The Implementation of Unmanned Clothing Stores Management System using the Smart RFID System

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Abstract

In this paper, we proposed the design of implementation of unmanned clothing stores management system using the smart RFID system. The proposed system consists of smart hanger, wireless communication module, display device, Winform software, and server. The performance of the proposed system is confirmed through experiments. Customers can choose any clothes on the server software and can match their faces to the clothes which they are interested for funny choose.

Keywords: *Unmanned clothing management, Smart RFID system, Smart hanger, Display device*

1. Introduction

In the 21st century, life for humans being has become busy to the extent that they strive for a comfortable and easy life [1]. In some countries unmanned stores start to become popular. The current ubiquitous technology, and as more and more applications in the field of RFID technology called smart labeling. RFID technology is remote sensing and recognition using radio waves, and has been applied many fields such as logistics tracking device, public transportation fare collection system, clothes stores.

But most of unmanned stores use the vending machine as the main operating method. And RFID technology is used in limited field. It is not applicable for clothing management. Our purpose is to design a management system to make clothing selling easy for sellers and customers. This system completely meets the requirement of unmanned stores.

We propose the design of smart management system for unmanned clothing stores. The proposed system consists of Smart RFID hanger, RFID tag display device, wireless communication module, server, and Winform software. Software has two parts. The main software is server software. Server software is responsible for tag ID collection from RFID reader and building data centre. Sub software is responsible for keeping exchanging information to server software. At the same time, sub software can show the picture of the clothes when customer touch the hanger. Also if customer clicks the clothes in the display computer, the hanger will open the led to show where it is. Customers can use face detection function to match their faces to the clothes which they are interested.

In order to verify the effectiveness of the proposed system, we perform the experiment.

2. Configuration of Proposed System

2.1. Smart Hanger

The smart RFID hanger consists of MCU, RF chip, display LED, RFID reader, RFID reader antenna, ring sensor and battery. Figure 1 shows the block diagram of smart hanger.

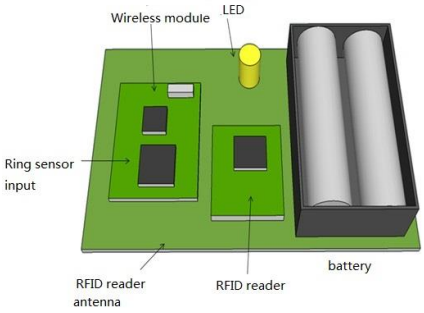


Figure 1. Block Diagram of Smart Hanger

Figure 2 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. Fig 3 shows the structure of smart RFID hanger.

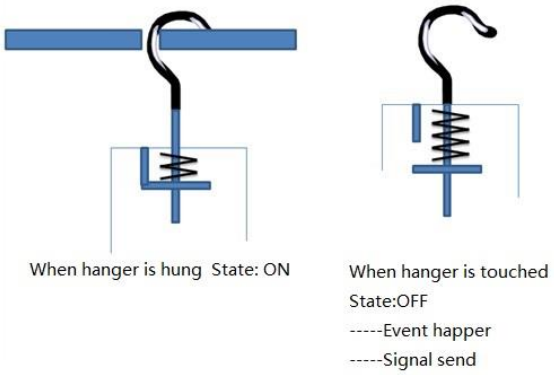


Figure 2. Ring sensor of smart RFID hanger

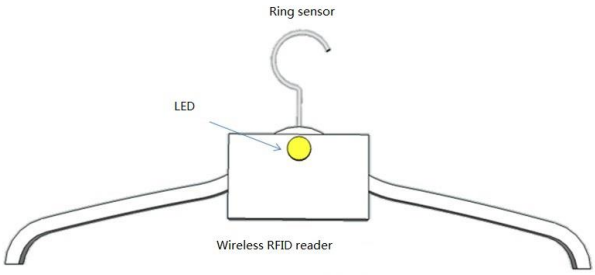


Figure 3. The structure of smart RFID hanger

There is a LED near the ring sensor. Figure 4 shows the location of Smart hanger and RFID tag. Figure 5 shows the picture of made hanger. This hanger combined RFID reader

and wireless communication module. The reader reads tags at 13.56 MHz and read range are about 180mm.

Figure 4. Location of RFID tag and Smart RFID hanger

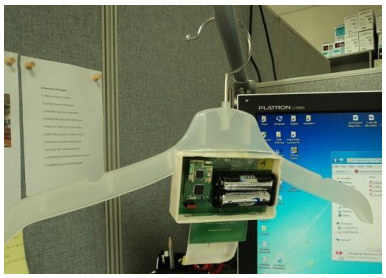


Figure 5. Picture of Smart Hanger

2.2. Wireless communication module

Figure 6 shows the wireless communication module of the proposed system. It is the bridge to collect tag ID from hanger to display 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 6. Wireless communication module

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.

Table 1. Communication Protocol

	Name	Description
0 1	Destination	Receive module ID
2 3	Source	Send module ID
4 5	Command	Action demand
6 7 8 9 10 11 12 13	UID	RFID tag UID
14 15	Battery	battery voltage
16 17	CRC	CRC

2.3. Display device

Figure 7. Touch Monitor

We use the touch monitor as the main display device. For the smart fitting room we use projector as the second display method.

2.4. Server

Server consists of DB management and server software. It uses Sqlserver programe to manage all the data. All the clothes tag ID should be stored here. It contains Smart clothes management function and clothes search function. It is the most part of unmanned clothing management.

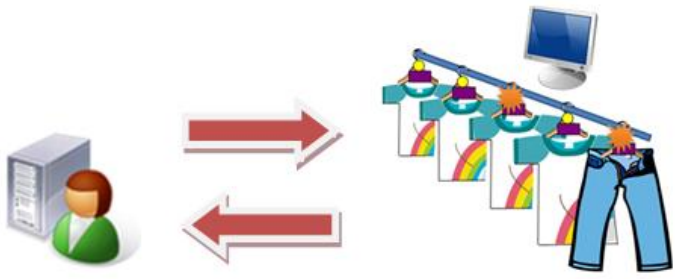


Figure 8. Server Communication

We use a computer as a server like Figure 8. Table 2 and Table 3 shows the command between Server and Smart RFID hanger. Server use SqlServer to manage the management information.

Table 2. Smart RFID hanger to Server

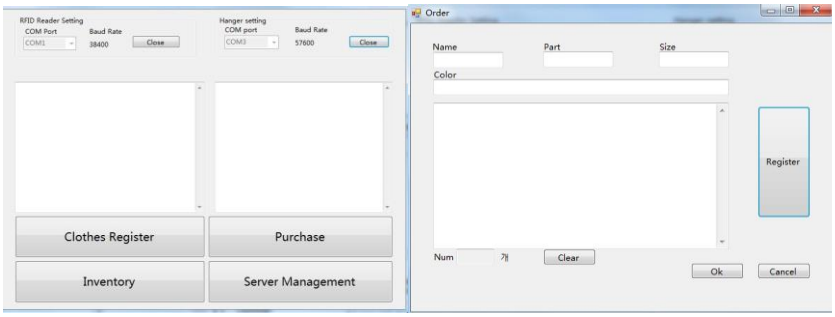
command	content
0x0010	RFID Reader read
0x0020	smart hanger LED open
0x0030	Module state sending each hour

Table 3. Server to smart RFID hanger

command	content
0x0000	smart hanger initialize
0x0001	RFID reader read
0x0002	smart hanger LED open

3. Software

3.1. Server Software



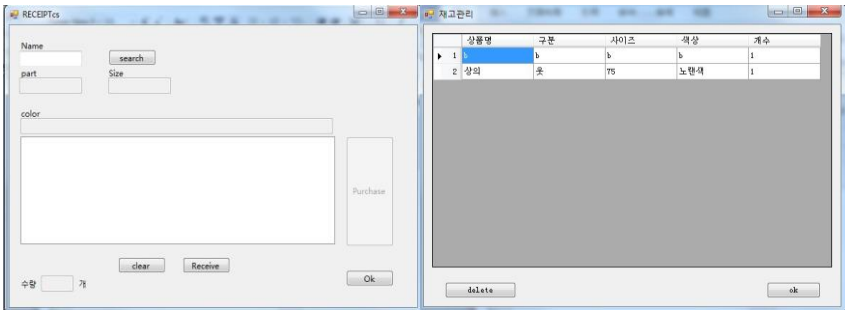


Figure 9. Data Centre Software Interface

Server software help server computer to register the clothes ID and send open LED command to help find the clothes. All the registered data can be checked on line. Each clothes only have one ID [3]. Figure 9 shows the data centre software interface and Figure10 shows the server software online function. When RFID hanger is touched, the display device will show like Figure 11.

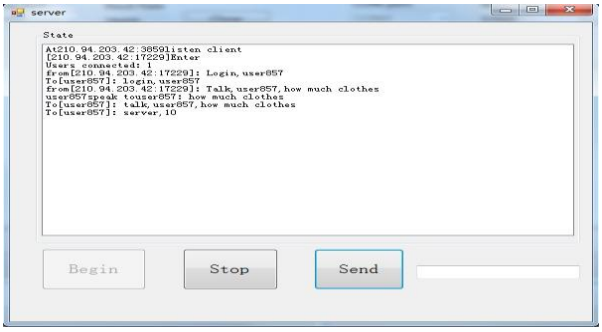


Figure 10. Server Software Online Function

For this function server manager can exchange information to any department online. If server manger send some special command such as “01” “02”, display computer will show the pictures like Figure 11. (Send “01” is just a simulation when RFID hanger is touched).

Figure 11. RFID Display Computer

3.2. Sub software

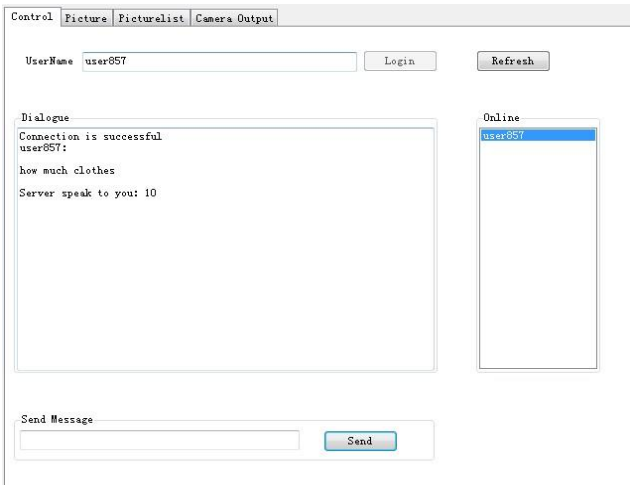


Figure 12. Sub Software Interface

The sub software can communicate with server software and each display computer at the same time. It is very convenient to keep real-time communication. The customer can see the new arrival clothes such as Figure 13 at real time.

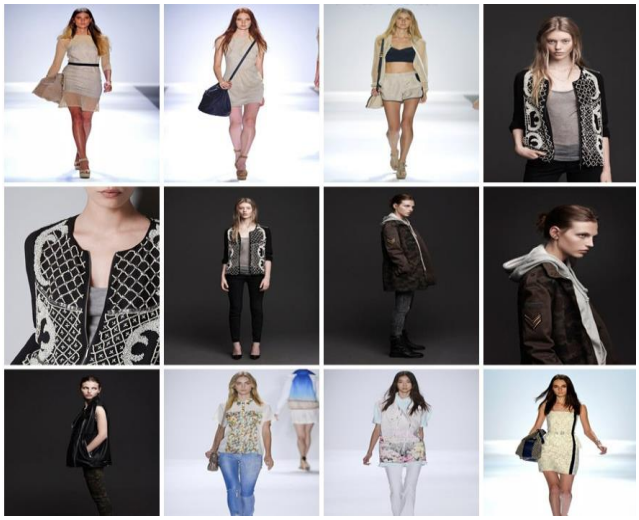


Figure 13. New arrival at sub software

For the unmanned clothing stores, we will try to combine our smart RFID hanger with new virtual technology. Figure 14 shows the smart fitting room. After customers choose their satisfied clothes, they just need to click the cloth they chose. The projector will show whether the cloth is suitable. Then the smart RFID hanger can react immediately and open the led. The customers don't need to wait anymore.

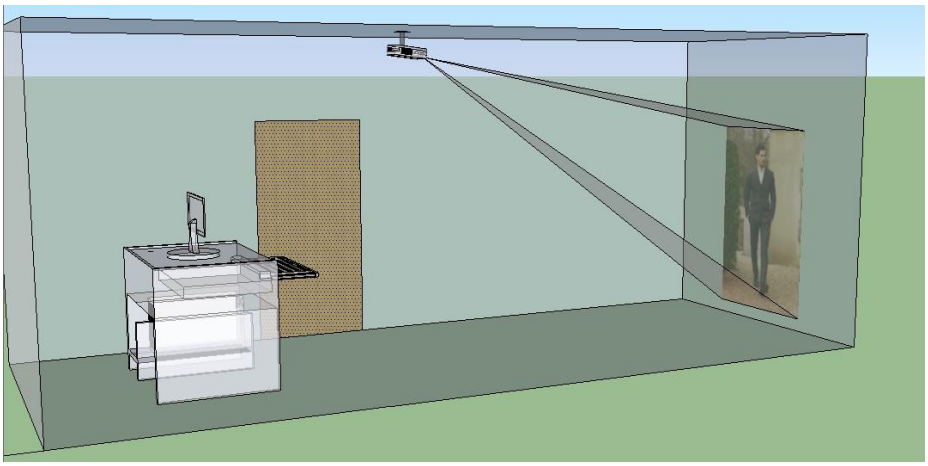


Figure 14. Smart Fitting Room

4. System Processing

4.1. Smart clothes management flow

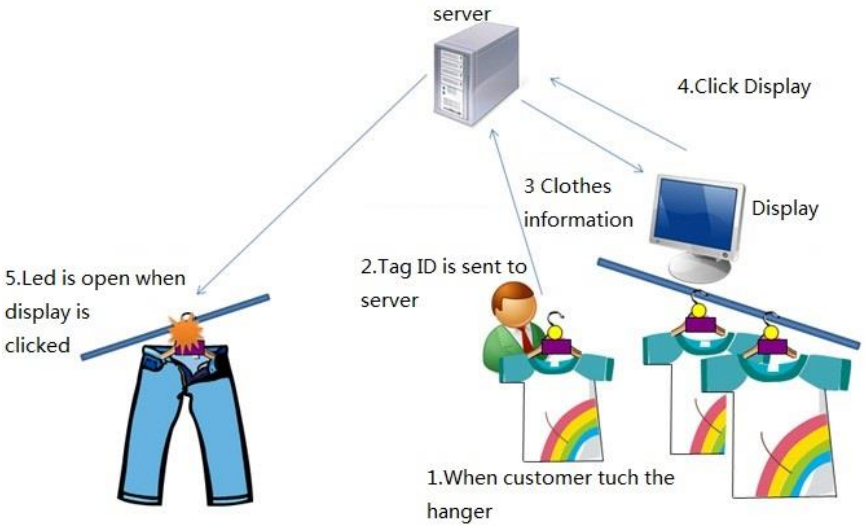


Figure 15. Smart clothes management flow

1. The customer chooses the cloth.
2. When the hanger is touched, Smart RFID hangers read the tag ID of the chosen cloth and send it to server.
3. Server processes this information and sends it to the display.
4. The customer views the recommended information of display then makes a selection.
5. Server sends this information to the smart RFID hanger, the LED of hanger will open.

4.2. Clothes searching flow

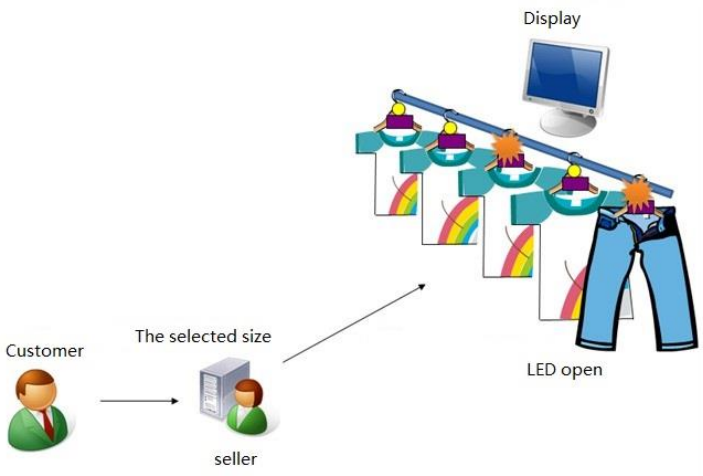


Figure 16. Clothes Search Flow

1. All the clothes information is stored in the database of the server. When customer gives the size demand to the seller, the seller searches the right cloth at server.

2. Server opens the LED of the smart RFID hanger. Another way is customer choose the recommended cloth on the display. Server open the recommended hanger's LED.

Customers visit cloth store in order to buy beautiful clothes. The system we proposed gives customers more choices and more convenient. Operator attaches RFID tags on the clothes and then use the server software register every cloth. All the information will be saved at data centre. Users can find their favorite clothes on line also can see the clothes details when they lift up the hanger. For the sellers, staff can exchange sale information with each other online. For the customers, they can use face detection function to choose their satisfied clothes.

5. Experiment

Our experiment was set-up like Figure 17, the tag was attached on clothes, and then the clothes were arranged in a line. Figure 18 shows the consumption of the communication module. We have done the experiment on the reading range of the RFID hanger, and the communication range between the display computer and the RFID hanger. Table 5 shows the test result.

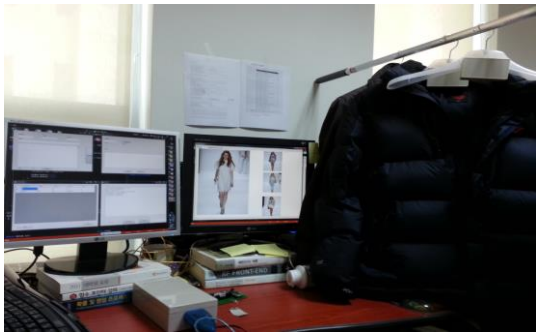


Figure 17. System for implementation

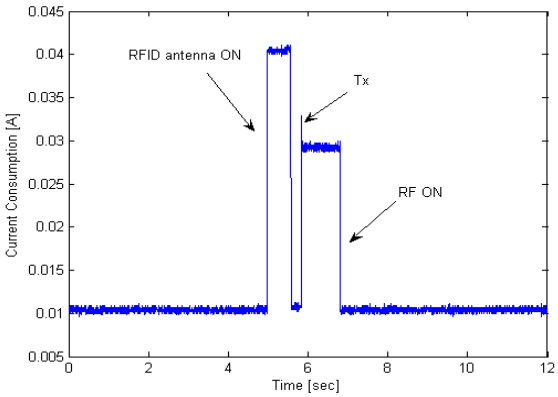


Figure 18. Low power consumption

Table 5. Experiment result

Distance(m)	PRR(%)	Current consumption of Smart RFID hanger	Life time of Smart RFID hanger	Response time of RFID reader
10	100	Less than 40mA	More than18 months	Less than 1 Second
20	100	Less than 40mA	More than18 months	Less than 1 Second
30	100	Less than 40mA	More than18 months	Less than 1 Second
40	99	Less than 40mA	More than18 months	Less than 1 Second

6. Conclusion

In this paper, we proposed the design of smart management system for unmanned clothing stores. The proposed system consists of smart RFID hanger, wireless communication module, display device, Winform software and server. The smart RFID hanger consists of MCU, RF chip, display LED, RFID reader, RFID reader antenna, ring sensor and battery. The reader has an ATmega 8 chip and EM4094 chip. The reader reads tags at 13.56 MHz and read range are about 180mm. The wireless communication module use Msp430 and CC2420 chip to keep a communication within 60m. The display devices displays the information received from the server, and receives customer input via the touch screen are sent to the server. In order to verify the effectiveness of proposed system, we have done the experiment. The experimental results confirm the excellent performance of the proposed system as shown below:

1. Less than 40m the accuracy average is 99.75%.
2. Smart RFID hanger power consumption is less than 40mA.
3. The life time of smart RFID hanger is more than 18 months.
4. The average response time of RFID reader is less than 1 second.

Acknowledgements

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