DESIGN AND DEVELOPMENT OF AN ANDROID-BASED FERTILIZER ORDERING APPLICATION IN THE BANGKALA REGION

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ABSTRACT

In the Bangkala Region of Jeneponto Regency, farmers continue to depend on the conventional system for the fertilizer ordering process. This system results in inefficiencies and consumes the time of both sellers and buyers. We require an Android-based fertilizer ordering system that integrates directly with the server. The objective of this study is to develop an Android-based application for ordering fertilizer in the Bangkala region. This application was developed using the Research and Development (R&D) methodology and the waterfall development model. The results of this research have yielded a product in the form of an Android-based fertilizer ordering application, which will be utilized by farmers in the Bangkala Region, Jeneponto Regency. The system was tested using the ISO 25010 standard across four aspects: functional suitability, portability, usability, and performance efficiency. Functional suitability testing indicates that this application is "suitable" for use. Portability testing revealed that this fertilizer ordering application system runs well on several versions of Android. The usability testing results of the application have been categorized as "Very Good". Furthermore, performance efficiency testing shows that the CPU usage is at 4%, memory usage at 156.4 Mb, and the application network activity is at 80 Kb/s. Based on this data, the application has been well-received by users and can serve as a streamlined platform for ordering fertilizers for farmers.

Keywords: Application, Ordering, Fertilizer, Android, Waterfall.

1. Introduction

The rapid development of information technology has impacted nearly every aspect of life, representing efforts to organize information effectively for organizational use. The evolution of internet-based technology serves as evidence of the significance of information organizations [1]. The continuous development of information technology has empowered individuals to connect and communicate with each other, irrespective of distance, space, or time limitations. As mentioned in [2], one of the most remarkable advancements is observed in the smartphone sector. With a mere smartphone, numerous activities can be accomplished through the utilization of mobile applications, serving as sources of entertainment, social communication, or tools for accessing and processing information.

In the agricultural sector, farmers require various types of information to bolster their agricultural enterprises. This includes not only information about crop production technology but also post-harvest details such as processing, storage, handling, and marketing. In broad terms, agriculture encompasses human activities involving farming, animal husbandry, fishing, and all aspects related to forestry. Large-scale farming entails all activities using living organisms, namely plants, animals, and microorganisms, to fulfill human needs [3].

In the process of ordering and selling fertilizer, farmers in the Bangkala Region, Jeneponto Regency still rely on a conventional system. In this system, consumers are required to visit the shop or call in advance to place their fertilizer orders. However, this often leads to errors in recording orders, including inaccuracies in quantity, type, price, and the total amount owed by consumers. In addition, sellers still resort to writing orders on paper to document the details of transactions, necessitating a manual sales recapitulation process involving the inputting of data one by one. This conventional system leads to inefficiency in managing fertilizer orders and sales, consuming valuable time for both sellers and buyers.

Based on these issues, there is a need for an Android-based fertilizer ordering system that integrates directly with the server. This system aims to streamline the management of fertilizer products for shop owners and simplify the ordering process for consumers. By providing comprehensive information, including product names, descriptions, and prices, the system aims to reduce ordering errors. Additionally, consumers can conveniently place orders without visiting the shop or contacting the seller by simply accessing the fertilizer ordering application on their Android device, selecting desired products and quantities, and placing the order. Then, the order results will be sent directly to the server, allowing the ordering process to be factual and efficient in terms of time and energy.
2. Research Methodology

a. Types of Research

The research methodology employed by the author in this study is Research and Development (R&D). R&D, also known as research and development, is a research approach utilized to create specific products and assess their effectiveness [4]. Research and Development (R&D) is employed to develop and refine products based on references and product criteria, to generate new products through multiple stages of validation or testing to ensure accountability [5].

b. Time and Place of Research

The research will be conducted from May 2023 to June 2023. The research will take place at Silanu Jaya Shop in the Bangkala Region, Jeneponto Regency.

c. Development Model

The development model utilized in this research is a software development model employing the waterfall method. According to [6], the waterfall model follows a sequential development approach. The waterfall model progresses systematically in constructing a software program. This development model offers several advantages, such as being easy to understand and applicable throughout the software development process.

![Waterfall Development Model](image)

The stages of the waterfall development model are as follows:

1) Requirement

At this stage, application developers require communication aimed at understanding the expectations of software users and the limitations of the software. System and software requirements are documented and will be reviewed by users to determine whether they fulfill their needs and desires.

2) Design

At this stage, the developer creates a system design to define the hardware and system requirements, which in turn assist in establishing the overall system architecture. Design is a stage that encompasses various aspects, including data structure, software architecture, user interface, and coding procedures. There are several types of software modeling techniques, with one commonly used model being the Unified Modeling Language (UML), which describes the software program to be developed. UML is designed to facilitate the software development process for developers.

3) Implementation

During this stage, the system is initially developed into small programs called units, which are then integrated into the subsequent stage. Each unit developed and evaluated for its function is referred to as unit testing. This evaluation is beneficial for minimizing errors that may occur before all parts are combined into a single software unit.

4) Verification

At this stage, the system undergoes verification and testing to determine whether it fully or partially meets the system requirements. The testing process aims to minimize errors encountered during system operation, with system testing encompassing both functional and software quality testing. Functional testing verifies the proper functioning of system operations, while software quality testing assesses the suitability of the system for use.

5) Maintenance

Maintenance is the final stage of the waterfall development method. The completed software program will be executed and maintained. Maintenance involves rectifying errors that were not identified in previous stages.

d. Data Collection Technique

Data collection in research activities is crucial as it pertains to the availability of data necessary for addressing research problems. In this study, the data collection methods employed included interview techniques and questionnaires.
1) Interviews
   The interview technique involves a conversation with a defined objective. It entails two parties: the interviewer, who poses questions, and the interviewee, who furnishes responses. This interview was conducted with multiple farmers in the Bangkala region to gather the necessary data for designing a fertilizer ordering application.

2) Questionnaire
   A questionnaire is a data collection technique that utilizes a list of questions employed by researchers to assess the suitability of the developed software. There are two types of questionnaires: closed and open questionnaires. The questionnaire utilized in this study is a closed questionnaire, which includes pre-provided answers, allowing respondents to simply select and provide direct responses. This questionnaire is employed to evaluate the feasibility of the fertilizer ordering application software in terms of functional suitability and usability. It was administered to gather data from both system validators and users.

e. Research Subject
   The term "research subjects" refers to individuals or groups who will test the applications that have been developed. Selecting appropriate research subjects is crucial as the research outcomes depend heavily on the results of the conducted trials or tests. According to [7], research subjects are divided into two groups: human subjects and non-human subjects. The research subjects in this paper are:
   1) Two expert lecturers from Makassar State University are tasked with testing the functional suitability aspects of the Android-based Fertilizer Ordering Application that has been developed.
   2) Fifteen farmers from the Bangkala Region are tasked with testing the usability aspects of the developed applications. As outlined in [8], the minimum number of respondents required to conduct test subjects or usability testing is 10 people.

f. Research Instrument
   Research instruments are tools utilized to gather data or measure objects related to a research variable. To ensure accurate data and conclusions are aligned with the actual circumstances, it is essential to employ instruments that are valid, consistent, and accurate in providing research data (reliable). The instrument employed in this research was a questionnaire. Validator questionnaires were utilized to assess functional suitability aspects, while user questionnaires were utilized to evaluate usability aspects.

g. Data Analysis Technique
   The data analysis process aims to calculate the variable data being tested, specifically software quality based on ISO 25010, which comprises eight aspects. However, in this stage, the author utilizes only four aspects based on the theory outlined in [9], namely:
   1) Analysis of Functional Suitability Aspects
      Testing for functional suitability is determined by calculating the percentage score for each instrument. Each question item on the answer sheet utilizes the Guttman scale. As stated in [10], this type of measurement scale yields clear responses, such as "Yes" or "No", "True" or "False", "Never" or "Never", "Positive" or "Negative". The table below represents the score conversion from the Guttman scale [10].

<table>
<thead>
<tr>
<th>Answer</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>1</td>
</tr>
<tr>
<td>No</td>
<td>0</td>
</tr>
</tbody>
</table>

The test results are calculated using the formula derived from the feature completeness matrix. This matrix serves as a tool to gauge the accuracy of feature implementation. Below is the calculation formula that can be utilized to process questionnaire data [11].

\[ X = \frac{I}{P} \]  

Information:

- I = Number of successfully implemented features
- P = Number of designed features

In the feature completeness matrix, a value close to 1 indicates the number of features that have been successfully implemented [7]. The software is considered to have good functional suitability based on the following table:

<table>
<thead>
<tr>
<th>Score</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 ≤ x ≤ 1</td>
<td>Good</td>
</tr>
<tr>
<td>0 ≤ x ≤ 0.4</td>
<td>Not Good</td>
</tr>
</tbody>
</table>
2) Analysis of the Portability Aspect
   Testing of the portability aspect was conducted by running the fertilizer ordering application on a smartphone with several different versions of Android, enabling the collection of data analysis results for the portability aspect from the test outcomes.

3) Analysis of Usability Aspects
   The analysis of usability aspects was conducted using the questionnaire method. In this questionnaire, responses to each question item were measured using a Likert Scale [10].

<table>
<thead>
<tr>
<th>Answer</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly agree</td>
<td>5</td>
</tr>
<tr>
<td>Agree</td>
<td>4</td>
</tr>
<tr>
<td>Doubtful</td>
<td>3</td>
</tr>
<tr>
<td>Disagree</td>
<td>2</td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>1</td>
</tr>
</tbody>
</table>

The formula used to calculate the percentage of test results is as follows:

\[
\text{Percentage Score} = \frac{\text{Total Score}}{\text{Maximum Score}} \times 100\% \quad \text{........................................... (2)[12]}
\]

After obtaining the percentage score results, they will be compared with the criteria table for score interpretation [13] as shown in the following table:

<table>
<thead>
<tr>
<th>Percentage of Achievement (%)</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥81% - 100%</td>
<td>Very Good</td>
</tr>
<tr>
<td>≥61% - 80%</td>
<td>Good</td>
</tr>
<tr>
<td>≥41% - 60%</td>
<td>Pretty Good</td>
</tr>
<tr>
<td>≥21% - 40%</td>
<td>Not Good</td>
</tr>
<tr>
<td>0% - 20%</td>
<td>Very Bad</td>
</tr>
</tbody>
</table>

4) Analysis of Performance Efficiency Aspects
   Testing the performance efficiency aspect involves the utilization of a testing tool, namely the Android Profiler in Android Studio, to measure performance relative to the resources utilized under specific conditions within the application system.

3. Results
   The research outcomes derived from designing an Android-based application for fertilizer ordering in the Bangkala region have led to the development of an application aimed at aiding farmers in ordering fertilizer and helping shop owners manage their fertilizer products for sale, while also enabling automatic sales recapitulation. The author conducted testing on the application with two expert system validator lecturers at Makassar State University and fifteen farmers from the Bangkala Region, Jeneponto Regency, who would utilize this Android-based fertilizer ordering application. The subsequent section provides an overview of the application testing results based on the ISO 25010 standard across four aspects.

1) Requirement
   During this stage, the researcher conducted interviews with farmers in the Bangkala Region, Jeneponto Regency, to gather data and information regarding the needs and requirements necessary for the development of the Fertilizer Ordering Application. The results of this stage are as follows:
   a) Users expect comprehensive product information features, such as providing a complete description of each fertilizer product, including its composition, benefits, dosage for use, and instructions for use. This information assists users in selecting products that meet their needs.
   b) Order history feature: This feature enables users to view their previous orders, including product details, order dates, and delivery statuses. It allows users to track their orders and access their transaction history.
   c) Due to the Cash on Delivery (COD) payment system, users require a page for selecting the delivery date and time directly, enabling them to adjust the delivery time according to their availability, even when they are at home.

2) Design
   After completing the requirements/interview stage and thoroughly documenting the needs, the researcher proceeds to the stage of creating a provisional design. This design entails producing a storyboard in the form of flowchart diagrams, use case diagrams, activity diagrams, and interface designs.
Figure 2. Flowchart Diagram

Figure 3. Use Case Diagram
3) Implementation

At this stage, researchers commenced building an Android-based fertilizer ordering application with the assistance of Android Studio software, utilizing the Java programming language while referring to designs and concepts formulated in the previous stage. Researchers meticulously attended to every aspect of the program's creation to ensure that the resulting software aligns with the specified requirements and development objectives. The following are the outcomes of the implemented software:

a) Splash screen display

b) Display of payment details
4) Verification

During this verification stage, researchers utilized the ISO 25010 standard to assess the feasibility of an Android-based fertilizer ordering application across four aspects: functional suitability, usability, performance efficiency, and portability.

a) Functional Suitability Testing Aspect

In this case, the research was conducted using an instrument in the form of a functional test case consisting of 24 questions related to the functionalities of the developed application. The functional suitability instrument was validated by a systems expert lecturer. For each functioning feature, the systems expert lecturer will mark a check in the “Yes” column, whereas if the feature does not perform well, a check will be placed in the “No” column.

Table 5. Functional Suitability Test Data Analysis

<table>
<thead>
<tr>
<th>Answer</th>
<th>Validator 1</th>
<th>Validator 2</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>24</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Not</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

After conducting functional suitability testing in the form of test cases, the scores for each assessment can be determined, namely:

Yes : (24/24) = 1
Not : (0/24) = 0

The data analysis reveals the results of functional suitability testing conducted by two expert system validator lecturers. These results demonstrate that the functional suitability test, based on calculations using the feature completeness matrix formula, yields a score of 0.5 ≤ × ≤ 1, placing the application in the ”Good” category due to the successful implementation of all features. Therefore, it can be concluded that this Android-based Fertilizer Ordering Application is "Appropriate" for use.

b) Portability Aspect Testing

The results of portability testing are utilized to assess the capability of an application or system to function effectively across diverse environments or platforms. Testing the portability aspect is crucial as the application will be deployed on various operating systems, hardware, and environments.

This test will be conducted by observing the output results generated using Android smartphones of different versions. Below are the results of portability aspect testing on the fertilizer ordering application built for Android.

Table 2. Portability Testing Results

<table>
<thead>
<tr>
<th>Version</th>
<th>Installation Process</th>
<th>Results</th>
</tr>
</thead>
</table>

After conducting portability testing by installing applications on several Android phones with different versions, the results indicate successful portability testing. Thus, it can be concluded that this Android-based fertilizer ordering application is "suitable" for use on Android phones with various versions.
c) Testing the Usability Aspect

Usability is a critical factor in the application design process as application systems are constructed to fulfill user needs; thus, prioritizing user ease in utilizing the application is essential. The questionnaire was distributed to 15 users and yielded the following results:

<table>
<thead>
<tr>
<th>Category</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Good</td>
<td>15</td>
<td>100%</td>
</tr>
<tr>
<td>Good</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Doubtful</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Not Good</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Very Bad</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td><strong>Amount</strong></td>
<td><strong>15</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

In the table above, it can be concluded that all 15 respondents indicated strong agreement, resulting in a percentage of 100%. No respondents expressed agreement, uncertainty, disagreement, or strong disagreement, representing 0%. This indicates that, on average, respondents are satisfied with this Android-based fertilizer ordering application, thus it can be deemed "appropriate" for use.

d) Testing the Performance Efficiency Aspects

Testing the performance efficiency aspect involves utilizing testing tools within the Android Studio SDK, particularly a profiler, to measure the CPU, memory, network, and energy usage of this Android-based fertilizer ordering application system.

![Performance Efficiency Aspect Testing](image)

Figure 2. Performance Efficiency Aspect Testing
Testing of the performance efficiency aspect is conducted using a profiler, which measures real-time data for CPU, memory, and application network activity. As depicted in Figure 5, the CPU usage is 4%, memory consumption is 156.4 MB, and network usage is 80 KB/s when utilizing the Android-based Fertilizer Ordering Application.

5) Maintenance

During the maintenance stage, the program will be executed, and maintenance activities will be conducted, including addressing errors not detected in previous steps. In this phase, researchers will perform regular performance monitoring to identify potential issues and bottlenecks. They will also implement functionality updates in response to user feedback and evolving requirements, which may involve adding new features or enhancing existing functionalities. Additionally, they will address bugs reported by users or identified during monitoring to ensure the smooth operation of the application.

4. Discussion

The Design of Android-based Fertilizer Ordering Application in the Bangkala Region is an application used for digitalized fertilizer orders by farmers in the Bangkala Region, Jeneponto Regency. This application is Android-based, allowing users to access it anytime and anywhere using various versions of Android smartphones. Aiming to meet high-quality standards, this application follows established guidelines for system development. This ensures accountability in the creation process, adhering to agreed standard procedures. Developed using the waterfall development model, this systematic approach includes requirements gathering, design, implementation, verification, and maintenance stages.

The process of creating the Android-based fertilizer ordering application begins with analyzing system requirements, involving data collection through interviews with farmers in the Bangkala Region. This stage defines user requirements, including features like product descriptions, order history, and user-customizable delivery schedules.

Next, a preliminary application design is crafted to outline the model. Design elements, including flowcharts, use case diagrams, activity diagrams, and interface designs, are meticulously crafted for consistency, recognizing their interconnectedness. Subsequently, the implementation stage commences, utilizing Android Studio SDK to build the application. Attention to detail ensures compliance with specifications and goals.

The application that has been developed will undergo testing based on the ISO 25010 standard [14]. The testing process focuses on reducing errors that may occur during application execution, ensuring its quality. Application testing encompasses four aspects: functional suitability, portability, usability, and performance efficiency.

Testing the software quality standards of ISO 25010 revealed that the results met the overall quality standards, particularly in the functional suitability aspect, as evaluated by validator lecturers. It was found that this application was rated as "Good" for use. Portability testing, conducted by observing the output results generated using various versions of Android smartphones [15], demonstrated that the application system operated smoothly across multiple Android versions. Usability testing, which involved questionnaires, yielded results in the "Very Good" category. Performance efficiency testing was conducted using the Android Studio profiler [16], measuring real-time data for CPU usage (4%), memory consumption (156.4 Mb), and application network activity (80 Kb/s) during application usage.

In the maintenance stage, which is the final stage in the waterfall development model, researchers strive to uphold the quality and reliability of the software while remaining responsive to farmers' needs. This ensures that the Android-based fertilizer ordering application can continue to be utilized effectively and efficiently.

5. Conclusion

Based on the results of the conducted research and the discussions presented, several conclusions can be drawn as follows:

1) The design and development of an Android-based fertilizer ordering application in the Bangkala region were carried out using the Waterfall development model and Research and Development (R&D) research methods to produce an Android-based fertilizer ordering application product. This application enables digital fertilizer ordering, facilitating farmers to place orders conveniently at any time and place, while also simplifying shop owners' tasks in managing fertilizer sales and automatically generating sales reports without the need for manual data input.

2) The test results of the design and development of the fertilizer ordering application in the Bangkala region, based on Android and compliant with the ISO 25010 standard, revealed that it met the standard in terms of functional suitability. The application was deemed "suitable" for use. Portability testing was conducted by observing output results generated using various versions of Android smartphones, demonstrating that the system functioned well across multiple Android versions. Usability testing, carried out by users/farmers in the Bangkala region, yielded results categorized as "Very Good." Performance efficiency testing, conducted using the Android Studio profiler to measure real-time data on CPU usage (4%), memory (156.4 Mb), and application network activity (80 Kb/s) during usage, further confirmed the application's feasibility. In conclusion, this Android-based fertilizer ordering application is deemed "feasible" for use.
References