Employee Attendance Application Using QR Code Android-Based at Eria Hospital Pekanbaru

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Abstract— ***Eria Hospital has implemented a fingerprint attendance system, but it has some limitations such as difficulty in reading fingerprints, limited access to fingerprint scanner which is only located in one place, and dependence on shared equipment. To overcome these problems, an Android-based attendance application was developed using Waterfall software design. This application uses QR code and GPS to make it easier for employees to record their attendance while in the work area. The quality of this application is based on ISO 25010 quality standards, which include functional testing with all functionalities working well, reliability testing with an A rating, compatibility testing with split-screen feature compatibility, security testing with an A rating, portability testing with results can be install on different devices and Android versions 8.1 to 12, maintainability testing with an A rating, efficiency testing with a startup time of around 1.6 seconds, and user experience testing with attractiveness score of 2.62, perspicuity score of 2.57, efficiency score of 2.62, dependability score of 2.51, stimulation score of 2.62, and novelty score of 2.40. Overall, the implementation of an Android-based attendance application using QR Code has proved to be a viable solution to the challenges faced by the fingerprint attendance system, and has contributed to the optimization of attendance data collection and processing in Eria Hospital.***

Keywords— Attendance, Android, QR Code

I. INTRODUCTION

Eria Hospital was initially a maternity hospital that started operating in 1993. It later developed into RSIA Eria Bunda a special hospital established in 1998 that provides healthcare facilities and services for mothers and children. RSIA Eria Bunda is managed by PT. Riau Sarana Medika and has been operating for more than 23 years. It has become the primary choice of healthcare provider for mothers and children in Pekanbaru and surrounding areas. On April 4th, 2021, RSIA Eria Bunda officially changed its form to a general hospital and is now known as Eria Hospital [1]. Eria Hospital is one of the hospitals that uses fingerprint-based attendance system. The main problem with the fingerprint machine is that the

fingerprints are difficult to read due to dirty or wet fingers, causing the fingerprint to be unclear to the sensor and the scanning process taking a long time [2]. Based on the results of an interview with the Human Resource Department (HRD) of Eria Hospital, the main problem with the fingerprint machines in the hospital is that it often fails to scan due to the aforementioned reasons.

The second problem is the unintentional delay caused by employees, particularly nurses who receive on-call shifts, often missing their attendance time because the fingerprint machine is only located in one place and the employees are already in the unit where they work. This affects the attendance of employees, causing delays in the check-in process [3].

The third problem is the need to avoid direct contact with shared equipment to prevent the risk of virus transmission. One of the alternative solution to this problem is using QR Code attendance system, which is more convenient and hygienic, as it eliminates the need for physical contact with shared equipment. As reported in [4], QR Codes in attendance systems can help to improve the accuracy and speed of attendance tracking and it is worth to be considered as an alternative solution for the attendance system. However, QR Codes also have drawbacks, one of which is the inability to track the location of employees who perform attendance at the Eria Hospital, so employees can cheat attendance by taking photos of the QR code and scanning the QR code in locations other than in the area of Eria Hospital. To overcome this drawback, it is necessary to add GPS [5].

GPS is useful for determining the location of users. With the addition of GPS, the shortcomings of using QR Code for attendance can be overcome by adding validation of the user's location when scanning attendance using QR Code [6]. GPS has a drawback, which is that it cannot accurately distinguish locations based on altitude or floor [7]. To overcome this, data on room location can be added to each QR Code. With the

presence of QR Code and GPS validation, all shortcomings of QR Code and GPS can be overcome.

An employee attendance application using QR Code will be based on Android because after conducting a survey on the type of smartphone operating system used by employees of Eria Hospital, 36 employees who filled out the survey were obtained and more than 97% of Eria Hospital employees use Android smartphones. Android can easily be carried anywhere and accessed anytime [8]. Android can easily run attendance applications because it supports built-in features such as accessing the camera, GPS, and notifications [9].

II. METHODOLOGY

A. Waterfall Software Design

The waterfall software design is a well-known model for software development, in which each phase of the project must be completed before moving on to the next. It is a linear, sequential approach that is often used in projects with well-defined requirements and a clear understanding of the problem domain [10]. One of the key advantages of the waterfall software design approach is that it allows for clear planning and control of the development process. This is achieved by breaking the development process down into a series of distinct stages, such as requirements analysis, design, implementation, testing, and deployment can be seen in Fig. 1. Each stage is focused on a specific set of tasks, and it is easy to track the progress of the project and identify any potential issues [11].
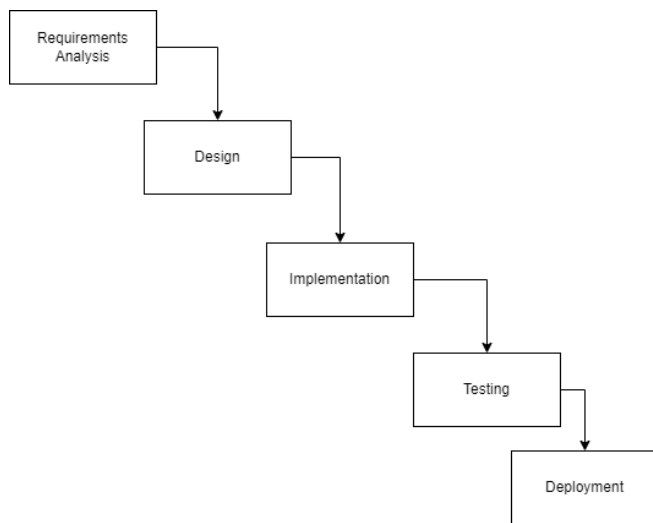

Fig. 1. Waterfall Software Design

Requirements analysis stage involves evaluating the needs of an attendance application by creating a use case diagram, defining functional and non-functional requirements.

Design stage involves producing a comprehensive plan for the development of the attendance application. This includes creating wireframes and an Entity Relationship Diagram (ERD) based on the requirements gathered during the requirements analysis stage.

Implementation stage involves the creation of the attendance application by converting the design into actual code using the Kotlin programming language.

Testing stage involves evaluating the software to guarantee that it complies with the requirements and adheres to the ISO 25010 standards for software quality.

Deployment stage involves the implementation of the software into the production environment. Upon completion of all stages, the application is packaged as an APK file, enabling employees to install the application.

B. Testing Method

ISO 25010 is a standard for software quality evaluation and assessment. It provides a framework for evaluating the quality of software products and systems, including functional and non-functional requirements [12]. ISO 25010 covers eight quality characteristics: functionality, reliability, usability, efficiency, maintainability, portability, compatibility and security [13].

Functionality testing using black box testing. Black box testing, also known as functionality testing, is a method of evaluating the functionality of a software application without knowledge of its internal structure or code [14]. This method involves testing the application from the perspective of the end user, by providing inputs and observing the outputs to ensure that the application behaves as expected.

Reliability testing using SonarQube with reliability rating A = 0 bugs, rating B = at least 1 minor bug, rating C = at least 1 major bug, rating D = at least 1 critical bug, and rating E = at least 1 blocker bug.

Usability testing using UEQ. UEQ (User Experience Questionnaire) is a tool used to evaluate the overall quality of a user's experience with a product or system. It is typically used to gather data on factors such as usability, effectiveness, and satisfaction [15]. UEQ has 26 question components and 7 answer options. UEQ already has Data Analysis Tools. The numbers inputted into the Data Analysis Tools range from 1 to 7 for each question component. The Data Analysis Tools then provide a benchmark result in the form of a score [16]. Bad, if 25% of the products have the lowest score. Below average, if 50% of the products have a higher score, while the remaining 25% have a lower score. Above average, if 25% of the products have a higher score, while the remaining 50% have a lower score. Good, if 10% of the products have a higher score, while the remaining 50% have a lower score. Excellent, if 10% of the products have the highest score.

Efficiency testing using Macrobenchmark measures the time required to open the application in milliseconds. The application has a slow startup time if it takes 5 seconds or longer.

Maintainability testing using SonarQube with a maintainability rating scale based on the improvement time as a percentage of the total time to create the attendance application. A rating of A corresponds to improvement time <=5%, B to 6% to 10%, C to 11% to 20%, D to 21% to 50%, and E to over 50%.

Portability testing using Android Emulator by installing the attendance application on different Android versions and screen sizes

Compatibility testing using Android Emulator by displaying two different applications on a single device side by side using split screen

Security testing using SonarQube with security rating A = 0 vulnerabilities, B = at least 1 minor vulnerability, C = at least 1 major vulnerability, D = at least 1 critical vulnerability, and E = at least 1 blocker vulnerability.

III. RESULT

A. Requirements Analysis

Functional requirements referring to the specific functions or tasks that a system, product, or service must perform in order to meet the needs of the user or customer. Functional requirements describe the capabilities, inputs, outputs, and interactions of the system and provide a clear understanding of what the system must do [17]. The functional requirements of employee attendance application are: (1) Employees can log in with a username and password. (2) Employees can self-register according to their username, name, password, NIK, phone number, address, and department. (3) Employees can view announcements. (4) Employees can view their username, name, NIK, phone number, address, and department. (5) Employees can change their password. (6) Employees can change their phone number, address, and department information. (7) Employees can perform attendance by scanning a QR code and GPS validation. (8) Employees can view attendance history and filter attendance history based on this year, last year, this month, last month, date, time in, and time out.

Non-functional requirements are the quality constraints and performance criteria that a software system must meet, but which do not relate directly to a specific function or behavior [18]. The Non-functional requirements of employee attendance application are: (1) The application can be run anytime 24/7. (2) The application is not prone to errors. (3) The application is user-friendly and can be used by anyone. (4) The application can run on Android platforms with different screen resolutions and versions. (5) A minimum RAM of 2 GB is required to run the application smoothly. (6) The start-up time is no more than 5 seconds. (7) The application uses password encryption. (8) The application is in the Indonesian language.
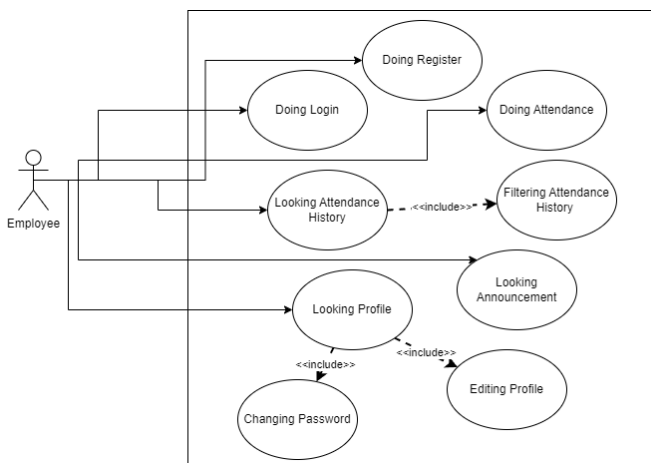
Fig. 2. Employee Attendance App Use case Diagram

Use case diagram illustrates the actions that can be performed by employees can be seen in Fig. 2, such as logging in, registering, displaying profiles, displaying announcements, displaying attendance history, and taking attendance.
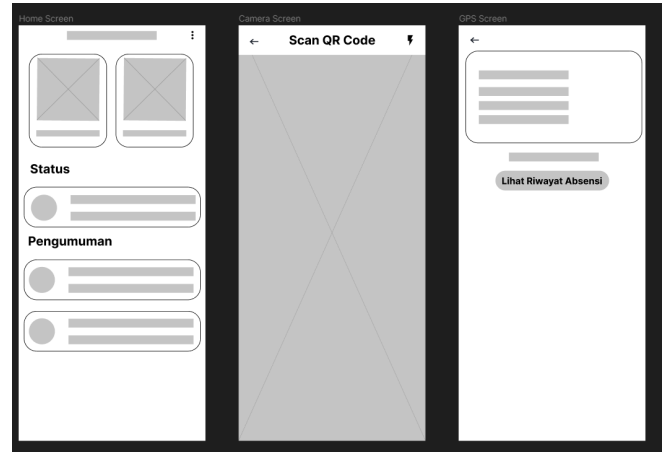
B. Design

Fig. 3. Employee Attendance Wireframe

Wireframe is a low-fidelity, visual representation of a user interface design, which outlines the structure and content of a website, application, or digital product. It is typically used in the early stages of the design process to communicate the basic layout and functionality of the interface before moving on to more detailed design and development work [19]. Wireframe in Fig. 3 depicts three screens: a home screen, a QR Code scanning screen and a GPS validation screen.
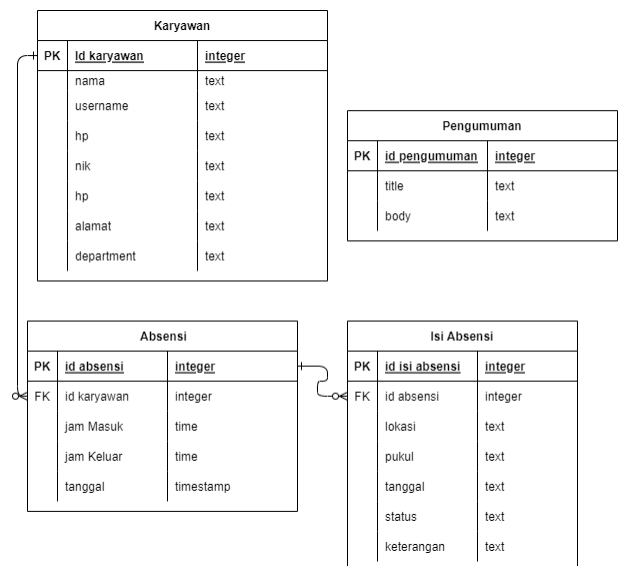
Fig. 4. Employee Attendance App Entity Relationship Diagram

Entity Relationship Diagram (ERD) serves as a graphical representation to depict the relationships within a database [20]. ERD in Fig. 4 includes four tables: attendance, scan attendance, announcements, and employee. The feature of announcement and status on the home screen in Fig. 5 can provide a way for employees to stay informed about important updates and schedule changes, and it can also help managers to track attendance and monitor employee performance. Additionally, the inclusion of a navigation menu for tasks such as filling out attendance, viewing settings, logging out, and viewing attendance history and employee profiles can help to streamline the process of managing employee attendance and performance.
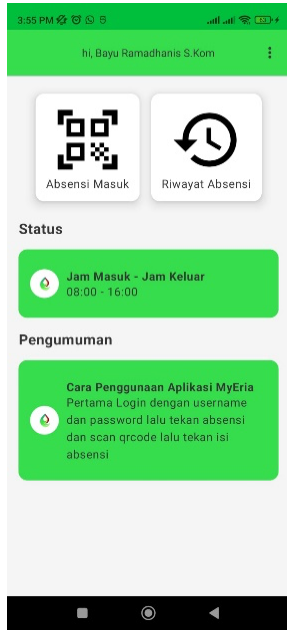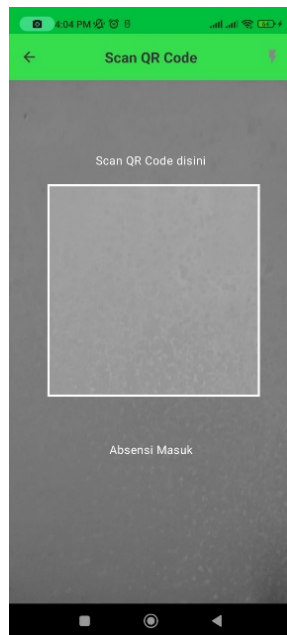
C. Implementation

Fig. 5. Home Screen

Fig. 6. QR Code scanning Screen

The QR Code Scanning Screen in Fig. 6 allows employees to scan QR codes, which will redirect them to the GPS Validation Screen. The screen includes a lightning bolt icon to turn on the flash and an arrow icon to go back to the home screen.
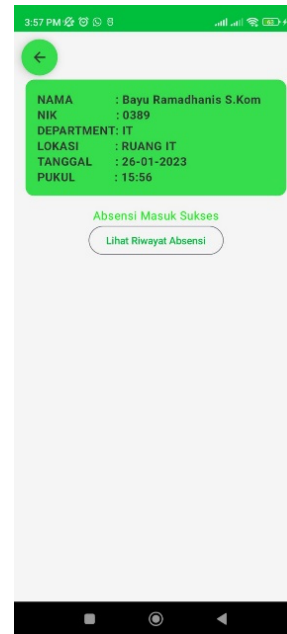

Fig. 7. GPS Validation Screen

The GPS Validation Screen in Fig. 7 uses GPS to confirm the user's location. If an employee is absent from Eria Hospital Pekanbaru, a notification will appear indicating that the employee is outside the designated area. If the employee is within the Eria Hospital Pekanbaru area, employee can submit their absence. The screen also features a view attendance history button to navigate to the attendance history screen and an arrow icon to return to the home screen.

D. Testing

The functional testing using black box testing approach in Table I has confirmed that all test scenarios, both with valid and invalid test data, have produced valid results.

TABLE I. FUNCTIONALITY TESTING RESULTS

No	Employee Attendance App			
	Testing Scenario	*Test Data*	*Expected Result*	*Conclusion*
1	Login Feature	Data Valid	Login Sucess	valid
		Data Invalid	Login Failed	valid
2	Register Feature	Data Valid	Register Sucess	valid
		Data Invalid	Register Failed	valid
3	Attendance Feature	Data Valid	Attendance Sucess	valid
		Data Invalid	Attendance Failed	valid
4	Edit Profile Feature	Data Valid	Edit Profile Sucess	valid
		Data Invalid	Edit Profile Failed	valid
5	Change Password Feature	Data Valid	Change Password Sucess	valid
		Data Invalid	Change Password Failed	valid

Fig. 8.   Reliability Testing Results

Fig. 9.   Reliability Testing Results in Chart

Reliability testing using SonarQube in Fig. 8 and Fig. 9 resulted in an A rating, indicating that there were no bugs present.
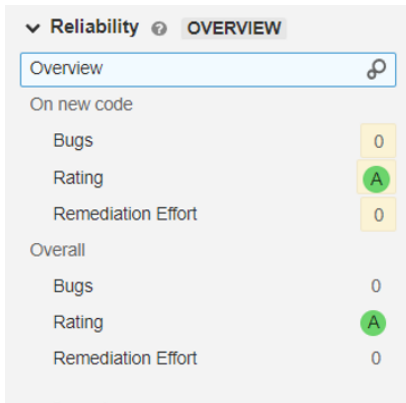

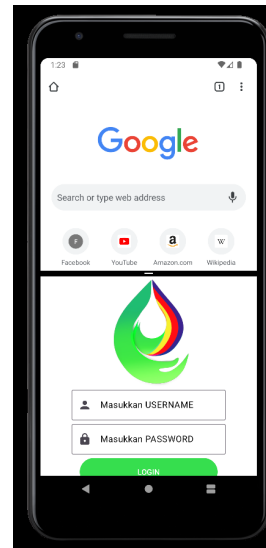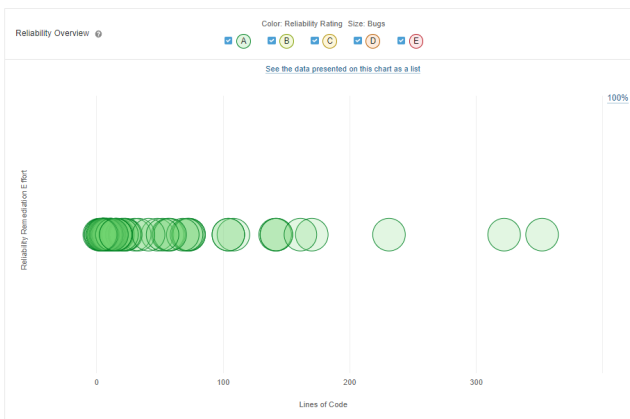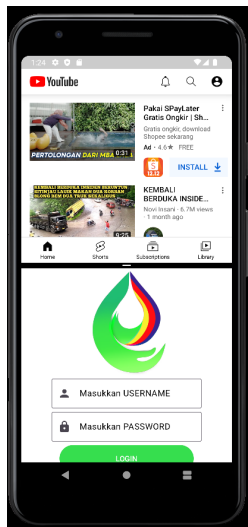Fig. 10. Youtube And Employee Attendance App

Fig. 11. Google Chrome And Employee Attendance App

Compatibility testing using split-screen on an Android emulator can run an attendance application alongside other applications such as YouTube in Fig. 10 and Google Chrome in Fig. 11 simultaneously.
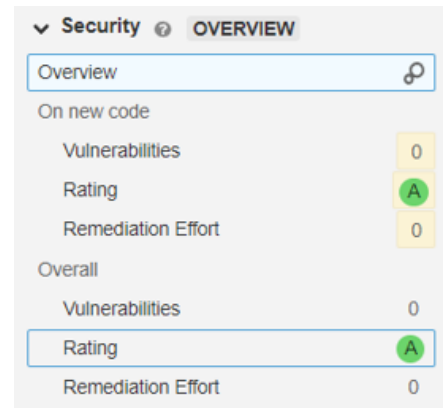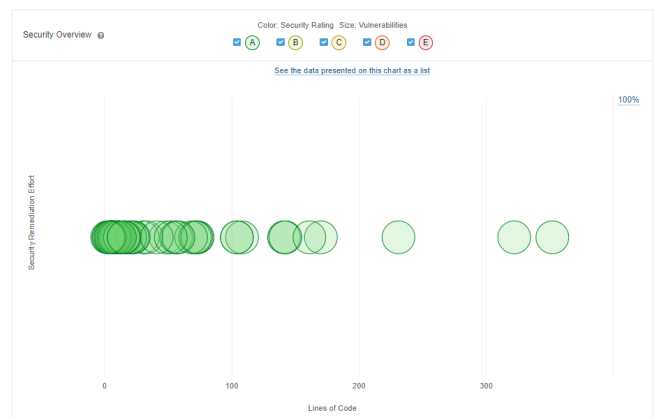

Fig. 12. Security Testing Results

Fig. 13. Security Testing Results in Chart

Security testing using SonarQube in Fig. 12 and Fig. 13 resulted in a security rating of A, indicating that there were no vulnerabilities found.

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TABLE II. PORTABILITY TESTING RESULTS

No	Employee Attendance App		
	Device	*Android Version*	*Conclusion*
1	Xiaomi redmi note 9	12	Success
2	Samsung galaxy A8	9	Success
3	Samsung j7 prime	8.1	Success
4	Vivo 1820	8.1	Success
5	Samsung galaxy A03	11	Success
6	Samsung A12	12	Success
7	Samsung A32	11	Success
8	Oppo reno 5	12	Success
9	Xiaomi Poco X3	12	Success
10	Pixel 3A	10	Success

Portability testing using Android Studio emulator with different Android versions can be seen in Table II and all of them passed the portability test.
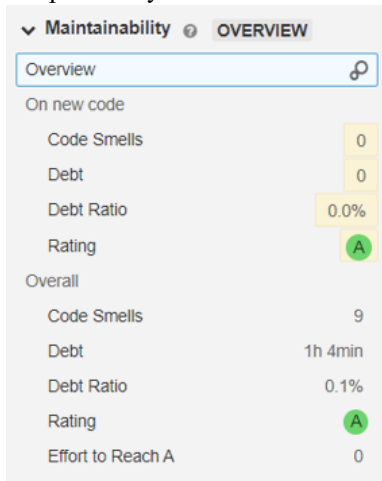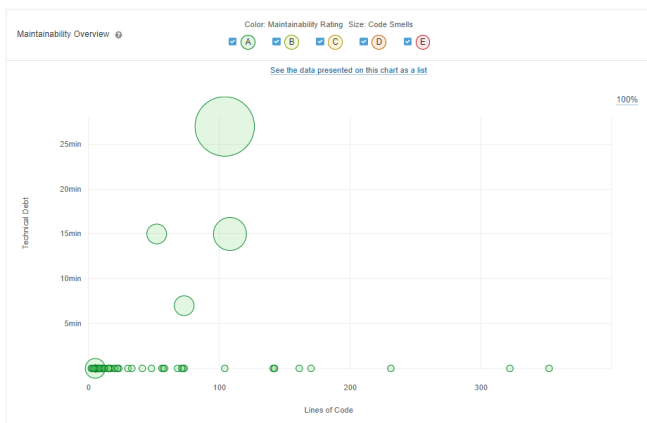

Fig. 14. Maintainability Testing Results

Fig. 15. Maintainability Testing Results in Chart

Maintainability testing using SonarQube in Fig. 14 and Fig. 15 was successful, resulting in an A rating, meaning that the time required for repairs is less than or equal to 5% of the total time needed to create an attendance application.
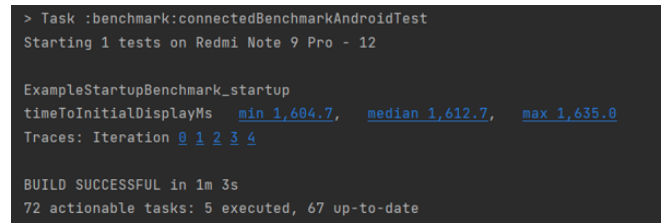

Fig. 16. Efficiency Testing Results

Efficiency testing using macrobenchmark can be seen in Fig. 16. With an application startup speed minimal of 1604.7 milliseconds or about 1.6 seconds, it is considered fast because it is less than 5 seconds.
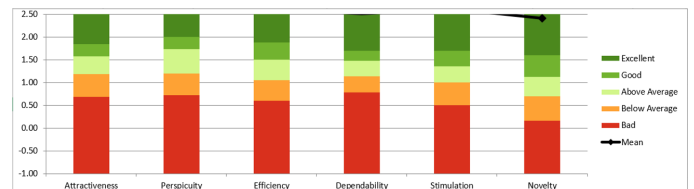

Fig. 17. Usability Testing Results

Fig. 18. Usability Testing Results in Chart

Usability testing using UEQ Data Analysis Tool in Fig. 17 and Fig. 18 showed high scores for attractiveness mean of 2.62, perspicuity mean of 2.57, efficiency mean of 2.62, dependability mean of 2.51, stimulation mean of 2.62, and novelty mean of 2.40, with a benchmark of excellent.

E. Deployment

After conducting tests, the next step is to publish the application by creating an APK file with the name "MyEria" with version 1.0.0, and size of 8MB.

IV. CONCLUSION

The employee attendance application using QR Code Android-based at Eria Hospital Pekanbaru has effectively addressed the limitations of the previously used fingerprint attendance system including difficulty in reading fingerprints, limited access to fingerprint scanners, and the need to avoid direct contact with shared equipment to prevent the risk of virus transmission. The application has received positive results and meets the ISO 25010 software quality standards.

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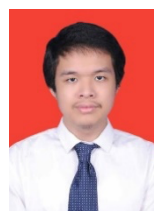
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