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Development of an Android Application to Identify Fish Species Using Kotlin-based Android Studio

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ABSTRACT

Indonesia has a rich variety of fish species, but the understanding and knowledge of the public about these fish species is still limited. This is the background of the problem raised in this research, with the aim of providing education to the Indonesian people about the types of fish in Indonesia. The solution offered is the development of an Android application that can identify fish species in Indonesia. This application is expected to be an effective educational tool for the community. The methods used in the development of this application include collecting data documentation from the internet, literature studies from various research journals, literature, and other scientific articles. The collected data is then used as a basis for application development. Tools used in the development of this application include Android Studio as the main software, Firebase as a database, Kotlin as a programming language, and XML as a markup language for data storage and transmission. Figma is used to design the application interface. Application testing is carried out using the black box testing method to ensure application functionality runs well. The algorithm used in this application is a recursive algorithm for processing fish identification data. With this application, it is hoped that Indonesian people can more easily recognize and understand the types of fish that exist in Indonesia, so that they can reduce the number of fish species in Indonesia.

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INTRODUCTION

Current technology advancements continue to evolve, encouraging humans to innovate and find breakthroughs to face daily life challenges. Technology is expected to make life easier by providing better access to data. Today, one of the main needs is technology, which constantly evolves. One example of this is the telephone or mobile phone, which is now referred to as a smartphone, a technology with an ever-expanding user base. According to the users' data, in 2017, 74.9 million people in Indonesia were using smartphones.

"Information technology is used to acquire, transmit, process, interpret, store, organize, and use data effectively to obtain relevant, accurate, and timely information."(Imamah and Hasanah 2023)

"Android is a mobile operating system designed for mobile devices, primarily cell phones, and commercially developed by the Open Handset Alliance. It was first released in September 2008."(Windy and Fajrin 2023)

A smartphone is a popular communication tool used by everyone, from the elderly to young people. These mobile phones have many advanced features and sometimes function like a computer. For some, a smartphone is a phone similar to a computer, running most of the software operating systems that provide a consistent and fundamental interface for app developers. For others, a smartphone is just a phone with advanced features such as internet access, email, and the ability to read e-books or other available content. In other words, a smartphone is a small computer with a VGA connector that also has telephony capabilities. Nowadays, the general public owns smartphones, which makes it easier for them to access a wide range of information.

The development of this useful technology is expanding in various sectors, such as industry, offices, stores, and more. The application of this technology appears to be more beneficial, making human work more efficient, practical, and directly visible in its benefits. Over time, technology continues to advance and become more sophisticated, as evidenced by the increasing speed of cyberspace communication, which allows people in the eastern hemisphere to learn about events happening in the western hemisphere within seconds. In the era of globalization, the advancement of communication technology has started to generate significant consequences, both positive and negative. This will certainly impact various aspects of life.

Indonesia has a vast maritime area with abundant natural resources, particularly aquatic resources that have economic value. Indonesia's rich aquatic resources are due to the fact that about 62% of its territory consists of water. Indonesia is the world's largest maritime and archipelagic country, with various coastal and marine ecosystems focusing on fisheries resources. Although the utilization and potential of freshwater, brackish, and marine fisheries resources are relatively high, fish consumption remains a cultural practice in most areas of Indonesia.

"Fishery production consists of the combined output from aquaculture and capture fisheries; aquaculture production includes all output from freshwater, brackish, and marine fisheries at the district/city level; capture production comes from inland waters and marine fisheries." (Maiman and Hasanah 2022)

"Fish is one of the most important animal-based foods that help the Indonesian population meet their protein needs, but ironically, the level of fish consumption in Indonesia remains low. Furthermore, data shows that fish consumption levels have not been evenly distributed across the islands."(Virgantari et al. 2022)

The level of fish consumption in Kondangjajar village varies, with 36% eating fish four to six times a week, 28% eating fish three times a week, and 36% eating fish only once or twice a week. All families consume fish at least once a week. Many people eat both freshwater and marine fish. The types of fish in this category include skipjack, tilapia, gourami, catfish, pompano, pangasius, tawes, carp, and layur. (Thirafi, Akbarsyah, and Khoirunnisa 2024)

Among the other major islands in Indonesia, Java has the lowest level of fish consumption. West Java is one of the regions on Java with the lowest per capita fish consumption, and the disparity in fish consumption between West Java and the eastern regions of Indonesia, which tend to have higher fish consumption, causes the national fish consumption rate to be lower. (Virgantari et al. 2022)

There are several factors that contribute to the low fish consumption in Indonesia, including :

1. The infrastructure needed to provide high-quality fish to consumers is lacking, including modern and supporting market infrastructure, insufficient ice stocks, or the lack of refrigeration on fishing boats. Since the shelf life of fresh fish is short, fish processing from boats to consumers must be thorough, with an effective value chain. If not, the quality of the fish will deteriorate, impacting fish consumption.
2. Meat is preferred over fish. In agricultural communities, beef and chicken are preferred over fish, despite fish protein being higher (52.7%) than beef (19.6%) and eggs and dairy products (23.2%).
3. "Several factors influence the level of fish consumption in a region. Education level, income, and proximity to coastal areas are some factors that have a positive influence."(Thirafi et al. 2024)

This shows that efforts to increase fish consumption require a very specific understanding of the eating habits and consumption patterns of a community. Therefore, generalizing programs may not be appropriate if the consumption patterns and habits are not understood before creating programs aimed at increasing fish consumption. With the advancement of information technology, data processing and dissemination can be done quickly, allowing the public to access it easily. This paper aims to create a static API service that can provide fish data in Indonesia and be used in an Android application to deliver such data. The methods used in this research include data collection, system requirements analysis, and application design. The result of this research is a static API service that can provide fish data in Indonesian waters.

One of the solutions to this problem is the development of an informative, interactive, and user-friendly application to identify fish species found in Indonesia. This application should be able to identify fish through images and have a comprehensive database of fish species with information about their nutritional content and benefits. It is expected to increase public knowledge, boost interest in eating fish, and increase people's purchasing power for fish, with a focus on education and accurate information.

RESEARCH METHOD

Data Collection Techniques Used by the Author in This Research:

1. Documentation
   The author gathered information about fish species, nutritional content, benefits, processing methods, and fish market locations from the internet. Data needed to support the application was collected through this method.
2. Literature Study
   To complete this task and to understand the theoretical foundations related to requirements analysis, the author also conducted data collection by seeking and obtaining theoretical data from literature, research journals, presentation materials, and other data available on the internet. This method was used as a reference and to support processes related to the case study that the author selected.

Next, in this phase of the research, the Waterfall Method is used to illustrate a systematic approach to software development. According to Sholikhah, Sairan, and Syamsiah, "Waterfall is a classical model that has a sequential nature in software design."(Kurniawan et al. 2020)

The following is the sequence of stages in the Waterfall Method:

1. Software Requirements Analysis
   The software requirements analysis phase includes studying the Android system for interface needs and database integration, gathering information by searching for data from various sources on the internet, and determining what types of information are required for software requirements that need to be documented.
2. Software Design
   After analyzing the software requirements, the next phase is to present the results of the previous process. The author will design the database, ERD (Entity Relationship Diagram), illustrate the logical record structure (LRS), create the UML software architecture, and design the UI using Figma.
3. Programming Code Development
   After completing the design, the author then writes the programming code using machine language based on the previously created display structure. At this stage, the author will use Kotlin as the programming language for the frontend of the Android-based application, and Firebase as the backend for database integration.
4. Testing Phase
   In the testing phase, the software is tested to ensure that it integrates logically and functionally. Additionally, the overall system is examined and tested to identify potential errors and failures. This is necessary to reduce errors and ensure the desired output. The Black Box Testing method was used by the author in this phase.
5. Support and Maintenance Phase
   Users operate the finished software and engage in development and maintenance in the final stage of the Waterfall method. Errors that were not detected in previous stages are corrected through maintenance. The software already in use by the users can undergo system developments. Certain factors trigger development, such as ignorance during the testing phase and the need for the software to adapt to a new environment. The support or maintenance phase is also crucial and involves repeating the development process, starting from specifications analysis to implement changes to the existing software, but without creating entirely new software.

The scope of the author’s discussion in developing the Android application to identify fish species will cover various aspects, starting from user login and registration features, fish species identification, information on nutritional content, processing recommendations, natural habitat, and benefits that will be identified in the application. The application will also implement machine learning technology to optimize data based on the required criteria. Kotlin programming language will be used for application development, and Firebase will serve as the database (data storage) in the developed application. The goal of creating this application is to produce a functional and beneficial application for users.

Startup Review

This application aims to provide an easy way for everyone to find and learn information about fish found in Indonesia. The author is working on creating an Android-based application for identifying fish species, which will greatly assist people in searching for and learning more about fish. In this Startup Review, the author uses nine points from the BMC (Business Model Canvas) in the Startup application, as shown in the bellow :

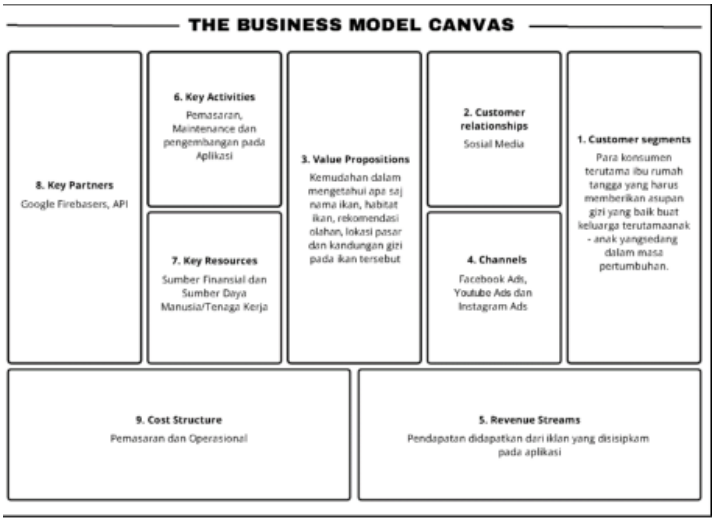

Figure 1 Business Model Canvassing (BMC)

The 9 (Nine) Points of BMC (Business Model Canvas) Applied in the Development of This Business:

1. Customer Segments (Target Market)
   The target market for this application is primarily consumers, particularly housewives who care about family nutrition, especially for children, in determining the nutritional value of the food they serve.
2. Value Proposition
   The main advantage of the application is the ease of identifying fish species, understanding their habitat, receiving recipe recommendations, finding fish market locations, and knowing the nutritional content of the fish.
3. Channels
   To distribute the application and make it known to users/consumers, the author utilizes digital marketing strategies such as Instagram ads, YouTube ads, and Facebook ads. These channels offer quick and wide distribution, leveraging the large number of internet users in Indonesia, especially on social media platforms.
4. Customer Relationship
   The approach to maintaining good relationships with users involves providing excellent service, particularly with regard to the application's features and ease of use. To keep a strong connection with users, we also use social media.
5. Revenue Streams
   The revenue from this application can come from advertisements embedded within the app, generating income from advertisers who want to reach the app's audience.
6. Key Resources
   The primary resources we currently have include financial resources and human resources. Our financial resources come from personal funds, while the human resources include programmers (Front End and Back End) and marketing personnel. The Front End team is responsible for developing the application, starting with UI design to create a memorable user experience, coding the application in Kotlin, and retrieving data from the database. The Back End team is responsible for designing the database, API, and both teams will also be in charge of future app development. Marketing staff are responsible for promoting the app so that more people learn about and use it.
7. Key Activities
   The main activities we engage in include ensuring that the app runs smoothly and meets high standards, as well as adding new features that will interest users. We also perform regular maintenance on the database and application. In addition, we focus on marketing the app through social media to increase its visibility. Development of the FISHLAB app continues with the addition of new features.
8. Key Partners
   Our partnerships in the app development process include Google Firebase as the database service provider, and API as the channel for adding and retrieving data to provide accurate and timely information.
9. Cost
   The costs associated with managing the application can be categorized into three types. Ongoing Costs, These include advertising costs for marketing the app through social media channels like Facebook Ads, YouTube Ads, and Instagram Ads. Database Service Costs, These are the costs for using Firebase services

for data storage. One-time Costs, These include the purchase of a Google Play Store developer account.

CONCLUSION

Software Requirements Analysis Phases. The software requirements analysis phase includes studying the Android system for interface needs and database integration, gathering information by reading several articles to understand the facts of the issue, evaluating the lack of nutritional information to determine what data is needed, and documenting the software requirements specifications.

As users will be interacting with this application, there are several actions that users will be able to perform, including:

1. Users can log in to the application.
2. Users can register on the application.
3. Users can edit their profile on the application.
4. Users can view news related to fish on the application.
5. Users can scan the fish they are interested in.
6. Users can see the location of the nearest fish market.
7. After the fish scanning process is completed, users can view the fish name, its natural habitat, recipe recommendations, and nutritional content.

Use Case Diagram Design

Below is the design of the Use Case Diagram for the FISHLAB application, as shown in the image below:

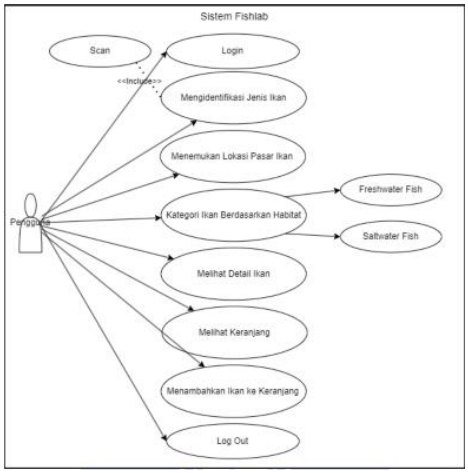

Figure 2. *Use Case Diagram*

Rancangan Diagram Aktivitas

Below is the Design of the Activity Diagram Based on the Requirements of the Application, as Shown in the Image :.

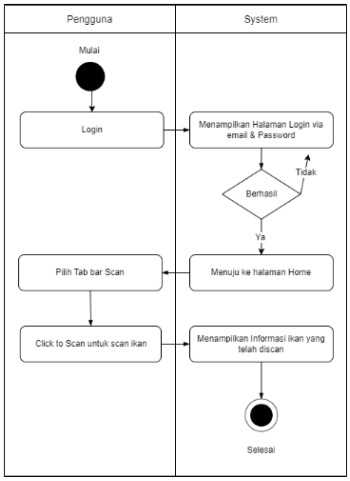

Figure 3. Activity Diagram Melakukan Scan pada Ikan

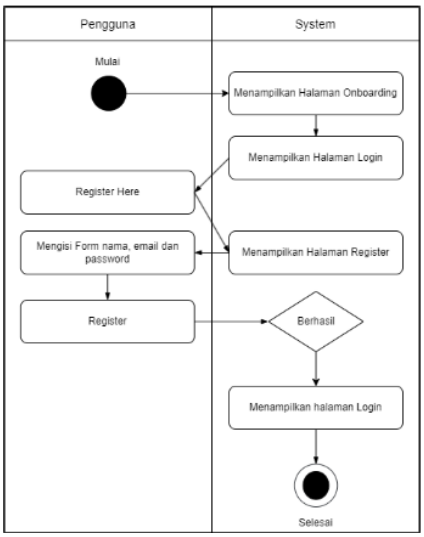

Figure 4. *Activity Diagram for Registration*

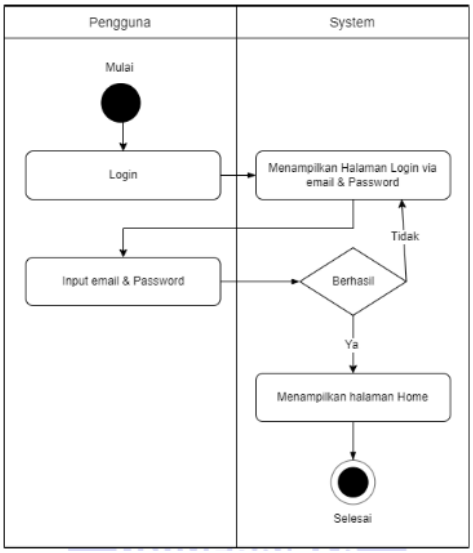

Figure 5. *Activity Diagram for Login the application*

User Interface Design

Here is the Design Display of the FISHLAB Application that has been created, as shown in the following image:

Figure 6. Application Mockup Display

Database Design

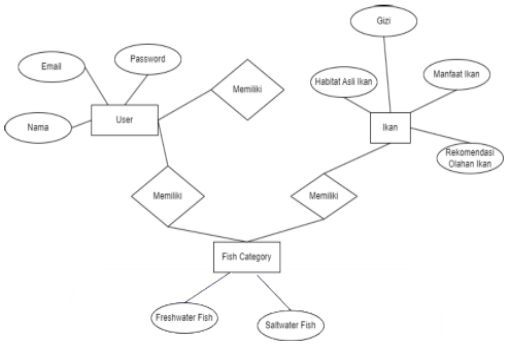

Figure 7. Entity Relationship Diagram (ERD)

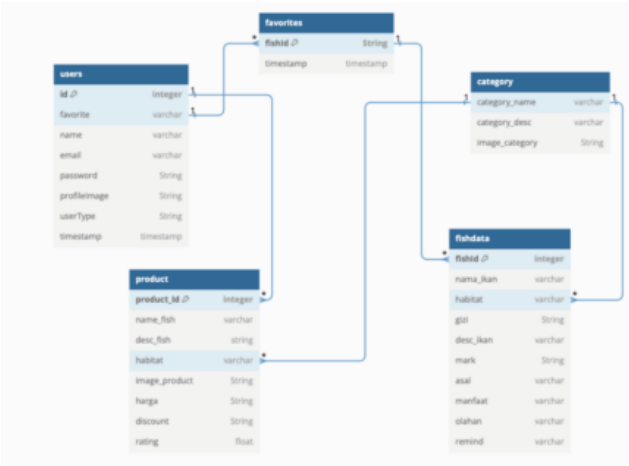

Figure 8. Logical Record Structure (LRS)

Implementation

Below is the implementation process of the design that has been created and is ready to be operated.

1. Onboarding Page

   After opening the FISHLAB application, the system will first display the Onboarding page, which contains summary of the features of the application.

Figure 9. Onboarding Page Display

2. Login Page

   After opening the application, users will be directed to the login page to begin using its features. If the user is already registered, they can directly enter their email and password to log in. However, if the user is not registered, they will need to complete the registration process first..

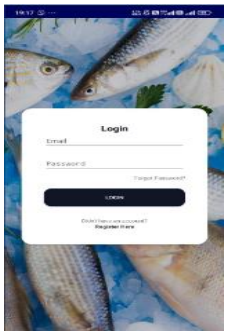

Figure 10. Login Page Display

3. Registration Page
   If the user is not registered, they will be directed to fill out the registration form on the register page. To register, the user can directly enter their name, email, and password..

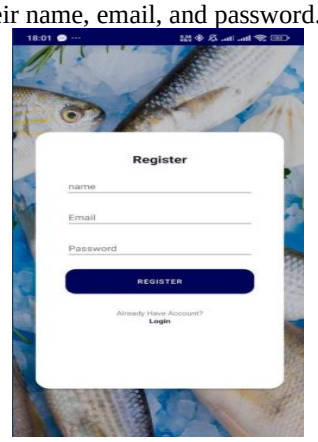

Figure 11. Login Page Display

4. Main Page/Home
   The home page will appear after the user logs in. Some of the features on this page include Location To view the locations of fish markets. Fish Category, To view information about Freshwater Fish and Saltwater Fish, displaying a list of information about both freshwater and saltwater fish species.

Figure 12. Main Page/Home

5. Scan Page
   The page display features the main function of the application, allowing users to scan fish. Users can use their device's camera to scan a fish they want to identify. The app will analyze the image and provide information about the fish species. When the user presses the Click to Scan button, the app will activate the camera and start scanning the fish. Once the scanning is complete, the app will display detailed information about the scanned fish.

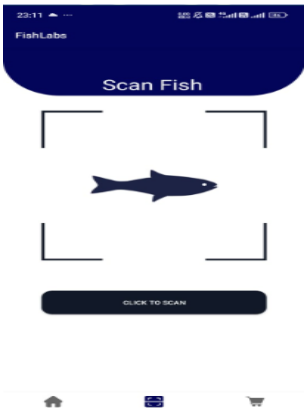

Figure 13. Scan Page Display

6. Cart Page
   The Cart page display allows users to choose fish types based on their habitat. Users can select between freshwater fish and saltwater fish to view the list of available fish. This page also provides pricing information and discounts for each fish type. Each fish displayed has details on the price per kilogram and the discount percentage offered, helping users make more informed purchasing decisions.

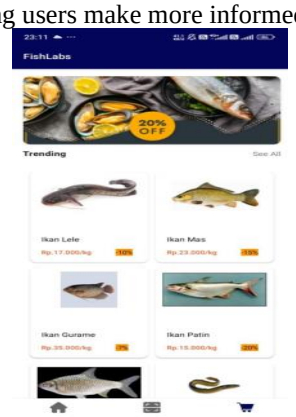

Figure 14. Cart Page Display

7. Fish Details Page
   This page provides general information, including details about fish species such as Trout and Catfish, offering a brief description of each fish. It also provides information on their living environment, natural habitat, nutritional content, and the benefits of consuming the fish. The page also includes recommendations for recipes and cooking methods that are suitable, helping users prepare delicious dishes.

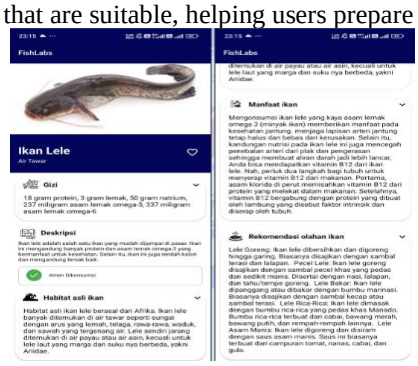

Figure 15. Fish Details Page Display

Implementation Results

After the application has been completed and tested functionally, the next step is to upload the application to the Google Play Store, making it ready for marketing and use. Below is an example of the application's output display on the Google Play Store.

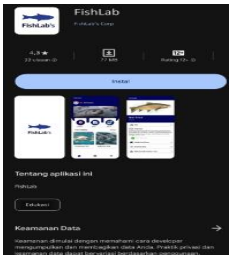

Figure 16. FISHLAB Application Display Uploaded to the Play Store

Application Testing

The author used the Black Box Testing method to test the performance of the FISHLAB application. The completed application was tested to ensure that it operates as expected. The system testing phase was conducted to test all the functions that have been implemented in the application to ensure they work smoothly and without issues.

Table 1. Results of Black Box Testing on the FISHLAB Application

No	Test Scenario	Test Case	Expected Result	Test Result	Conclusion
1	Login fails if email and password are incorrect / do not match	Enter incorrect email and password	Return to the Login page	As Expected	Valid
2	Login succeeds if email and password are correct / match	Enter correct email and password	Successfully log into the app and display the Home page	As Expected	Valid
3	Select the Scan menu tab	Click the Scan menu tab	Navigate to the Scan page	As Expected	Valid
4	Select the Location button	Click/select Location	Navigate to the Location page	As Expected	Valid
5	Select the News button	Click/select News	Navigate to the News page	As Expected	Valid
6	Select the Chat AI button	Click/select Chat AI	Navigate to the ChatGPT web page	As Expected	Valid
7	Select the Freshwater fish category	Click/select Freshwater Fish category	Display the list of Freshwater Fish	As Expected	Valid
8	Select the Saltwater fish category	Click/select Saltwater Fish category	Display the list of Saltwater Fish	As Expected	Valid
9	Select a fish from the freshwater fish list that appears	Click/select a freshwater fish from the list	Display the details page for the selected freshwater fish	As Expected	Valid
10	Select a fish from the saltwater fish list that appears	Click/select a saltwater fish from the list	Display the details page for the selected saltwater fish	As Expected	Valid
11	Select the profile menu on the home page	Click/select the profile picture	Navigate to the profile page with information about name, email, and password	As Expected	Valid

12	Enter the edit profile page	Click/select edit profile on the profile page	Display a form to edit name, email, and password	As Expected	Valid
13	Enter the shopping cart menu	Click/select the shopping cart icon	Display the shopping cart page with a list of fish and their prices	As Expected	Valid
14	Logout from the application	Click/select the Back button on the navigation menu	Logout from the app and return to the Get Started page	As Expected	Valid

Task Descriptions

1. Project Manager / System Analyst

A Project Manager is a professional responsible for planning, executing, and controlling a project from start to finish. Their main responsibilities include leading the team, setting project goals, and communicating with stakeholders. Therefore, the success or failure of a project lies entirely in the hands of the Project Manager (Andriana 2022).

A Project Manager is accountable for ensuring that the application project runs smoothly and achieves its goals. Below are some key responsibilities they must handle:

a. Project Planning
   The Project Manager creates a project plan that includes objectives, schedule, budget, and resources. They must identify potential risks and devise strategies to mitigate them to ensure the project proceeds smoothly.
b. Team Management
   The Project Manager leads and coordinates the project team, ensuring that each team member knows their responsibilities. They must also handle conflicts and provide support, direction, and motivation to the team.
c. Monitoring and Control
   They are responsible for monitoring the project's progress and identifying and resolving issues or obstacles. They also ensure that the project stays within budget and on schedule.
d. Communication
   The Project Manager acts as the main communication link between stakeholders, including clients, executives, and the internal team. They must ensure that all parties are well-informed about the project's progress and any changes.
e. Budget Management
   The Project Manager manages the project budget carefully to ensure that spending is done on time. They also look for ways to reduce costs while maintaining the quality of the project.
f. Quality and Compliance
   Testing and verification are necessary to ensure that the developed product or service meets the required quality standards and compliance regulations. This ensures that the final deliverable meets the specified requirements.
g. Project Completion
   They must ensure that the project is completed on time and that all deliverables are provided according to the agreed specifications. They must also evaluate the results and assess team performance for process improvement in the future.

2. Database Administrator / Programmer

A Database Administrator (DBA) is responsible for ensuring that all databases, including those related to financial or customer information, adhere to the established rules and procedures to prevent data loss. They use their skills in computer science to resolve issues if something happens in their workplace (Kourmentza 2024)

The DBA plays a crucial role in the success of an application startup. The DBA is responsible for designing, implementing, and maintaining the database systems. Their main tasks include:

a. Database Design
   The DBA creates an effective database schema that includes tables, indexes, and relationships to ensure scalability and optimal performance.
b. Maintenance and Security
   The DBA is responsible for maintaining the security of the database, including managing access rights,

encrypting data, and tracking activities to prevent unauthorized access.

c. Backup and Recovery
   The DBA implements recovery and backup methods to prevent data loss or corruption.
d. Monitoring and Tuning
   The DBA checks database performance, makes adjustments, and optimizes the database configurations to improve performance.
e. Maintenance and Updates
   The DBA ensures the database software is patched and upgraded regularly to maintain stability and security.

A Programmer is responsible for writing and testing the code used to create software. They transform the program designs made by developers into computer instructions that can be understood and executed. In some cases, they may also collaborate with developers. If there are errors in the code, the programmer will inspect and fix them. Some of the programmer's tasks include:

a. Project Development
   A programmer must be proficient in writing code using programming languages such as C++ and Java to create functional programs.
b. Integrating Front-End and Back-End
   A programmer integrating with the back-end is responsible for managing and processing the data in the program, including designing and implementing logic, algorithms, and databases required for the program's functions. On the other hand, a front-end programmer develops the user interface or program's visual display, ensuring that users can interact with the program.
c. Routine Reports to the Product Manager
   Programmers need to create and maintain a set of features or instructions for the program. To ensure each feature meets the business objectives and needs, the product team, led by a product manager, manages the features. Programmers regularly report progress to the product manager to show how far the development has come.
d. Collaborating with the Design Team
   Every set of instructions in a program is typically designed by User Interface (UI) and User Experience (UX) designers. UI designers focus on making each page visually appealing, while UX designers ensure that the instructions are easy to use and not confusing. However, collaboration between programmers and designers is not always smooth. Due to differences in views and priorities between design implementation and technical implementation, programmers sometimes ask designers to consider the difficulty level of implementing designs. On the other hand, designers may focus too much on visual aesthetics without considering technical feasibility. To achieve a balance between functionality and aesthetics, effective communication and collaboration are essential.

3. System Tester

A System Tester, also known as a Quality Assurance (QA) Tester, is responsible for testing the functionality and usability of software before it is released, ensuring that there are no major bugs. They also ensure that the software meets the requirements and expectations set beforehand. QA testers work closely with developers to resolve any issues that arise during testing. They document defects, bugs, or shortcomings in the software and report them to the development team.

QA testers also provide suggestions for improvements and necessary upgrades to create high-quality software that meets customer expectations. With the assistance of QA, which performs thorough testing and feedback, developers can make the necessary improvements and refinements before the software is released. QA ensures that the software introduced to the market is of high quality, free from significant bugs, and provides a satisfying user experience. Some of the tasks of system testers or QA testers include:

a. Evaluating and Analyzing System Specifications: QA testers evaluate and analyze the system specifications to ensure that the software is developed according to the agreed-upon requirements.
b. Collaborating with Quality Developers: They work with the quality developers to create optimal testing strategies and plans.
c. Performing Test Cases (Manual and Automated): QA testers execute test cases either manually or using automated testing tools and analyze the results.
d. Assessing the Product Code: They assess the product code to ensure it meets the defined specifications.
e. Maintaining Logs: QA testers keep detailed logs to track the testing phases and defects found.
f. Reporting Errors and Bugs: They report bugs and errors to the development team to be fixed.

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