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Design and Development of An Android-Based Nutrition Education And Stunting Prevention Information System For Pregnant Women (Case Study Sekotong Community Health Center)

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Abstract **Malnutrition and stunting are serious issues in Indonesia, particularly in Sekotong Subdistrict, West Lombok Regency, West Nusa Tenggara. The prevalence of stunting in this subdistrict reached 94 cases in 2020. This research aims to develop an Android application called Yess Nutrition as a medium for educating pregnant women about nutrition and stunting prevention in Sekotong Subdistrict. The Design Thinking and Personal Extreme Programming methods are employed in the development of this application. The test results show that the application received a mean opinion score of 4.173, indicating good quality and user interface. It is expected that the Yess Nutrition app will enhance the knowledge of pregnant women regarding nutrition and stunting prevention. By leveraging the vast potential of the Android platform, this application has the potential to become an effective educational tool for raising awareness about nutrition and preventing stunting.**

Key words: Education, Nutrition, Stunting, Personal Extreme Programming, Sekotong.

I. INTRODUCTION

Malnutrition and stunting are the main factors contributing to the low quality of health in Indonesia. This is also true for the province of West Nusa Tenggara (NTB), which ranks fifth as the largest contributor to cases of malnutrition and stunting in Indonesia. Furthermore, Lombok Barat district has the third highest cases of malnutrition and stunting in NTB, with a percentage of 22.71% in 2021 [2]. The percentage graph of stunting cases in NTB is shown in Fig. 1 [1].

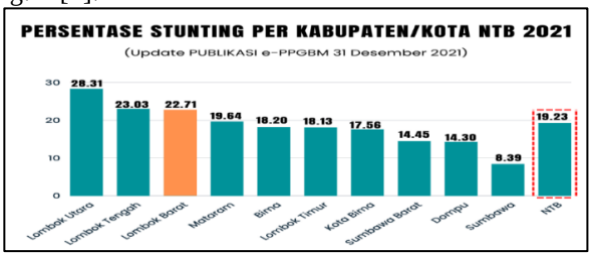

Fig. 1. The percentage of stunting in NTB in 2021

One of the sub-districts in West Lombok regency with a significant number of malnutrition and stunting cases is Sekotong sub-district. In 2020, there were 49% of children under five experiencing malnutrition and 94 cases of stunting in this sub-district. Data from Sekotong Community Health Center (Puskesmas) shows that in November 2017, there was a prevalence of 26.8% underweight (low weight-for-age) and 6.52% severely underweight (very low weight-for-age). The stunting prevalence (low height-for-age) was 56.52%, normal height-for-age was 43.47%, severely short stature (very low height-for-age) was 2.17%, underweight (low weight-for-height) was 8.69%, and severely underweight (very low weight-for-height) was 2.17% out of a total of 93 children [2].

Based on observations and interviews conducted with nutrition officers at Sekotong Community Health Center on November 8, 2022, the majority of malnutrition and stunting issues in Sekotong sub-district are caused by factors related to mothers. The mothers have limited knowledge about nutrition and how to prevent stunting during pregnancy and childbirth. Furthermore, there is a high prevalence of early marriage among teenagers, resulting in parents who lack sufficient nutrition and are unaware of proper parenting practices and stunting prevention. The issue of malnutrition and stunting is also influenced by the inadequate role of integrated health posts (Posyandu) in providing education to mothers about preventing malnutrition and stunting. Additionally, the Posyandu in Sekotong sub-district lacks appropriate media for delivering education on preventing malnutrition and stunting. So far, education has only been provided through lectures, which are difficult for mothers to remember due to the abundance of information shared. By utilizing the Android platform as a medium for nutrition and stunting education, mothers who may have difficulty understanding the content during Posyandu sessions can revisit the nutrition and stunting education materials anytime and anywhere.

The potential utilization of Android as a medium for nutrition and stunting education in Sekotong sub-district is significant, especially considering that during the Covid-19 pandemic, almost every household has at least one or two Android devices. Research conducted by the PEW Research Center in 2018 provides the fact that smartphones are one of the most frequently accessed media by mothers and the general public. Efforts to reduce the prevalence of stunting by providing a prevention education platform through Android-based applications are considered quite effective [3].

Building upon the issues of malnutrition and stunting, as well as recognizing the potential of utilizing the Android platform as a medium for nutrition education and stunting prevention, the author proposes the idea of an Android-based nutrition education and stunting prevention information system. This application is called YessNutrition and will be developed using the Design Thinking and PXP (Personal Extreme Programming) methods. The Design Thinking method is chosen because each process is based on the problems and desires of the users. It also helps identify the actual issues experienced by the community and comprehensively understand the users' desires and needs. [4]. Meanwhile, the PXP method is chosen because it follows a concise development process while still being able to deliver an application that meets user needs. Apart from its short process, this application development involves a single developer, making PXP more suitable compared to other agile methods that require coordination among development teams. [4][5]. It is hoped that in the future, this application can be utilized by pregnant women to enhance their knowledge regarding nutrition and stunting prevention education.

II. Literature Review

Fitriami and Galaressa [3] conducted a study entitled "Stunting Prevention Education Based on Android Applications in Increasing Mother's Knowledge and Attitudes". This research was conducted at the Tenayan Raya Health Center in Pekanbaru with a total sample of 54 respondents. This study aims to determine the effect of Android application-based stunting prevention education to increase mothers' knowledge and attitudes so that stunting in toddlers can be prevented. The results of this study were to find the effect of education on stunting prevention using the Android application on increasing the knowledge and attitudes of mothers at the Tenayan Raya Health Center in Pekanbaru. Then, in this study it was also said that stunting prevention education using an Android application proved to be effective in increasing mother's knowledge of stunting.

Lestari [6] conducted a study entitled "Nutrition Education with Android-Based Application Media to Increase Knowledge, Attitudes, and Actions of Pregnant Women About Chronic Energy Deficiency (KEK)". This study aims to develop, validate, and examine the effectiveness of Android-based applications to increase pregnant women's nutritional knowledge, attitudes, and behavior about Chronic Energy Deficiency (KEK). The method used in this research is research and development (R&D) involving IT experts and nutrition experts. This study involved 36 pregnant women respondents who were selected through a purposive sampling method in the working area of the Meo-Meo Health Center, Baubau city. Data analysis in the media application validation process used quantitative descriptive analysis techniques and to see the effectiveness of the application on increasing knowledge, attitudes, and behavior used the McNamer test. The results of this study indicate that by using the application, knowledge, attitudes, and behavior of pregnant women towards SEZ increases with an increase percentage of 72%, 78%, and 39% respectively.

Noe'man and Lubis [7] conducted a study entitled "Design of Learning Nutrition for Pregnant Women to Overcome Android-Based Infant Mortality and Disabilities". This study aims as a media for learning nutrition in pregnant women to overcome the risk of death and disability in babies based on android. The results of the study found that applying the application could be a learning medium for pregnant women's nutrition. It could also make it easier for pregnant women, especially in finding information about the nutrition they need during pregnancy. This research is relevant to the research that the author will conduct because the focus of the discussion is equally related to how the media or applications that are made can make it easier for users to find the information about the nutrition they need.

Awaluddin, et al [4] conducted a study entitled "Parenting Information Systems Using Design Thinking and Personal Extreme Programming Methods". This study aims to develop children's socio-emotional character by providing assistance, activity recommendations, and character development milestones based on the child's age. This study also aims to provide information on activity recommendations that are in accordance with the needs and development of children through a website-based information system. This study combines the design thinking method as a step for validating problems and solutions, namely using the empathize, define, and ideate stages, and the personal extreme programming method as an information system development method, with the requirements and planning stages applying the design thinking, iteration initialization, design, implementation, system testing, and retrospective. These two methods are combined because they have the same principle, namely prioritizing user needs and producing solutions that are right on target related to solving problems experienced by users. The results of this study are that the developed information system can assist parents in developing children's socio-emotional character, this is based on the percentage of ratings for the question "Can this website help parents in developing children's character?" with data 3.3% answered enough, 36.7% answered agreed, and 60% answered strongly agreed, and obtained the MOS test result value of 4.4.

Fahcrian, et al [8] conducted a study entitled "The Effect of the Design Thinking Method combined with the Extreme Programming Method in Building Innovation on the "Kerjayuk" Website for Telkom University Students". This study aims to determine the effect of combining design thinking and extreme programming methods and to find out how to combine the two methods. The combination of the design thinking method with the extreme programming method is carried out by applying the three stages of the design thinking method, namely empathize, define, and ideate into the requirements and planning stages of the extreme programming method. Furthermore, it combines the next two stages in design thinking, namely prototyping and prototype testing into extreme programming planning methods. The results of this study found that the process of incorporating design thinking methods into extreme programming helps in validating problems and user needs. With the design thinking method being able to overcome problems at the requirements and planning stages, the extreme programming method focuses too much on the technical side of software development which causes user requirements to not be analyzed thoroughly. Through a combination of the two methods, better results are obtained, namely the development team feels benefits such as minimizing changes in requirements, iterations, and application development time.

Trisnadoli [9] conducted a study entitled "Implementation of Extreme Programming (XP) Agile Software Development in the Development of KELUARGAKU Information Systems". This study aims to develop a website-based information system with the function of displaying information as well as being a media for public education according to the needs of the Prosperous Family Service Center. The software development method used is the Agile method, namely Extreme Programming which is suitable for the case of KELUARGAKU information system development because it is flexible and appropriate to the focus to be achieved by the developer. In this research, the information system interface design process was also carried out. This design process is carried out by first making an interface design that is adjusted to the initial requirements. After that, the design that has been made is tested first to the client to get input from the client's leadership and discuss agreements regarding the design of the information system that will be developed.

III. METHODOLOGY

The method used for the design and development of the nutrition education and stunting prevention information system is Personal Extreme Programming (PXP). This method combines the requirement and planning stages with three stages of the Design Thinking method: empathize, define, and ideate. The aim is to identify the problems and find appropriate solutions for the users. The process includes iteration initialization, design phase (incorporating prototype and prototype testing from the Design Thinking method), implementation, system testing, and retrospective. The research stages are illustrated in a flowchart diagram shown in Fig. 2.

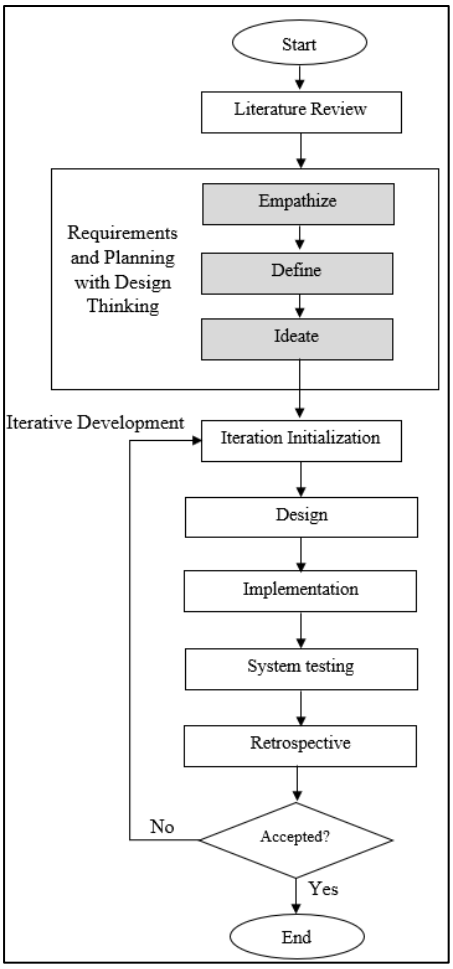

Fig. 2. Research Flowchart

A. Requirement and Planning

he planning process will incorporate the initial three stages of the Design Thinking method to gather and identify problems related to malnutrition and the lack of knowledge among mothers regarding stunting in Sekotong sub-district.

A.1. Empathize

In this stage, an approach is taken through interviews with users, specifically mothers, and experts, in this case, the health center cadres of Sekotong. The purpose of this process is to understand everything that users need to do (need to), their challenges (pain), and their expectations (gain) related to the context of the problem, which is malnutrition and the lack of knowledge among mothers regarding nutrition and stunting.

The interview process is conducted by providing a customer empathy board to potential users, focusing on the need to, pain, and gain aspects. Furthermore, for each of these aspects, they are asked about what is their main concern (most need to do, most pain, and most gain).

A.2. Define

Based on the data collected during the empathize stage, the next step is to proceed with the define process by determining the main problem statement. After accumulating all the gathered data, the defined result is as follows:

1. Most need to do: Paying attention to regular and balanced eating patterns that align with nutritional needs, providing socialization and education on nutrition and stunting prevention.
2. Most pain: Lack of knowledge about balanced nutrition and stunting in the community, especially among mothers.
3. Most gain: Achieving balanced nutrition for mothers and children, as well as reducing the prevalence of stunting.

Based on the above results, the main solution identified for the YessNutrition application includes features such as information on nutrition and maternal health during pregnancy, assessment of maternal nutritional status and calorie requirements, as well as stunting prevention education.

A.3. Ideate

After obtaining the defined result, the main problem statement has been determined. The next step is to proceed with the ideate process by creating a solution flow related to user problems. The following are the details of the solution flow that utilizes an Android-based application:

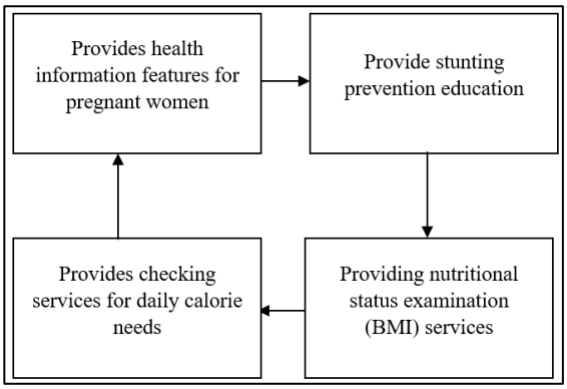

Fig. 3. Main Application Feature Solution Flow

Fig. 3 depicts the solution flow based on the previous define process. There are four main solutions that will be provided in the YessNutrition application, namely providing information on nutrition and maternal health during pregnancy, delivering stunting prevention education, offering nutritional status assessment service using the Body Mass Index (BMI), and providing a service for daily calorie requirement assessment for users.

A.4. User Story

After completing all the stages in the Design Thinking method, the next step is to create user stories. A good user story follows the INVEST model, which stands for Independent, Negotiable, Valuable, Estimable, and Small. Independent means there is no dependency between user stories. Negotiable means that all the details are obtained through collaboration. Valuable means the user story brings value to the users. Estimable means it can be estimated in terms of time and cost. Testable means that acceptance criteria can be determined. A user story can be considered "done" if the acceptance criteria for that user story are met and achieved [10].

A.5. Iteration Plan

The Iteration Plan is a stage of planning that involves estimating the stories and dividing the iterations for each of the determined stories [11]. In this research, the division of user stories for each iteration can be seen in Table I.

TABLE I. ITERATION PLAN

No	US Code	Description	Estimate (days)
Iteration-1			
1	US-01	Sign up	2
2	US-02	Login	2
3	US-03	Home Page	2
4	US-04	Stunting prevention education	3
5	US-05	Monitoring the Progress of Fulfilling Daily Macro Nutrition Needs	2
6	US-06	Meal Schedule Setting	2
7	US-07	Health Information for Pregnant Women	2
Velocity			15
Iteration-2			
8	US-08	Information on the nutritional content of food	3
9	US-09	Profile Settings	2
10	US-10	Check Nutritional Status (BMI)	4
11	US-11	Check Calorie Needs	4
12	US-12	Stunting Check	2
Velocity			15

In Table I, the velocity value can be determined as 15, indicating that a developer can complete 15 story points in a single iteration. Each iteration can be completed within 15 days. Based on the table above, it is known that the total user story points amount to 30, requiring 2 iterations to complete all the created user stories.

B. Design

After planning, the next step is to do the design stage. At this stage, the visual information system design is carried out using the Unified Modeling Language (UML) for means of object-oriented system design, as well as the design and testing of high-fidelity prototypes.

1. Use Case Diagram

The use case diagram designed has two actors, namely the user and the admin. The designed use case can be seen in Fig. 4.

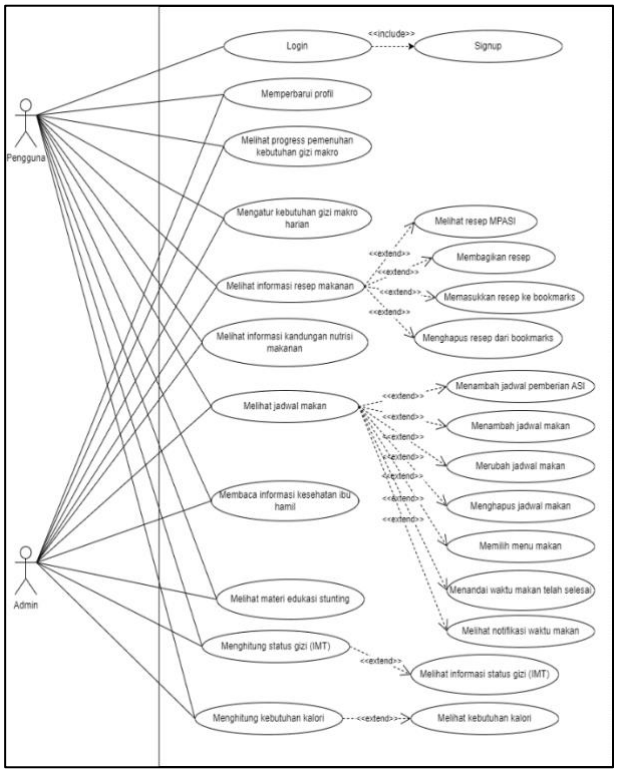

Fig. 4. Use case diagram

2. Application Prototype

The prototype will be built using Figma, a tool that enables the creation of high fidelity prototypes with a high level of accuracy, representing the actual system. The use of a high fidelity prototype allows users to directly experience and interact with the prototype independently. One of the application prototype designs can be seen in Fig. 5.

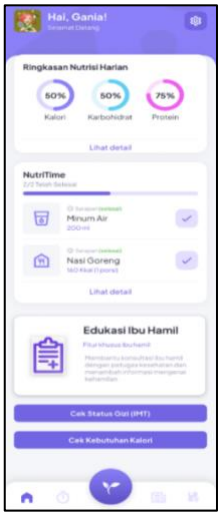

Fig. 5. Application Prototype

3. Prototype Testing

The prototype testing process is conducted by sharing a clickable prototype link from Figma with the users. Prototype testing is carried out only once during the initial design stage to obtain early feedback from users regarding the design quality and feature concepts in the application.

The prototype testing process applied in the PXP design stage refers to [9] also conducted design testing with the client to agree on the design and features of the application during the initial stage. The testing involved 15 respondents. After trying the prototype, users were provided with a feedback form. The feedback form contained risky assumptions or parameters used to measure user availability and interest in implementing the proposed solutions. The provided risky assumptions consisted of usability, functionality, and solvability. The scale used was 1-5, with 1 indicating "did not answer" and 5 indicating "strongly agree." The following data represents the results of the conducted prototype testing.:

TABLE II. USABILITY TESTING

No	Question	Scale					Average
		1	2	3	4	5	
1.	Android device availability	0	0	0	0	15	5
2.	Adequate internet availability	0	0	0	1	14	4.9
3.	Ease of use solution	0	0	0	1	14	4.9
Total Average							**4.9**

TABLE III. FUNCTIONALITY TESTING

No	Tested features	Scale					Average
		1	2	3	4	5	
1.	Home Page	0	0	0	0	15	5
2.	BMI check feature	0	0	0	0	15	4.9
3.	Check Nutritional Needs Feature	0	0	0	0	15	4.9
4.	Checking Food Nutrient Content Feature	0	0	0	0	15	5
5.	Stunting Prevention Educational Features	0	0	0	0	15	5
6.	Educational Features for Pregnant Women	0	0	0	1	14	4.9
7.	Complementary (MPASI) Recipe Features	0	0	0	1	14	4.9
8.	Meal Schedule feature	0	0	0	2	13	4.8
9.	Stunting Check feature	0	0	0	0	15	5
10.	Health Article Feature	0	0	1	1	13	4.8
Total Average							**4.92**

TABLE IV. SOLVABILITY TESTING

No	Question	Scale					Average
		1	2	3	4	5	
1.	Can the YessNutrition application help meet nutritional needs and increase knowledge about stunting and how to prevent it?	0	0	2	6	7	4.3
2.	Can the YessNutrition application help Puskesmas staff in helping mothers and their children to meet nutritional needs and increase knowledge about stunting and how to prevent it? **(Specific questions to health workers at the Sekotong Health Center)**	0	0	2	5	2	4

Based on the results of the prototype testing as shown in Table II, Table III, and Table IV, the average scores for usability testing were 4.9, functionality testing was 4.92, and solvability testing was 4.33 and 4, which indicates that on a scale of 5, the responses lean towards addressing user issues. Therefore, the process can proceed to the application development stage.

C. Implementation

In the implementation stage, the developer will perform the application coding process. The coding process for system implementation is carried out by the author as an individual developer using a mobile-based application running on the Android operating system. The programming language used is Dart, and the Flutter framework is utilized.

At the stage of developing the Yess Nutrition application, a framework using a clean architecture was implemented. The use of clean architecture aims to divide application program code into several layers so as to be able to separate parts of the code for user interface components, services and processes, as well as databases in applications. This serves to simplify the application maintenance process. If you want to change the user interface, it will not interfere with application processes and databases, and without the need to disrupt the application's main business code. The clean architecture also makes testing easier [12][13].

D. System Testing

The system testing is conducted using automation unit testing with a tool called Repeato. Repeato works by utilizing computer vision and machine learning to test Flutter-based application units. This approach ensures high testing accuracy and saves time in the testing process. The next step in the system testing is Black Box Testing, which focuses on functional testing of the software, examining the execution results of each feature in the application.

Subsequently, the application is tested with users to assess their acceptance levels, both in terms of ease of use and user activity achievement within the application. Therefore, User Acceptance Testing (UAT) needs to be conducted. UAT testing will be performed using the Mean Opinion Score (MOS) approach by distributing questionnaires to 30 respondents. MOS testing is a method used to measure the performance and quality of the built application. Users will be asked a series of questions and will provide responses on a predefined scale ranging from 1 to 5. A scale of 1 represents "Strongly Disagree (SD)" and a scale of 5 represents "Strongly Agree (SA)." [3]. Next, the average rating is calculated from all respondents to obtain the Mean Opinion Score (MOS) of the YessNutrition application.

Afterward, an analysis is performed on the testing results to determine the outcomes of the testing. Thus, conclusions can be drawn regarding the development of the application that has been carried out.

E. Retrospective

Retrospective is conducted after the system testing and is the final stage in system development using the Personal Extreme Programming (PXP) method. The retrospective stage is carried out for self-reflection on the implementation and testing results that have been conducted previously. In this stage, each completed iteration is reviewed, comparing it with the initial plan. Entering this stage signifies the end of the iteration that has been carried out. If the results do not align with the initial plan, problem identification is conducted, and solutions are found for the next iteration. If everything goes well, the development process is considered complete.

IV. Results and Implementation

The YessNutrition application was developed using the Extreme Programming method, as depicted in the research flowchart in the previous chapter, specifically in Fig. 2. In this stage, the designed system was implemented into an Android-based application system, along with its discussion. The discussion in this subsection follows the flow of the Extreme Programming method, which includes design, coding, and testing, with an explanation of each iteration conducted. Meanwhile, the planning stage was conducted in the Methodology section

A. Iteration 1

There were some changes in the first iteration. The change involved moving the user story from the second iteration with the code US-09 (Profile Settings) to the first iteration in the third position, resulting in a new user story code, which is US-03. Consequently, the user stories that come after it also underwent changes in their respective user story codes.

TABLE V. Iteration Plan

No	US Code	Description	Estimate (days)
Iterasi-1			
1	US-01	Sign up	2
2	US-02	Login	2
3	US-03	Profile Settings	2
4	US-04	Home Page	2
5	US-05	Stunting prevention education	3
6	US-06	Monitoring the Progress of Fulfilling Daily Macro Nutrition Needs	2
7	US-07	Meal Schedule Setting	2
8	US-08	Health Education for Pregnant Women	2
Velocity			17

A.1. Database Implementation

The database used in building this system is a non-relational database (NoSQL database) based on the document-oriented model. The provider used is Google's Firestore Database, which also provides a development environment for the Flutter framework, facilitating the coding process.

Within the database, several collections are built to store the necessary data. Each collection will store documents that contain records of related data to be used by the system. There are three collections that will be stored in the Firestore Database provider: "users," "users-food-schedules," and "users-nutrients." Other collections will be stored locally in the form of JSON (JavaScript Object Notation).

A.2. Class Implementation

The next implementation is Class implementation from the Yess Nutrition application which is implemented into coding using Visual Studio Code tools and the Flutter framework. The development of this application applies the Clean Architecture architectural pattern which aims to make the code more organized and easier to develop.

A.3. Interface Implementation

1. Signup

Fig 6. Signup Feature Interface Implementation

Fig. 6 is the implementation of the signup feature page. Users will be asked to complete their name, email, password and confirm the password. In the app, usernames are limited to 100 characters. Furthermore, the criteria for an accepted password is a minimum of 8 characters with a combination of numbers and letters. If there is an error when filling in the data, the application will provide an error notification and what the user must do.

2. Login

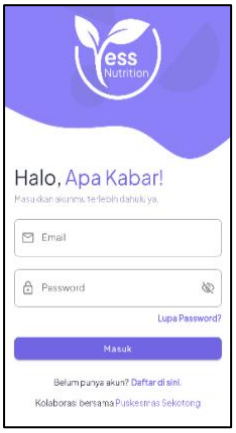

Fig. 7. Login Feature Interface Implementation

Fig. 7 is an implementation of the Login feature. To enter the application, users need to enter an account that has been registered first. If the user enters the wrong email and password, the system will notify the user of an error.

3. Profile Setting

Fig. 8. Implementation of the Profile Settings Feature Interface

Fig. 8 is an implementation of the Profile Settings feature interface. In this feature, users can update profiles, change passwords, and change profile photos.

4. Home Page

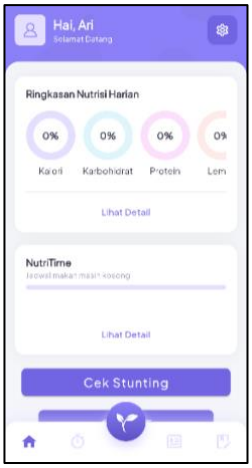

Fig 9. Home Page Feature Interface Implementation

Fig. 9 is the implementation of the Home page. There is a user profile photo and username at the top of the application. Furthermore, there is a summary of the user's daily nutrition, there is also a list of mealtime schedules and exclusive breastfeeding schedules. Underneath there is a card to the Stunting Check feature and the BMI Check feature button.

5. Stunting Prevention Education

Fig. 10 is the implementation of stunting prevention educational feature pages. On this page the application will display a list of existing education along with the name of the expert who wrote the material. Users can choose the material they want to read, after which the application will display a detailed educational page according to the user's choice.

Fig. 10. Interface Implementation of Stunting Prevention Education Features

6. Daily Nutrition Monitoring

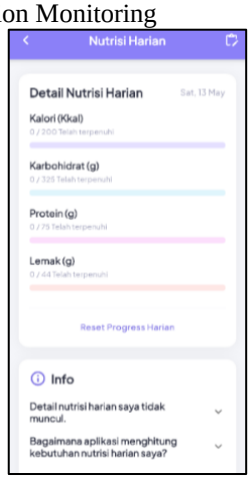

Fig. 11. Implementation of Daily Nutrition Monitoring Feature Interface

Fig. 11 is the implementation of the User's Daily Nutrition Monitoring feature. Users can view daily monitoring of macronutrients by entering daily nutritional needs according to daily nutrient calculations in the Check Daily Calorie Needs feature using the Harris-Benedict formula.

7. Meal Time Schedule

Fig. 12 is the implementation of the User's Daily Nutrition Monitoring feature. Users can view daily monitoring of macronutrients by entering daily nutritional needs according to daily nutrient calculations in the Check Daily Calorie Needs feature using the Harris-Benedict formula.

8. Health Education for Pregnant Women

Fig. 13 is an implementation of the Pregnancy Health Education feature Interface. This page displays a menu of educational options for pregnant women. If you press one of the menus, the application will display educational details according to the menu that has been selected.

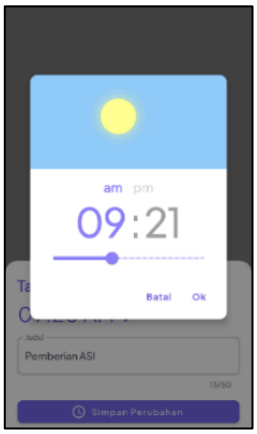

Fig 12. Meal Time Schedule Setting Interface Implementation

Fig 13. Interface Implementation of Health Education Features for Pregnant Women

A.4. Unit Testing

Unit testing in this study was carried out to find out that each existing unit did not experience failure or error. In this test, automation unit testing was carried out using a computer vision-based tool called Repeato [14]. The use of automation testing aims to avoid subjectivity in manual testing. Automation testing is also able to avoid large costs and time on manual testing, Automation testing shifts existing manual or conventional testing. In automation testing no longer involves human intervention [15]. The way these tools work is to connect the real device to a PC using a USB and open the application, then the tools will intelligently be able to run unit testing of the application [14]. The results obtained are all units in the application successfully run. Access time and application rendering are relatively fast as shown in Fig. 14.

A.5. Black Box Testing

The black box testing method used aims to test system functionality and check whether all functions in the application are as expected or not. The black box test was carried out by researchers together with the Head of the Sekotong Health Center, the Nutrition Officer, and the Sekotong Health Center Midwife as shown in Table VI.

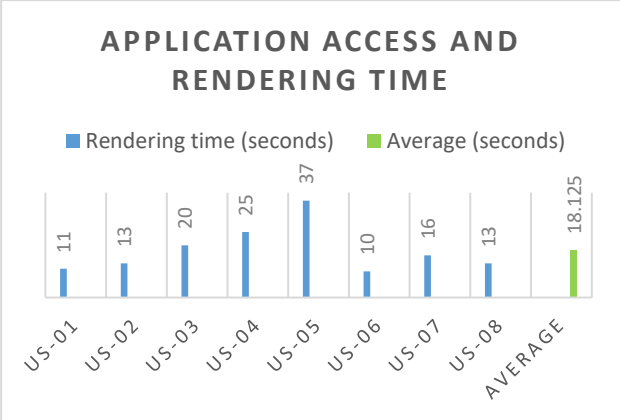

Fig. 14. Automation Unit Testing Duration Iteration 1

TABLE VI. ITERATION PLAN

No	Testing Activity	Results
1.	Account Registration	Succeed
2.	Login	Succeed
3.	Update Profile	Succeed
4.	Filling Daily Nutrition Details	Succeed
5.	Calculating Daily Nutritional Needs	Succeed
6.	Pregnant Women Education	Succeed
9.	Turn off Mealtime Alarm Notifications	Succeed
10.	Changing Meal Time Alarm	Succeed
11.	Remove Meal Time Alarm	Succeed
12.	Reading Stunting Prevention Educational Materials	Succeed
13.	Changing Passwords	Succeed
14.	Logout	Succeed

B. Iteration 2

There are additional user stories at the request of the Sekotong Health Center staff, namely the early stunting screening feature using the Anthropometric method of the Ministry of Health of the Republic of Indonesia based on the child's Body Length index based on age (TB/U) with code US-14. The addition of other user stories, namely the addition of features for food recipes and MPASI with the US-13 code, and changing the description on US-12 to the Cadre Page. There is also a transfer of user stories to the first iteration. Changes in the estimated workmanship also experienced changes, from previously being worked on with an estimate of 15 days to 17 days.

TABLE VII. ITERATION PLAN

No	US Code	Description	Estimate (days)
Iterasi-1			
1	US-09	Information on the nutritional content of food	3
2	US-10	Body Mass Index (BMI) checking feature	2
3	US-11	Check Calorie Needs	2
4	US-12	Cadres page	4
5	US-13	Food and MPASI Recipes	3
6	US-14	Early Stunting Checks	3
Velocity			17

B.1. Database Implementation

The database used in building this system is a document-based non-relational database (NoSQL database). The provider used is Google's Firestore Database which has also provided a developer environment for the Flutter framework, so that it can facilitate the system coding process.

In the database several collections are built that are needed, each collection will store a document containing records of related data that will be used by the system. There is one collection that will be stored in the Provider Firestore Database, namely the inspection_data collection. While the food collection, user_picks_food, food_recipes, and reads_food_recipes, will be stored on local storage in the form of JSON (Javascript Object Notation).

B.2. Class Implementation

The next implementation is Class implementation from the Yess Nutrition application which is implemented into coding using Visual Studio Code tools and the Flutter framework. The development of this application applies the Clean Architecture architectural pattern which aims to make the code more organized and easier to develop.

B.3. Interface Implementation

1. Information on the nutritional content of food

Fig. 15. Interface Implementation of Food Nutrition Content Information Features

Fig. 15 is an implementation of the information feature interface for the nutritional content of food. In this feature, users can search for the food they want, can set meal schedules, and can view food search history. After the user searches for the name of the food he wants to check, the system will retrieve data via the API. If the name of the food is found, the application will display the name of the food and its nutritional content. However, if it is not found, then the application will give a food message not found. There is additional detailed information on one portion of food weighing 100 grams according to the directions of a nutritionist at the Sekotong Community Health Center and based on the Indonesian Ministry of Health's KIA book.

2. Body Mass Index (BMI) checking feature

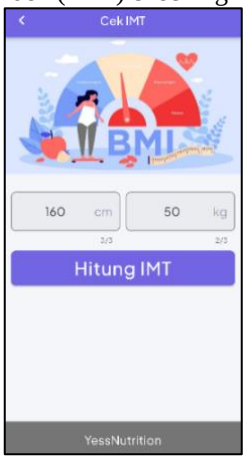

Fig. 16. BMI Check Feature Interface Implementation

Fig. 16 is an implementation of the Body Mass Index (BMI) checking feature. interface. In this feature the user can calculate the value of Body Mass Index by entering height and weight.

3. Check Calorie Needs

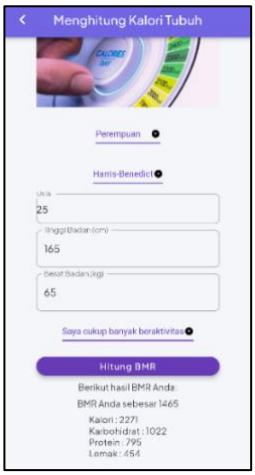

Fig. 17. Implementation of the Check Calorie Needs Feature Interface

Fig. 17 is an implementation of the Check Calorie Needs feature interface. In this feature the user can calculate the value of the required daily calorie needs based on the Harris-Benedict calculation method. In addition, the daily macro nutrient requirements will also be displayed, consisting of carbohydrates, protein, and fat.

4. Cadres Page

Fig. 18 is an implementation of the Health Center/Posyandu cadre page interface. In this feature, cadres can record the examination of the condition of pregnant women during health consultations.

5. Food and MPASI Recipes

Fig. 19 is an interface implementation of the MPASI recipe feature. In this feature, users can view MPASI recipes. The MPASI recipe in this feature is sourced from a nutritionist at the Sekotong Community Health Center, which is in accordance with the potential produce of the Sekotong community gardens.

Fig. 18. Implementation of the Interface for Health Center Cadres/Posyandu Cadres

Fig. 19. Implementation of Food Recipe and MPASI Feature Interface

6. Early Stunting Checks

Fig. 20 is an implementation of the stunting early screening feature interface. In this feature, users can check early whether a baby is indicated to be stunted or not based on the height/age standard of the Indonesian Ministry of Health's anthropometry.

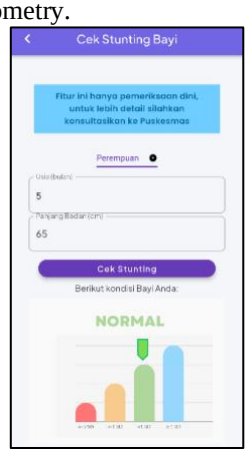

Fig 20. Implementation of Stunting Check Feature Interface

B.4. Unit Testing

The results obtained in iteration 2 are that all units in the application are successfully running. Access time and application rendering are relatively fast as shown in the following graph:

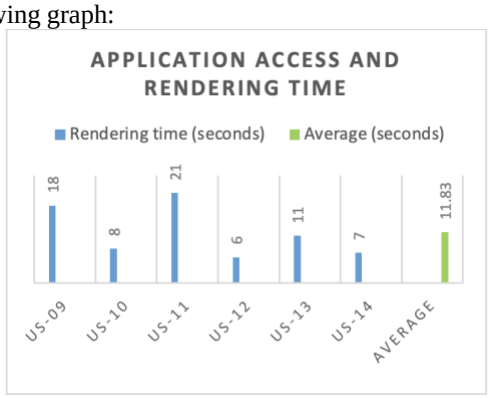

Fig. 21. Automation Unit Testing Duration Iteration 2

B.5. Black Box Testing

The black box testing method used aims to test system functionality and check whether all functions in the application are as expected or not. The black box test was carried out by researchers together with the Head of the Sekotong Health Center, the Nutrition Officer, and the Sekotong Health Center Midwife.

TABLE VIII. ITERATION PLAN

No	Testing Activity	Results
1.	Check Food Nutrition	Succeed
2.	View food search history	Succeed
3.	Delete food search history	Succeed
4.	Set a mealtime alarm	Succeed
5.	Turn off mealtime alarm notifications	Succeed
6.	Change the meal time alarm	Succeed
7.	Remove mealtime alarms	Succeed
8.	Check out the MPASI recipe	Succeed

C. User Acceptance Testing

After testing by giving questionnaires to respondents, the results of respondents' answers that have been obtained will be calculated to get conclusions about the feasibility of the application and see the user's response to the Yess Nutrition application. The questionnaire consists of 19 questions. The following are questions asked to respondents:

1. Is the application display easy to understand ?
2. Is the registration feature easy to operate ?
3. Is the login feature easy to operate ?
4. Is the profile setting feature easy to operate ?
5. Is the daily nutrition summary feature easy to operate?
6. Is the daily nutrition calculation feature easy to operate ?
7. Are the educational features for pregnant women easy to operate ?
8. Is the stunting check feature easy to operate ?
9. Can the stunting check feature help check stunting status early on in infants?
10. Is the BMI calculation feature easy to operate ?
11. Are NutriTime features easy to operate ?
12. Can the NutriTime feature help manage meal schedules ?
13. Is the food nutrition check feature easy to operate ?
14. Does the food nutrition check feature help in knowing food nutrition ?
15. Is the check food recipe and MPASI feature easy to operate ?
16. Are the nutrition and stunting education features easy to operate ?
17. Can educational features increase knowledge regarding nutrition, health, pregnant women, and stunting ?
18. Overall, is the app easy to use ?
19. Does the application meet the user's needs ?

Respondents were asked to answer the questionnaire with the following answer choices: 1 = Strongly disagree, 2 = Disagree, 3 = Enough, 4 = Agree, 5 = Strongly agree.

Based on the MOS calculation that has been carried out from the 19 questions that have been given to the user, the results are obtained in the Table IX.

TABLE IX. ITERATION PLAN

Question	SA(5)	A(4)	E(3)	DA(2)	SD(1)	Mean
Question 1	14	16	0	0	0	4.47
Question 2	18	11	1	0	0	4.57
Question 3	19	10	1	0	0	4.6
Question 4	14	14	2	0	0	4.4
Question 5	12	17	1	0	0	4.37
Question 6	12	17	1	0	0	4.37
Question 7	12	16	2	0	0	4.33
Question 8	19	9	2	0	0	4.57
Question 9	10	16	4	0	0	4.2
Question 10	17	13	0	0	0	4.57
Question 11	14	15	1	0	0	4.43
Question 12	13	16	1	0	0	4.4
Question 13	13	17	0	0	0	4.43
Question 14	11	19	0	0	0	4.37
Question 15	14	15	1	0	0	4.43
Question 16	19	10	1	0	0	4.6
Question 17	9	19	2	0	0	4.23
Question 18	12	17	1	0	0	4.37
Question 19	9	20	1	0	0	4.27
MOS (Mean Opinion Score)						4.173

The table above shows the results of the MOS calculations performed on 30 respondents; these results indicate that the Android-based Yess Nutrition application has a MOS value of 4.173. Based on the predetermined scale, this value indicates that the Yess Nutrition application has good quality to use because it has a value above 4.0 (MOS > 4.0).

Next, the average percentage of respondents' answers is determined using the calculation formula 4-2 as shown in Fig. 22. The results obtained for the SA scale (Strongly Agree) of 45.29%, S (Agree) of 51.31%, C (Enough) of 4.74%, and D (Disagree), and SD (Strongly Disagree) each of 0%. Thus, users give a positive response and provide an assessment that the Yess Nutrition application has an easy-to-use display and access, and is able to meet user needs in nutrition education and stunting prevention.

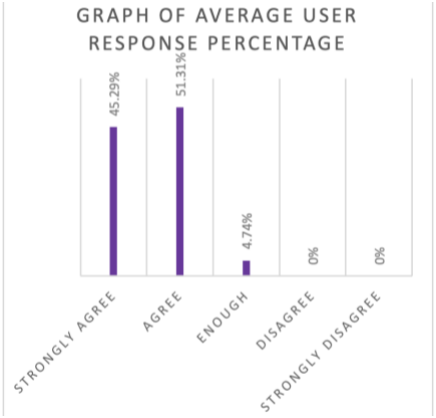

Fig. 22. Graph of Average Percentage of User Response

V. CONCLUSION

The Yess Nutrition application, a nutritional education and stunting prevention app for pregnant women, aligns with the standards of the Indonesian Ministry of Health and has undergone expert testing at the Sekotong Health Center. Utilizing the design thinking method, the app validates solutions to community issues through empathizing, defining, ideating, prototyping, and testing. This approach identifies the most significant problems and desires within the community, offering tailored and appropriate solutions.

Development of the Yess Nutrition application through the Personal Extreme Programming (PXP) method is able to quickly handle application changes so that the development process is successfully completed in two iterations, and the use of the Flutter framework with various supporting packages helps in developing applications using the PXP method.

The test results using automation unit and widget testing show that the Yess Nutrition application runs well and is able to render the display with a time of 18.125 seconds for iteration 1 and 11.83 seconds for iteration 2. Based on the User Acceptance Testing test, the Mean Opinion Score is 4.173 and as many as 45.29% of respondents strongly agree that the Yess Nutrition application can increase knowledge regarding nutrition, pregnant women's health, and stunting prevention.

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