Development of Mobile QR Warehouse Management Apllication Based on Flutter and Firebase

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Abstrak — *Since the Covid-19 pandemic took place, the number of MSMEs (Micro, Small and Medium Enterprises) has increased. Running a good business requires good product management to minimize losses that occur due to errors in product management. This research aims to increase the efficiency of the product management process with the QR Scanner feature which can make things easier for MSME owners. This research was designed through various needs gathering steps which included literature studies, surveys and competitor analysis. The application design method used in the development of the QRHouse application will be based on the Object Oriented Programming (OOP) method which has many advantages ranging from its object-oriented nature so that the data structure will be more organized, and also has a variety of concepts that can be used for application development. Application development will also be supported through several UML diagrams consisting of use case diagram, use case description, activity diagram, class diagram, and sequence diagram. Each diagram will have a function that will make the application development process more organised and minimise the occurrence of errors and bugs during application development. The results of the research are an Android and iOS based mobile application called QRHouse. The testing methods used include User Acceptance Test, User Interface Survey, UI Evaluation with 8 Golden Rules, UX Evaluation with 5 Measurable Human Factors. The results of the research were achieved when the application developed succeeded in increasing efficiency in product stock management.*

Keywords: Product Stock Management; QR Code; QR Scanner; Android; iOS; Mobile Application

I. INTRODUCTION

Since the COVID-19 pandemic, many offline businesses have turned online to survive amidst protocols that hamper business activities in almost every field. For example, MSME owners who have been affected by the COVID-19 pandemic prefer to shift their business to online shops. Unlike large companies which have their own warehouse management, most MSMEs feel that they do not need the help of an application or software like those of large companies because they consider their business to be still small scale. According to (Richards, 2021) Warehouse Management System is a system that can process data in a short time and manage the movement of stock / goods in warehousing. A smart Warehouse 4.0 approach to Pallet management using machine vision and the Internet of Things (IoT) using QR Codes, and the importance of successfully managing warehouses in large-scale manufacturing businesses (Vukićević et. al, 2021). QR Codes on Mobile Platforms can Improve Order Capture Process in a Lean Factory Warehouse to help a business compete with its competitors by increasing efficiency in order data management (Pipatprapa, 2019)

Even on a small scale, manual product stock management has many drawbacks. Among other things, there is frequent negligence on the part of responsible employees, fraud in the data collection process, or ineffective management due to the large amount of highly varied product data. One of the problems in managing the product stock of an MSME is the time spent when entering and updating product stock - products that have variations in data types. Especially for MSMEs which have a variety of products ranging from food, daily necessities

and others. The large number of variations increases the occurrence of human error. As a result, losses can occur for both customers and MSME owners. By using a QR Code developed by Denso Wave in 1994, it can store data information and can be read by a smartphone (Tiwari, 2016). The current development can be used in Mobile Apps that can be downloaded on Google Play and App Store (Hasan el. al, 2019). Previous research states (Retnoningsih, 2017): OOP (Object Oriented Programming) is a programming method whose focal point is on the object. Then according to (Windmill, 2020): Flutter is a mobile SDK, created and open sourced by Google; and at its core, it's used to help everyone develop beautiful mobile apps. Furthermore, according to (Redmond, 2012): A database can be defined as a group of data tables containing interconnected information. After that, according to (Premana, 2019): A data dictionary is a collection of lists of data elements that flow in a software system so that inputs and outputs can be generally understood (has a standardised way of writing). According to (Khawas & Shah, 2018): Firebase is a Backend as a Services (BaaS) that provides a variety of tools and services to help developers develop an application (web and mobile) more quickly. According to (Enterprise, 2019): Visual Studio Code is software for developing applications. According to (Dennis et. al, 2015), Unified Modelling Language (UML) is a method to describe the workings and interactions that occur in the system of a program. There are several designs for warehouse management systems using Mobile Applications for the Shoe Manufacturing Industry. Such as the business process in the logistics department of a Philippine company which receives about 300 containers of materials per month (Torress et. al, 2021).

Based on the results of the research, in Jakarta there are approximately 50,000 MSMEs from 2010 - 2022. Data source: Kemenkopukm (*https://satudata.kemenkopukm. go.id/kumkm_dashboard/*). Manual product stock management usually takes quite a long time because every item that comes in or goes out must be recorded one by one. Then, there is a possibility that the book used to manage product stock is lost or gets wet with water, so that the data in the book becomes lost or incomplete. This causes product stock data to become less secure. Apart from that, usually the management of product stock is often carried out by officers or employees who work at the MSME. So there is a possibility that the product stock management process can be manipulated, which of course could have a bad impact on MSMEs and their owners.
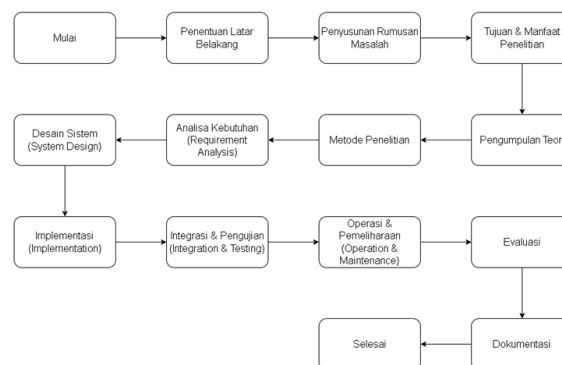
II. METHODS

2.1 Reasearch Flow

Figure 1. Research Flow

Research methods consist of data collection methods, application design methods, and application development methods. For details of the work process, it has been explained in Figure 1, which is a framework for the flow of thinking consisting of determining the background, formulating the problem, determining goals and benefits, collecting theories, determining research methods, needs analysis, system design, implementation, testing, system maintenance, evaluation, and documentation.

The data collection method used is a questionnaire used to collect user requirements from potential application users, and also literature studies used to explain the theories used in this thesis. Theories are collected through references from various articles.

The application design method used in developing the QRHouse application will be based on the Object Oriented Programming (OOP) method which has many advantages starting from its object-oriented nature so that the data structure will be more organized, and also has various concepts that can be used for application development . Application development will also be supported through several UML diagrams consisting of use case diagrams, use case descriptions, activity diagrams, class diagrams, and sequence diagrams. Each diagram will have a function that will make the application development process more organized and minimize the occurrence of errors and bugs during application development.

The application development method used to develop the QRHouse application is the Waterfall development method.

2.2 Requirement Analysis
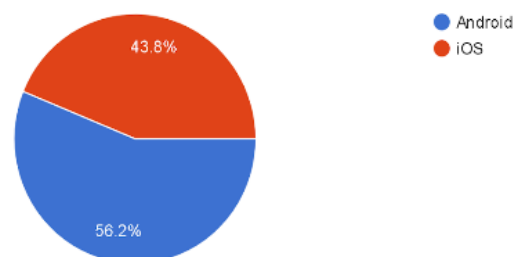## 2.2.1 The operating system used

Figure 2. Percentage of Smartphone Operating Systems used by Respondents

Based on Figure 2, the survey results showed that 56.2% or 50 respondents used smartphones with the Android operating system. Furthermore, 43.8% or 39 respondents used smartphones with the iOS operating system.

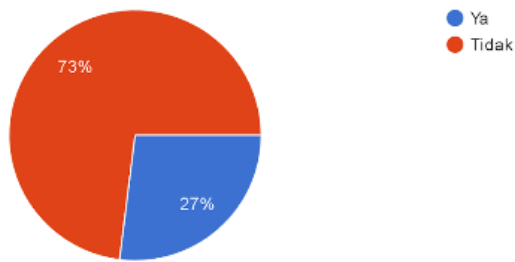**2.2.2 Does the respondent own a business?**

Figure 3. Percentage of Respondents Who Have an Ongoing One

Based on Figure 3, the survey results showed that 73% or 65 respondents did not have a running business. Furthermore, as many as 27% or 24 respondents have ongoing businesses.

2.2.3 How often do respondents experience difficulties when they want to record the stock of each product they own?
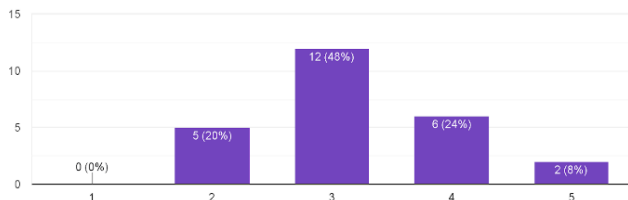

Figure 4. Percentage of Respondents Who Have Difficulty Recording Product Stock

Based on Figure 4, the survey results showed that 48% or 12 respondents chose a value of 3 (neutral). Furthermore, 24% or 6 respondents chose point 4, which means that respondents often experience difficulties when they want to record the stock of each product they own. Then as many as 20% or 5 respondents chose point 2, which means that respondents do not often experience difficulties when they want to record the stock of each product they own. Finally, 8% or 2 respondents chose point 5, which means that respondents often experience difficulties when they want to record the stock of each product they own.

2.2.4 How important is the product stock management process in business processes for respondents
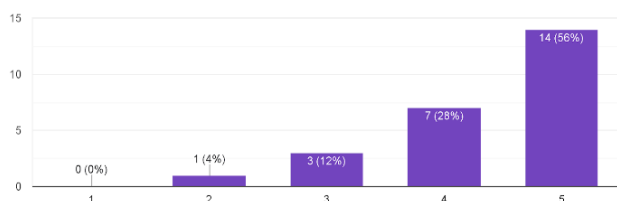

Figure 5. Percentage of Importance of Product Stock Management Process in Business Processes for Respondents

Based on Figure 5, the survey results showed that 56% or 14 respondents chose point 5, which means that respondents felt that product stock management in business processes was very important. Furthermore, 28% or 7 respondents chose point 4, which means that respondents

felt that managing product stock in business processes was important. Then 12% or 3 respondents chose point 3 (neutral). Finally, 4% or 1 respondent chose point 2, which means that respondents felt that managing product stock in business processes was not important.

2.2.5 Do respondents think the product stock management process with the help of the Scan QR feature helps increase the efficiency of the stock management process?
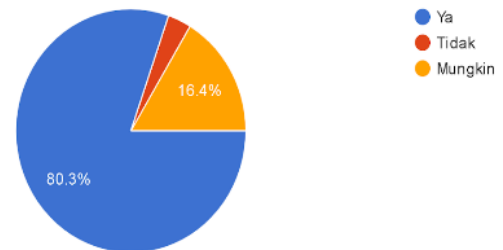

Figure 6. Percentage of Respondents Who Agree that the QR Scan Feature Helps Increase the Efficiency of the Stock Management Process

Based on Figure 6, the survey results showed that 80.3% or 49 respondents answered that the product stock management process with the help of the Scan QR feature helps increase the efficiency of the stock management process. Furthermore, 16.4% or 10 respondents answered that the product stock management process with the help of the Scan QR feature might help increase the efficiency of the stock management process. Then as many as 3.3% or 2 respondents answered that the product stock management process with the help of the Scan QR feature does not help increase the efficiency of the stock management process.
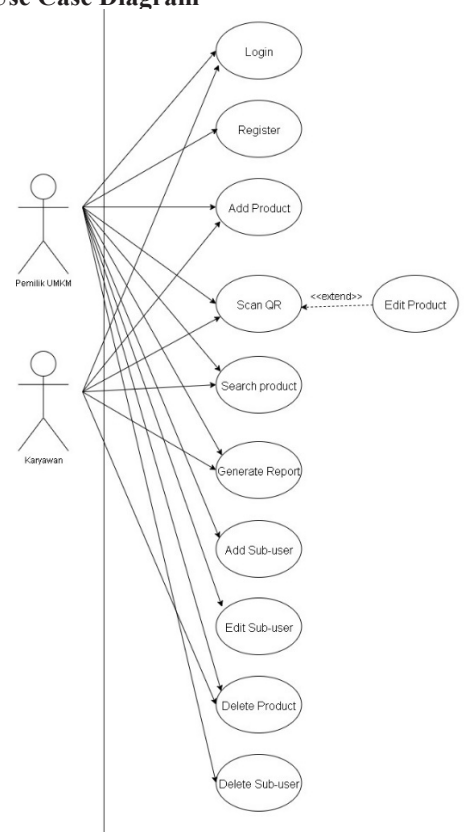
2.3 Design

2.3.1 Use Case Diagram

Figure 7. *Use Case Diagram*

III. RESULTS AND DISCUSSION

3.1 Hardware Specification

Table I. Android Hardware Specification

Device	Minimum	Reccommendation
Processor	Qualcomm MSM8916 Snapdragon 64-bit	Qualcomm Snapdragon 732G
RAM	3 GB	6 GB
Storage	250 MB *available space*	350 MB *available space*
Screen	5 *inch*	6 *inch*

Tabel II. iOS Hardware Specification

Device	Minimum	Reccommendation
Processor	Apple A8	Apple A11
RAM	1 GB	4 GB
Storage	250 MB *available space*	350 MB *available space*
Screen	5 *inch*	6 *inch*

3.2 Spesifikasi Software

Tabel III. Android Software Specification

Device	Minimum	Reccommendation
Opeartion System	*Android* 9	*Android* 11

Tabel IV. Android Software Specification

Device	Minimum	Reccommendation
Opeartion System	*Android* 9	*Android* 11

3.3 Questionnaire Evaluation

To evaluate the questionnaire, a survey was designed which was then distributed to potential users of the QRHouse application. The survey results were obtained with a total of 51 respondents and were concluded as follows:

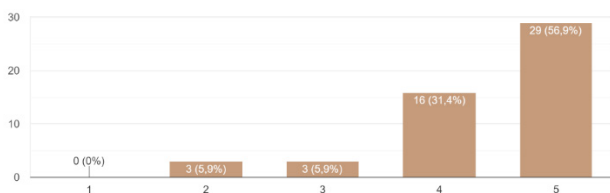1. **How easy is the UX of the QRHouse app to understand?**

Figure 8. Percentage of Respondents' Ratings Regarding How Easy the UX of the QRHouse Application is to Understand

Based on Figure 8, the survey results showed that 56.9% or 29 respondents chose point 5. Then 31.4% or 16 respondents chose point 4. Then 5.9% or 3 respondents chose point 3. Finally, 5.9% or 3 respondents chose point 2.

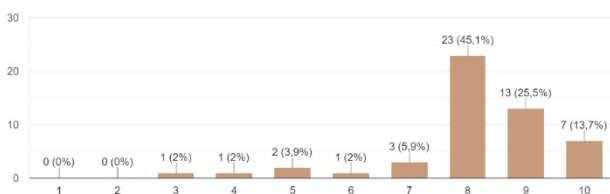2. **How much value is given to QRHouse's UI/UX?**

Figure 9. Percentage of Respondents' Assessment of the UI/UX of the QRHouse Application

Based on Figure 9, the survey results showed that 45.1% or 23 respondents chose point 8. Then 25.5% or 13 respondents chose point 9. Then 13.7% or 7 respondents chose point 10. Then 5.9% or 3 respondents chose point 7. Then 3.9% or 2 respondents chose point 5. Then 2% or 1 respondent chose point 6. Then 2% or 1 respondent chose point 4. Finally 2% or 1 respondent chose point 2.

3.4 User Interface Evaluation

UI evaluation uses 8 golden rules based on Ben Schneiderman's theory. There are 8 principles that can help a developer or designer to design a more interactive interface. These principles are also known as the 8 golden rules which consist of:

- Strive For Consistency
- Seek Universal Usability
- Offer Informative Feedback
- Design Dialogs to Yield Closure
- Prevent Errors
- Permit Easy Reversal of Actions
- Keep Users in Control
- Reduce Short-term Memory Load

3.5 User Experience Evaluation

Evaluation of the user experience of the QRHouse application is carried out based on the concept of 5 measurable human factors which have assessment benchmarks based on 5 main elements, namely:

- Time to Learn
- Speed of Performance
- Rate of Errors
- Retention Overtime
- Subjective Satisfaction

3.6 User Acceptance Test (UAT)

Table V. Add Product Page UAT

Test Step	Test Description	Expected Results	Pass/ Fail
Test script #1 - Diakses oleh user yang tidak memiliki otorisasi 'Add'			
1.	Click the Add Product menu	Displays an error message that the user does not have authorization	*Pass*
Test script #2 - Accessed by authorized users			
1.	Click the Add Product menu	Directed to the Add Product page	*Pass*
Test Script #3 - Menambahkan gambar produk			
1.	Click the Add Image icon	Displays the Add Image pop up dialog	*Pass*
2.	Click the Add Image button on the Add Image pop up dialog	Directed to the user's device gallery	*Pass*
3.	Select an image from the gallery	Displays the selected Image on the Add Product page	*Pass*
Test Script #4 - Cancel adding product images			

Test Step	Test Description	Expected Results	Pass/Fail
1.	Click the Add Image icon	Displays the Add Image pop up dialog	Pass
2.	Click the Cancel button on the Add Image pop up dialog	The pop up dialog closes	Pass

Test Script #5 - Add product variant names			
Test Step	Test Description	Expected Results	Pass/Fail
1.	Click the Add Variant button	Displays the Add New Variant Name pop up	Pass
2.	Empty the Add Variant Name form, then click the Save button	Displays an empty field error message	Pass
3.	Fill in the variant name, then click the Add button	• Added variants to the Add Products page • Displays the success add variant name message	Pass

Test Script #6 - Cancel adding product variant names			
Test Step	Test Description	Expected Results	Pass/Fail
1.	Click the Add Variant button	Displays the Add New Variant Name pop up	Pass
2.	Fill in the variant name, then click the Cancel button	*Closes the pop up dialog*	Pass

Test Script #7 - Add variant contents to the name of the variant that has been added			
1.	Don't fill in the variant contents, then click the submit button	Displays an error message, variant cannot be empty	Pass
2.	Fill in the value in the name of the variant that has been added	Displays a table listing product details with variants according to the values entered	Pass
3.	Click the 'Add more variant value' button	Displays a new form field in the Add Product display	Pass
4.	Fill out the variant value form	The detailed product variant table changes dynamically according to the contents of the variant value	Pass

Test Script #8 - Add custom fields			
1.	Clik add field button	Displays custom field forms	Pass
2.	Fill in the name field & value field	Add custom fields to product data	Pass

Test Script #9 - Canceling the Add Product process			
1.	Click Cancel button	Displays the process cancellation confirmation dialog	Pass
2.	Click 'cancel' in the dialog	Closing the confirmation dialog, the abort process is cancelled	Pass
3.	Click 'Yes' in the dialog	Redirected to Home page, process cancelled	Pass

Test Script #10 - Carry out the process of adding products			
1.	Click the Submit button, with validation that is not yet appropriate	Displays error messages on components that do not comply with validation	Pass
2.	Click the Submit button, with appropriate validation	• Add products to the company's product list • Displays the QR Code of the product ID that has been created	Pass
3.	Click the 'Save Image' button	• The QR Code image is saved in the user's device gallery • Displays a success save image message	Pass
4.	Click the 'Done' button	Directed to the Product List page	Pass

3.7 UAT QR Scanner Page

Table VI. Product Detail Page UAT

Test script #1 - Scanning for invalid QR codes			
Test Step	Test Description	Expected Results	Pass/Fail
1.	Scan invalid qr codes	The error message user qr code is invalid is displayed	Pass

Test script #2 - Scan valid QR code			
Test Step	Test Description	Expected Results	Pass/Fail
1.	Scan valid QR code	Directed to the Product Detail page according to the scanned product ID	Pass

Test script #3 - Testing features on the QR Scanner page			
Test Step	Test Description	Expected Results	Pass/Fail
1.	Click Flash button	• If OFF, the flash on the device will be turned on • If ON, the flash device will be turned off	Pass
2.	Click the Flip Camera button	The device camera will be reversed	Pass
3.	Click the Pause button	The device camera is freeze	Pass
4.	Click the Resume button	The device camera is turned on again	Pass

IV. CONCLUSION

Based on the data obtained after going through the analysis, design, development, testing and evaluation stages, it can be concluded that the QRHouse Application with its QR Code Scanner feature will make it easier for users to manage product stock. The QRHouse application was developed by following Ben Shneiderman's 8 golden rules and 5 measurable human factors so that the application provides users with a good user interface and user experience and will help minimize the occurrence of human errors. The QRHouse application with Weekly Inbound and Outbound Graph and Reporting features will help users find out which products have been released within a weekly and monthly period. The QRHouse application was developed using the Dart programming language and uses the Flutter framework which allows this application to run on Android and iOS platforms.

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