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APPLICATION OF THE INTERNET OF THINGS IN SMART LAUNDRY

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Abstract

The service system for every laundry in every area is currently still done manually, this is considered less efficient because the waiters are often confused when looking for clothes that a customer wants to pick up. Then waiters sometimes forget to give information to customers to pick up clothes that have been washed. This becomes a problem where customers have to go back and forth to ask whether their clothes have been washed or not. Smart laundry is a form of implementation whose main objective is to help customers find out which clothes are ready to be picked up and can help waiters find out where the customer's clothes are. RFID tags for customers who are registered as members of the laundry service are used as a tool to store customer data when the customer brings clothes to be washed and to find out where the customer's clothes have been washed when the customer picks up the clothes. This research also uses the QoS (Quality of Service) method to measure the delay parameters produced in the network used. The results of testing that were carried out 35 times in this research resulted in a delay of 0.956458 seconds. From the test results, the maximum reading distance between the RFID tag and the RFID reader is 3 cm. From the results of 10 trials, the percentage of system success in sending notifications in the form of clothes that have been completed and ready to be picked up to customers is 80% and system failure in sending notifications is 20%.

Keywords : **RFID, WhatsApp, Wemos D1 ESP8266**

INTRODUCTION

Busy work or other activities mean that people don't have much time to wash, dry and iron their clothes. Therefore, clothes washing services or what is usually called laundry is a means to help someone with their work in washing, drying and ironing clothes. In every city, even in every urban area, there are many laundry services available. However, the services offered are still manual, for example providing information for picking up clothes that are ready to be picked up, and laundry staff who are confused about finding clothes that are ready to be picked up on the laundry rack. Along with the rapid development of technology, especially in the field of information technology, the impact on daily life is increasing. One of them is using the Internet of Things (IoT) model which can be used to make it easier for users to find out which clothes have been completed and are ready to be picked up. The tool in question is a laundry controller.

Based on this problem, research was conducted with the title "Application of the Internet of Things in Smart Laundry" where the system was created using RFID (Radio Frequency Identification). This system will detect the presence of clothes on the laundry rack by using RFID tags at the laundry service. The system can also send notifications to the customer's WhatsApp application if the clothes are finished and ready to be picked up. The preparation of this final assignment took several references from previous research, including journals related to this research. Research conducted by Grislend Gloria Natalies, Denny Darlis, and Suci Aulia (2014), with the title "Implementation of a Clothing Identification System Using RFID and SMS Notifications in Laundry Services". In this research, a clothing identification system was implemented using RFID and SMS notifications. This system uses an RFID LAUNDRY TAG which is installed on each customer's clothing. Furthermore, the clothes will be identified by the RFID Reader when the customer submits the clothes to be washed. After being identified by the RFID Reader, the microcontroller will process the ID and store the data in the database provided.

Based on the test results, this system can identify clothing with an ID reading success percentage of 100%. The average time required for the system to send SMS notifications to customers is 30 seconds. [1].

Other research was also carried out by Novi Yanti (2018) in her final project entitled "Design of a Library Book Layout Detection System Using WEB-Based RFID". In this research, RFID technology was used to detect the location of library books. Based on the results of this research, it is. Network quality during this test was very good with an average value obtained from Packet Loss of 0% for tests with and without barriers, Delay of 114 ms for tests using barriers, and 142 for tests without barriers. throughput value is 2411 bps for testing using a barrier, and 4112 bps for testing without a barrier. And the jitter value is 116 ms for testing using a barrier, and 141 for testing without a barrier. [2]. Another research was conducted by Christian Yacob (2018) in his final project entitled "RFID-Based Vehicle Position Prediction System in Parking Areas". In this research, RFID technology is used to predict the position of vehicles in a very large parking area. The size of the parking area and the large number of vehicles in the parking lot are obstacles for car drivers to know or find the location where the driver has parked the vehicle and the empty parking space. Based on the results of this research, namely predicting the position of vehicles in the parking area based on RFID using an Arduino Mega 2560 microcontroller and RFID as a UID reader which has an RFID tag, the RFID tag is used as a replacement for a ticket and a serial cable is used as a replacement for WiFi. empty and empty parking space data is displayed on the LCD at each block door. The results show that the success rate for sending UID data and reading UID data reached 100%, the empty parking space reader reached 100%, and the RFID information test failed because the Arduino program was not yet functioning. Overall testing reaches 80%, user data is displayed in the Visual Studio application. [3].

Another research conducted by Muhammad Nasir, Usmardi, Rachmawati, and Fachri Yanuar (2019) with the title "Lecture Attendance Monitoring System Using Raspberry Pi Based RFID". In this research, RFID was used for lecture attendance. The application of RFID technology to the student attendance system uses an RFID card which functions to send information codes and read input data using the RC522 module. Then the RC522 module will be read and processed by the Raspberry PI B+. This attendance system application was created using the Python and PHP programming languages. Based on test results; The maximum detection distance for a student's RFID card to the RC522 module is 4-5 cm. This research also uses the QoS (Quality of Service) method to measure the delay parameters produced in the network used. The results of the tests carried out in this research at a distance of 1-7 meters resulted in very good signal quality with an average delay of 80 ms. [4].

In this research, a design will be created to create a Smart Laundry system using RFID (Radio Frequency Identification). When a customer brings clothes to the laundry, the customer data will be stored in the admin database using the customer's RFID tag. If the customer's clothes are finished and ready to be picked up, the system will send a notification to the WhatsApp application. The system can also notify the whereabouts of customer clothing using RFID tags.

METHOD

The research method used is: (1). Literature study, at this stage a search is carried out on various types of literature such as books, scientific journals, references both through libraries and the internet and so on which are related to the title of this research. (2). System Framework. From the results of the literature study, an IoT system framework for smart laundry using Wemos D1 (R1), (3) will be designed. System Testing, at this stage, is testing the system commands in sending notifications to the WhatsApp application and the delay on a network when sending notifications, (4). Conclusions are drawn to see the results of the system testing that has been carried out

A. Hardware Requirements Analysis

Hardware requirements in designing this system are as follows:

1. Laptop or PC
2. Wemos
3. RFID Tags

4. RFID Reader

B. Software Requirements Analysis

The software requirements for this system are as follows:

1. Arduino IDE Software
2. WhatsApp application as recipient of information
3. Notepad++
4. PhpMyAdmin
5. Xampp

C. System Block Diagram

The block diagram or description of the system design can be seen in Figure 1

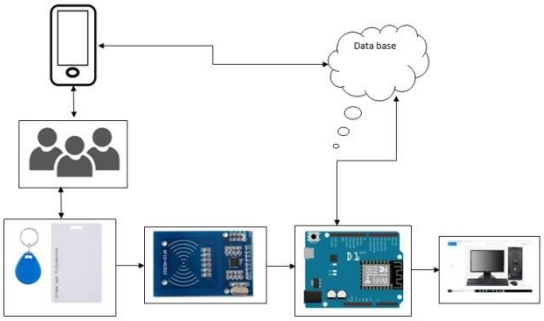

Figure 1. Block Diagram

D. Use Case Diagrams

This diagram depicts a collection of use cases, actors and their relationships. Use case diagrams are modeling to describe the behavior of the system that will be created to describe an interaction between one or more actors and the system that will be created. The system use case diagram can be seen in Figure 2.

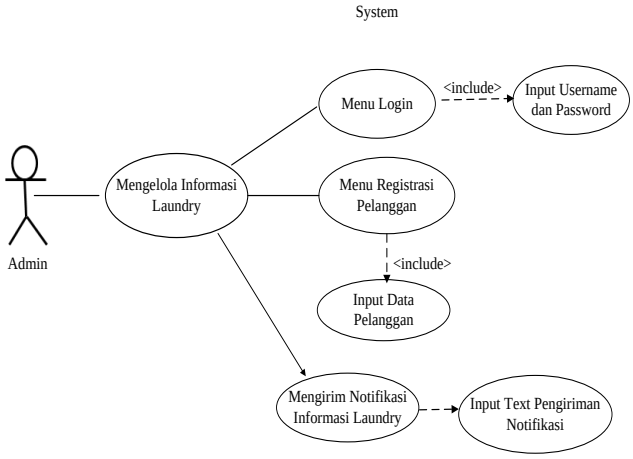

Figure 2. Use Case Diagram

E. System Flowchart

1. Flowchart displays information on RFID readings.

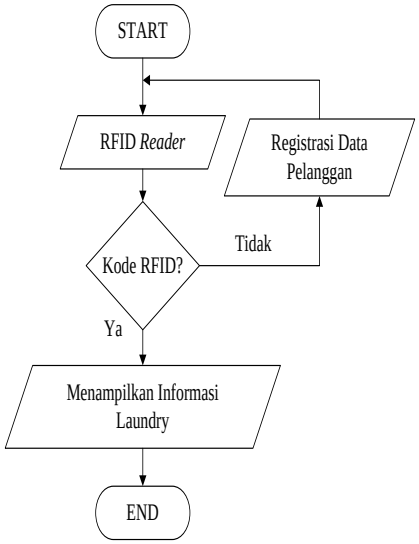

Figure 3. Flowchart displays RFID tag reading information

2. The flowchart displays the search for information on the whereabouts of clothing

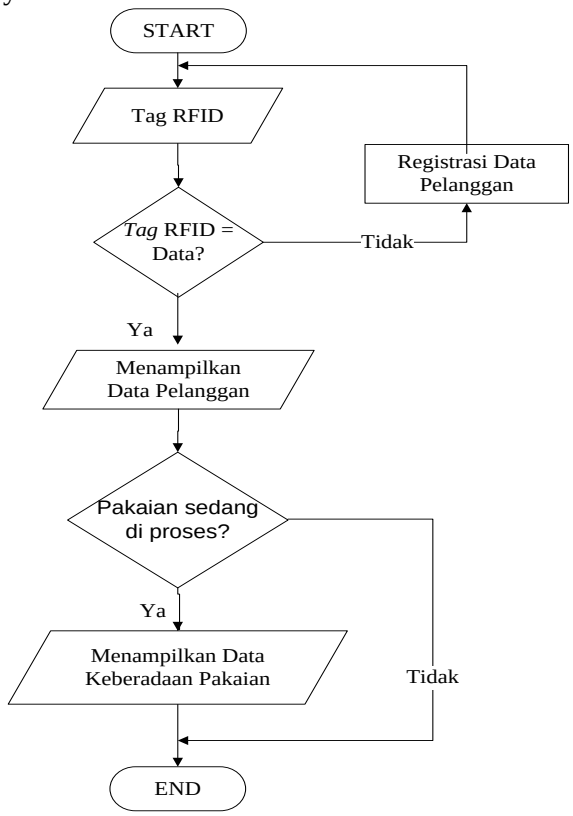

Figure 4. Flowchart showing the search for information on the whereabouts of clothing

3. Flowchart sends laundry information notifications.

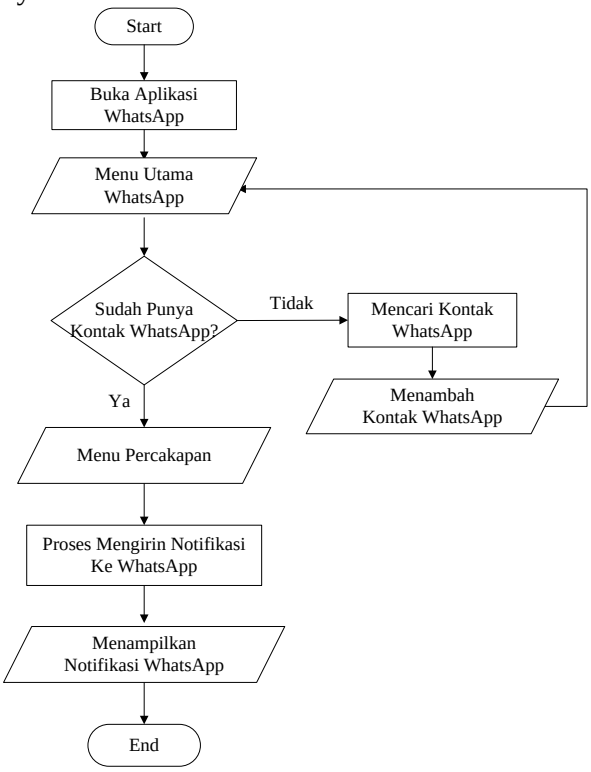

Figure 5. Flowchart of sending laundry information notifications

F. User Interface

1. Login Page

This page is designed to enter the laundry service system by entering the username and password which can be seen in Figure 6 below.

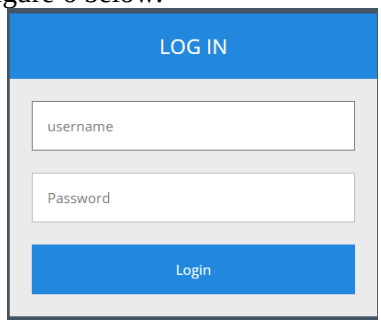

Figure 6. Login page

2. Customer Data Registration Menu Page

This customer registration form is used to register or input customer data via RFID tag ID. The display of the customer registration form can be seen in Figure 7 below.

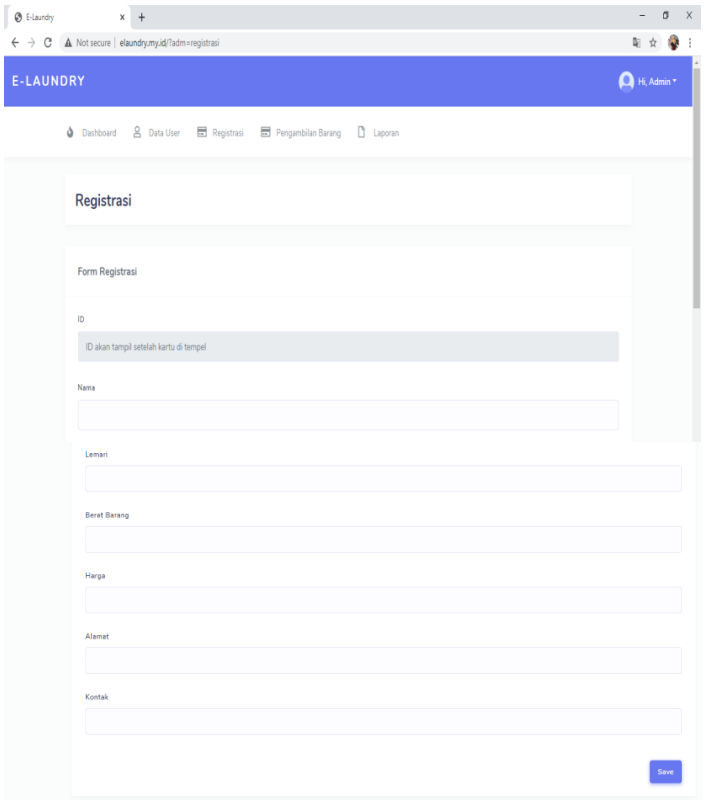

Figure 7. Customer Data Registration Menu Page

3. Read Tag ID page

In this ID tag read form, we can find out customer data and find out where the customer's clothes are in the laundry wine. The display of the ID tag read form is the result of the user interface design in Figure 8 below.

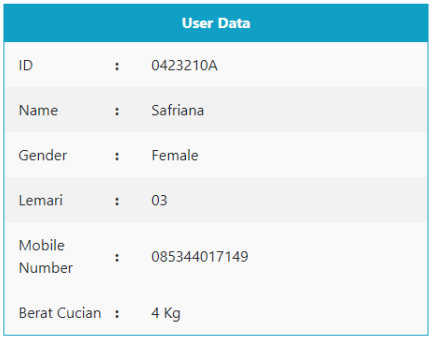

Figure 8. Information display on the whereabouts of customer clothing

RESULTS AND DISCUSSION

A. Testing RFID Tag Reading by RFID Reader Before Connecting to the Application.

After all the devices are connected to the computer, the next test will be to see the level of success of the system being carried out, namely during the process of reading the RFID tag by the RFID reader before connecting to the application. The results of the RFID tag scanning process on the Arduino Uno IDE serial can be seen in Figure 9 below.

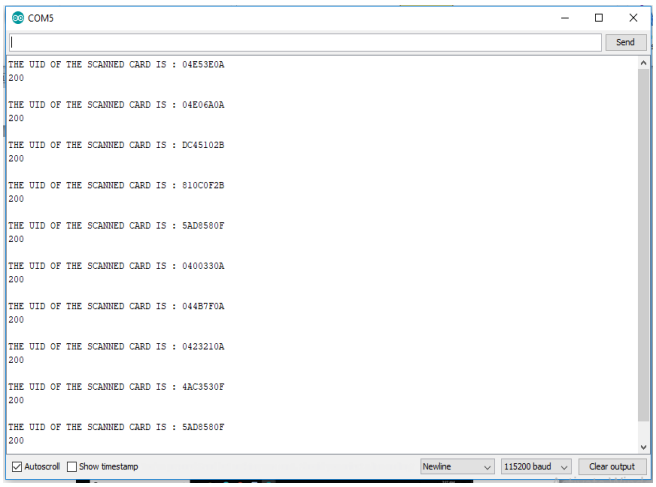

Figure 9. Reading RFID tags by RFID Reader

B. Implementation of WhatsApp Notification Display

The application used to receive information that the customer's clothes have been completed and ready to be picked up is the WhatsApp application. Where Telegram will receive a message sent by the laundry admin in the form of clothes that have been completed and are ready to be picked up. The WhatsApp notification display can be seen in Figure 10 below.

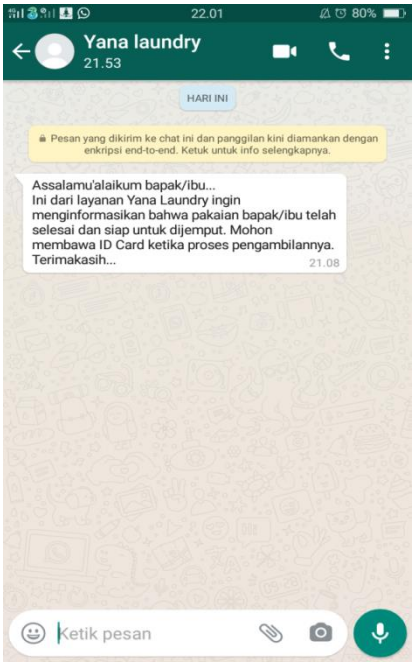

Figure 10. WhatsApp Notification Display

C. Test Results Data

1. RFID Tag Reading Testing With an RFID Reader

TABLE I
TESTING RESULTS FOR READING RFID TAG WITH RFID READER

ID Card	**Information**
04E53E0A	Detected
04E06A0A	Detected
DC45102B	Detected
810C0F2B	Detected
5AD8580F	Detected
0400330A	Detected
044B7F0A	Detected
0423210A	Detected
4AC3530F	Detected
5AD8580F	Detected

2. Testing RFID Tag Reading Distance by RFID Reader

TABLE II
RESULTS OF MEASUREMENT OF RFID TAG READING RANGE WITH RFID READER

Distance	**Information**
0 cm	Detected
1 cm	Detected
2 cm	Detected
3 cm	Detected
4 cm	Not detected
5 cm	Not detected
6 cm	Not detected
7 cm	Not detected
8 cm	Not detected
9 cm	Not detected
10 cm	Not detected

3. System Error Testing and Clothing Notification Accuracy

TABLE III
SYSTEM ERROR TESTING RESULTS AND APPEARANCE NOTIFICATION ACCURACY

Testing To	Time	WhatsApp Notifications	*Error* (%)	Accuracy (%)
1	03.30	Sent	20%	80%
2	03.32	Not sent		
3	03.35			
4	03.36			
5	03.38	Sent		
6	03.39	Sent		
7	03.40	Not sent		
8	03.45	Sent		
9	03.47	Sent		
10	03.48			
Average system error and system accuracy			20%	80%

Based on table III, testing system errors and system accuracy in sending notifications that the customer's clothes have been completed and are ready to be picked up on the WhatsApp application, we found an error of 20% and system accuracy of 80%. The percentage of system errors is obtained using the formula:

$$\text{Average error} = \frac{\text{Total } Error}{\text{Total Uji}} \times 100$$

$$= \frac{2}{10} \times 100$$
$$= 20\%$$

4. Delay Testing Data

This test is carried out to determine the delay that occurs on a network. Data from the results of testing a network's delay can be seen in table IV below

TABLE IV
DELAY TESTING

No	Package Sent Time	Package Received Time	Time Delay
1	0.000000	0.011858	0.011858
2	0.996380	0.11092	-0.88546
3	1.002267	0.013530	-0.988737
4	1.000750	0.011617	-0.989133
5	1.005645	0.012053	-0.993592
6	1,000192	0.012603	-0.987589
7	1.004922	0.012191	-0.992731
8	1.002153	0.011851	-0.990302
9	1.003647	0.014247	-0.9894
10	1.001353	0.011367	-0.989986
11	1.004743	0.011012	-0.993731
12	1.004781	0.011292	-0.993489
13	1.001456	0.012115	-0.989341
14	1.003548	0.014232	-0.989316
15	1.002114	0.020872	-0.981242
16	0.988274	0.012001	-0.976273
17	1.002492	0.012819	-0.989673
18	0.999771	0.011679	-0.988092
19	1.003113	0.011631	-0.991482
20	1.003502	0.012787	-0.990715
21	1.006048	0.012452	-0.993596
22	0.995971	0.012809	-0.983162
23	1.018525	0.011696	-1.006829
24	0.998055	0.012849	-0.985206
25	1.000324	0.013425	-0.986899

26	1.000304	0.013045	-0.987259
27	1.001229	0.013865	-0.987364
28	1.000416	0.013437	-0.986979
29	1.001023	0.016264	-0.984759
30	1.000686	0.012563	-0.988123
31	0.998721	0.012662	-0.986059
32	0.998337	0.013786	-0.984551
33	0.997922	0.012423	-0.985499
34	0.998580	0.019904	-0.978676
35	0.984620	0.011950	-0.97267

So to calculate the average delay for a network, you can use the following formula:

$$Rata - Rata\ Delay\ = \frac{Total\ Delay}{Total\ uji}$$

$$Rata - Rata\ Delay = \frac{-33.476057}{35}$$

= 0.956458 seconds

So the average delay resulting from a network is 0.956458 seconds

CLOSING

The conclusions that the author can conclude after conducting research regarding the application of the internet of things in smart laundry are:

1. The tag scanning process cannot be done all at once, this is because the system cannot read the tags simultaneously.
2. The working process of the smart laundry system when reading the RFID tag card by the reader can work well and the process of reading the RFID tag when the customer wants to pick up finished clothes and to find out the whereabouts of the customer's clothes runs well when viewed from the functional aspect of the system.
3. The maximum reading distance between the RFID tag and the RFID reader is 3 cm. The percentage of system success in sending notifications in the form of clothes that have been completed and ready to be picked up by customers is 80% and system failure in sending notifications is 20%.
4. The result of testing the delay that occurs in a network is 0.956458 seconds

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