A Healthcare Laundry Management System using RFID System

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Abstract

This paper presented the use of Ultra-High Frequency (UHF) Radio Frequency Identification System (RFID) for laundry management system in healthcare. The laundry management system is designed to detect, count, record and report the laundry process from washing, drying, ironing, folding, and packaging. The laundry management system is consisted of the waterproof RFID laundry tags, RFID reader and the data recording system which was build using Visual Basic and Microsoft Access software. In this project, the users will be able to monitor the process of the hospital's linen which includes the pillowcases, bedsheets, towels, and other hospital linens. The advantage of using this laundry management can reduce the human error of missed count the items and also to ensure smooth laundry item cleaning process to be executed. The database recording system allows the user to monitor the number of in and out item processed at the laundry. As the items passed though the RFID reader, they will be automatically detected by its unique ID of each item. The database recoding system will display out the number of RFID tag detected at one time and store it into the database. The RFID reader is placed at the entrance of different processing area. Therefore, the user will be able to monitor the status of certain linen items. From the database recording system, users will be able to check for any missing linen along the cleaning process. For the laundry operator who serve for more than one hospital, this laundry management system can help reduce the possibility for different linen from different hospital to be mixed. The database recoding system presented in this paper is able to reduce the human error, effective and systematic compared to the traditional laundry counting and recording system. This laundry management system also can be used for hotels laundry management for the linen that can be tagged to prevent the loss of items such as towels, blanket, and curtains.

Keywords: Visual Basic, laundry system, UHF RFID, laundry tagging multiple scanning;

1. Introduction

Laundry services comes in three forms; self-service, drop off and big scale laundry. This paper presented the laundry management system for large scale application with capacity load more than thousands of linen operation which includes the washing, drying to folding section. According to the research presented in Ref. 1, the development of laundry-work assistance robot by using internet of thing (IoT) technology introduced a robot that able to do some tasks such as drying and taking in the items. There are three main function of the robot such as rain prediction, taking in the laundry automatically and control the operation with the smartphone. Ref. 2 presented the use of washable RFID tags to manage the laundry process effectively. The washable RFID tags used to identify the items and it will attach to the items. After the RFID attached to the item, the items will store in the storeroom. Next, the items will send to the laundry shop for the cleaning process. When the cleaning process is done, the clean item will send back to the shop. Once the clean items reach the shop, the staff will remove the

RFID tag from the items and wait the customer come and collect the items.

The cost is depending on the capacity of the machine used by the them. The drop off laundry is a bit pricey because the whole process was done by the laundry's staff. Plus, its also includes ironing service to the customer. While, the big scale laundry is focusing on the tons of clothed to be cleaned. Its normally comes from the hospitals and hotels to washes the pillow case, bad sheet, blankets and many more. Either the drop off or big scale laundry, in order to make sure the cleaning process can be done in allocated time, the laundry required to have a practical and efficient laundry management system[3].

A laundry management system is a management system that able to run the working flow smoothly to the laundry store such as washing status, count the dirt clothes and billing system. This system mostly done by the manpower resource. According to the research, most of the traditional laundry management is using the manpower to complete the task such as count the clothes and calculate the fees manually. Therefore, this system is not stable and efficient because the manpower resource able to create mistake and failure easily. For example, the staff miscount or overcount the quantity of the clothes. In this generation, some of the system are using the barcode or RFID label to identify and monitor the washing clothes to increase the efficient and prevent miscount. Thus, the system with barcode or RFID provided a lot of benefit compared to the traditional system such as reduce the manpower and so on. This project is using the ultra-high frequency radio-frequency identification (UHF RFID) allow the system becomes smarter than the traditional system. In this system, there are three UHF RFID reader used for this system. Fig.1 shows the flow of the laundry management system presented in this paper. Multiple reader will be used to represented each different stages of washing, drying and folding process. Then, the hardware will send the data as a signal and recorded into the database. If the user required to check the data, the system allow the user to check the data. Therefore, if the system displayed there are some towels are missing then it will instantly proceed to the customer service for assistant. Last, if there is zero missing the system will proceed to payment option.

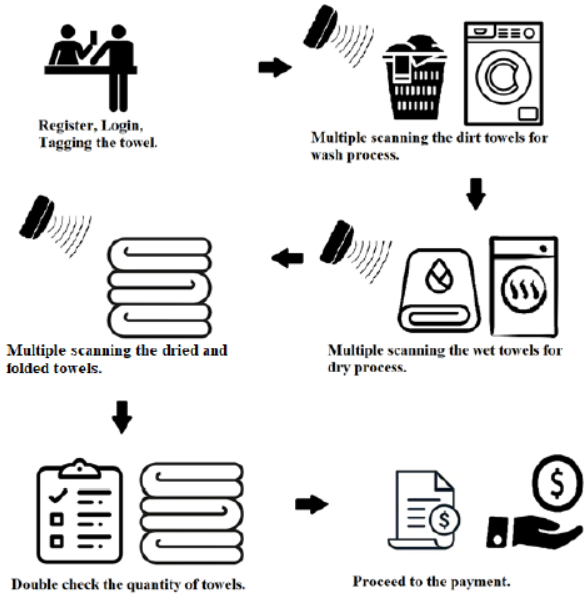

Fig. 1: Laundry Management System using Multiple RFID Reader

2. Methodology

Firstly, the main objective of this project to use the UHF RFID device for multiple scanning. A RFID device to two object which is the reader and the tags. The reader has its own antenna that's works by detecting any tagged items around a certain area typically three to four meters depending on the RFID frequency. The reader is connected to PCs to display and store the information received. The tags are the small components that was attached to the towels. Each tag comes with a specific ID which stored in the small chips. User can read and write the data from the tag's chip if they are within the reading range. In this project, UHF RFID system is used due to its wide reading range. This will benefit to the system because the users might need to detect hundreds of items at one time. Next, the system interface implemented and created to read and items passing through the RFID reader. The system interface created and designed by the Visual Basic language. The tags detected by the reader then it will send the data signal to the computer program for data processing. After data processing, the computer program will store the data to the database as a record. When the user wishes to check out the items then the computer will read the data from database and display out the result for the user.

2.1. *Hardware and Software Interface Integration*

The important items in this project are the tagged linen. Each individual items will be attached with the laundry tag which carry different identification number. The small chip installed in the RFID tag will store the unique ID which represent each individual items. The user may create their own serial number format to differentiate each item such as towels, bedsheet, pillowcase and more. Fig.2 shows the example of RFID tag placed on a towel. Laundry tag or textile tag are now available in the market with cost less then $2 each. They are reusable and safe to be use through the washing, drying, and ironing phase. However, there are some limitations of temperature and chemical to be used which may varied for different types of tag. This project will not further discuss on the durability of the textile or laundry tag but to focus on the implementation of this textile tag into the laundry management system. Therefore, the analysis of the tag durability will not be included in this paper.

Fig. 2: Textile RFID Tag placement on the towel

Next, the tagged linen will need to be visible to the reader to be identified. The placement of the reader needs to be accurately set up to ensure that all tagged items can be detected by the reader at the same time. Therefore, the selection of RFID reader is also important to be considered. In this project, the Mi-1802B RFID[4] reader with size of $440mm \times 440mm \times 50mm$ and average reading of $10ms$ per 64 bits is used. This reader is a long range type which can supports up to 6 meters reading range and supports multiple readers operation. The multiple reader is required in this project to differentiate each stage of linen processing area.

The third item which allows the system to well operated is the software or apps which was computed to read the data from the reader and transform it into a readable data to be stored into the database for further analysis or process by the user. In this project, the application was build using Microsoft Visual Studio with Microsoft Access integration to manage the data received by the reader. In this project, a simple interface system was built to project the number of items detected by the reader from each station. The system also will be able to display the missing items by comparing the detected linen from at the final stage to the initial stage.

Fig. 3 shows the example of missing linens calculated based on the initial number count of 114 linens from the washing and drying stage. At this point, user can start to investigate for the missing linens.

Fig. 3: Linen detection at final stage

This interface is to check the quantity of the towels if the number of the towels are not missing then the user can proceed to the payment option. There are four buttons for this interface. The first button is the 'Get Data', it used to obtain the data from 'Washing', 'Drying' and 'Folding' interfaces. In the same way, the 'Insert' button is to save and record the data to the database. Else, the data of the real date and time and the number of washed, dried and folded towel will record and save into the database once the user click the button. Moreover, the 'Compare' button is to display and calculate the data of the washed, dried and folded towels. The software interface also allows the user to check the status for each stages to see the current number of item being wash, dry or fold accordingly as shown in Fig. 4.

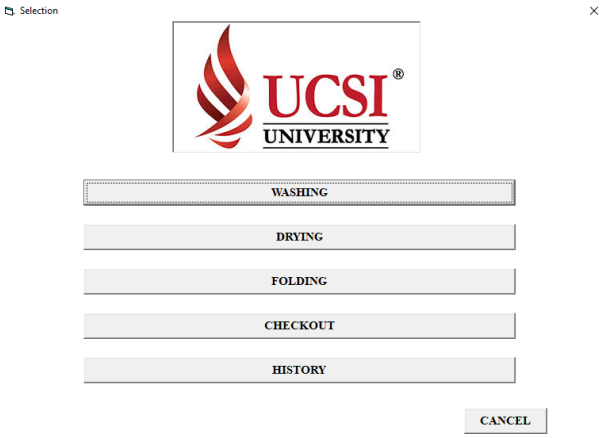

Fig. 4: Selection of individual stage of linen process

When the linens passed through the reader form one section to another, the data will be automatically recorded. The scanning time usually takes 3-5 seconds to scan 100 towels. The display will display out the number of units, scanned time and the identity of the RFID tag. The 'Tag Count' will count the number of the tagged towels. The counter in the software interface has been programme to count the items with the same ID as one. Therefore, duplication of linen counts which may lead to false count can be avoided.

3. Reader Setup Analysis

The unique feature of contactless detection between the RFID reader and tagged items makes RFID as a very useful system. In addition, the ability to detect multiple items in one second proved that this RFID system can provide better service compared to single item scanning system. However, the reading distance and angle are depending on the surrounding and tagged items. Reflector object such as metal or absorber material such as water are not a good friend to RFID system. Both types of material can degrade the performance of the reader[5]. The scanning angles played the significant role in this system. Different angle will have different reading distance. In this project, there are three different angles tested which are the top corner, top and left scanning angle as shown in Fig. 5. In this testing, the UHF RFID need to scan 100 unit of towels with different angles and compare the result. The washable RFID tags will be placed at the corner of the towels. The 1420mm x 420mm x 1190mm size trolley was filled with 100 units towels.

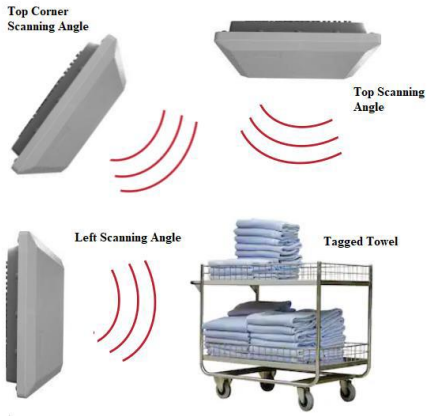

Fig.5: Towel scanning at three different angles

Table 1 shows the result of scanning at three different angles. The best detection was measured when the reader is place on above the trolley at a distance of 700 mm with detection rate of 99-100% while the left and top corner angle gives lower detection rate of 96-98%. The failed detection might be due to the position of the towel on the trolley, speed of the trolley while passing the reader or the thickness of the towel to reach each layers of towel.

Table 1: Analysis of detection rate for 100 towels at three different angles.

Type of Scanning Angle	First Scanning	Second Scanning	Third Scanning	Overall Rate (%)
Top Corner	95	96	98	96.33
Left	97	97	96	96.67
Top	99	100	99	99.33

4. Conclusion

In the conclusion, the simple and efficient software and hardware integration for the laundry management system using RFID application has been developed. The database included in the software interface can be further utilize for advance purpose such as to generate the invoice for the linen owner. The stability of the linen detection has been conducted and the reader detection from the top of the stacked linen is the best setup. This laundry management system using RFID system presented in this paper can also be use at the hotel to prevent any lost of the towels or others valuable items. For laundry application, this system can be further

improved by developing the mobile apps for the user and the linen owner to monitor the linens cleaning process.

5. References

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