



DEVELOPMENT OF IoT-BASED PRESENCE SYSTEM FOR SCHOOL USING PROTOTYPE METHOD (CASE STUDY: YPPMNU AJIBARANG)

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Abstract

Today's rapid development of technology makes it easy to do everything from shopping to reading today's news to studying online and more. This technology has been widely used, for example in government agencies, schools, hospitals, clinics, and so on. Digital or computerized information technology can improve work efficiency. The technology present in the current era of globalization has developed, including attendance or attendance systems using fingerprints, irises, and RFID cards. Many large companies, SMEs, and schools take advantage of technological developments, therefore this research wants to implement IoT technology developments at YPPMNU Ajibarang because of the large number of employees, there are around 200 active employees. Moreover, the attendance itself is carried out every day, of course, the attendance data that they process is very large. The Ma'arif NU Education Organizing Foundation (YPPMNU) Ajibarang is a foundation engaged in education in the Ajibarang area. YPPMNU has four technical implementing units (UPT), Ma'arif NU 1 Ajibarang Vocational School, Ma'arif NU 2 Ajibarang Vocational School, Ibnu Sina Ajibarang STIKES, and Ibnu Sina Ajibarang Modern Islamic Boarding School, with an active number of around 200 active employees. YPPMNU already uses an information system called the YPPMNU Ajibarang Personnel Management Information System, which has functions such as employee capabilities. The pandemic has brought the work system from working directly from the office to working from home. Previously, YPPMNU had its own attendance system using a web-based application. This study aims to develop an IoT-based attendance system using the prototype method and evaluate an IoT-based attendance system using the UAT testing technique so that it can be well received by users. The research method used in this design is to use the prototype method. The results of this study are an evaluation of how the IoT-based attendance system uses the UAT method, and the IoT-based attendance system uses the prototype method.

Keyword: Attendance, ESP8266, Laravel, RFID, UAT.

1. INTRODUCING

Today's rapid development of technology makes it easy to do everything from shopping to reading today's news to studying online and much more [1]. This technology has been widely used, for example in government agencies, schools, hospitals, clinics, and so on. Digital or computerized information technology can increase work efficiency [2]. The technology present in the current era of globalization has developed, including attendance or attendance systems using fingerprints, irises, and RFID cards. RFID (Radio Frequency Identification) technology [3] has been proven by the existence of modern and sophisticated devices that can help users [4].

Many large companies, SMEs, and schools take advantage of technological developments [9], therefore this research wants to implement IoT technology developments at YPPMNU Ajibarang because of the large number of employees there are around 200 active employees [10]. Moreover, the attendance itself is carried out every day, of course, the attendance data that they process is very large. Data steps become unstructured and difficult to track in the event of a crash [11]. Vulnerable to calculation errors for monthly and annual daily recaps or what is commonly called human error [12], human error. Absenteeism done by teachers and YPPMNU employees is also done using their smartphones, they have to take their cellphones out of their bags when they want to take attendance, if they don't have their smartphones with them or they don't have an internet connection on their cellphones, they can't take attendance.

The previous attendance system was by means of employees manually signing on paper for incoming attendance and signing back for home attendance or also attendance being done using a cellphone that still requires an internet connection and GPS, so the author wants to develop based on the previous attendance system into an easier attendance system. used, fast, and practical. So that employees can more easily make attendance and the data processing section makes it easy to manage employee attendance data.



By taking advantage of the development of IoT technology, researchers want to solve this problem, namely by developing an attendance system using the prototype method, which is faster, easier and safer, no longer an attendance system that needs to rely on cellphones and internet connections. Employees only need to check their body temperature by tapping the card they have every day on the tools provided, the data will automatically be stored directly on the server [16]. IOT-based attendance systems can make it easier for employees who don't have a connection to their cellphones or those who forget to bring their cellphones to still be able to take attendance. The results of this study are an evaluation of how the IoT-based attendance system uses the UAT method, and the IoT-based attendance system uses the prototype method.

This research aims to evaluate the previous attendance system that still relied on cellphones and the internet for YPPMNU Ajibarang employees with an IOT-based attendance system so that it can be accepted by users, utilizing IOT technology has been widely applied in various places, not only in schools. The research that has been done previously shows that IOT is a technology in the form of a physical hardware device that usually uses an Arduino, RFID scanner, RFID card, buzzer and several other components that are assembled according to existing rules so that the tool can be used properly and utilize a web server to become the server of the device. The following is an explanation of the results of a review of previous studies.

In the first study entitled Designing Student Attendance Using Arduino Uno-Based RFID which aims to be able to design information systems and manage electronic attendance activities for vocational high school students conducted by Muh. Firmansyah Firdaus, Ahmad Hanafie and Syarifuddin Baco in 2021 [17]. In this study, the experimental method was used, namely making student attendance tools by implementing artificial intelligence into a tool so that the tool is able to do work like humans. The data used in this study came from recording attendance directly from the attendance process with the school. The results of this study indicate that student attendance using RFID has been successfully designed and created using Arduino Uno.

In the second study entitled Prototype of Attendance System Using Iot-Based Rfid which aims to evaluate the work of lecturers and students in classroom learning. This research was conducted by Qomarul huda, Hairul Fahmi and Ahmad S. Pardiansyah. The design method used Research & Development (R&D) [18]. The results of this attendance system can record and send attendance data directly to the database server based on the schedule made by the academic.

2. RESEARCH METHODS

2.1 Research Subjects and Objects

Based on the background previously described in Chapter 1, the subject used in this study is the attendance system which is still being carried out using a website-based application at YPPMNU Ajibarang. While the research object was taken based on what has been explained in the abstraction section, namely the Ajibarang Ma'arif NU Education Organizer Foundation.

2.2 Research Flowchart

The flow of this research consists of data collection, research or literature studies, software development methodologies or methods, application development, performance evaluation, and conclusions. This study uses the prototyping method. The first step is gathering basic device requirements which are done by software developers and software users directly. This phase is also known as listening to the customer. The next step, namely the second step, is to make a prototype. And the third step is last step is the testing phase directly to the user.

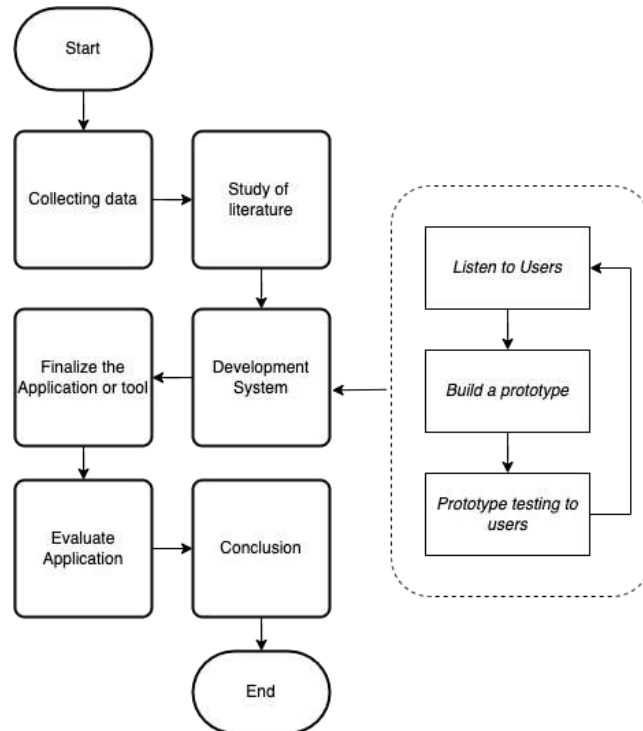


Figure 1. Research Flowchart.

The picture above explains the flowchart or research flowchart, starting from data collection, literature study, system development methods which mean prototyping, then making applications or tools, evaluating performance and finally drawing conclusions.

2.2.1 Data collection

Researchers collected data by visiting the foundation directly, observing the number of employees and observing the performance of previous attendance there as evaluation material when the research was completed. Do not forget to also discuss the hardware and software requirements required with the user.

2.2.2 Literature Study

Researchers use journals with the same topic as literature studies so that researchers know what previous research has done, namely regarding IOT-based attendance.

2.2.3 System Development

At the development stage this system will be divided into 3 parts which are repeated until the prototype is in accordance with what the user wants.

a. Listen to users

Discuss with users the needs such as constraints and problems experienced by users regarding this system. To collect this information, the researchers came directly to the foundation and made observations and discussions there.

b. Build prototypes

After researchers get information from users, researchers start designing and making prototypes based on the needs that have been discussed together before. If the prototype has been completed, it will be continued at the testing stage by the user directly.

c. Prototype trials

At this stage the researcher will carry out testing after the prototype has been made, the test is carried out by drawing conclusions from the results of experiments carried out by the user. If there are still problems submitted by the user, the researcher will solve the problem by re-prototyping and testing again.

2.2.4 Application Finalization

First, the researcher will improve the backend of the application so that it can fulfill requests from ESP8266 as the client application and do not forget that the researcher will improve the appearance as well as the function of the website application so that it can process data properly, such as improving the function of recording attendance, recapitulating attendance data, and so on.



The two researchers will improve and perfect the IOT prototype device so that the ESP8266 microcontroller as an application client can receive data from the sensors that have been installed and receive data from the RFID Tag sensors and send the data to the previously repaired web server. So that the web server can process the received data again to be displayed to the user.

2.2.5 Software Performance Evaluation

This stage is carried out when the backend and the tool have been completed, the researcher will evaluate all the performance of the tool. This stage is very important to do so that researchers can understand whether this attendance system is running well or not according to the problems that have been discussed with users. If not, the researcher will carry out repairs, tests and re-evaluate until the problems from users can be overcome. In addition, researchers will evaluate user questionnaire data from the UAT method that has been done before, to draw conclusions at a later stage.

2.2.6 Conclusion

At this stage the researcher will draw conclusions after going through several previous stages, namely the discussion stage with the customer, the prototyping stage and the testing stage directly by the user. The conclusions obtained from the analysis and performance testing of the attendance system that has been made and the questionnaire that has been carried out previously are in the form of descriptions and graphs.

3. RESULT AND DISCUSSIONS

3.1 Results of data collection

At this data collection stage the researcher collected data and formulated the problem using the User Acceptance Test (UAT) method and conducted interviews directly at the Ajibarang NU Ma'arif Education Organization Foundation by asking several questions to one of the YPPMNU Ajibarang employees.



Figure 2. Data collection

The author draws several conclusions that the web-based attendance system can still be used properly by YPPMNU Ajibarang employees such as incoming attendance, home attendance and reporting, but here the author finds several obstacles such as inaccurate attendance coordinates, unable to change application profile photos, attendance reporting features incomplete and there are several other bugs. The author asks 5 questions to 5 respondents using the UAT testing method with a Likert scale of 1 to 5 represented by strongly agreeing (5), agreeing (4), undecided (3), disagreeing (2) and strongly disagreeing (1) during interviews with employees who were there, the results can be seen as in table 1 shows that the system is not running well because there are still some errors and the percentage of the attendance system needs to be improved is still quite high.



Table 1. Test results using UAT

No	Question	Answer					Percentage				
		5	4	3	2	1	5	4	3	2	1
1	Can the attendance system be used properly?	3	2	0	0	0	60%	40%	0%	0%	0%
2	Are the coordinates accurate?	2	2	1	0	0	40%	40%	20%	0%	0%
3	Is the presence report feature good enough?	1	1	2	1	0	20%	20%	40%	20%	0%
4	Is it possible to change the profile on the system?	2	1	1	1	0	40%	20%	20%	20%	0%
5	Does the system need to be upgraded again?	4	1	0	0	0	80%	20%	0%	0%	0%

3.2 Development Phase

This development phase uses a prototype software development method using a web-based attendance system that previously existed as a prototype version 1, here the author interacts directly face to face or indirectly using social media communication media to get information on changes and improvements to this attendance system.

3.2.1 Prototype version 1

a. Listen to users

In this first version of the prototype, YPPMNU asked for an RFID-based attendance feature where employees only need to check their body temperature and tap their identity card, but in the web-based application several changes must be made such as adding an RFID menu and adding API integration settings so that it can communicate with the IoT device.



Figure 3. Discuss together for prototype version 1

The results of listening to users that have been done before, on the prototype version 1 the author has summarized and can be seen in table 2.

Table 2. prototype version one features

No	Information	Type
1	Presence feature enters with IOT	Features
2	Home presence feature with IOT	Features
3	RFID API integration settings menu	Features

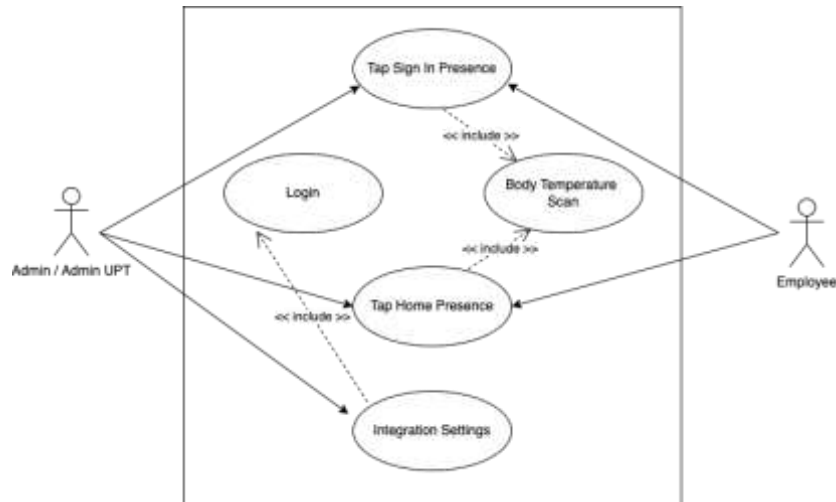


Figure 4. Use case diagram

Figure 4 explains the access rights and capabilities of each user based on the user level, the UPT admin can carry out attendance, return attendance and carry out IOT-based attendance integration arrangements, while employees can only enter and leave attendance.

b. Make a prototype

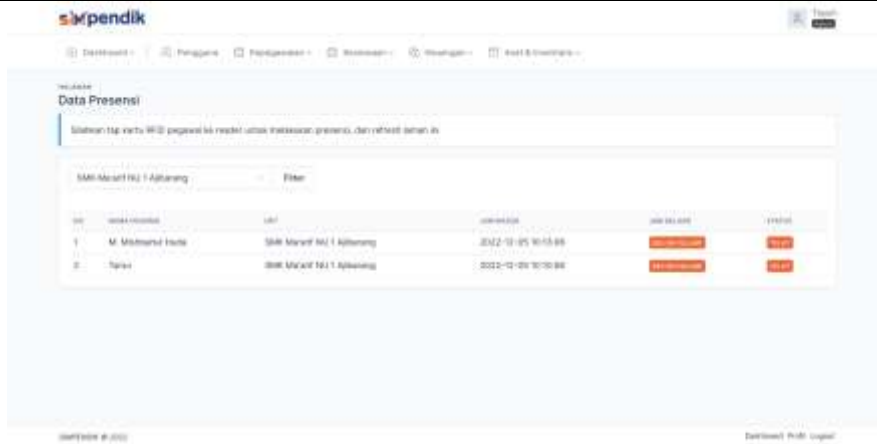
Prototyping consists of the stages of prototyping and testing using the UAT testing method. The stages of making a prototype can be seen in table below

Table 3. Make a version one prototype

No	Results
1	<p>RFID integration settings page</p>



2



Employee RFID attendance page, to see at a glance the data of employees who have attended today

3



Designing an IOT tool for attendance that will be connected to the web

Furthermore, system testing was carried out by 5 YPPMNU employees using a questionnaire, with the UAT testing method based on the features in table below with a scale of 5 to 1

Table 4. Testing for prototype version one

No	Question	Answer					Percentage				
		5	4	3	2	1	5	4	3	2	1
1	Can the IOT presence system be used properly?	3	1	1	0	0	60%	20%	20%	0%	0%
2	Is this presence more practical than the previous attendance?	3	2	0	0	0	60%	40%	0%	0%	0%
3	Is this attendance report system very important to make?	5	0	0	0	0	100%	0%	0%	0%	0%
4	Does this attendance reporting system need to be improved again?	3	2	0	0	0	60%	40%	0%	0%	0%
5	Is attendance using this card more efficient than using a cell phone?	2	2	1	0	0	40%	40%	20%	0%	0%
6	Is there still an error found in the system?	2	1	1	1	0	40%	20%	20%	20%	0%



The test results show that the IOT-based presence system can be used properly, is more practical than the previous attendance system and is also more efficient than using a cellphone because YPPMNU employees do not need to connect their cellphones to the internet, but here there are several points that need attention such as the report feature presence, the presence feature needs to be improved again because the reporting feature is very important to make it will continue in the second stage of development.

4.2.2 Prototype version 2

a. Listen to users

In the prototype version of the two parties, YPPMNU Ajibarang asked for a report feature, because this is very important for managing employee attendance. This reason is also reinforced by the research results in table 1 and table 4. The author collects data again by direct discussion with the person in charge of the attendance application.



Figure 5. Discuss for prototype version two

The results of listening to users that have been done before in designing the prototype version 2 the author has summarized and can be seen in table below.

Table 5. Features for prototype version two

No	Information	Type
1	Absence reporting feature	Features
2	The report export feature is a PDF document	Features

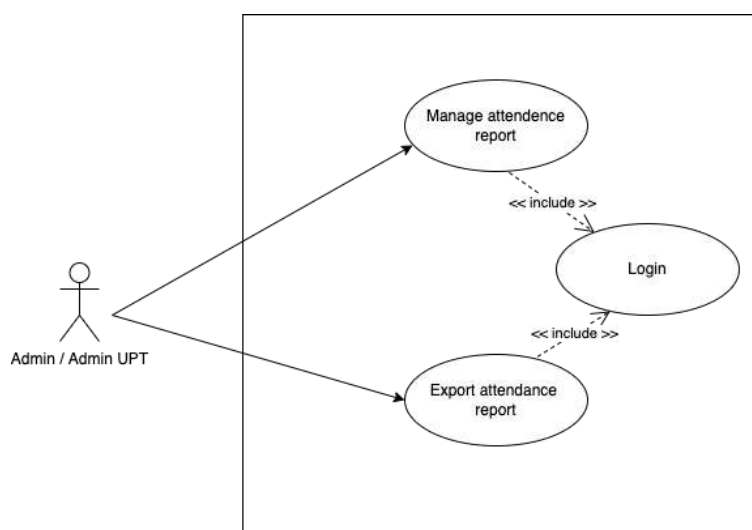


Figure 6. Use case for reporting



Figure 6 shows the use case diagram for the reporting feature of this second version of the prototype design, in the figure that the admin can report IOT-based absences such as viewing the data as a whole, viewing it on a weekly basis per month and exporting attendance data to a PDF document

b. Prototyping

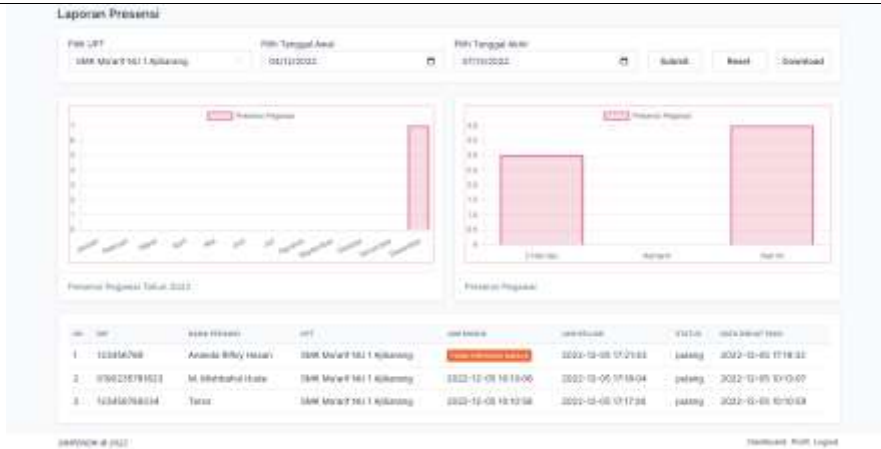
Just as in the prototyping stage of version one, the making of version two of the prototype begins with making a prototype in the presence application which the author describes into tables and is followed by retesting using the UAT method.

Table 6. Prototype version two

No	Results																																																																
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2	<p>Presence report start page with data filter</p> <table border="1"> <thead> <tr> <th>no</th> <th>id</th> <th>nama karyawan</th> <th>UPT</th> <th>tanggal masuk</th> <th>tanggal keluar</th> <th>status</th> <th>tanggal absen</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>123456789</td> <td>Akmalia Rizky Hasm</td> <td>SMK Muhammadiyah 1 Adharing</td> <td>2022-12-07 10:00:02</td> <td>2022-12-07 10:00:00</td> <td>hadir</td> <td></td> </tr> <tr> <td>2</td> <td>12345678934</td> <td>Tessa</td> <td>SMK Muhammadiyah 1 Adharing</td> <td>2022-12-07 10:00:53</td> <td>2022-12-07 10:40:00</td> <td>hadir</td> <td></td> </tr> <tr> <td>3</td> <td>998877665544</td> <td>M. Muhammad Huda</td> <td>SMK Muhammadiyah 1 Adharing</td> <td>2022-12-07 10:00:08</td> <td>2022-12-07 10:30:00</td> <td>hadir</td> <td></td> </tr> <tr> <td>4</td> <td>1234567</td> <td>Malyssa</td> <td>SMK Muhammadiyah 1 Adharing</td> <td>2022-12-07 10:00:08</td> <td>2022-12-07 10:30:00</td> <td>hadir</td> <td></td> </tr> <tr> <td>5</td> <td>123456789</td> <td>Akmalia Rizky Hasm</td> <td>SMK Muhammadiyah 1 Adharing</td> <td>2022-12-08 17:17:43</td> <td>2022-12-08 17:19:02</td> <td>gulang</td> <td></td> </tr> <tr> <td>6</td> <td>998877665544</td> <td>M. Muhammad Huda</td> <td>SMK Muhammadiyah 1 Adharing</td> <td>2022-12-08 17:10:08</td> <td>2022-12-08 17:10:00</td> <td>gulang</td> <td></td> </tr> <tr> <td>7</td> <td>12345678934</td> <td>Tessa</td> <td>SMK Muhammadiyah 1 Adharing</td> <td>2022-12-08 10:50:08</td> <td>2022-12-08 10:50:00</td> <td>gulang</td> <td></td> </tr> </tbody> </table> <p>Complete list of employee attendance along with monthly and daily charts, yesterday and two days ago</p>	no	id	nama karyawan	UPT	tanggal masuk	tanggal keluar	status	tanggal absen	1	123456789	Akmalia Rizky Hasm	SMK Muhammadiyah 1 Adharing	2022-12-07 10:00:02	2022-12-07 10:00:00	hadir		2	12345678934	Tessa	SMK Muhammadiyah 1 Adharing	2022-12-07 10:00:53	2022-12-07 10:40:00	hadir		3	998877665544	M. Muhammad Huda	SMK Muhammadiyah 1 Adharing	2022-12-07 10:00:08	2022-12-07 10:30:00	hadir		4	1234567	Malyssa	SMK Muhammadiyah 1 Adharing	2022-12-07 10:00:08	2022-12-07 10:30:00	hadir		5	123456789	Akmalia Rizky Hasm	SMK Muhammadiyah 1 Adharing	2022-12-08 17:17:43	2022-12-08 17:19:02	gulang		6	998877665544	M. Muhammad Huda	SMK Muhammadiyah 1 Adharing	2022-12-08 17:10:08	2022-12-08 17:10:00	gulang		7	12345678934	Tessa	SMK Muhammadiyah 1 Adharing	2022-12-08 10:50:08	2022-12-08 10:50:00	gulang	
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3



Report page when data filter has been done

4



Presence data download page into PDF document

Furthermore, when the second version of the prototype was completed, the author conducted another test using a questionnaire with a scale of one to five to 5 employees of YPPMNU Ajibarang as was the case with testing the prototype version one in table 4. The results of testing the second version of the prototype can be seen in table below

Table 7. Testing for prototype version two

No	Question	Answer					Percentage				
		5	4	3	2	1	5	4	3	2	1
1	Can attendance reports be used properly?	4	1	0	0	0	80%	20%	0%	0%	0%
2	Is this attendance report easy to use?	3	1	1	0	0	60%	20%	20%	0%	0%
3	Has this report helped, especially data recording?	2	2	1	0	0	40%	40%	20%	0%	0%
4	Is the data filter of this report system correct?	2	3	0	0	0	40%	60%	0%	0%	0%
5	Is the presence download going well?	3	1	1	0	0	60%	20%	20%	0%	0%

Based on table 7, the conclusion that can be drawn is that the presence report feature is good enough in its function because the numbers show that scales 4 and 5 have shown a fairly high answer compared to the other scales. Referring to the background of this research, attendance reporting is very important in various agencies including at



YPPMNU Ajibarang, because this report will be used for employee data analysis and can even be used for employee payroll, the numbers in the test in table 7 show that the reporting system can be used properly and the download presence scale has shown well.

4. CONCLUSION

Based on the objectives of this study, developing an IOT-based attendance system using the prototype method so that the results are in accordance with what users want and so that the attendance system can be accepted by users and evaluating IOT-based attendance systems using the UAT (User Acceptance Test) testing method so that the system is accepted by users. It can be concluded that there are several additional features added from the presence system version one, such as the presence integration feature to activate and deactivate the IOT-based presence feature, view presence data features, data reporting features along with graphs and download attendance reports, not forgetting physical devices. The presence is designed using NODEMCU ESP8266. Tests have been carried out but in these tests there were several errors such as the presence system could not be used properly because the user's network connection and the presence device's network connection resulted in several errors, because this is a deficiency of a wireless network that is less stable and fighting over bandwidth with one device other.

The number assisted in terms of attendance recording is quite high, because the data has been stored on the application server which makes the data safe, and with a complete data filter, the presence data processing section is greatly helped by the filter and download report features.

Based on the research that has been done, the authors have several suggestions for this IOT-based presence feature, especially on the physical presence device to speed up communication with the server when employees attach their identity cards, then the tool needs to add an ethernet module or what is commonly called a wired network so that the connection is more stable for the device when communicating with the server via the API. So as to minimize the occurrence of interference when the user makes a presence.

The researcher hopes that this research can help others in further research.

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