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Development of Mobile Learning Application for Diabetic Nutrition using Augmented Reality

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Mobile Learning Application, Diabetes, Fruit Nutrition, Augmented Reality

Abstract

Diabetes has been suffered by 3.9 million Malaysians due to unbalanced food intake as the main cause. As the awareness of good nutrition among society has been increasing, providing knowledge about nutrition to diabetic patients is important to manage their condition effectively. Dissemination of knowledge to diabetes patients could be supported with suitable technologies. Augmented reality (AR) can provide a productive and comprehensive experience by increasing a person's knowledge and understanding. The existing applications does not provide a specific guide on the nutritional content of fruits, and lack of interactivity. Thus, in this project, an application based on augmented reality has been proposed to share knowledge about nutritional intake for diabetic patients. The contents are based on Malaysian Health Websites and the proposed application is known as Diabetic Nutrition AR (Fruit). This project is aimed at diabetic patients around the age of 18 years old to 60 years old. This application was developed using the "Multimedia Mobile Content Development (MMCD)" approach. Furthermore, this application aims to guide diabetic patients in explaining information about fruit nutrition using AR technology. Additionally, the user acceptance test reached the System Usability Scale (SUS) acceptable range with an average score of 71.75. Thus, with marker-based augmented reality technology, the application is anticipated to assist target users in learning about diabetes and the necessary nutrition.

1. Introduction

Regarding the National Health Morbidity Survey (NHMS) 2019, one in every five Malaysian people aged 18 and up has diabetes. That implies that 3.9 million Malaysians have diabetes currently. Diabetes is a chronic condition in which the pancreas generates inadequate insulin, or the body cannot adequately implement the insulin produced. According to a research report, most Malaysians do not completely comprehend diabetes and its accompanying health issues. It is worth noting that Malaysians believe that a high-calorie diet, among other things, is one of the primary causes of diabetes. [1].

Diabetes management systems face challenges in user experience, cost-effectiveness, and disease management. The complexity of their interfaces can be intimidating, especially for senior users or those with low technological skills. This high learning curve discourages persistent use, as users may struggle to navigate the software or fully utilize its capabilities. The cost-effectiveness of these apps is another challenge, as many involve subscription fees or in-app purchases, which can be prohibitively expensive

for some users. This financial strain is particularly burdensome for those already dealing with substantial medical bills. The complexity of these interfaces also requires users to spend time learning to use the app, especially if the program lacks intuitive design elements or simple instructions. This can lead to users abandoning the app before successfully managing their diabetes.

The objectives of this study are to design a Diabetic Nutrition AR mobile learning application based on Augmented Reality approach, to develop an interactive learning application by implementing object detection augmented reality technology, and to perform functionality and user acceptance beta testing on the developed application to the target user. The idea behind the application is to use augmented reality (AR) technology in education to captivate the attention of individuals and make their learning experience more flexible and enjoyable. It focuses on users aged 18 years old and above. The subject matter expert (SME) participating in this project is Madam Mazlinawati Binti Mohd Shariff, head nurse at the Unit of Non-Communicable Diseases (NCDs) in Negeri Sembilan. Moreover, this application also necessitates the use of some software which is Unity Game Engine and the Vuforia Engine.

The Diabetic Nutrition AR (Fruits) application contains three modules such as fruits tracker, calories counter and learning module. All interactive buttons in the application are expected to perform well. The sound button is provided as part of the learning content.

The remainder of the document is structured as follows: The research domain, the technology used, and the outcome of the comparative analysis are all covered in Section 2. The Multimedia Mobile Content Development (MMCD) methodology that is selected for this project is explained in Section 3, along with the results of the analysis and design stages of the project. Additionally, Section 4 presented the findings and a discussion of the current condition of application.

2. Related Work

In this section, the study domain, technology used and result of the comparative analysis are discussed.

2.1 Diabetic Nutrition

Nutrition is crucial for diabetic patients to manage their condition effectively. Dietary guidance, often provided by healthcare providers, is increasingly important. Carbohydrate counting and insulin adjustments are primary for type 1 diabetes, while weight control is crucial for type 2 diabetes. Dietary guidance focuses on patient-centered treatment, and practical alternatives for behavioral interventions are examined. It is acknowledged that information alone won't change behavior, so practical alternatives are explored [2].

2.2 Technology Used

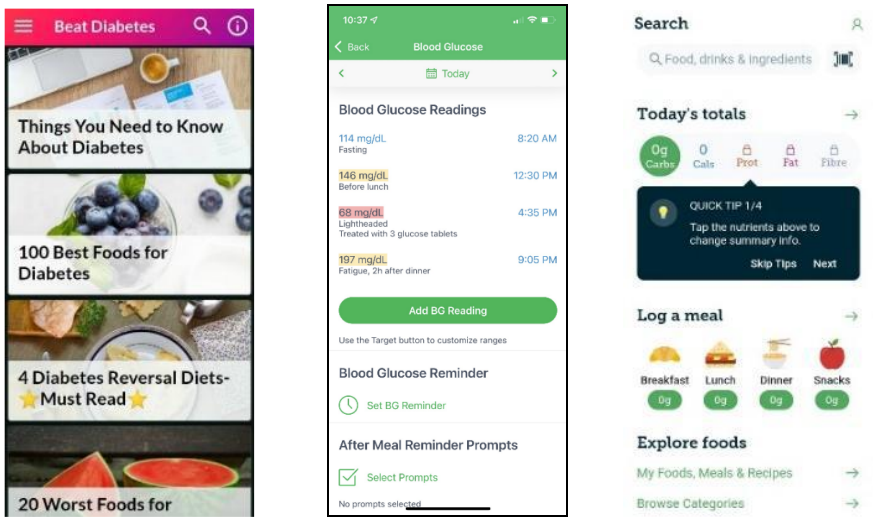
Mobile technology encompasses various gadgets, including new dual technologies, that enable network communication with various devices. These devices improve communication and connectivity, allowing people to stay connected and access knowledge while on their own. Mobile technology has transformed our way of connecting with the world, from smartphones and tablets to wearable gadgets and IoT devices [3].

The digitalized world has enhanced knowledge accuracy and increased technological productivity. Augmented reality (AR) is a revolutionary innovation that overlays digital items on real-world objects, revolutionizing communication with our surroundings. AR is categorized into marker-based and markerless applications, with markerless AR being divided into location-based, projection-based, and contour-based types [4].

Object recognition is a computer vision technique that uses machine learning and deep learning algorithms to identify objects in images or videos. It is used in applications like augmented reality, surveillance systems, and autonomous driving. Object recognition aims to teach computers to recognize objects as individuals, like how humans understand and engage with visual environments. Object detection involves finding occurrences of an item in a graphic, while object recognition involves object identification and location. It allows for the identification and recognition of multiple objects in a single image, making it a crucial tool in various fields [5].

2.3 Comparative Analysis

It can be determined from the analysis of the current applications that comparisons between them may be used to determine how they are different from one another. The table listed the application's strengths and shortcomings of this writing. As an outcome, the suggested application will strengthen its flaws while incorporating some of its benefits. Table 1 provides a summary of the comparisons of the current application, Beat Diabetes, Diabetes & Diet Tracker, Carbs & Cals: Diet & Diabetes, and the proposed application which is Diabetic Nutrition AR.



(a) **(b)** **(c)**

Fig. 1 *(a)Beat Diabetics [6]; (b)Diabetes & Diet Tracker [7]; (c)Carbs & Cals: Diet & Diabetes [8]*

Table 1 *Comparison between existing applications and proposed applications*

Features/ Apps	Beat Diabetes	Diabetes & Diet Tracker	Carbs & Cals: Diet & Diabetes	Diabetic Nutrition AR (FRUIT)
Supported Platform	Android 5.0 and up	Android 8.0 and up	Android 9.0 and up	Android 8.0 and up
Module	Learning (document form)	Blood Glucose Tracker, Insulin Tracker, Meal planner, barcode scanner,	- Barcode scanner - Daily diary to track your carb, calorie, protein, fat, sat fat & fibre consumption.	Calories Counter, Learning (explore foods nutrition) and nutrition tracker
Mode	Offline	Online	Offline	Offline
Augmented Reality (AR) approach	None	None	None	AR
Database	None	Food Database	Food Database	User Login Database
Security Element	Do not need authorisation to open the app	User authentication method	Do not need authorisation to open the app	Email and Password required to register and login to the app
In-app advertisement	Contain Ads	Ads Free	Ads free	Ads free
Version availability	Free	Need to purchase	In-app purchases	Free

Table 1 *(cont)*

Advantage	Facts Information about diabetes, providing expert advice and tips on controlling blood sugar levels and managing the condition.	Has comprehensive tracking, personalized Meal Recommendations, medication and glucose reminders	Has weight loss and maintaining a healthy weight, following a keto, low-carb, lowcalorie or verylow- calorie diet, and sports nutrition.	Can provided information about nutrition clearly and free without payment.
Limitation	Only recommended across the UK by NHS dietitians and healthcare providers.	Need to purchase, internet dependency, limited support for non-English Languages.	To have the full database user need to purchase the unlimited plan.	Only focus on local fruits.

3. Methodology

The goal of the suggested app, Diabetic Nutrition AR (Fruit), is to educate users about diabetes through mobile learning while enabling them to effectively scan fruits using the fruit tracker function. Applications for mobile learning, or m-learning, are developed in the interim using the Multimedia Mobile Content Development (MMCD) methodology [9]. Therefore, it has been decided to use in this project. In Figure 2, the five stages of the MMCD approach are displayed. The stages are: developing the core function, designing the process, analysing the structure, testing, and creating the application idea. Subsequently, the MMCD phases are examined in the subsequent subsections.

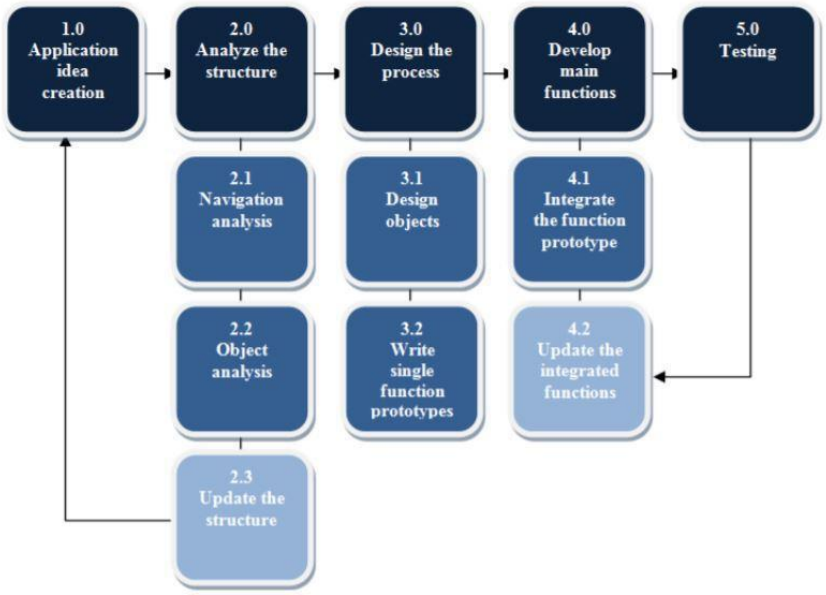


Fig. 1 *MMCD Methodology [6]*

3.1 Application Idea Creation

Application idea creation is the first phase of MMCD methodology. In this phase, the information required before the design and development of the Diabetic Nutrition AR (Fruit) are determined. Table 2 shows the application idea creation checklist. Additionally, two information gathering methods have been used to identify user requirements. Firstly, an interview session was conducted with a Subject Matter Expertise (SME). The transcript is attached in Appendix A. Second, a set of questionnaires is prepared and distributed to the target users via the Google Form. A total of 51 responses from individuals aged between 18 years old and above has been collected as attached in Appendix B. The results of the user analysis are tabulated in Table 3.

Table 2 *Application Idea Checklist*

Items	Description
Type of Application	Mobile Learning
Target Device	Android-based smartphone
Target Users	Diabetic Patients between 18 to 45 years old
GUI (Graphical user interface)	Main Menu, Fruits Tracker, Colories Counter, Learning Module
Unity	• Version: 2021.3.25f1 • Resolution: Free aspect
Canva	• Design Background and Button
Flaticon	• Design Button and Icon
Images	• Backgrounds, About Diabetes
Application Synopsis	• Diabetic Nutrition AR is a mobile learning application that includes the use of nutrition tracker and counter in it. This application is focused to diabetic patients to implement it in their daily life to monitor their intake in taking fruits. The application provided interactive graphics to deliver the learning content.

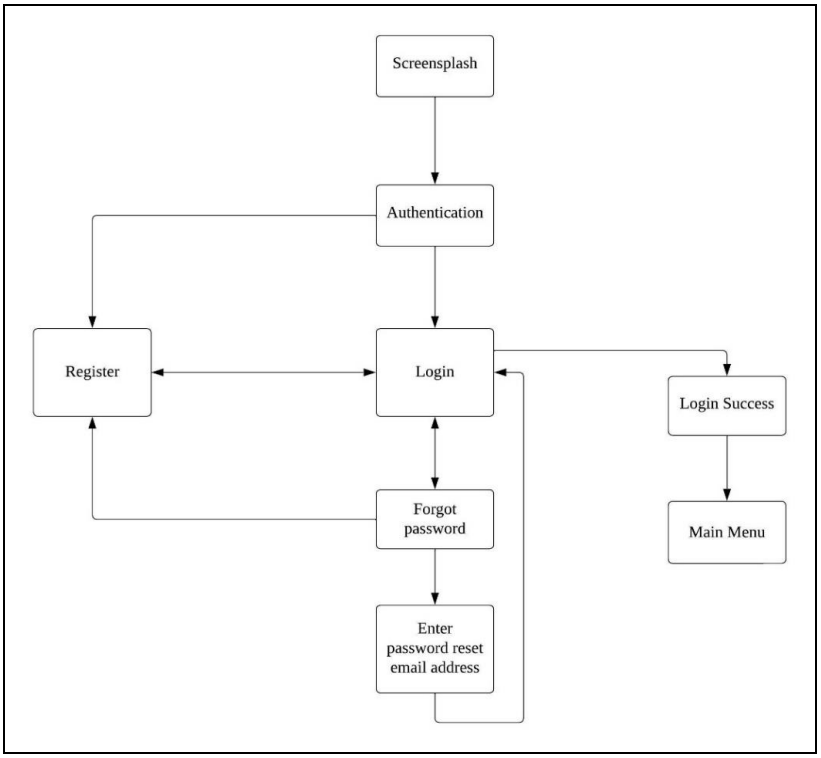
Table 3 *User Requirements Analysis*

Participant	Role in Product	User Requirement	Action Needed
Subject Matter Expertise (Madam Mazlinawati binti Mohd Shariff, a head nurse at the Unit of Non-Communicable Diseases (NCDs) in Negeri Sembilan)	Expertise within the related industry material advisor	Based on the interview, use a user-friendly interface.	• Keep the design clean and straightforward. • Use clear and simple language.
		Use interactive way to convey information.	• Ensure the interface is easy to navigate with logical flow and clearly labeled sections.
Diabetic Patients (between 18 years old and above)	End-user of the proposed application	Based on the questionnaire, the user preferences	• The application should be free without any payment to use it features. • The application should be developed in offline mode which allows users to access whenever and wherever they want. • The application contents should be from the legal source which from Ministry of Health, Malaysia.
General People (between 18 years old and above)			

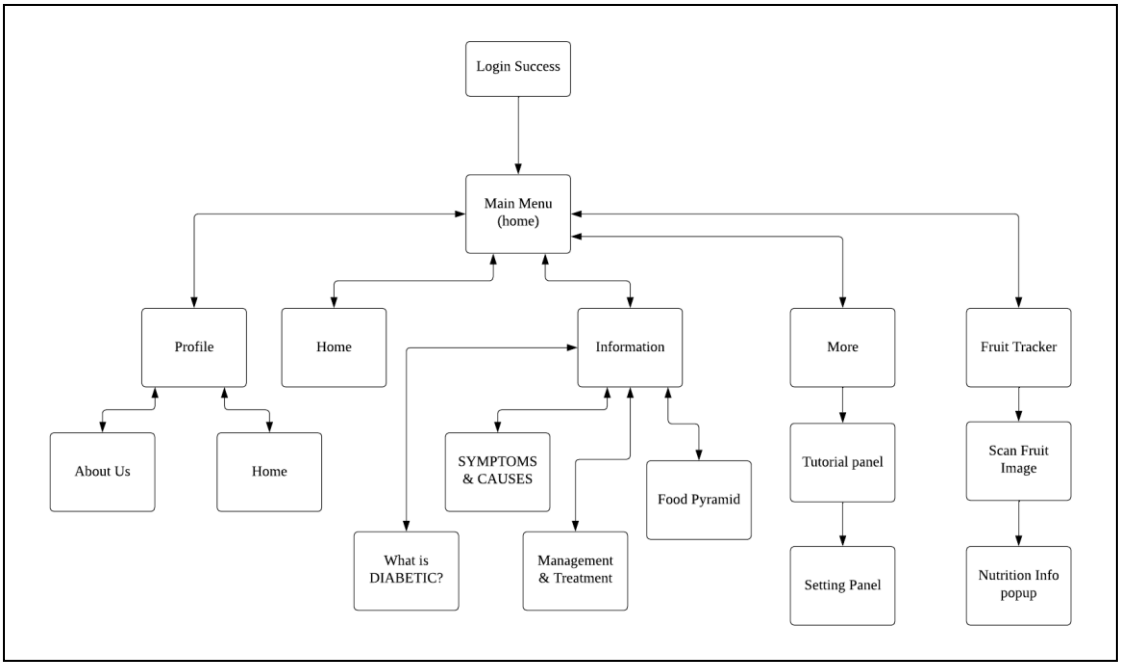
3.2 Analyze the Structure

In the second phase of the MMCD methodology, the structure of the application to be developed is analyzed. The navigation analysis has been conducted. Figure 2(a) and Figure 2(b) shows the navigation

structure, while Figure 2(c) presents the content structure. System flowcharts and modules are shown in Figure 3(a). Meanwhile, functional and non-functional requirements are listed in Table 4 and Table 5 as attached in Appendix C.



(a)



(b)

Fig. 2 *(a)-(b) Navigation structure*

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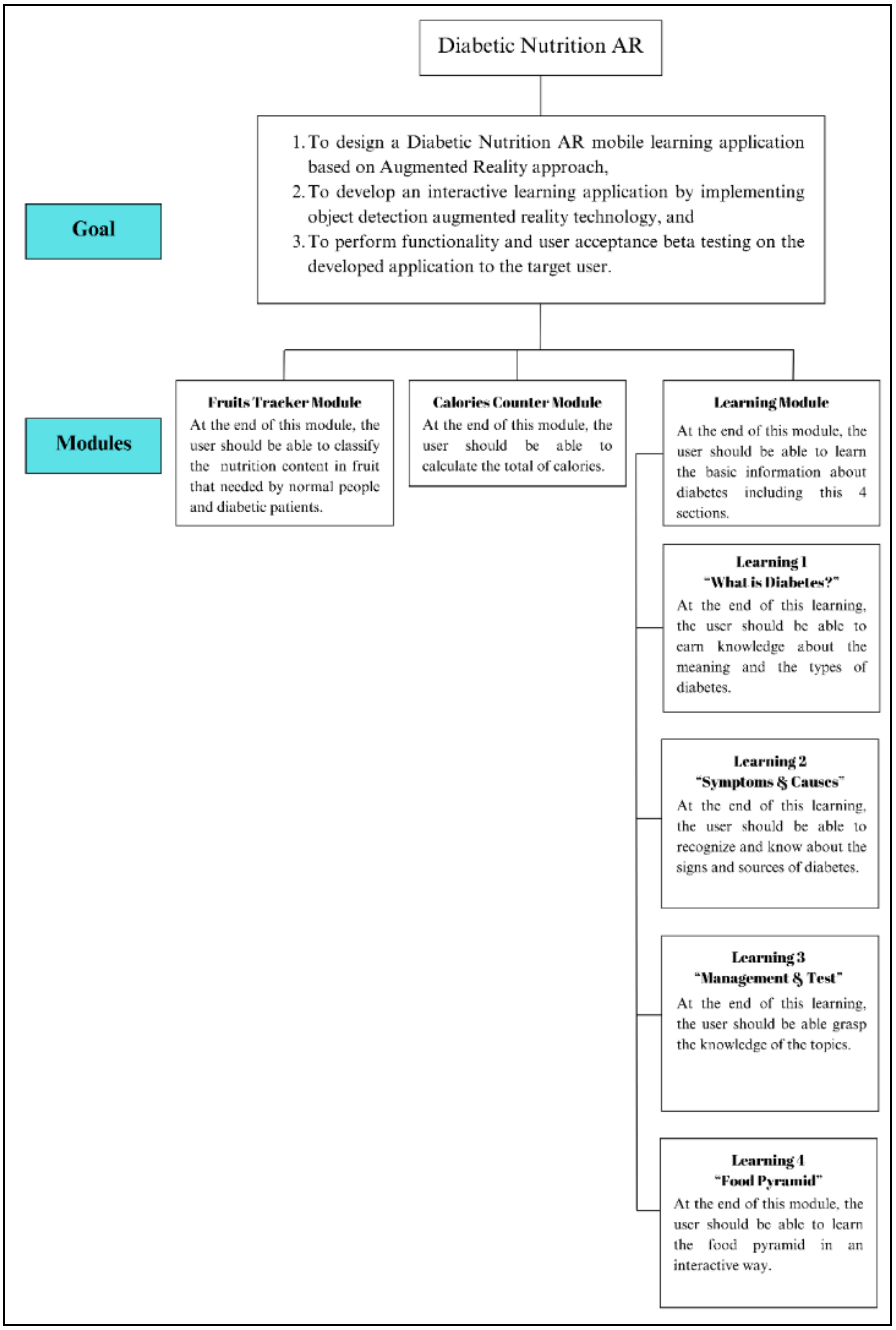
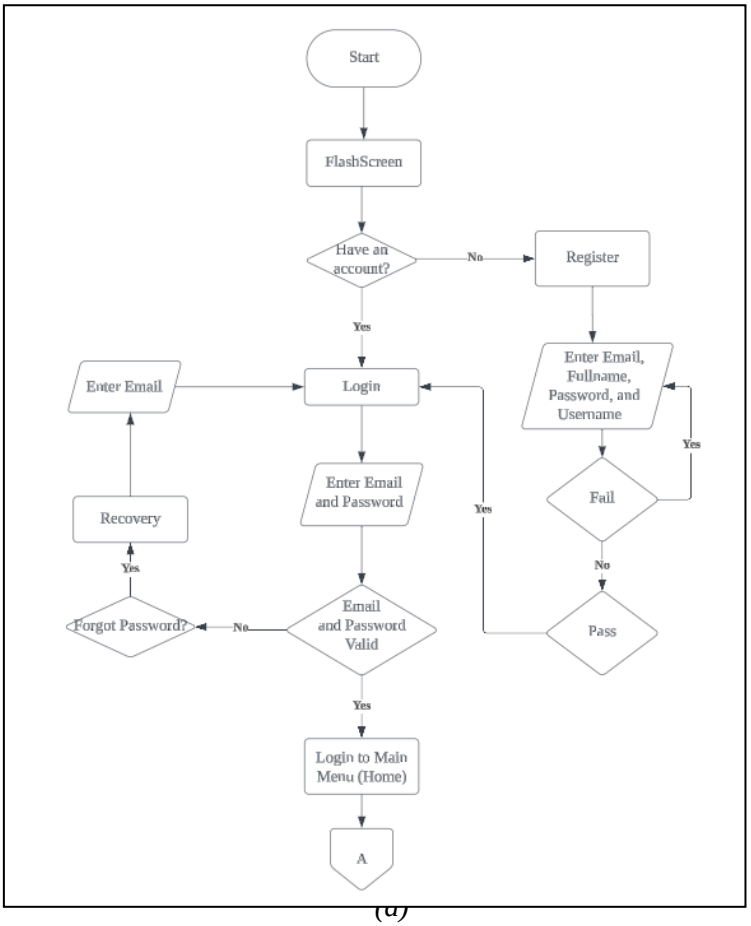
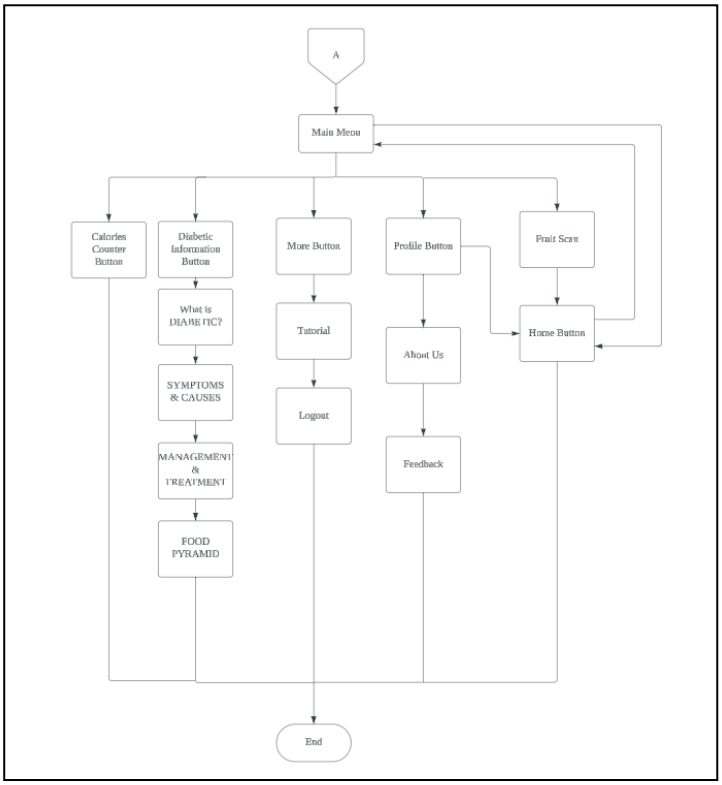


Fig. 2 *(b) Content structure*



(a)



(b)

Fig. 3 *(a)- (b) Flowchart for the application*

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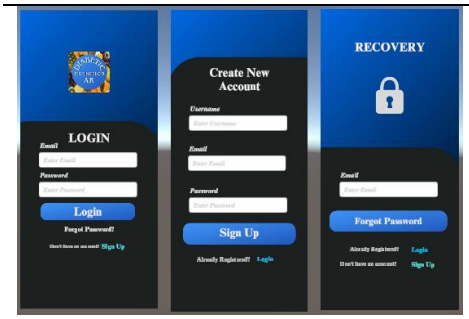
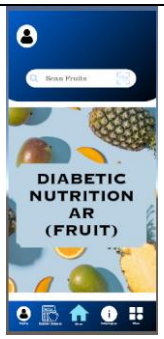
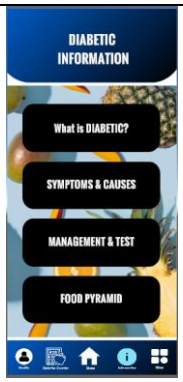
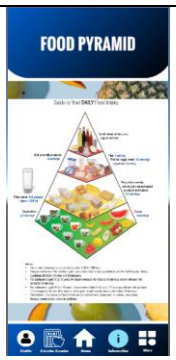
3.3 Design the Process

The first phase focuses on preparing the application, consisting of writing the script for a single-function prototype and designing prototypes. This phase leads to the completion of the initial prototype, which includes images, item designs, and single scripting. The main function scripting is then written to ensure the application operates as intended. The second phase involves object design and scripting for a single-function prototype. Graphic designs are created using Canva and Unity, while the user interface, interaction button, picture object, and button icons are created using the sample initiative. The main object and graphic designers must be completed before the prototype can be produced. The first script is written and tested to ensure all essential components are working correctly. Table 6 shows the button design, while Table 7 shows the interface design.

Table 6 *Button Design*

Buttons	Description
	• This is the button design for login, register and forgot password button. • It appears in the login, register, and recovery page. • It navigates users to the main interface page (homepage).
	• This button appears in the learning/information module. • It navigates users to topics that they want to select.
	• This button appears in main interface page (homepage). • This navigates users to camera in fruit tracking module.
	• This button appears throughout all interfaces except the in the fruit tracker page. • This navigates users to the profile panel.
	• This button appears throughout all interfaces except the in the fruit tracker page. • This navigates users to calories counter page.
	• This button appears throughout all interfaces except the in the fruit tracker page. • This navigates users back to main interface.
	• This button appears throughout all interfaces except the in the fruit tracker page. • This navigates users to learning module page.
	• This button appears throughout all interfaces except the in the fruit tracker page. • This navigates users to the setting and tutorial panel.

Table 7 *Interface design*

Interfaces	Description	Interfaces	Description
	This is the authentication interface of the proposed application. For the first time user, they need to register first		This the main interface menu .
	This is the calories counter module, users can use it to count the nutrition of the fruit by adding the gram of the fruit.		This is the diabetic information modules.
	This is the section in the diabetic information modules		This is the section in the diabetic information modules
	This is the section in the diabetic information modules		This is the section in the diabetic information modules

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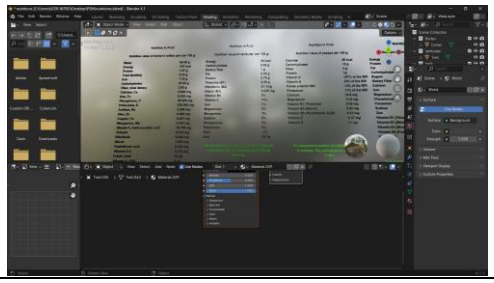
3.4 Develop Main Function

This application allows users to select between its main menu and selected modules like learning modules, calorie counter, and fruit tracker. Scripting is necessary for navigational buttons to function properly. The fruit tracker's nutritional tracking relies on track scripts. C# and other programming languages will be used for seamless integration, ensuring accurate data analysis.

The application also includes a user interface, interaction button, picture object, and button icons. The prototype requires completion of the main object and graphic designers, followed by writing the first script and testing for functionality. According to Table 8 shows the application assets development of this application.

Table 8 *Application assets development*

Assets	Development	Description
Graphics		This illustrates the creation of buttons using Canva software. These buttons are utilized in various areas throughout the application, including profile panels, links to other modules, and learning module buttons. Furthermore, these buttons are functionally appropriate. For example, the information icon will connect users to the diabetes information modules section, while the "X" icon serves as the quit or close button.
3D Model		The 3D models for the Diabetic Nutrition AR (FRUIT) application are created using Blender software. The 3D models are utilized to create the model target for the AR component, which serves as a recognition system to aid in the scanning modules. In addition to developed models, other free 3D models and materials are available through with Blender Software features.
AR		The development of augmented reality (AR) technology within the Unity platform, with a specific emphasis on a fruit scanning application, necessitates the intricate integration of advanced computer vision algorithms with immersive user interfaces to provide a seamless and dynamic user experience. Furthermore, the development approach includes thorough design considerations to ensure that the user interface is intuitive and visually appealing, guiding users through the scanning process while presenting important and entertaining information about each scanned fruit. Using Unity's sophisticated rendering capabilities and Vuforia's extensive AR features, the application would create lifelike virtual representations of the scanned fruits, increasing the user's sense of immersion and realism.

3.5 Testing

The application development process is incomplete without the testing phase. The final phase in the MMCD process is to test for functionality and user acceptance. If errors are detected here, development will be resumed to correct the integrated functionality from the previous step. Table 9 displays the outcomes of functional testing, whereas Section 4 provides user acceptance testing.

Table 9 *Functional testing*

Test	Expected Result	Actual Result	Corrective Action
Login Button	Navigates to Main Interface – Home	Work well as planned.	Not needed.
Sign Up Button	Navigate to Register Interface.	Work well as planned.	Not needed.
Forgot Password Button	Navigate to Recovery Interface.	Work well as planned.	Not needed.
Fruit Tracker Module Button	Navigate to AR Module Interface.	The fruit nutrition information will appear.	Add model target 3D model with correct features.
Profile Button	Navigate to profile panel.	Work well as planned.	Not needed.
Calories Counter Module Button	Navigate to the Module Interface.	Work well as planned.	Not needed.
Home Button	Navigate to Main Interface – Home.	Work well as planned.	Not needed.
Diabetes Information Module Button	Navigate to the Module Interface.	Work well as planned.	Not needed.
More Button	Navigate to More Panel.	Work well as planned.	Not needed.
Back Button	Close the section.	Work well as planned.	Not needed.
About Us Button	Navigate to About Us Panel	Work well as planned.	Not needed.
Feedback Button	Navigate to Feedback panel.	Work well as planned.	Not needed.
Submit Button	Save users Feedback	Work well as planned.	Not needed.
What is Diabetes? Button	Navigate to the Module Interface	Work well as planned.	Not needed.
Symptoms & Causes Button	Navigates to the Module Interface	Work well as planned.	Not needed.
Symptoms & Causes: Children Button	Navigates to Symptoms & Causes for Children Interface	Work well as planned.	Not needed.
Symptoms & Causes: Adult Button	Navigates to Symptoms & Causes for Adult Interface	Work well as planned.	Not needed.
Symptoms & Causes: Senior Citizen Button	Navigates to Symptoms & Causes for Senior Citizen Interface	Work well as planned.	Not needed.
Tutorial Button	Shows tutorial video	Work well as planned.	Not needed.
Logout Button	Exit the application.	Work well as planned.	Not needed.

4. Result and Discussion

4.1 Usability

There are 10 questions to determine the application's usability. According to Figure 4(a), all responders to the questionnaire offered higher scores between strongly agree, agree, and neutral. Although there were questions with a disagree option with the positive statement of the application's usability such as "I think that I would like to use this application frequently" and a strongly disagree option with the positive statement of the application's usability such as "I found the various functions in this system were well integrated". This could be related to a little engaging with gadgets among the respondents, who are mostly senior individuals. Therefore, the usefulness of the Diabetic Nutrition AR (FRUIT) application is satisfactory.

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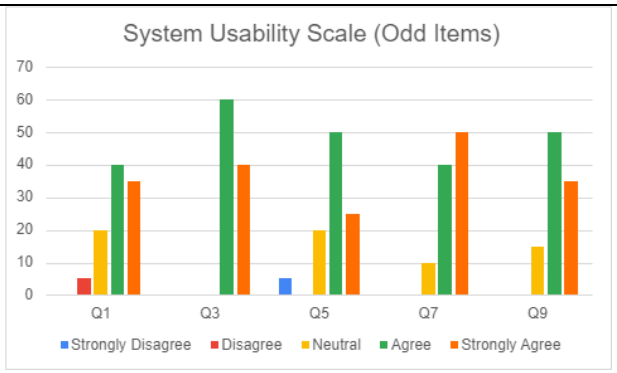
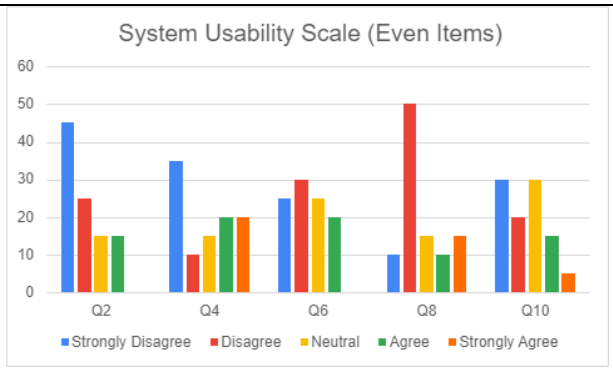


Question 1: I think that I would like to use this application frequently.
Question 3: I thought the system was easy to use.
Question 5: I found the various functions in this system were well integrated.
Question 7: I would imagine that most people would know how to use this application very quickly.
Question 9: I felt very confident using this application.

Fig. 4 *(a) Analysis of System Usability Scale (SUS) positive questions*

According to Figure 4(b), most respondents strongly disagree and disagree with the negative remark about the application's usability, such as “I found this application unnecessarily complex” or “I found the system very cumbersome to use”. There also a few individuals strongly agree, agree, or are neutral about the negative states regarding the app's usability. Thus, there are a lot of benefits and drawbacks to using the application.



Question 2: I found this application unnecessarily complex.
Question 4: I think that I would need the support of a technical person to be able to use this application.
Question 6: I thought there was too much inconsistency in this system.
Question 8: I found the system very cumbersome to use.
Question 10: I needed to learn a lot of things before I could get going with this application.

Fig. 4 *(b) Analysis of System Usability Scale (SUS) negative question*

4.2 Technology Acceptance Model (TAM)

This section includes statistics and analysis from user acceptance testing. Testing is conducted to determine how well the application is perceived by users. In this project, the Technology Acceptance Model (TAM) [10] is used and accepted. Google Drive was used to distribute the software to its intended audience of diabetic patients aged 18 and up, along with a Google Form survey. The questionnaire measures four items: perceived ease of use (PEOU), perceived usefulness (PU), attribute of usability (AU), and user satisfaction. The survey also employs a 5-point Likert scale, with response options including'strongly disagree', 'disagree', 'neutral', 'agree', and'strongly agree'. There were 70 responses, and the results were examined.

According to Figure 4(d), 45% of respondents agreed that the app was straightforward to use, while 45% were ambivalent. More than half of respondents agreed or were neutral, indicating that the Diabetic Nutrition AR (FRUIT) app can be deployed. Figure 4(e) demonstrates that an average of 55%

of respondents agreed with the application's diabetic information, while 40% were ambivalent. However, 0% of respondents strongly disagreed, whereas 5% disagreed.

Figure 4(f) demonstrates that on average, 55% of respondents rated the Diabetic Nutrition AR (FRUIT) app satisfactory, whereas 40% were neutral. Figure 4(g) also demonstrates that an average of 50% of respondents are satisfied and 40% are ambivalent about the app's overall performance. In conclusion, the Diabetic Nutrition AR (FRUIT) application passed user acceptance testing with positive comments from intended users.

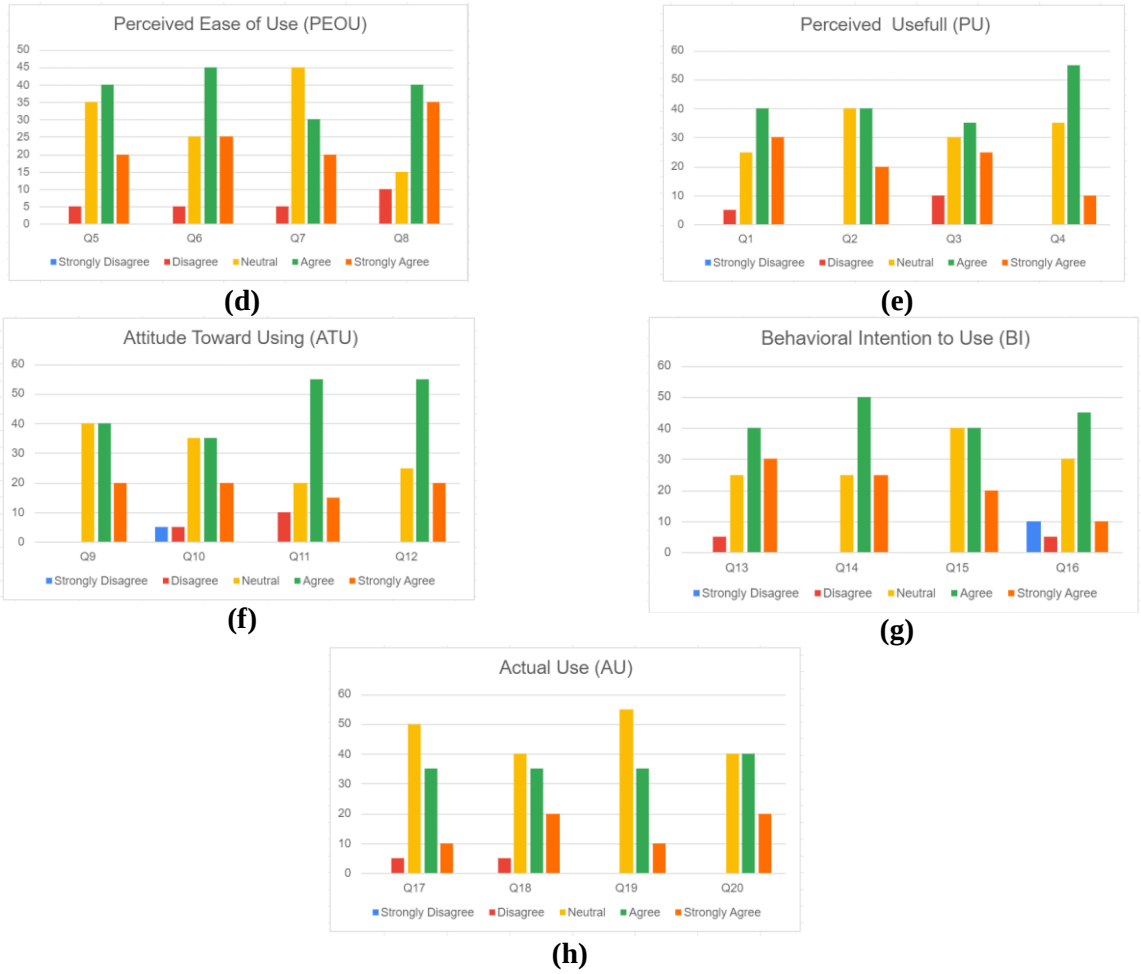


Figure 4 *(d) Analysis of Perceived Ease of Use (PEOU); (e) Analysis of Perceived Useful (PU); (f) Analysis of Attitude Toward Using (ATU); (g) Analysis of Behavioral Intention to Use (BI)*

5. Conclusion

The project proposes Diabetic Nutrition AR (FRUIT), an augmented reality learning mobile application that provides an engaging way for diabetic patients to learn about diabetes and recognize fruits without the need to search online. This application aims to provide an alternative option for studying and learning more entertainingly. The Multimedia Mobile Content Development (MMCD) methodology was used in the development process, and the application has received positive reviews from target users, demonstrating its effectiveness in improving diabetes knowledge.

Finally, some recommendations were received to improve the application for future use. Future development for the Diabetic Nutrition AR (FRUIT) app could concentrate on a few key areas to improve its functionality and accessibility. The following planned efforts and recommended enhancements, such as expanding the database to include a greater selection of fruits and other food items, would make the app completer and more useful to a larger audience. Furthermore, adding support for various languages will considerably improve accessibility for non-English users, making the software more useful to a broader user base.

Through the testing stage, several good qualities of the Diabetic Nutrition AR (FRUIT) application have been discovered, contributing to its overall success and user satisfaction. The advantages are as the Diabetic

Nutrition AR (FRUIT) app enhances nutritional awareness by using augmented reality (AR) to overlay detailed nutritional information on real-world fruit items, making it easier for users to understand the nutrition contents in the fruits. The Diabetic Nutrition AR (FRUIT) app provides valuable educational tools, including learning modules that cover diabetes symptoms and causes, diabetes management, healthy eating habits, and the impacts of diabetes at differences ages. The Diabetic Nutrition AR (FRUIT) app enhances convenience and accessibility by simplifying the process of calculate the total calories of the fruits by inserted the weight in grams, this can help to make informed choices whether at home, in a restaurant, or while grocery shopping.

Even Diabetic Nutrition AR (FRUIT) be affirmed with positive reviews by target users, this application has been found to have several limitations after analyzing the results of user acceptance test. The limitations include not all fruits can be scanned by the app, which limits its effectiveness in providing comprehensive nutritional information for a wide variety of foods. Additionally, the user can count the calories of the fruits that are provided only.

Future work for the Diabetic Nutrition AR (FRUIT) app could focus on several key areas to enhance its functionality and accessibility. The following future works and suggested improvements can be considered by expanding the database to include a broader range of fruits and other food items would make the app more comprehensive and useful for a wider audience, improving the accuracy and speed of the AR scanning technology could also enhance user experience, ensuring reliable and quick access to nutritional information

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: ***study conception and design:*** *Nur Afiqah, Suriawati;* ***data collection:*** *Nur Afiqah, Suriawati;* ***analysis and interpretation of results:*** *Nur Afiqah, Suriawati;* ***draft manuscript preparation:*** *Nur Afiqah, Suriawati. All authors reviewed the results and approved the final version of the manuscript.*

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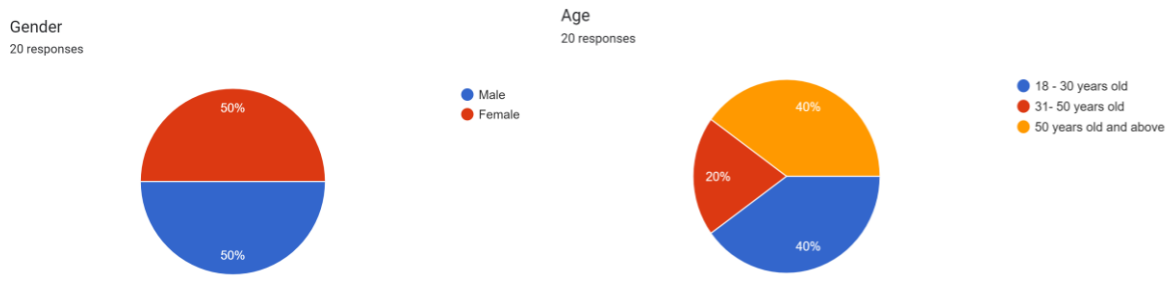
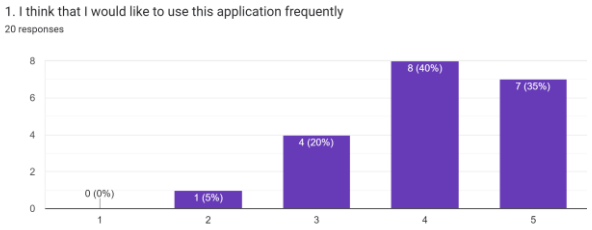
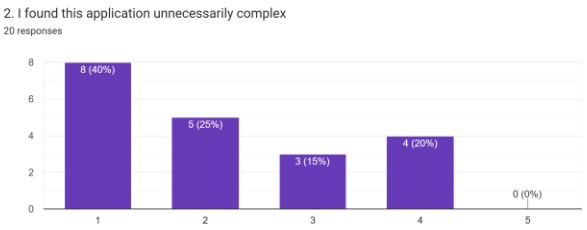
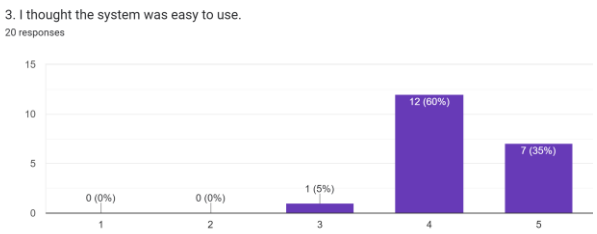
Appendix B

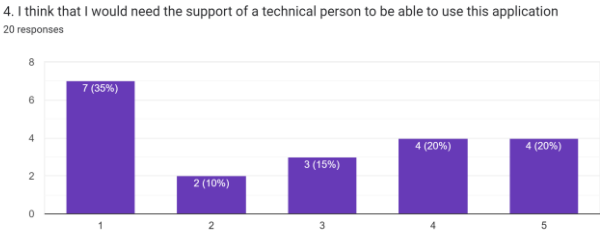
This section shows the result of the questionnaires for user analysis.

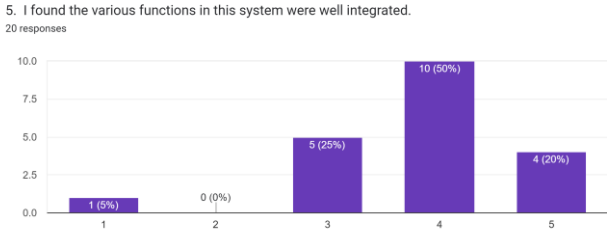


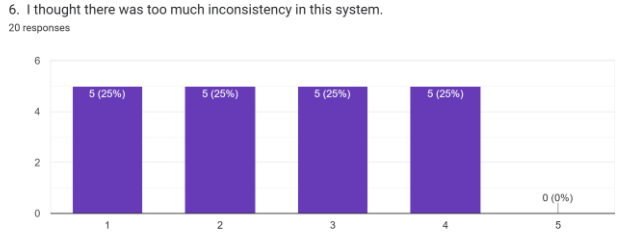


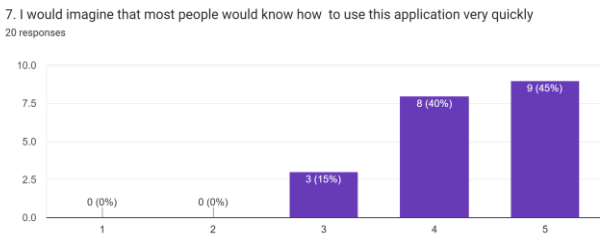


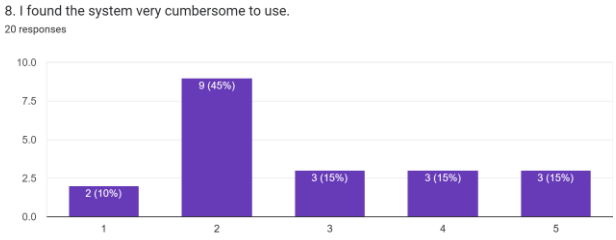


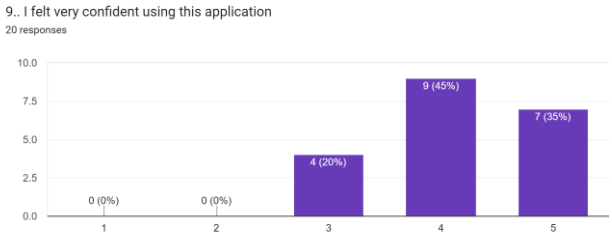


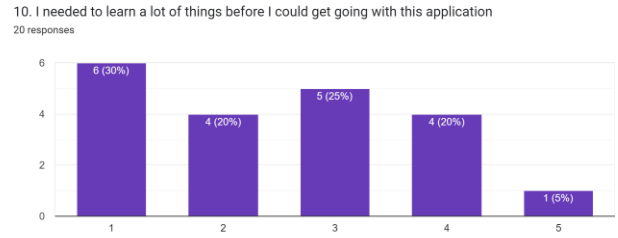












Appendix C

Table 4: Functional requirements

No	Function Requirement	Description
1.	Autonomous system activity	• All the application's functional buttons, including search, profile, home, calories counter, information, and more button will be shown in the main interface. • The application should determine that the correct nutrition information shown up when the users scan the fruits in fruit tracker module. • The application should calculate the total of the calories for fruits in the calories counter module.
2.	User interaction support	• The application should provide the users to register and login function. • The application should provide users the ability to scan the fruits when using the search button. • The application should allow users to go to setting and tutorial by click the more button. • The application should allow users to navigate throughout the application by using appropriate buttons. • The applications must provide users smooth navigation throughout the application.
3.	Provide learning content	• The application shall give users valid information of the Diabetes in the information module. • The application should help users to expand their knowledge about diabetes throughout these modules.

Table 5 *Non-functional requirements*

No.	Non-functional Requirement	Description
1.	Usability	• The application should be able to let users to access at anytime and anywhere. • The application should employ basic terms to offer learning contents. • The application's color scheme and major user interface layout should be consistent without being too demanding on the eyes. • The application should utilize an appropriate color scheme for each button and adjust the button size accordingly.

2.	Reliability	• The application should be able to provide users with safe personal information.
3.	Supportability	• The application should be ought to resolve by the developer immediately when it malfunctions to guarantee that it is performing at its most efficient.
4.	Implementation	• The application should be compatible with Android mobile device with Android version 5.0 and above.
5.	Performance	• The application shall operate completely offline. • The application should perform smoothly.
6.	Legal	• The application shall give users the information from authorized content only.
7.	Cultural	• The application should be design according to the Diabetes information from Ministry of Health Malaysia. • The application shall utilize English language as the main language.