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IMPLEMENTATION OF QR CODE IN A STUDENT ATTENDANCE INFORMATION SYSTEM BASED ON WHATSAPP GATEWAY

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ABSTRACT
The attendance information system at Senior High School 7 Sigi, still uses a manual attendance system, namely writing on paper sheets. The problem that often occurs is the loss of student attendance books which causes the school to have difficulty in recapitulating attendance and also reporting attendance to parents. Another problem that occurs due to manual attendance is that parents cannot directly monitor their children's attendance at school which causes some students to skip school. The recommended solution is to use an attendance information system by utilizing QR Code technology so that student attendance is more practical and also the data storage is much safer. WhatsApp Gateway is used as a monitoring medium for parents because this system will send notifications via the WhatsApp application every time the lesson starts, effectively and in real-time. This attendance system uses the Waterfall method which starts from the planning, analysis, design and implementation stages

I. INTRODUCTION

THE The rapid development of information technology at this time has a major effect on human daily life. Human work has become much more effective and efficient. One of the major impacts that occurs is the development in the world of education. One of the educational media used to help people with skills become more capable is school [1]. The attendance system is one that plays an important role in everyday life, especially in environments that require attendance, such as schools, universities and offices [2]. Policies and procedures in a school environment provide an example of how to handle discipline in that environment [3].

Currently Senior High School 7 Sigi, still uses manual attendance where the teacher will call one by one the student's name and will record manually on the student attendance sheet or book. Student attendance data stored in the form of a book is considered less effective, the manual recording process is time consuming, especially in large classes, thus reducing the time available for teaching and learning activities. Manual recording is prone to human error, such as negligence or inaccuracy in recording student attendance. This greatly impacts the recapitulation of attendance, as manual attendance reports take longer to process, causing delays in information to interested parties, including parents. Parents are also still concerned about their children's condition at school. Parents often think about the question of whether or not their children are actually present at school every day. This concern arises because parents want to ensure that their children get a proper education and make the best use of school time. In this case, parents also want to control to know the level of discipline of their children at school. The lack of communication between the school and parents can be used by students to not attend classes and not fill in attendance. Parents do not realize that their child is missing out on lessons and also their child's progress at school is unknown [4].

This QR Code is one of the technologies that can be used to solve certain problems. QR Code is a two-dimensional matrix code that can store information up to thousands of alphanumeric characters. It is a development of the Barcode, which is only capable of storing less than 20 characters in a single code. With the development of increasingly sophisticated smartphones, the QR Code has become a very fast link between offline and online media.

QR codes have been widely used in the field of information technology as input media or scanning media. In industry, QR codes are used to organize production processes, label products, and attendance systems, among other uses [5]. QR Code implementation helps the attendance process to be better and fast recapitulation and also has the ability to store data in it [6]. QR Code (Quick Response Code) is a code that can send information quickly and get a fast response too [7]. This system reduces teacher errors in filling out student attendance lists, student attendance data can be directly uploaded and stored in the system, providing accurate information and in real time. The attendance process becomes faster and more efficient due to the use of QR Code [8]. In addition to attendance, the application also provides the right solution to bring order and make it easier for schools to recapitulate student attendance, both daily, weekly and annually[9], [10] . This system also minimizes the possibility of students lying about their attendance, because each QR Code scan is directly linked to the student ID in the database. Each subject is assigned a unique QR Code that is directly connected to the database. QR Code scanning automatically records attendance data such as name and NISN, replacing the error-prone manual method.

WhatsApp Gateway is an application that allows users to send and receive messages through an Application Programming Interface connection [11]. This API acts as an intermediary that sends messages from the user to the recipient, the system will be notified of the action to be performed and respond to the request appropriately [12]. When teachers use the website to record student attendance, parents will receive WhatsApp messages directly from the teacher in the form of attendance information [13]. The application of WhatsApp Gateway to the attendance information system is a solution for parents who are worried about their children's attendance at school. The purpose of this research is to provide solutions to schools to manage student attendance developed in a web-based application. It is hoped that this information system can help teachers' work so that student attendance and recapitulation of attendance is more optimal, effective and efficient as well as helping schools improve communication with parents where schools can share information related to student attendance delivered via short message. After the student's attendance data is recorded, the system will send a notification to the student's WhatsApp parents through the subject teacher. WhatsApp is an application that is more instant compared to other applications, very popular and used by many people in various circles. Most people such as employees or parents of students are used to using it, so it does not require special training. WhatsApp can be accessed through various devices such as smartphones, tablets and computers allowing easy access from anywhere. WhatsApp provides real-time communication, where messages are received and can be replied to immediately. WhatsApp provides instant notifications to mobile devices, while email notifications are not as fast and are often ignored, which greatly affects the communication between schools and parents. With WhatsApp gateway, the attendance process becomes easier because it can be done simply by sending a short message, without following more complicated steps as in email. Overall, WhatsApp gateway offers a faster, more efficient and user-friendly solution compared to other communication applications.

II. RESEARCH METHODOLOGY

The type of research used is qualitative research, which focuses on understanding social phenomena through data collection such as interviews, observation and document analysis. The system development method used is the waterfall method. The main advantage of this method in the context of research is in its ability to produce comprehensive documentation at each stage. The documentation produced in the waterfall method plays an important role in maintaining the integrity of the research. Every decision, change, and result obtained is well recorded, making it easier to analyses and evaluate. The needs analysis stage is a crucial step in system development, aiming to identify in-depth user needs and system functionality. Through data collection techniques such as interviews and surveys, researchers can gain a comprehensive understanding of the system's scope, required functions, and associated risks. The main advantage of this stage is that it provides a strong foundation for the entire system development.

A. Data Collection

Data collection methods in qualitative research focus on obtaining in-depth information about something that is being researched.

1. Observation
   Observation is one of the data collection methods in qualitative research where the researcher directly observes the research subject in its original environment or it can be said that the object is directly observed. The objects referred to in this observation are students and teachers of Senior High School 7 SIGI.

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2. Interview
   Interviews are one of the main methods in qualitative research because they are used to collect data in depth. Interview is a data collection technique carried out by means of direct question and answer with related parties. In this study, interviews were conducted directly to teachers of Senior High School 7 SIGI.
3. Literature Study
   Data collection techniques by looking for sources of reference on the development of student attendance information systems from research that has been made before.

B. Subject And Object of Research

In qualitative research, the subject and object of research are closely interrelated. The research subject provides data that allows researchers to understand and analyses the research object. Therefore, choosing the right subject is very important to obtain relevant data that can explain the object of research.

C. System Development Method

The method used in making this application is the waterfall method. The waterfall method is a software development process that follows the current development cycle which is carried out in a systematic and organized manner for system design [14]. It is called waterfall because it is done in stages, where the next stage will be done when the previous stage is complete and runs sequentially [15].

1. *Analysis*
   This stage explains the initial needs of the system to be built. The goal is to know and identify the needs that must be met by the software to be developed [16]. Through interviews, discussions or direct surveys, information for software development can be obtained [17]. An analyst must understand the scope of information, the functions required, the desired work results and the risks associated with using the information system to be developed [18].
2. Design
   The design of the design is done with the aim to help provide a complete picture of what must be done. The design of the software program, which consists of data structures, software architecture, interface representations and coding techniques, is the main focus of the multi-step process known as software design [19].
   In figure 1 illustrates the stage of making QR Code starting with taking the ID of the subject that has been inputted on the system then creating a random code, the random code that has been created is entered into the database after creating a random code followed by creating a QR Code for each existing subject, save the QR Code using the SVG format and display the QR code on the website.

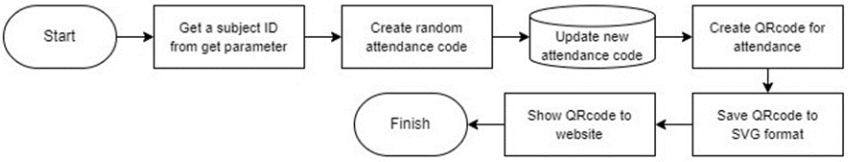

Figure 1. QR Code Creation

Figure 2 illustrates the process of WhatsApp Gateway and message delivery. Starting with retrieving the student's parents' phone number based on the NIM that has been inputted into the database then creating a WhatsApp message to be sent to the student's parents followed by creating a WhatsApp URL using the API (Application Programming Interface). After that there is a condition where when all the data has been processed, the system will be completed and if not, it will return to the process of getting the parents' mobile phone number.

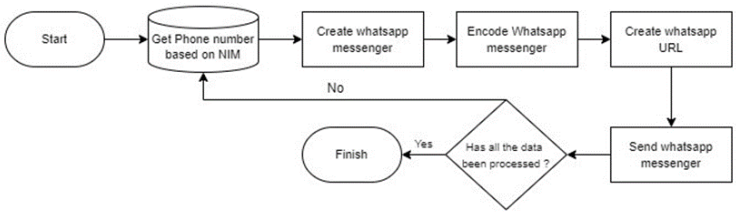

Figure 2. WhatsApp Gateway Creation

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This Use Case diagram explains the interaction between students, teachers, admins and parents with the system [20]. There are four actors, namely students, teachers, admins and parents. Login serves to verify each account that will enter the system. Students get access to login, select subjects and scan QR codes or fill out attendance lists. Teachers get access to login, view or select subjects according to what they teach and then create QR codes, send notifications of student attendance via WhatsApp to parents and recapitulate attendance. School admins have login access, input student, subject and teacher data. Parents of students receive information related to their child's attendance via WhatsApp. Figure 3 is Use Case result.

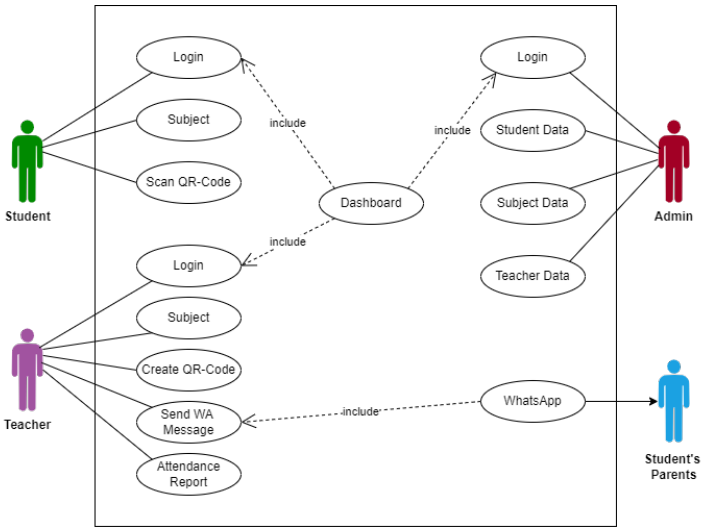

Figure 3. Use Case

3. Implementation

This stage involves integrating the ideas of analysis and application design into the programming language to create data structures that can support both [21]. Coding is a process stage that will be passed so that it becomes a program unit [22]. The languages used for application design are HTML, CSS, PHP and JavaScript. For the database is using MySQL.

4. Testing

After the implementation stage, the next stage carried out is the testing stage where inspection and testing of the system as a whole to identify possible system failures and errors. Black box testing is the software used to test the software that has been made [23]. In this test, the system will be thoroughly evaluated from the user's perspective, without the need to understand the internal structure of the system. The testing team will design various test scenarios that cover a wide range of possible inputs and outputs to ensure that the system functions according to the predefined specifications. Besides black box testing, user testing will also be conducted to get direct feedback from end users regarding the usability and effectiveness of the system. This testing will be conducted in an environment that simulates actual usage conditions to identify issues that may not have been detected in previous testing. One popular instrument used to measure usability is the System Usability Scale.

System Usability Scale is a numerical measure used to evaluate the performance and usability of a system. The goal is for the system to run well and fulfil the user's wishes. The SUS questionnaire method consists of five responses, arranged from strongly disagree to strongly agree [24].

III. RESULTS AND DISCUSSION

A. Collection Data Result

This research uses real data from Senior High School 7. The table contains Subject data, students in grades X to XII and also the name of the teacher who teaches the subject. In table 1 there are subject data and teachers who teach these subjects.

TABLE I
SUBJECT

Subject	The Subject Teacher
Indonesian Language	Alfianus
English	Aenimar
Civic Education	Fatmawati
General Math	Muh. Nur Akbar
Math	Novalin D Samel
Islamic Education	Siti Maryam
Christian Education	Ester
History	Irfan
Physical Education	Aprisen
Workshop	Suarman
Art and Culture	Andriansah
Biology	Nurjani
Physics	Yulia Nur Annisa
Chemistry	Yuliana Sri Dewi
Geography	Vivi Dhamayanti
Sociology	Suci Alifyanti
Economics	Mustakim
Arabic	Nova Retni Mandasari

In table 2 there are the names of students in X Class and their NISN.

TABLE II
STUDENTS OF CLASS X

Student Name	NISN
Yusuf Sugiono	0097036006
Abdul Mohammad Firmanysa	0082192778
Adila Saputra	0075342062
Aditya Pratama	0087395200
Adjib Pramana Putra	0084985870
Afrianti	0077681634
Agil Fergiawan	0083561652
Agis Pratiwi	0062868102
Agisti Anisya	0087445459
Ahmad Taim	0083016538

In table 3 there are the names of students in XI class and their NISN.

TABLE III
STUDENTS OF CLASS XI

Student Name	NISN
A. Mutya Chandani Raun	0076062534
Abdi	0071491182
Abdi Pratama	0074513779
Abu Bakar	0061015855
Aiman	0085384339
Al Afan	0071272094
Bayu Septiansa Saputra	0065929434
Cinta Nurhidayani	0077926800
Citra	0078042501
Charinulysia	0066515949

In table 4 there are the names of students in XII class and their NISN.

TABLE IV
STUDENTS OF CLASS XII

Student Name	NISN
Aan Sanjaya	0054528192
Adel	0057513145
Adelia Putri Suryani	0054626521
Adelia Putri Yulianti	0062139179
Adhid Praditya	0065663375
Adit Saputra	0062013704
Afrianto	0053266381
Afriana	0068936760
Ahmad Kurniawan	0057168656
Ahmad Mubarak	0056781348

B. QR Code

This system utilizes QR Codes that are generated dynamically using the PHP programming language. Each

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QR Code is customized for each subject and linked to the school database. In this way, attendance data can be recorded accurately and efficiently. Before starting the lesson, teachers distribute QR Codes to students to take attendance. Students can then scan the QR Code. Once scanned, the system will automatically record student attendance in the database. This attendance process using QR Code provides convenience and speed in managing student attendance data. QR Code attendance can save time significantly, especially with a large number of students in each class. With 30 students per class, the time saved is approximately 6 minutes because each student only needs an average time to scan the QR Code of around 4-7 seconds. Meanwhile, if doing manual attendance takes approximately 10-20 seconds per student and the teacher has the potential for errors such as writing mistakes or recording mistakes which will certainly require even longer time.

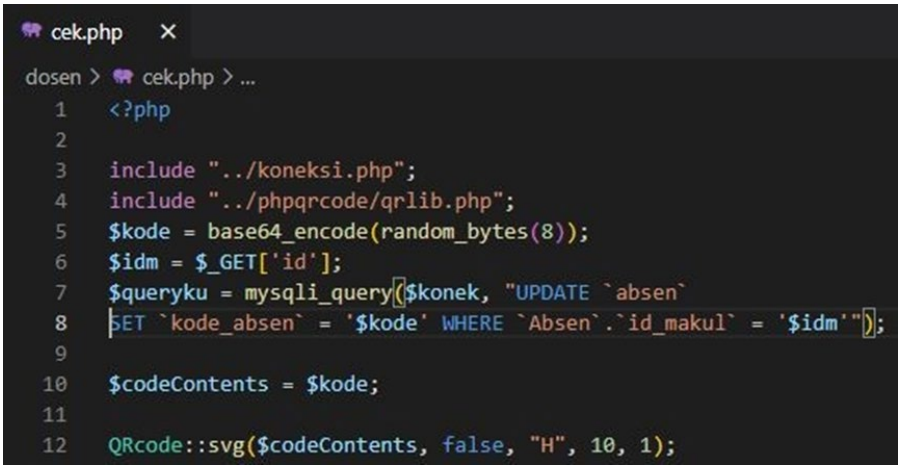

Figure 4. QR Code Coding

Figure 4 is a coding image to create a QR Code and in Figure 5 the output of the coding.

Figure 5. QR Code Result

On the figure 6 student dashboard page, a complete list of subjects that are being followed is displayed. When lesson time arrives, students can easily identify the subjects that are in progress. To record attendance, students can simply click on the "View Details" button available on each course. This will redirect students to the course details page, where they can select the option of Absent or QR Scan.

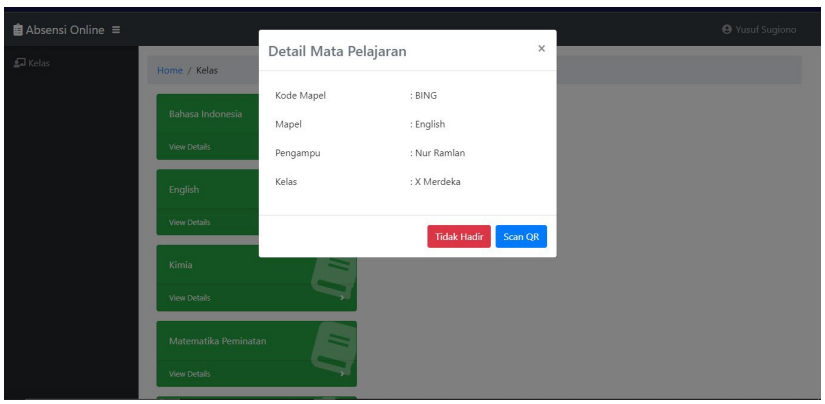

Figure 6. Student Attendance Page

If a student chooses not to attend a subject, the system will require the student to provide valid evidence as the reason for the absence. This mechanism aims to maintain transparency and accountability in recording

student attendance. As proof of absence, students are required to upload relevant documents, such as a doctor's certificate for sick leave or other certificates for other reasons of absence. In addition, students are also required to provide a brief explanation of the reason for their absence. Thus, the school can verify each student's absence more effectively. figure 7 is the student absence page on the system.

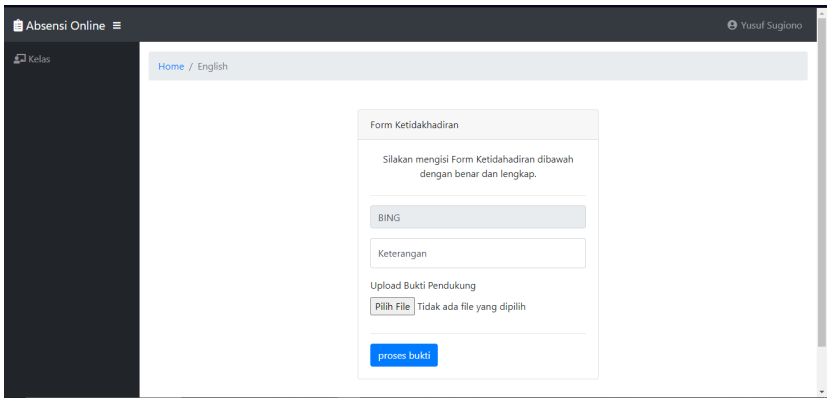

Figure 7. Student Absence Page

When students select the "Scan QR" option, the system will direct users to the QR code scanning page. On this page, students are asked to scan the QR code that has been generated by the system for each learning session. After the scanning process is successful, the system will display a success notification and automatically record student attendance. To prevent falsification of attendance data, the QR code generated by the system is designed to change automatically every 30 seconds. This mechanism ensures that a QR code that has been scanned by a student at one time cannot be reused to scan at a different time. In addition, the system will also block re-scanning attempts on the same QR code after it has been successfully done once, so that each student can only take attendance once in each learning session. Figure 8 is the display of the page when scanning the QR Code.

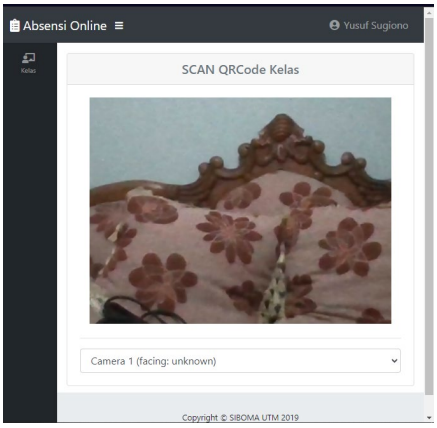

Figure 8. Scan QR Code

C. *WhatsApp Gateway*

After the student has taken attendance by scanning the QR Code, information about the student's attendance will be sent directly to the student's parents via WhatsApp message. Parents mobile phone numbers have been previously recorded in the school database. This feature allows parents to always know their child's attendance at school in real time. The WhatsApp message sent to parents contains information about the student's attendance or absence during the subject. Subject teachers can send messages through the integrated information system. Thus, parents can obtain accurate and up-to-date information about their child's learning activities at school. An example of the format of a WhatsApp message sent to parents can be seen in Figure 10.

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```php
<?php
$sqlKelas = mysqli_query(
  $konek,
  "SELECT * FROM Kehadiran WHERE id_matkul='$id_matkul' ORDER BY nim"
);
while ($data = mysqli_fetch_assoc($sqlKelas)) {
  $phone = $data['nohp'];
  $encodedMessage = urlencode("Today, Student by the name of : "
    . $data['nama'] . "," . " NISN: " . $data['nim']
    . " Attend " . $l['matkul'] . " course");
  $whatsappUrl = "https://api.whatsapp.com/send?phone=$phone&text=$encodedMessage";
```

Figure 9.WhatsApp Gateway Coding

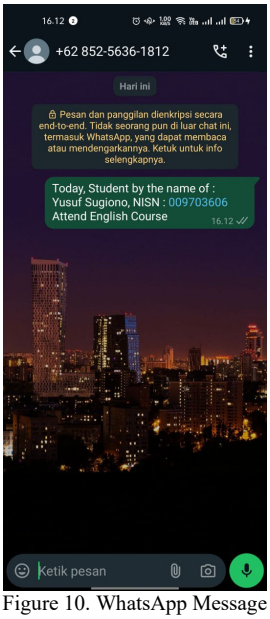

Figure 10. WhatsApp Message

D. *Black Box Testing*

Black box is used to test all features contained in the attendance information system, the results will be declared successful or valid. Testing is also carried out on the stages of inputting student data, inputting teacher data, inputting subject data, filling in student attendance to student attendance information [4]. Black box testing is an important method in software testing that helps ensure that the information system meets user needs and functions properly as expected. Table 5 is the result of black box testing.

TABLE V
BLACK BOX RESULT

Test Case	Description	Result
Login	Display dashboard page if use the username and password are correct	Success
Input Student Data	Ability to add, edit and delete student data in system	Success
Input Teacher data	Ability to add, edit and delete teacher data in system	Success
Input Subject	Ability to add, edit and delete subject data in system	Success
Generate QR Code	The system will create a QR Code for the subject to be accessed	Success
Scan QR Code	Students scan QR Code to fill attendance	Success
Send WhatsApp Message	The system will send a message via WhatsApp Gateway to the student's parents	Success
Print Attendance	The system will create an absence recapitulation	Success

systems potentially have weaknesses or problems that may not have been detected during black box testing, it is important to perform additional, more in-depth steps. to find out the weaknesses of the system can simulate extreme conditions, such as a very large number of users or poor network conditions, to see how the system functions under pressure. This helps identify system limitations and possible failure points that will occur in the system.

E. *System Usability Scale*

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An application usability testing method known as System Usability Scale (SUS) uses ten scales that provide an analysis of the usability of an application from the user's perspective. The aim of this method is to assess the usability of the application that has been created in a way that is easy and fast but still reliable.

TABLE VI
INSTRUMENTS ON SUS

No	Statement	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
1	I find it very easy to scan QR-Codes for attendance	1	2	3	4	5
2	I feel that the attendance information sent via WhatsApp is very clean and easy to understand	1	2	3	4	5
3	I feel there are too many steps I have to take to do attendance	1	2	3	4	5
4	I feel this attendance system is very easy to use	1	2	3	4	5
5	I feel this attendance system is efficient	1	2	3	4	5
6	I feel this attendance system is confusing	1	2	3	4	5
7	I feel the design of this attendance system is not attractive	1	2	3	4	5
8	I feel satisfied with this online attendance system	1	2	3	4	5
9	I feel this attendance system makes me feel frustrated	1	2	3	4	5
10	I feel safe using this attendance system to record my attendance	1	2	3	4	5

TABLE VII
SUS RESPONDENT RESULT

Respondent	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Total	x 2,5
1	4	4	3	3	4	2	2	4	1	4	31	77,5
2	5	3	3	4	4	3	3	4	2	3	34	85
3	5	3	3	4	4	3	3	4	2	3	34	85
4	4	4	4	4	4	3	3	4	2	3	35	87,5
5	3	4	3	4	3	3	3	4	2	4	33	82,5
6	5	4	3	4	3	2	3	4	2	4	34	85
7	5	4	3	5	3	2	3	3	2	4	34	85
8	4	4	2	4	3	2	3	3	2	4	31	77,5
9	4	4	2	4	3	2	2	3	2	4	30	75
10	4	4	2	4	4	2	2	3	2	4	31	77,5
11	4	4	2	4	4	4	3	4	2	4	35	87,5
12	4	4	2	4	4	4	3	4	2	4	35	87,5
13	4	4	3	4	4	4	3	4	2	4	36	90
14	4	4	3	4	4	3	3	4	2	4	35	87,5
15	5	4	4	4	4	3	3	4	2	4	37	92,5
16	4	4	4	5	4	3	3	4	2	4	37	92,5
17	4	4	4	4	4	3	3	4	2	4	36	90
18	4	4	2	4	4	3	3	4	2	4	34	85
19	4	4	2	4	4	3	3	4	2	4	34	85
20	4	4	2	4	4	3	3	4	2	4	34	85
												1.700

Table 7 shows the results of the calculation of SUS scores that have been done by respondents. Then the SUS score will be sought for its average value by summing up all respondent scores that have been multiplied by 2.5 and then divided by the number of respondents then the SUS value will be obtained. The number of respondent SUS scores is 1,700 and there are 20 respondents, so the average value obtained is 85, which means that this system is worth it for use and gets a good response too.

This system made certainly has disadvantages and also advantages when compared to previous research. In the research "IMPLEMENTASI SISTEM KEHADIRAN PRAKTIKUM BERBASIS QR-CODE DENGAN WHATSAPP GATEWAY MENGGUNAKAN METODE RAPID APPLICATION DEVELOPMENT (RAD)" has advantages that are not owned by the system that has been made, one of which is that this research uses the Rapid Application Development method which focuses on developing applications through repeated development and feedback. Research using this method is a faster process compared to the waterfall method which requires fairly rigid planning. A significant difference in these two studies is in the QR Code, in research [25] the QR Code that has been made cannot change which allows students to be late for attendance while in the

research made this QR Code can change which allows no delays and become more disciplined. Both of these studies have advantages and disadvantages but can be improved for further research.

IV. CONCLUSION

This system was created to simplify the attendance process in schools to be more effective and efficient. An innovative solution to improve efficiency and accuracy in the attendance recording process is to implement QR Code technology and WhatsApp Gateway. The attendance process becomes faster because attendance data is automatically recorded in the system after students scan the QR Code. This can reduce human error in manual recording. The use of WhatsApp Gateway in this system allows sending notifications directly to parents about student attendance data at school. The attendance process through QR Code connected to WhatsApp gateway is considered more efficient and effective than manual recording.

Based on the results of black box testing, the implementation of QR Code and WhatsApp gateway as well as supporting features in the system is declared successful. This system can help record student attendance at school to be more effective and efficient.

The results of the System Usability Scale (SUS) test obtained a value of 85 in the Excellent category with a grade scale B which means that this information system is good and suitable for use.

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