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# Design and Implementation of Slipper Loan and Safety Systems Using Ultrasonic Sensors and Internet of Things Based RFID Sensors

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**Abstract**

The comfort of the mosque is a top priority, so visitors feel comfortable when praying. For example, borrowing sarongs and safety sandals still uses a manual system. Borrowing mosque sarongs, for the most part, cannot known how many of them are available, and the safety of the sandals makes it familiar for visitors to exchange sandals and even lose their sandals. So digitization is needed as displayed on the LCD screen or website in designing this system, using the prototype method to detect system errors more quickly. In addition, this system was built using the PHP language with a more flexible website appearance and testing using a black box. So that by making this system, mosque visitors become more comfortable in carrying out worship.

**Keywords**: *Website, Internet of Things, Ultrasonic Sensor*

***Abstrak***

*Kenyamanan masjid menjadi prioritas utama, sehingga pengunjung merasa nyaman saat beribadah. Sebagai contoh, peminjaman sarung dan sandal pengaman masih menggunakan sistem manual. Peminjaman sarung masjid, sebagian besar tidak dapat diketahui berapa jumlah yang tersedia, dan pengaman sandal membuat pengunjung tidak jarang tertukar bahkan kehilangan sandal. Sehingga diperlukan digitalisasi seperti yang ditampilkan pada layar LCD atau website dalam perancangan sistem ini, dengan menggunakan metode prototype untuk mendeteksi kesalahan sistem dengan lebih cepat. Selain itu, sistem ini dibangun dengan menggunakan bahasa PHP dengan tampilan website yang lebih fleksibel dan pengujian menggunakan black box. Sehingga dengan dibuatnya sistem ini, pengunjung masjid menjadi lebih nyaman dalam menjalankan ibadah.*

***Kata-kata kunci***: *website, Internet of Things, Sensor Ultrasonik*

## 1. Introduction

Indonesia has a population of 273 million people [1]. With various races, ethnicities, cultures and religions, Indonesia has multiple handicraft products [2]. Sarong is a handicraft product often used to cover the stomach to the ankles when carrying out worship [3]. In addition, based on the data obtained through the questionnaire, sarongs are necessary when on long trips, because many people rely on sarongs provided at every mosque. In addition, the results of the data obtained based on the questionnaire to the respondents said that the facilities that need to be improved at the mosque are the safety of sandals. The security of sandals is a major problem in mosques because several mosques in each region have the same problem, namely the frequent exchange of sandals and even loss of sandals [4]. This needs higher dals to have a low level of security. In addition, the facility that needs to be improved at the mosque is the safety of sandals. Based on the data obtained with the questionnaire, visitors to the mosque in several places where they live often exchange sandals and even lose sandals. Because sandals have a low level of security, the facility that needs to be improved at the mosque is the safety of sandals. Based on the data obtained through questionnaires, visitors to the mosque in several places where they live often exchange sandals and even lose sandals. Because sandals have a lower level of security.

From the problems above, researchers will make tools for borrowing sarongs and the safety of sandals. With the title "Design and implementation of a system for borrowing gloves and sandal security using Ultrasonic sensors and RFID sensors based on the Internet of Things.". Because in designing the system for borrowing gloves and the safety of sandals, researchers used ultrasonic sensors to obtain data on gloves. The sheath is then brought closer to the ultrasonic sensor. The reading results can be displayed on the LCD screen. Then the sandal security system uses an RFID tag as a digital identity. This is because RFID has unique codes stored on it each tag, so RFID is used to determine digital identity, such as for an SMS gateway-based attendance system [5]. So to find out the digital identity of sandals using RFID, where for the working system the RFID tag is brought closer to the RFID reader So that it can detect the digital identity of the owner of the sandals displayed through the website, to minimize the exchange of sandals, with this system, the authors hope to be able to overcome existing problems, especially in terms of borrowing sarongs and the safety of sandals.

## 2. Method

The method used by the author to conduct this research is the prototype method. The prototype method is chosen because it can detect system errors better and faster to find a way out or a solution to the problem correctly. In addition, the prototype method can interact between developers and users during system development activities [6]. Prototype method structure can be seen in Figure 1.

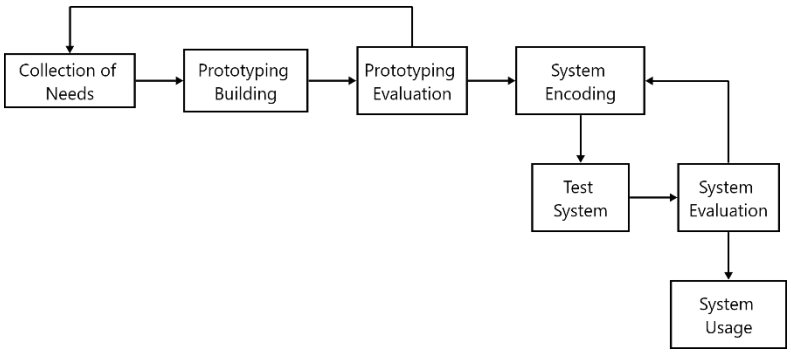



Figure 1. Prototype method structure

a. Collection of needs

The collection of prototype requirements for the system to be built is divided into two types: prototype requirements from the hardware side and prototype requirements from the software side. In the hardware section, there are use case diagrams and design schemes. Whereas in software, namely the website, which consists of website use cases, database table design, and website display design for designing Prototypes.

In building a prototype for a system for borrowing sarongs and safety for sandals, there are several parts needed in the design, such as use case diagrams, design schemes, databases, and website designs.

1) Use case diagram

The use case diagram is a description of the behavior of the system to be made. Use cases contain interactions between systems that will be made with one or more actors. The purpose of the use case is to find out what functions can be performed on the system [7]. In the use case, Figure 2 explains that users or visitors who will borrow a sarong can scan the sarong after taking or returning the sarong to the window display. Meanwhile, the system can display the number of available sarongs via the LCD screen.

In the use case, Figure 2 explains that visitors to the mosque who will leave sandals must scan the RFID as an identity on the owner's sandals and can register if the RFID tag has not been registered in the system. Meanwhile, what can be done for mosque officers is to set the mode on

the system of whether visitors will leave or enter and can control the security sandal website. Use case for borrowing sarongs and sandal safety can be seen in **Figure 2**.

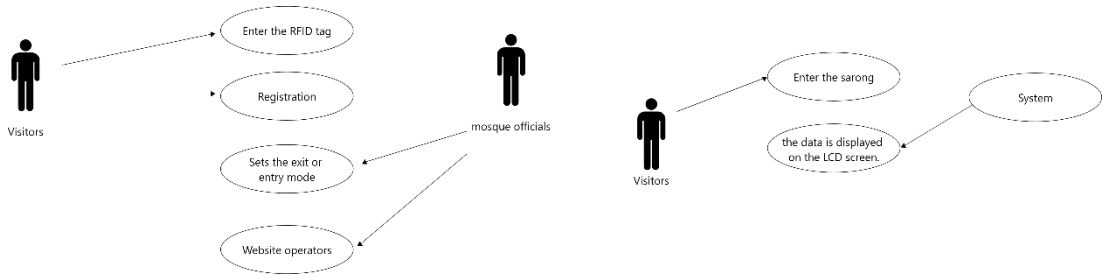



**Figure 2.** Use Case for Borrowing Sarongs and Sandal Safety

2) Design scheme

The design scheme is a design concept that can be evaluated before the system is created or further developed **[8]**. The schematic for designing the sarong and safety sandals borrowing system includes several sensors and electronic components, and a microcontroller. In **Figure 3,** the sheath lending system requires two ultrasonic sensors, Arduino Uno, and a 16x2 LCD screen. In this system, the ultrasonic sensor functions to add and subtract on the sheath, which is managed on Arduino Uno, and then the data that has been processed will be displayed on the LCD screen.

In **Figure 3,** the sandal security system requires several RFID tags, RFID readers, push buttons, NodeMCU, and a database. Each visitor to the mosque will have two RFID tags, one for the sandals and one for the owner's name. Which later can be brought closer to the RFID reader, who will read the results of the id tag to be managed on NodeMCU. Then the identity that has been detected will be stored in the database so that it can be displayed on the website. Schematic design of the sarong borrowing system and safety of sandals can be seen in **Figure 3**.

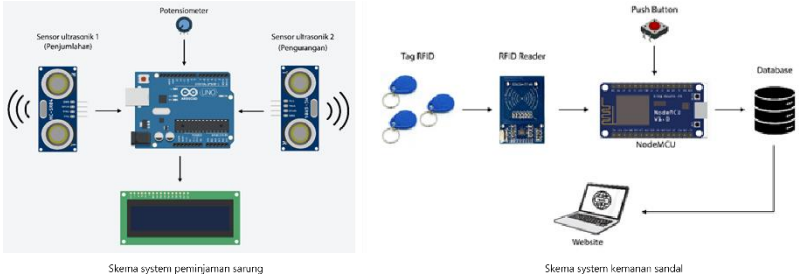



**Figure 3.** Schematic Design of The Sarong Borrowing System and Safety of Sandals

3) Database design

Database design is the design of storage areas and data sets that will later be logically connected between tables **[9]**. The database has a function to facilitate the process of identifying data by grouping data and storing it digitally **[10]**. **Figure 4** explains that the system will require

four tables, each with a primary key with different data types. As for the visitor, tmprfid, and sandal data tables will be correlated with the nokartu column. The status table functions as data storage with values one and two, where the meaning of mode one is the entry, while the meaning of mode two is the exit. Sandal security database design can be seen in **Figure 4**.

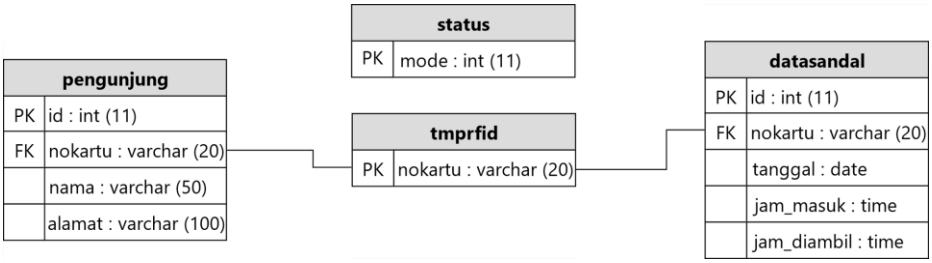
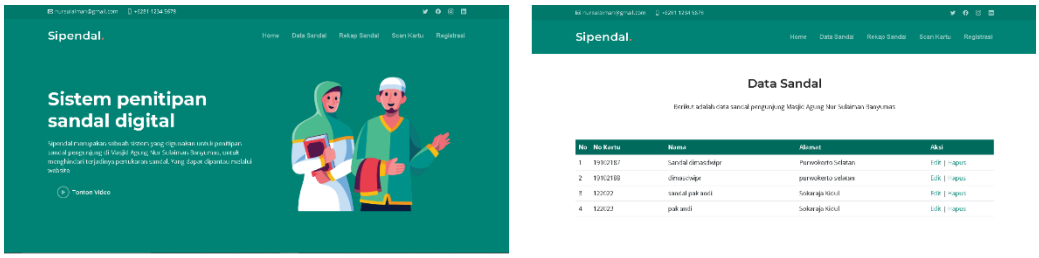



**Figure 4.** Sandal Security Database Design

4) Website display design

Design is a system of design types that focus on seeing all the problems that are not isolated [11]. The website display design for Sandal Security uses the PHP language with MySQL as the database. Mosque administrators can only control this website to discover the digital identity of the sandals of mosque visitors. The home page of **Figure 5** displays brief information about the mosque's history, and a description of the mosque and displays the sandals data registered with the system after scanning using an RFID tag. Home page design and data sandals can be seen in **Figure 5**.



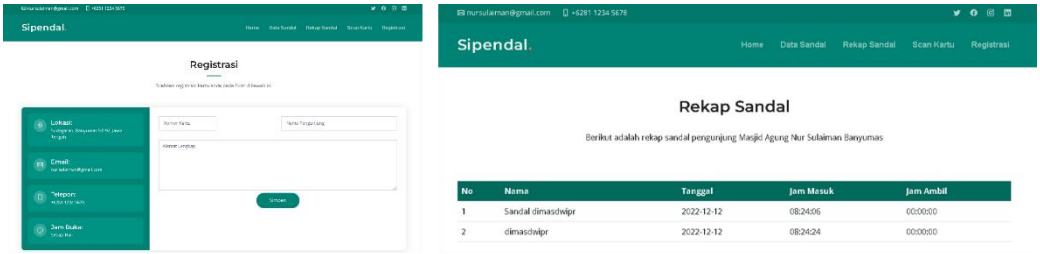

Tampilan halaman home

Tampilan halaman data sandal

**Figure 5.** Home Page Design and Data Sandals

**Figure 6** display the registration page, whose function is registering the RFID tag so that the system registers it before entrusting the sandals to the mosque staff. **Figure 6** there is also a display of the sandals recap page for visitors to the mosque at a particular time. This page will display the name of the sandals and the owner of the sandals, the date of deposit, the time when

the sandals were deposited, and the time for taking the sandals or leaving the sandals. Registration page design and sandal recap can be seen in **Figure 6**.

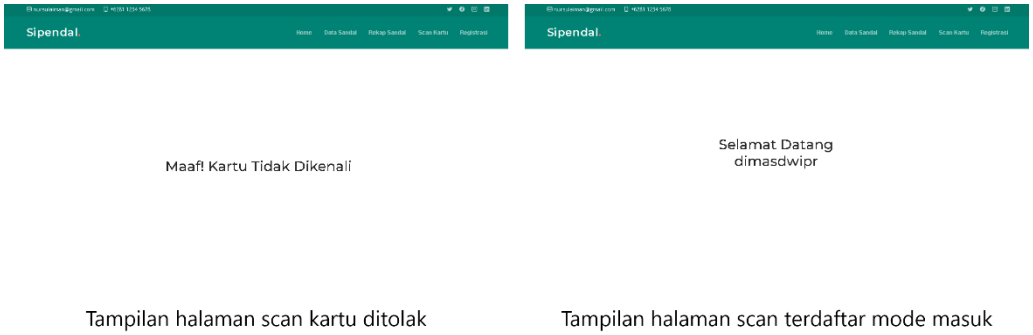



Tampilan halaman registrasi

Tampilan halaman rekap sandal

**Figure 6.** Registration page design and sandal recap

If the RFID tag is not registered in the system, then the website will display a message that the RFID tag cannot be recognized. The display is shown in **Figure 7**, while visitors who have completed the registration process and will leave sandals must scan the RFID tag again, the website will display a message saying "Selamat Datang". Card page design is rejected, and the scan is registered in entry mode can be seen on **Figure 7**.

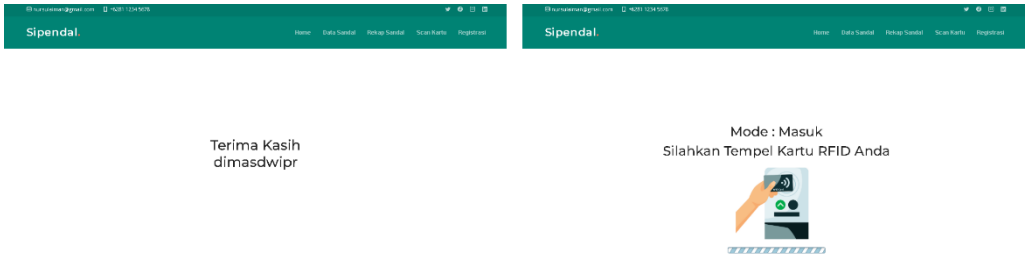



Tampilan halaman scan kartu ditolak

Tampilan halaman scan terdaftar mode masuk

**Figure 7.** Card Page Design is Rejected and the Scan is Registered in Entry Mode

Mosque visitors who take sandals must scan the RFID tag again to verify the safety of the sandals. It is intended to avoid happening exchange sandals end of the mosque. If the RFID tag has been registered and the data is stored in exit mode, a "Terima Kasih" message will be displayed. **Figure 8** shows the scan page display registered with the exit mode and the scan page display for the incoming mode. Scan page design listed exit mode and scan incoming mode can be seen on Figure 8.




Tampilan halaman scan terdaftar mode keluar  Tampilan halaman scan mode masuk

**Figure 8.** Scan Page Design Listed Exit Mode and Scan Incoming Mode

The exit mode RFID scan has a display and work system that is almost the same as the entry mode. It's just different from the text shown in **Figure 9**. This informs mosque administrators as website operators that the system is in exit or retrieval mode. Exit mode scan page design is presented on **Figure 9**.


Tampilan halaman scan modekeluar/ambil

**Figure 9.** Exit Mode Scan Page Design

b. Evaluation of prototypes

Prototype evaluation functions to determine whether the prototype was built by what was planned. This is done to consider the placement of the tool's position and the sensor's location so that the system can run properly.

c. Encoding the system

At the system coding stage, the approved design will be programmed using the Arduino IDE software. Arduino IDE software is used to program the module, microcontrollers, and sensors in order to communicate with one another. As for websites built using visual studio code. Websites that are built using MySQL as the database, bootstrap to set the website display layout, and use PHP programming language for the backend.

d. Testing the system:

System testing is done to determine whether the system built has performed its functions correctly. In testing this system, researchers used the black box method because testing using the black box method focuses on one goal: the function of the system being built.

e. System evaluation

The system evaluation stage is used to determine if, after testing the system, there are system components that cannot function properly. Then at the evaluation stage, the system will re-analyze and re-check to improve the system components' functioning properly.

f. System usage

The system that has successfully passed the system evaluation stage will then be followed up with implementing the system at the Nur Sulaiman Banyumas mosque and will be implemented as needed.

## 3. Results and Discussion

Based on the research results, the problem with the mosque is the system for borrowing sarongs and the safety of sandals. When borrowing sarongs, taking them is often not orderly because the number of sarongs available cannot be monitored. In addition, when it comes to sandal security, sandals often get exchanged and lost sandals. So to overcome this, a system is created to monitor the number of sarong availability using ultrasonic sensors as data retrieval. Meanwhile, to find digital identity using an RFID sensor that can be displayed through the website. With this system, it can simplify and provide better mosque services and have good comfort in carrying out worship.

a. The result of a series of sarong borrowing systems

The series of sarong lending systems is shown in **Figure 10**. This system is wrapped in a box with the ultrasonic sensor placed in front, as well as the location of the LCD screen, which is in front of the top of the ultrasonic sensor, and the potentiometer is located to the right of the box. This system works by utilizing two ultrasonic sensors. If a visitor is going to borrow a sarong, then the visitor must bring the sheath closer to the sensor to the left of the box (exit) later, the system will perform a reduction operation, and if the visitor will return the sarong, then the sarong must be brought closer to the right sensor of the box which then results will display the result of the operation of addition. From the calculation operation will be displayed on the LCD screen. Sheath lending system can be seen in **Figure 10**.

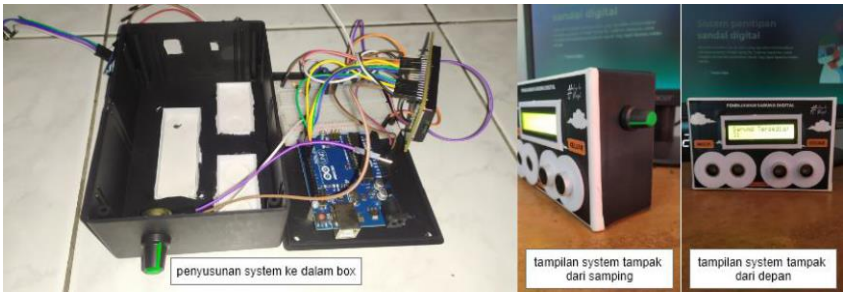



**Figure 10.** Sheath Lending System

b. The result of a series of sandal security systems

In the sandal security system, so that each component cannot be separated from the box, screws are used. The arrangement of components in **Figure 11,** such as the RFID reader, is placed on the front, while the exit/entry mode button is located on the right side of the box. This system brings RFID tags closer together, where each visitor will use two RFID tags. The first tag is to be placed in the sandals, and the second tag is kept by the owner of the sandals. The RFID tag here is shaped like a keychain. Each visitor must register each tag with the administrator or mosque officer.

Then the mosque staff will fill out the form available on the website. If submitted, the data will automatically be stored in the database. Then, the visitor scans again. This works so the system can find that the visitor left his sandals at a particular hour. After scanning, the system will automatically appear to read "Silahkan Masuk", as well as the taking of sandals. The visitor required a re-scan. If the RFID tag is not read, the system will display a message that the system does not register the visitor's RFID card.

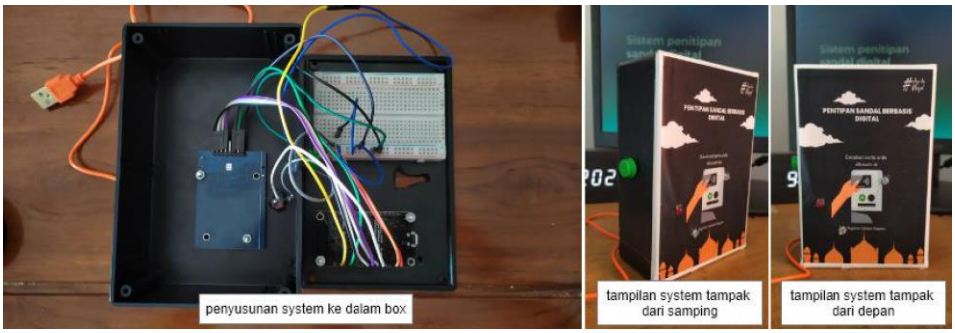



**Figure 11.** Result of Flip Security System

c. The results of testing the sum operation on the ultrasonic sensor 1

The sum operation of the ultrasonic sensor has a data capture distance of 5 cm. From **Table 1,** it can be obtained that the ultrasonic sensor for performing the sum has been successful by the functions that have been planned. The data has been successfully added where the sarong has been brought closer to a distance of 1-5 cm and displays the results on the LCD. And if the

sheath is brought closer to a distance of 6-10 cm, the ultrasonic sensor cannot perform calculations, so the display on the LCD screen is fixed, and the value does not change. The results of ultrasonic sensor testing 1 can be seen on Table 1.

**Table 1.** The Results of Ultrasonic Sensor Testing 1

| Distance of ultrasonic sensor to sheath (cm) | Testing the addition operation | Shown on the LCD screen | Information |
|---|---|---|---|
| 1 cm | read | Appears, the data is growing | succeed |
| 2 cm | read | Appears, the data is growing | succeed |
| 3 cm | read | Appears, the data is growing | succeed |
| 4 cm | read | Appears, the data is growing | succeed |
| 5 cm | read | Appears, the data is growing | succeed |
| 6 cm | Can not be read | Shown, fixed data | succeed |
| 7 cm | Can not be read | Shown, fixed data | succeed |
| 8 cm | Can not be read | Shown, fixed data | succeed |
| 9 cm | Can not be read | Shown, fixed data | succeed |
| 10 cm | Can not be read | Shown, fixed data | succeed |

d. The results of the reduction operation test on the ultrasonic sensor 2

The reduction operation test on the ultrasonic sensor has been carried out, with the results shown in **Table 2**. The ultrasonic sensor has been programmed, bringing each glove closer to a distance of less than 5 cm. The ultrasonic sensor will process the data that has been caught. **Table 2** explains that for each sheath that is brought closer to a distance of 1 to 5 cm, the data will decrease, and the value displayed on the LCD will change, while if the sheath is closer than 5 cm, the value will not change and the value displayed on the LCD will not change. The results of ultrasonic sensor testing 2 can be seen on **Table 2**.

**Table 2.** The Results of Ultrasonic Sensor Testing 2

| Distance of ultrasonic sensor to sheath (cm) | Testing the addition operation | Shown on the LCD screen | Information |
|---|---|---|---|
| 1 cm | read | Appears, the data is growing | succeed |
| 2 cm | read | Appears, the data is growing | succeed |
| 3 cm | read | Appears, the data is growing | succeed |
| 4 cm | read | Appears, the data is growing | succeed |
| 5 cm | read | Appears, the data is growing | succeed |
| 6 cm | Can not be read | Shown, fixed data | succeed |
| 7 cm | Can not be read | Shown, fixed data | succeed |
| 8 cm | Can not be read | Shown, fixed data | succeed |
| 9 cm | Can not be read | Shown, fixed data | succeed |
| 10 cm | Can not be read | Shown, fixed data | succeed |

e. Test results on the RFID sensor

Testing on the RFID sensor are carried out by bringing the RFID tag closer to the RFID reader with a distance starting from 1 cm to 4 cm. This test is carried out jointly using the website on the registration page. This test uses three RFID tags. The results obtained are shown in **Table 3**. And it can be concluded that the sensor can read each RFID tag with a distance of 1 cm – 3 cm and appears on the website. However, when it reaches a distance of 4 cm, the RFID reader sensor cannot capture the data, so the website cannot display the data obtained. RFID sensor test results presented on **Table 3**.

**Table 3.** RFID Sensor Test Results

| RFID tag number | Distance of RDIF reader and RFID tag (cm) | Show website | Information |
|---|---|---|---|
| 1324120535 | 1 cm | Appear on the website | succeed |
| 1324120535 | 2 cm | Appear on the website | succeed |
| 1324120535 | 3 cm | Appear on the website | succeed |
| 1324120535 | 4 cm | Does not appear on the website | Not successful |
| 173319335 | 1 cm | Appear on the website | succeed |
| 173319335 | 2 cm | Appear on the website | succeed |
| 173319335 | 3 cm | Appear on the website | succeed |
| 173319335 | 4 cm | Does not appear on the website | Not successful |
| 1253919335 | 1 cm | Appear on the website | succeed |
| 1253919335 | 2 cm | Appear on the website | succeed |
| 1253919335 | 3 cm | Appear on the website | succeed |
| 1253919335 | 4 cm | Does not appear on the website | Not successful |

## 4. Conclusion

The results of tests on the system for borrowing gloves and the safety of sandals can be concluded that the two ultrasonic sensors that capture data and perform calculation operations can work properly as long as the gloves are brought closer to no more than 5 cm. Suppose the sheath is brought closer to more than 5 cm. In that case, the system cannot calculate because the two ultrasonic sensors have been programmed with a maximum data capture distance of no more than 5 cm. Meanwhile, the RFID reader can read tags up to 3 cm in the sandal security system. With a distance of 3 cm, the RFID reader can process the data obtained to be displayed on the website the mosque administrator controls. However, if the distance between the RFID tags is more than 3 cm, then the RFID tag number cannot appear on the website.

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