. In the figure, x-axis is the distance between the hangers and hangers, and y-axis is success rate.

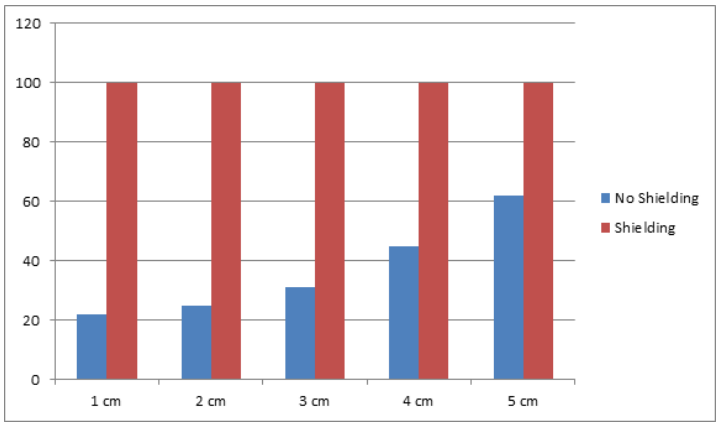

Figure 15. Experimental Results of Electric Wave Absorber

3.2. The Clothing Store Monitoring System

Figure 16 shows the main board of the hanger. There are MCU, RF chip, and RF antenna in this picture, and Figure 17 is the picture of experimental set.

Figure 16. Main Board of Smart Hanger

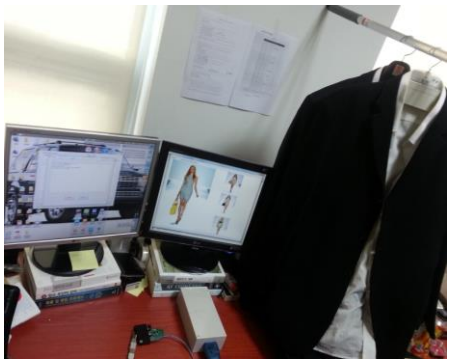

Figure 17. The Picture of Experimental Set

Figure 18 shows clothing search flow chart.

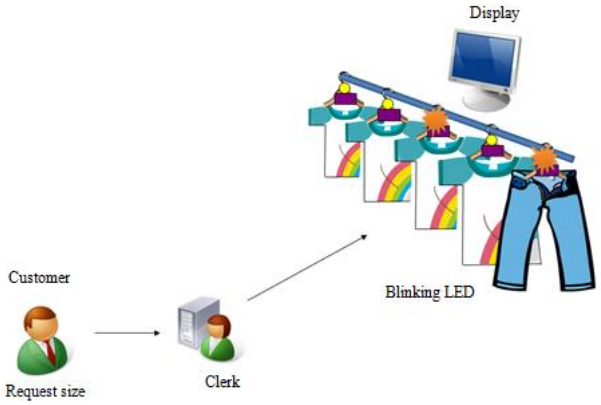

Figure 18. Clothing Search Flow Chart

Clothing search order is as follows:

0. Storing information of clothing (color, size etc.).
1. Customers are requested to the wanted size.
2. Search the DB server will look for the color and size fitting clothing.
3. The server makes the smart hanger's LED blink.
4. Customers choose the recommended clothes on the display device, and transmits the information to the server.
5. The server makes the smart hanger of recommended clothing with LED blink.

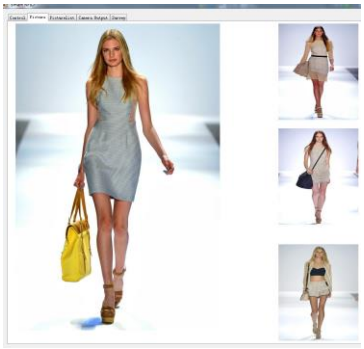

Figure 19. Display screen

Figure 19 shows screen of display device. Figure 20 shows the monitoring of smart hanger, and smart hanger monitoring can show the degree of satisfaction. It has two LCD, It not only shows the degree of satisfaction but also show the comments of users on Facebook.

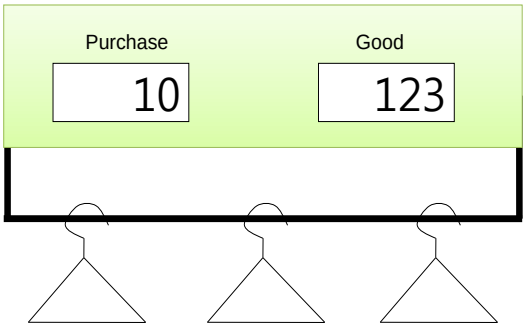

Figure 20. Monitoring of Smart Hanger

3.3. Laundry Monitoring System

Implemented system was described in Figure 21. The tag was attached on cloth, and then was holding on hanger with RFID reader. Another RFID reader which read tags before washing clothes and Kmote-B was connected with PC. With the system some experiments was carried out in office.

Figure 21. Monitoring System of Laundry

The packet data is sent and received through radio module Kmote-B to the wireless RFID reader. The sent and received packet rate was calculated and represented in Table 3. According to experiment, the average reception rate at 40m distance is 99.75%. In case of the scale of laundry store, it is reasonable to apply.

Table 3. Packet Reception Rate (PRR) According to Distance

Distance (m)	PRR (%)
10	100
20	100
30	100
40	99

4. Conclusion

This paper proposed the smart hanger system based on the RFID. Proposed system consists of smart hanger, server, and wireless communication module. The smart hanger consists of LCD, LED, MCU, RF chip, RF antenna, ring sensor and battery. In order to verify the usefulness of the proposed smart hanger system, we experiment the clothing store and laundry monitoring system. The shopping center server connects with the SNS server through the internet. When the clothes are sold, the information is transmitted to the hanger. Shopping center server read the "Purchase" and “Good" information and transmit it to the smart hanger through the wireless communication module. Then the LCD shows this information. This smart hanger system can be used for shopping mall to increase sales. Next laundry monitoring system, when customers come to the store to wash their clothes, washable tag is attached on the clothes. All the customer information is saved in database on server. It is very convenient for the customer to check their cloth status through web application. The laundry store can search customer’s clothes by interface on computer, and collect it easily by indicated LED on smart hanger. This system shows the laundry status for customer’s convenience.

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