

# **BSC (HONS) COMPUTER SCIENCE AND SOFTWARE ENGINEERING**

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## **ANDROID BASED APPLICATION WHICH HELPS FOR PARKINSON'S DISEASE PATIENTS**

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### **CONTEXTUAL REPORT**

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## List of Abbreviations

PD	Parkinson's disease
APDA	American Parkinson Disease Association

# 1.0 Introduction

## 1.1 Project Background

In past few years, technology has advanced to new heights, with thousands of systems developed to help humans in guiding their activities and supporting in all sectors. Human health care is the most important industry in this world. With the current pandemic situation, most patients are unable to visit doctors or obtain relevant information about the diseases to manage or slow them, and patients may not receive their medicines on time if caregivers become busy. Patients suffering from diseases require a plan and an exact time to complete their diet plans, medicines, body exercises, relaxations, and so on. To full fill these requirements, a system must be developed to help patients and caregivers by guiding them in the right direction and reminding them of important information at the right time.

The proposed project is an Android application which help and guide the Parkinson patients to do their daily Activities. The proposed application fulfills all the requirements listed above for assisting patients and caregivers with their daily tasks. With a questioner form on the application, the system will be developed to identify the diet plans and exercises that are offered to patients. There are two types of symptoms: motor symptoms and non-motor symptoms. Tremor, Bradykinesia, Rigidity, Postural Instability, and Vocal Symptoms are classified as motor symptoms, while depression, sleep problems, loss of smell, sweating, and melanoma are classified as non-motor symptoms. Following a balanced diet improves general well-being and increases your ability to deal with disease symptoms and doing daily exercises helps to maintain strength, flexibility, and body balance. Also, completing puzzles can help patients to manage Parkinson's symptoms by strengthening their minds. All these parts are covered with this proposed project. PD patient will be able to learn about more technics to slower the disease.

## 1.2 Aim

- To provide a trustworthy platform for Parkinson's disease patients and caregivers to learn about their disease.
- Providing guidelines to the patients and slow down the disease via an Android application.

## 1.3 Objectives

- To gather information regarding other existing services related to PD
- To identify how to use machine learning on this system
- To collect patient's requirement and information's on PD
- To train the application to offer the most appropriate answers to users based on their needs.
- To train the system to identify other diseases that affect the meals system.
- Develop the best database for the proposed system to update user information.

## 1.4 Description of Artifact

The proposed project is an Android application that will support patients suffering from Parkinson's disease. The application includes a questioner-based user interface to gather information and provide the most appropriate answers for their needs. Patients with Parkinson's disease who have chronic diseases can also use the application to fulfill their goals. The proposed system will guide Parkinson's disease patients and their caregivers, and it includes diet plans, exercises, and puzzle games. The most important aspect of this system is the exercise and diet plans that will be provided to patients under the age, as well as the filtering of other diseases.



## 1.5 Structure of the Report

The report includes four main topics from the proposed project:

- Introduction
- Literature Review
- Project Plan
- Planning Artefact

The introduction gives the reader a general idea of the project and it is divided into four major sub sections as project background, goals, objectives, and description of artifacts.

The literature review included in the contextual report consist of scholarly articles, blogs, and academic papers and other sources related to the proposed project. By examining previous works which have done and published the researcher research to get a summary and get a critical evaluation of it. In between 2010 to 2021, all the data acquired through academic papers, blogs, and articles.

The project plan gives an idea to the reader about planning of the artefacts by breaking it down into time plans. The researcher archives the achievements using a Gannt chart and a Work Breakdown chart. As a result, the reader will understand the project plan and time intervals.

The planning artifact will give the information about how the proposed system was planned and what development methodology has been used. use case diagram will be demonstrated during the Planning Artefact section.

## 2.0 Literature Review

### 2.1 Introduction

The following literature review summarizes the main findings and provide an overview of technologies involved in producing the proposed "PD Health Care" application which is an Android-based application that helps the Parkinson's patients to guide their daily activities. The researcher carried out a literature review on chronic diseases, human nutrition, human exercise, motor, and non-motor symptoms. All technologies and frameworks related to the proposed project will be demonstrate in this chapter. The research papers and articles are used to gather information are from 2010 to 2021.

### 2.2 Chronic Diseases

The proposed project includes a diet and exercise plan for Parkinson's disease patients. If a PD patient also has diabetes, the system should provide a diet plan for both diseases. Therefore, this chapter will discuss gathering information about other common diseases as well as diet plans, exercise plans, and human nutrition for each disease and this will discuss about the chronic diseases.

In 2005 age between 30-69 years, 35 million people died from heart disease, stroke, cancer, and other chronic disease and only 20% of them died in high-income countries while 80% of peoples died in low-income countries and middle-income countries. As a percentage more deaths are listed on low-income countries and medium-income countries. As in Figure 1 shows that the global distribution of the total deaths of 58 million in 2005. According to this pie-chart we can see 13% of Cancer, 2% of Diabetes, 30% of Cardiovascular disease, Chronic respiratory disease, 9% of Other Chronic disease, 9% of injuries, and 30% of Communicable, maternal, perinatal conditions, and nutritional deficiencies. As in figure 2 shows the value of 35 million in 2005 has increased in 2015 to 64 million (Strong, Mathers, Leeder and Beaglehole, 2005).

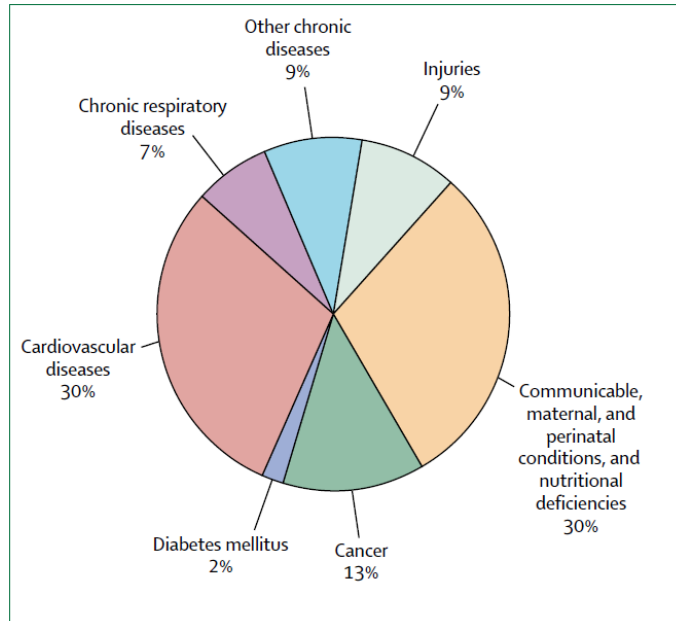


Figure 1 Projected global distribution of total deaths (58 million) by major cause, 2005 (Strong, Mathers, Leeder and Beaglehole, 2005).

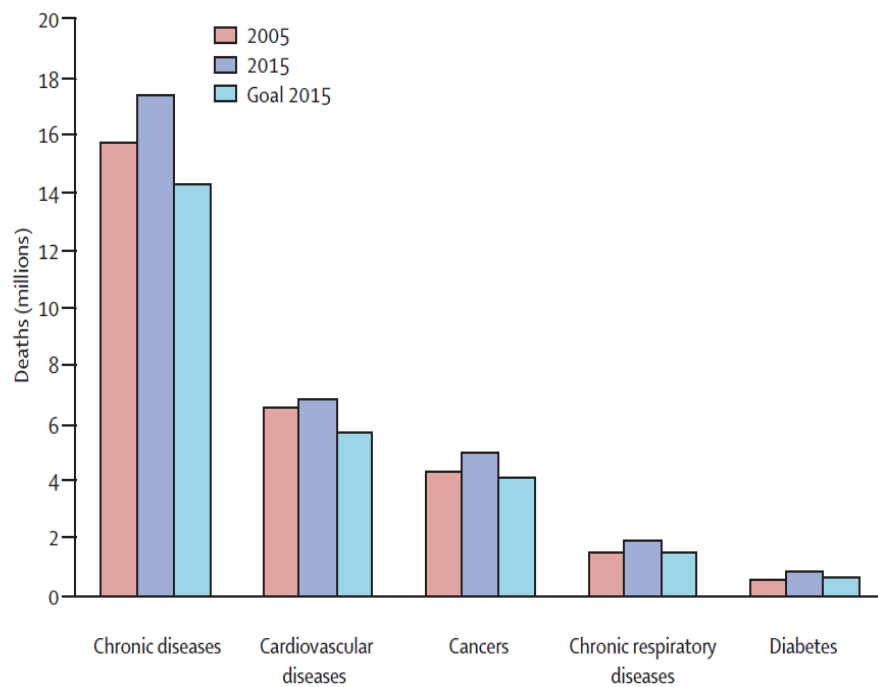


Figure 2 Chronic disease deaths (millions) projected from 2005 to 2015 (Strong, Mathers, Leeder and Beaglehole, 2005).

## 2.2.1 Human Nutrition

Fruits, nuts, and vegetables play an important role in human nutrition and it will reduce the risk for some diseases like cancer, diabetics, heart diseases, stroke, and other Chronic Diseases. Table 1 and 2 will evaluate how fruits and vegetables affect chronic diseases and show how many vitamins and portions they contain and shows the beneficial to health, as well as their sources (Zesiewicz and Evatt, 2009).

*Table 1 Nutritive constituents of fruits and vegetables that have a positive impact on human health and their sources (Zesiewicz and Evatt, 2009)*

<b>Constituent</b>	<b>Sources</b>	<b>Established or proposed effects on human-wellness</b>
<b>Vitamin C (ascorbic acid)</b>	broccoli, cabbage, cantaloupe, citrus fruits, guava, kiwifruit, leafy greens, pepper, pineapple, potato, strawberry, tomato, watermelon	prevents scurvy, aids wound healing, healthy immune- system, cardiovascular-disease
<b>Vitamin A (carotenoids)</b>	dark-green vegetables (such as collards, spinach, and turnip greens), orange vegetables (such as carrots, pumpkin, and sweet potato), orange-flesh fruits (such as apricot, cantaloupe, mango, nectarine, orange, papaya, peach, persimmon, and pineapple), tomato	night blindness prevention, chronic fatigue, psoriasis, heart disease, stroke, cataracts
<b>Vitamin K</b>	nuts, lentils, green onions, crucifers (cabbage, broccoli, brussel sprouts), leafy greens	synthesis of pro-coagulant factors, osteoporosis
<b>Vitamin E (tocopherols)</b>	nuts (such as almonds, cashew nuts, filberts, macadamias, pecans, pistachios, peanuts, and walnuts), corn, dry beans, lentils and chickpeas, dark-green leafy vegetables	heart-disease, LDL-oxidation, immune-system, diabetes, cancer
<b>Fiber</b>	most fresh fruits and vegetables, nuts, cooked dry beans and peas	diabetes, heart disease
<b>Folate (folicin or folic acid)</b>	dark-green leafy vegetables (such as spinach, mustard greens, butterhead lettuce, broccoli, brussels sprouts, and okra), legumes (cooked dry beans, lentils, chickpeas and green peas), asparagus	birth defects, cancer heart disease, nervous system
<b>Calcium</b>	cooked vegetables (such as beans, greens, okra and tomatoes) peas, papaya, raisins, orange, almonds, snap beans, pumpkin, cauliflower, rutabaga	osteoporosis, muscular/skeletal, teeth, blood pressure
<b>Magnesium</b>	spinach, lentils, okra, potato, banana, nuts, corn, cashews	osteoporosis, nervous system, teeth, immune system
<b>Potassium</b>	baked potato or sweet potato, banana & plantain, cooked dry beans, cooked greens, dried fruits (such as apricots and prunes), winter (orange) squash, and cantaloupe	hypertension (blood pressure) stroke arteriosclerosis

Table 2 Non-nutritive plant constituents that may be beneficial to human health (Zesiewicz and Evatt, 2009)

Constituent	Compound	Sources	Established or proposed effects on human-wellness
<b><u>Phenolic compounds</u></b>			
Proanthocyanins	tannins	apple, grape, cranberry, pomegranate	cancer
Anthocyanidins	cyanidin, malvidin, delphinidin, pelargonidin, peonidin, petunidin	red, blue, and purple fruits (such as apple, blackberry, blueberry, cranberry, grape, nectarine, peach, plum & prune, pomegranate, raspberry, and strawberry)	heart disease, cancer initiation, diabetes, cataracts, blood pressure, allergies
Flavan-3-ols	epicatechin, epigallocatechin catechin, gallocatechin	apples, apricots, blackberries, plums, raspberries, strawberries	platelet aggregation, cancer,
Flavanones	hesperetin, naringenin, eriodictyol	citrus (oranges, grapefruit, lemons, limes, tangerine)	cancer
Flavones	Luteolin, apigenin	celeriac, celery, peppers, rutabaga, spinach, parsley, artichoke, guava, pepper	cancer, allergies, heart disease
Flavonols	quercetin, kaempferol, myricetin, rutin	onions, snap beans, broccoli, cranberry, kale, peppers, lettuce	heart disease, cancer initiation, capillary protectant
Phenolic acids	Caffeic acid, chlorogenic acid, coumaric acid, ellagic acid	blackberry, raspberry, strawberry, apple, peach, plum, cherry	cancer, cholesterol
<b><u>Carotenoids</u></b>			
Lycopene		tomato, watermelon, papaya, Brazilian guava, Autumn olive, red grapefruit	cancer, heart disease, male infertility
$\alpha$ -carotene		sweet potatoes, apricots, pumpkin, cantaloupe, green beans, lima beans, broccoli, brussel sprouts, cabbage, kale, kiwifruit, lettuce, peas, spinach, prunes, peaches, mango, papaya, squash and carrots	tumor growth
$\beta$ -carotene		cantaloupes, carrots, apricots, broccoli, leafy greens (lettuce, swiss chard), mango, persimmon, red pepper, spinach, sweet potato	cancer
Xanthophylls	Lutein, zeaxanthin, $\beta$ -cryptoxanthin	sweet corn, spinach, corn, okra, cantaloupe, summer squash, turnip greens	macular degeneration
Monoterpenes	limonene	citrus (grapefruit, tangerine)	cancer
<b><u>Sulfur compounds</u></b>	glucosinolates, isothiocyanates, indoles, allicin, diallyl isulphide	broccoli, Brussels sprouts, mustard greens, horseradish, garlic, onions, chives, leeks	cancer, cholesterol, blood pressure, diabetes

## 2.2.2 Human Exercises

People in the previous century did not have vehicles and machines, so they worked on their own, and there was no need for them to do exercise for their health. Researchers estimate that before 20,000 BC, the average number of footsteps per day was 13,200 - 21,120. By 2010, the average number of footsteps per day had decreased to 5340 due to changes in the nature and availability of machines and vehicles. As a result, humans are increasing the incidence of many chronic diseases. Table 3 shows an estimate of a human's daily footsteps from the past to the present (Booth, Roberts and Laye, 2012).

*Table 3 Estimated Historical Reductions in Daily Steps by Humans (Booth, Roberts and Laye, 2012).*

Population year	Steps per day	References
Paleolithic (~20,000 BC)	~13,200-21,120 (men); ~10,560 (women)	(384)
Amish (2002)	18,425 (men); 14,196 (women)	(27)
Mean of 26 studies (1966-2007)	7473 (mainly women)	(63)
Colorado (2002)	6733 (men); 6384 (women)	(572)
US adults (2010)	5340 (men); 4912 (women)	(26)

Exercise is important for older people because it reduces disability and increases the number of people who can live. Exercise also improves physical and mental performance capacity. High blood pressure, diabetes, and other chronic diseases will be reduced in our lives by eating at regular intervals and attempting some meditation. Figure 3 illustrates the main evidence-based pathway for how physical activities or exercises delay disease progression, disability, and death (Kujala, 2009).

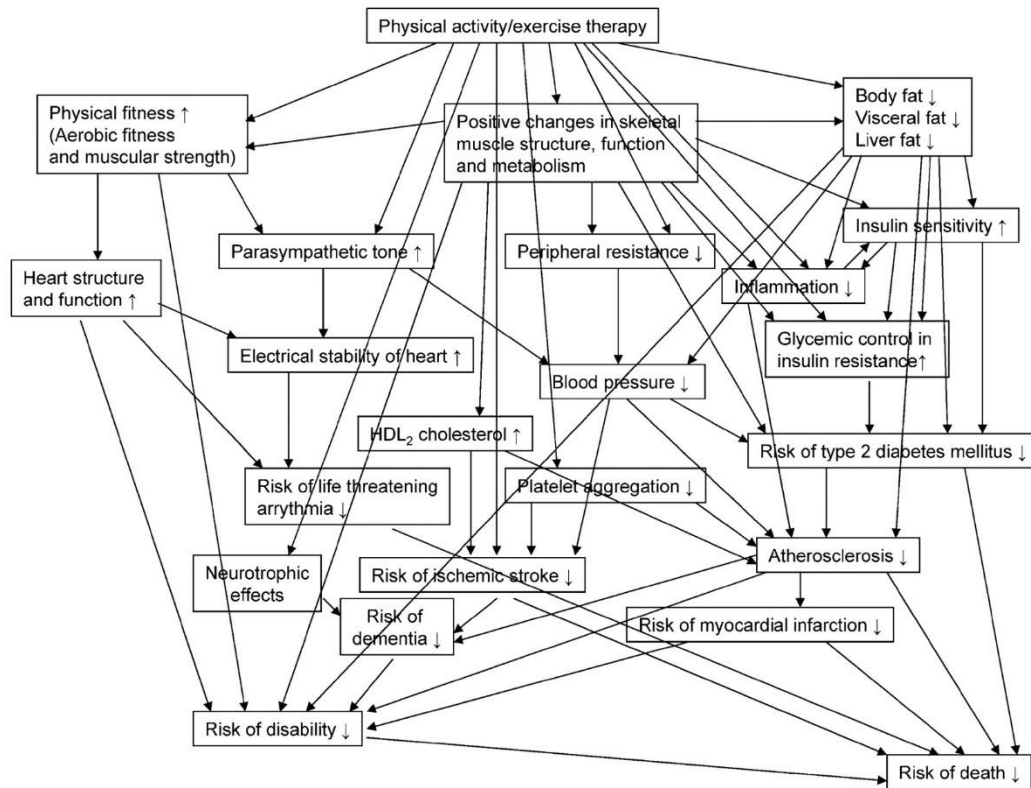


Figure 3 Physical activity/exercise therapy (Kujala, 2009).

## 2.3 Therapy on Motor and Non-Motor Complications in Parkinson's Disease

There are two types of symptoms in Parkinson's disease patients: motor and non-motor. The motor symptoms that are related to patient movements such as Tremor, Bradykinesia, Rigidity, Postural Instability, and Vocal Symptoms while non-motor symptoms that are not related to movements as Depression, Sleep Problems, loss of sense of smell, Sweating and melanoma, and Gastrointestinal issues. The proposed project focuses on both motor and non-motor symptoms, as motor symptoms include diet and exercise plans, while non-motor symptoms include brain exercises. The researchers demonstrated how diet and exercise plans affect PD (Zesiewicz and Evatt, 2009). Tables 4 and 5 show how the diet and exercise plans work in the presence of motor complications in Parkinson's disease.

Table 4 Diet and motor complications (Zesiewicz and Evatt, 2009).

Diet	Key findings
Low-protein diet	Compared with a balanced diet, a low-protein diet significantly reduced off time and slightly reduced patient bodyweight. Compared with a control diet, a diet using low-protein products for renal patients increased energy expenditure, improved motor function and increased dyskinesias (but also increased global improvement scores)
Ketogenic diet	Increased intake of total fat and unsaturated fatty acids was associated with a lower risk of incident PD. UPDRS scores improved while adhering to a ketogenic diet (no placebo control)
Urate	Higher dietary urate intake was associated with a significantly lower risk of incident PD. Dairy consumption (which lowers urate) increased the risk of incident PD, particularly in men
'Prudent' diet	A 'prudent' diet (a high intake of fruit, vegetables, legumes, whole grains, nuts, fish and poultry, a low intake of saturated fat and a moderate intake of alcohol) protected against PD compared with a 'Westernized' diet

Table 5 Exercises and motor complications (Zesiewicz and Evatt, 2009).

Intervention	Key findings
<b>Exercise regimen</b>	
Any	Exercise may benefit physical function, health-related quality of life, strength, balance and gait speed (systematic review). May reduce risk of falls
Resistive	May improve motor function; high-intensity resistive exercise improves motor function more effectively than low-intensity exercise
Mind/body	Tai chi or Qigong may improve motor function
Aerobic	Improves exercise capacity but does not improve motor symptoms
Home exercise	Improves motor function. May be as effective as physiotherapist-monitored exercise programmes
<b>Physical therapy regimen</b>	
Any	Improves motor function, but effects may be temporary
Rhythmic clues	May improve motor function and reduce variability in motions
Motor imagery	May improve the efficacy of physical therapy
Whole-body vibration	Improves motor function and postural control. May not be more effective than conventional physical therapy



## 2.4 Existing Systems

### 2.4.1 Websites

There are several websites for people with Parkinson's disease, and some of them are developed to help patients with daily tasks, motivation, meditations, and some reports are published to read. Some websites allow users to make donations.

#### 2.4.1.1 The Michael J. Fox Foundation

The Michael J. Fox Foundation is a website for help PD patients to view the details of the disease. It allows users to do donations, view some published reports about the disease and some symptoms which are related to PD

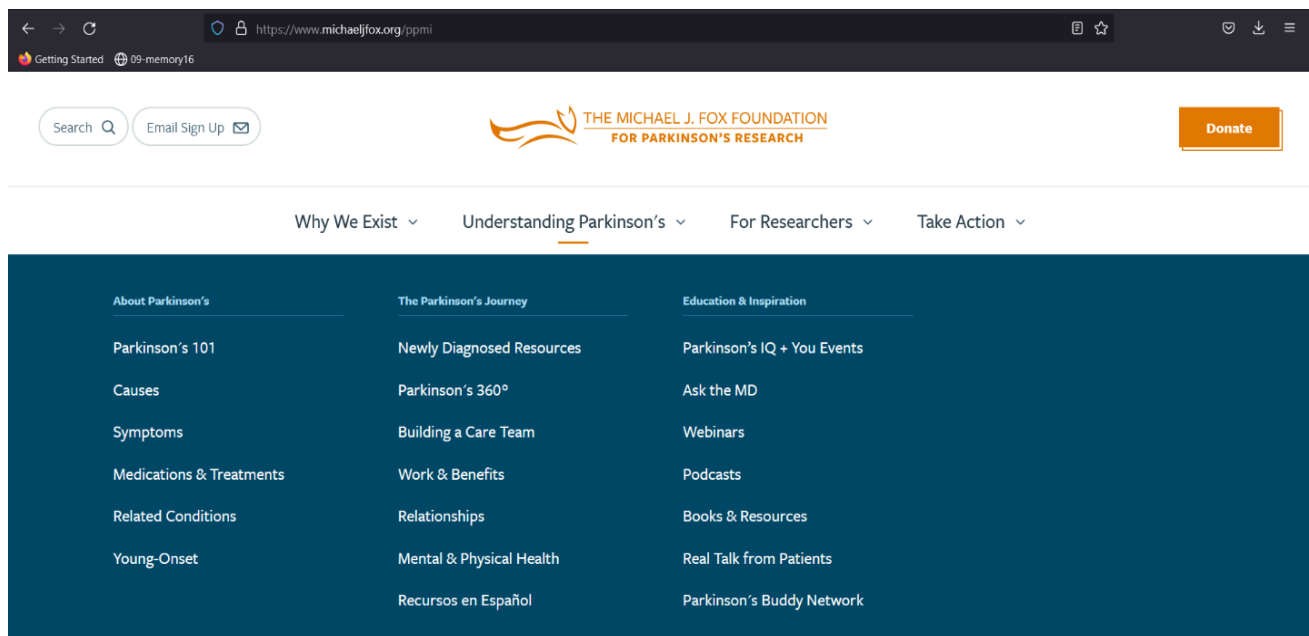


Figure 4 The Michael J. Fox Foundation

### 2.4.1.2 APDA

This web application also contains the donation part and some information's which relevant to PD patients. Also, there are some blogs and articles which published by them.

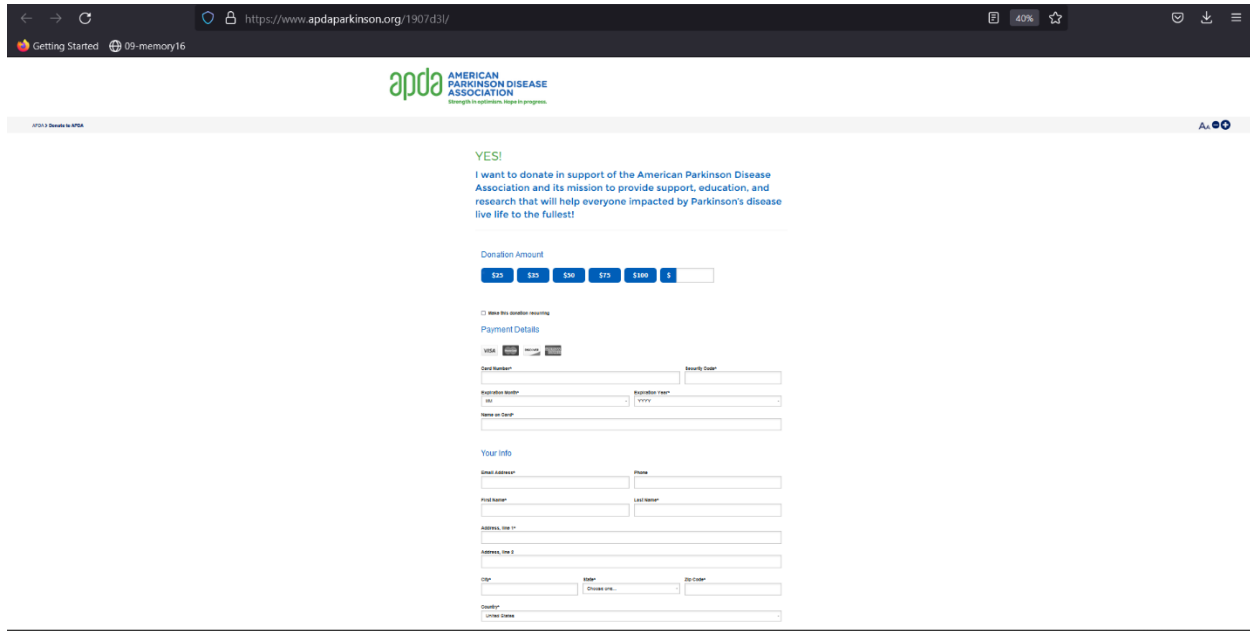
A screenshot of the American Parkinson Disease Association (APDA) website's donation page. The browser address bar shows the URL 'https://www.apdaparkinson.org/1907d3/'. The page features the APDA logo and a motivational quote: 'YES! I want to donate in support of the American Parkinson Disease Association and its mission to provide support, education, and research that will help everyone impacted by Parkinson's disease live life to the fullest!'. Below this, there is a 'Donation Amount' section with buttons for \$25, \$50, \$100, \$150, \$200, and a custom amount field. A checkbox for 'Make this donation recurring' is present. The 'Payment Details' section includes fields for card number, expiration date, and name on card. The 'Your Info' section contains fields for email, phone, first and last names, address, city, state, zip, country, and a dropdown for 'Country'. The page is clean and professional, with a light blue and green color scheme.

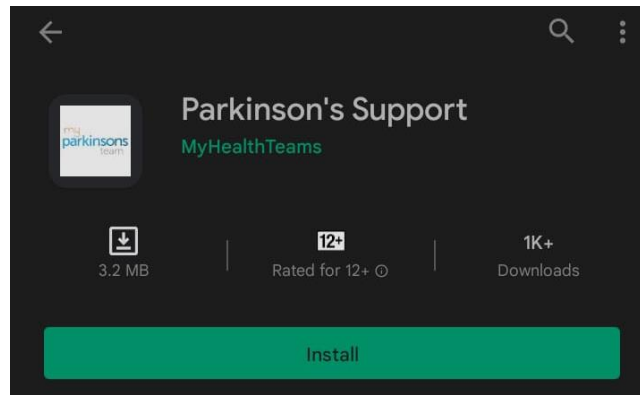
Figure 5 APDA

### 2.4.2 Android Applications

There are some mobile applications available for people suffering from Parkinson's disease. Most of the published applications assist patients in carrying out their daily activities like exercises and some voice training. In some of the applications, there are questions and answers that patients can ask and post. Reminders are used by the large percentage of Android applications.

### 2.4.2.1 Parkinson's Support

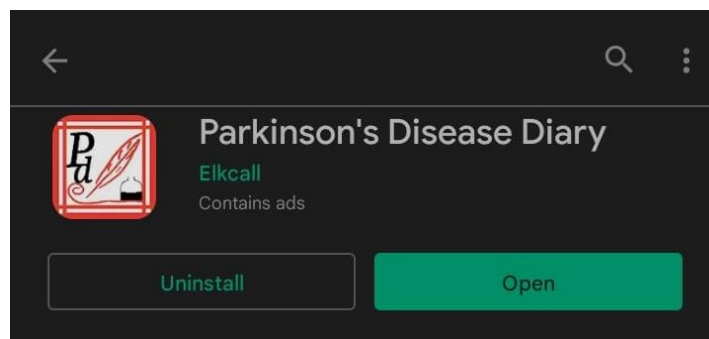
Users can post personal questions to other users and receive responses with this Android application as well as they can post stories which related to them or related with the disease. From this application the patient can find someone like them from there nearby places and meet them.



*Figure 6 Parkinson's Support*

### 2.4.2.2 Parkinson's Disease Diary

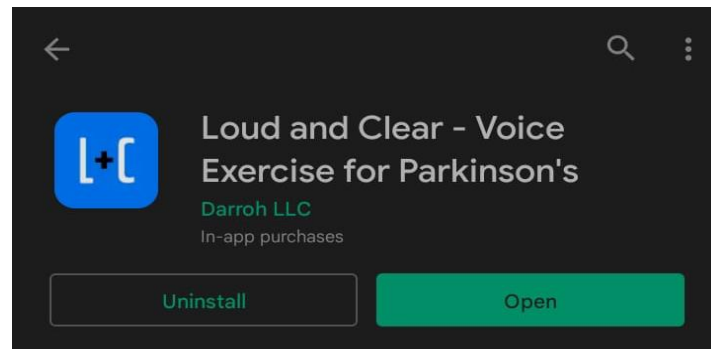
The user can add medication, activity, and meals reminders as the main feature of this mobile application. The system has shown how important it is for a Parkinson's disease patient to take medicines on time and track symptoms to ensure that their medicines are working as effectively as possible.



*Figure 7 Parkinson's Disease Diary*

### 2.4.2.3 Loud and Clear

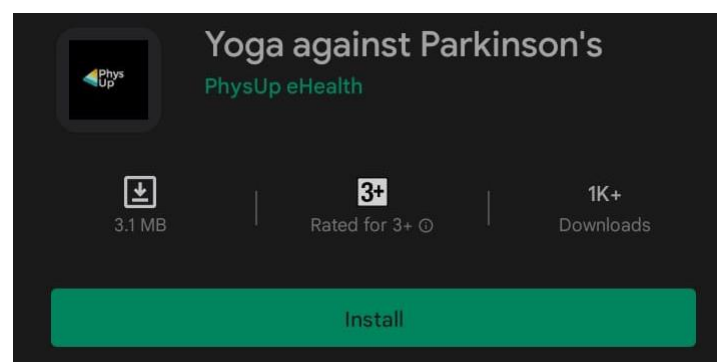
This android application focuses on hearing the patient's voice loud and clear. Warm-ups and daily exercises are provided by the system to help recalibrate and maintain the integrity of the patient's voice. This app includes voice-findings to perfectly voice train Parkinson's disease patients.



*Figure 8 Loud and Clear*

### 2.4.2.4 Yoga against Parkinson's

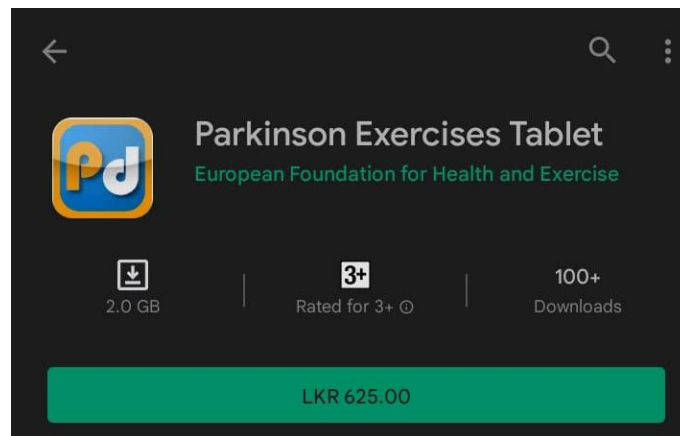
This android application is fully focuses about yoga exercises. The app offers up to 24 yoga positions that can help patients to manage some of the side effects related to Parkinson's disease. The large percentage of yoga positions are available to patients who have problems with body balancing.



*Figure 9 Yoga against Parkinson's*

#### 2.4.2.5 Parkinson Exercises Tablet

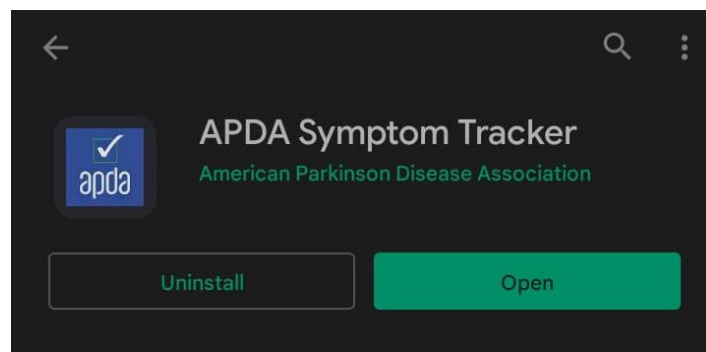
This is a video-app for patients and therapists dealing with Parkinson's Disease. The app includes over 50 home exercise videos, as well as movement advice and instructions for daily exercises and mobility. Walking, posture, bed mobility, balance, flexibility, and relaxation exercises are covered with this android application.



*Figure 10 Parkinson Exercises Tablet*

#### 2.4.2.6 APDA Symptom Tracker

This is an android application which the system introducing an easier way to track patients' symptoms. The APDA Symptoms Tracker app helps in keeping track of patients' symptoms including tremors, rigidity, balance and non-motor symptoms and the system create a report to share with patients care team. This system allows users to add useful notifications and reminders.



*Figure 11 APDA Symptom Tracker*

## 2.5 Research Gap

The researchers selected some of the highest touted applications from the Google Play store that use a similar technology to the proposed system and explained it in the above section. Above mentioned android application mainly targets on exercises, meals, reports, reminders, and voice trainings. However, the existing systems do not handle these types of parts which are diet plans for PD patients which also suffering from chronic diseases, a questioner form, mind train games and instructions for daily activities.

The existing system mainly focused on the Parkinson's patients and build their functions. If a Parkinson's disease patient who also has chronic diseases uses these existing apps, the system will only recommend Parkinson-based exercises and meals. However, the existing system cannot full fill the proposed requirement and functions. By settling such issues, we can also recommend the proposed application to patients suffering from chronic diseases. The reader can get an idea of the proposed system which covers all the functions and requirements above mention to fill this research gap.

## 2.6 Features Comparison: Proposed System vs Similar Systems

*Table 6 Proposed System vs Similar Systems*

<b>Proposed App Features</b>	<b>PDP Care App</b>	<b>Similar Apps</b>
User Friendly Interface	✓	✓
Diet plans related for both diseases (chronic & Parkinson's)	✓	✗
Exercises related for both diseases (chronic & Parkinson's)	✓	✗
Puzzle Games	✓	✗
Questioner Form	✓	✗
Voice Trainings	✗	✓
Reminders	✗	✓
Generate Reports	✗	✓
Instructions for daily activities	✓	✗

## 3.0 Project Plan

### 3.1 Gantt Chart

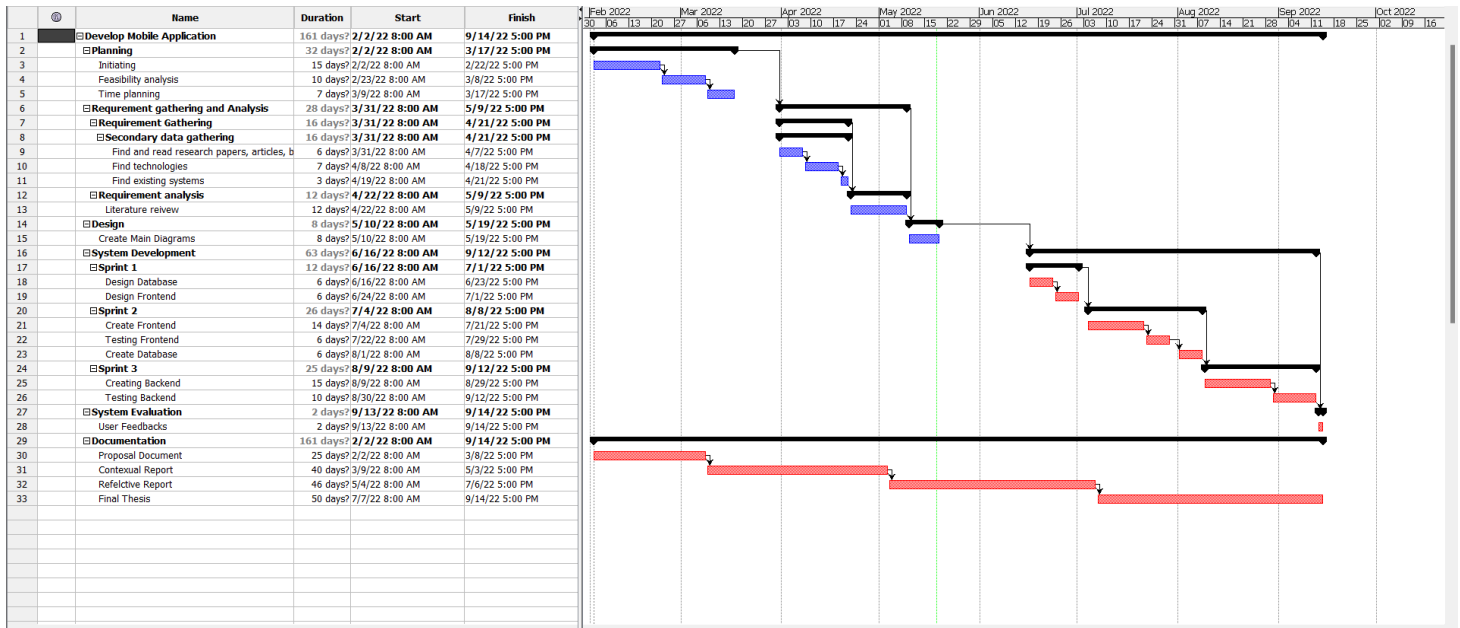


Figure 12 Gantt chart



### 3.2 Work Breakdown Structure

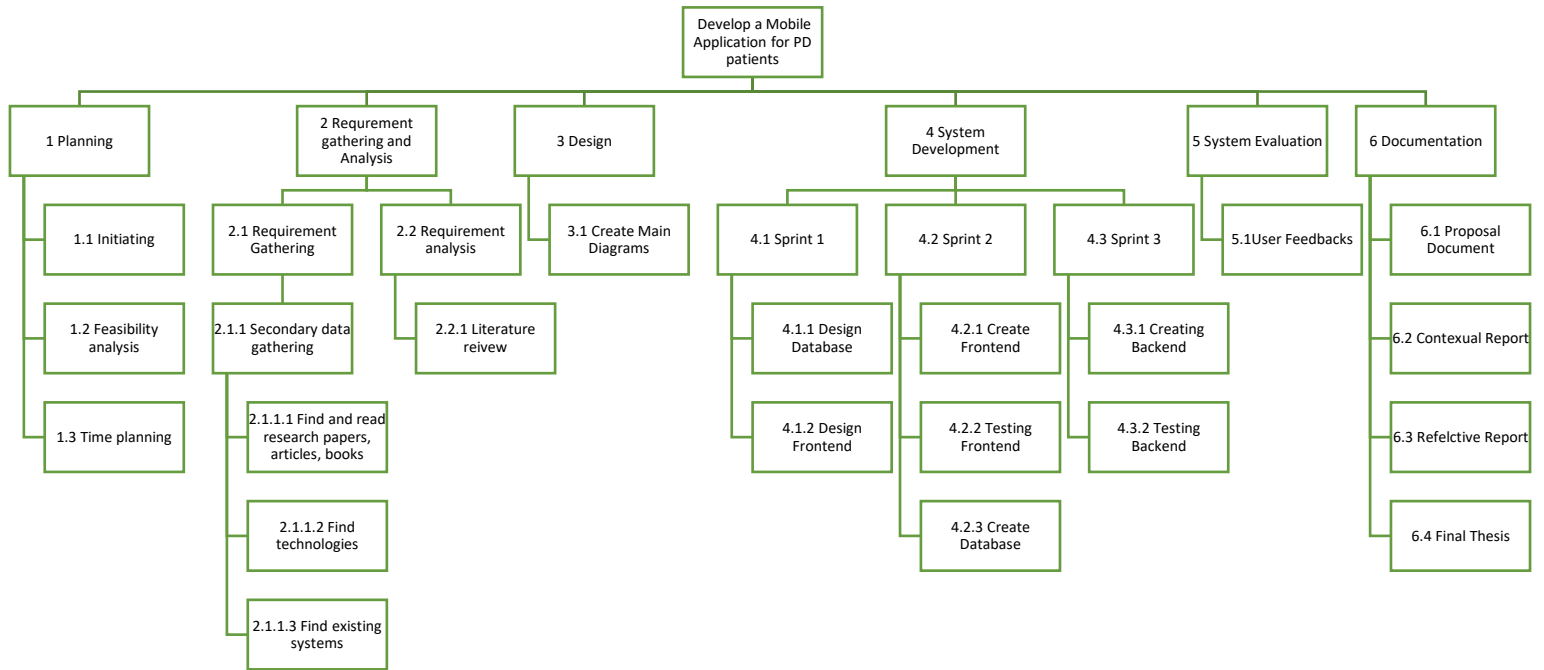


Figure 13 Work breakdown structure

## 4.0 Planning Artefact

### 4.1 Methodology

The Agile development methodology is used for the proposed project. Agile methodology is a conceptual framework for software engineering that starts with planning and continues through iterative and incremental interactions throughout the project life cycle. Agile software development technique is a lightweight approach to software development that reduces overhead and costs while allowing for change without affecting the process. The main benefits of agile-based software development are increase teamwork and communication, the quick release, flexibility of design and more reasonable procedure (Samer Sawalha and Hiba Abdel Nabi, 2020).

As illustrated in Figure 14, one of the key characteristics of agile development software is its ability to adapt to changes. The incremental delivery property of agile processes reduces and flattens this cost, allowing for a later stage change without a significant cost and time loss.

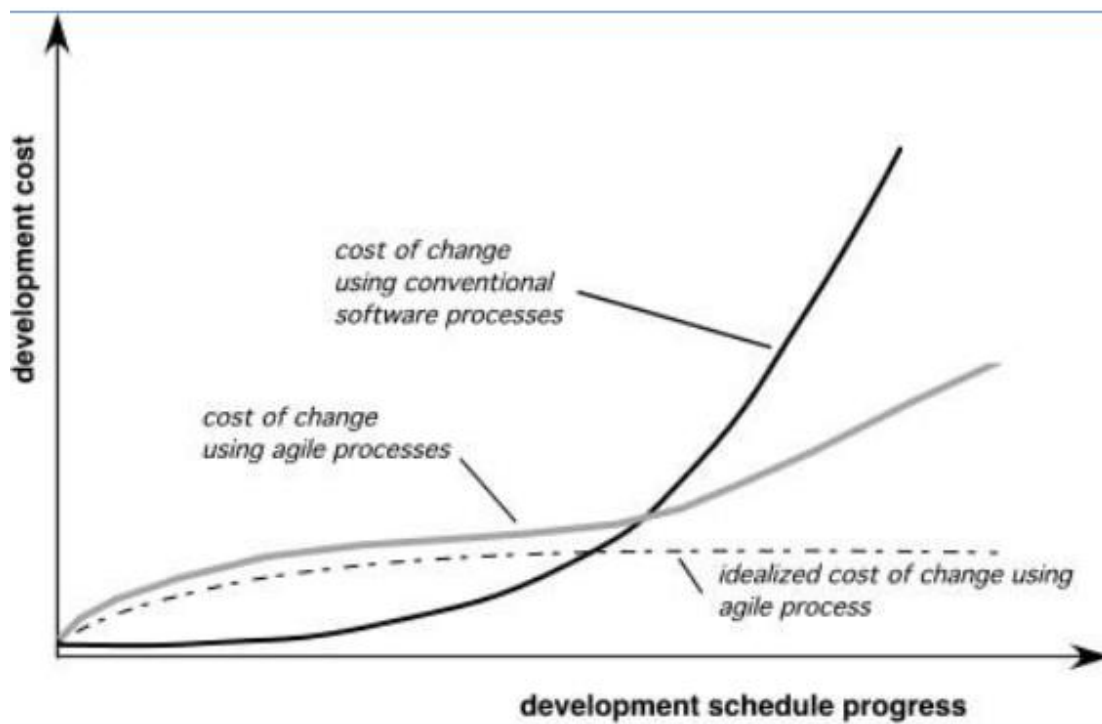


Figure 14 The development cost vs. change in the development process (Samer Sawalha and Hiba Abdel Nabi, 2020: p.251)

There are differences between agile and traditional software development methods; agile is known as the lightweight approach, while traditional is known as the heavyweight approach. Table 7 compares agile development to traditional development.

*Table 7 Agile Development vs Traditional Development (Samer Sawalha and Hiba Abdel Nabi, 2020: p.252)*

<b>Parameter</b>	<b>Traditional Methods</b>	<b>Agile Methods</b>
<b>Ease of Modification</b>	Hard	Easy
<b>Development Approach</b>	Predictive	Adaptive
<b>Development Orientation</b>	Process Oriented	Customer Oriented
<b>Project Size</b>	Large	Small or Medium
<b>Planning Scale</b>	Long Term	Short Term
<b>Management Style</b>	Command and Control	Leadership and Collaboration
<b>Learning</b>	Continuous Learning while Development	Learning is secondary to Development
<b>Documentation</b>	High	Low
<b>Organization Type</b>	High Revenue	Moderate and low Revenue
<b>Organization's Number of Employees</b>	Large	Small
<b>Budget</b>	High	Low
<b>Number of Teams</b>	Multiple	One
<b>Team Size</b>	Medium	Small

According to the comparison in Table 7 between agile development methodology and traditional development methodology, agile methods are more efficient to use in small and medium-sized projects. The documentation for traditional methods must be high level and detailed, so it will require extensive work and will be a large document. The number of teams and employees in projects that use traditional methods is greater than agile methods and it requires a larger budget to full fill the requirements. Furthermore, the Agile development methodology is the most appropriate for the proposed project.

## 4.2 Requirement gathering and Analysis

There are two ways to gather data under requirement gathering the first way is primary data gathering and the second way is secondary data gathering. Questionnaires are used for primary data collection, while research papers, journals, e-books, and articles are used for secondary data collection. Since the proposed project is a PD health care application, gathering secondary data is the most efficient way to move the project forward. Secondary data gathering help in understanding the differences between technologies, functions, and how others have completed tasks related to the project. It is useful to discover how to finish the remaining gaps in existing systems. Referring to all the research papers, documents and articles which are published between 2010 to 2022 help to full fill the gaps in the existing systems with the proposed project.

## 4.3 Design and Development

Based on the requirements gathered by the researcher, the proposed application's design will begin at the bottom by designing the UI elements of the application as mock interfaces in Adobe XD which is a user interface design tool. The proposed project will be developed by Flutter which is an open-source UI framework for creating native mobile applications. Flutter enables developers to create mobile apps for both IOS and Android using a single codebase and programming language. Dart is the programming language used to create Flutter apps.

## 4.4 Implementation

The following resources are required for this proposed project:

- User Requirement:
  - Stable Network Connection
  - Android smart device
  
- Developer Requirements:
  - Laptop/ Desktop computer
  - Android Mobile Phone
  - Android Studio
  - Visual Studio Code
  - Flutter Framework
  - Dart
  - Firebase SDK
  - GitHub
  - Adobe XD
  - Stack overflow
  
- Library Dependencies:
  - RxDart
  - Firebase Auth
  - Firebase Core

## 4.5 Testing and Evaluation

After the proposed system has been completed, the researcher will conduct the testing phase. The researcher must test the application for bugs and errors after completing the main three components, which are the frontend, backend, and database. The flutter framework consists of three main testing methods to test applications. Unit testing is used to test single functions, methods, or class while widget testing tests a single widget. After first two methods are completed then the integration testing will test the complete application (Testing Flutter apps, 2022). After completing the testing phase, the application will be given to the user to evaluate the application. The user must run the application without any bugs or errors and this evaluation process checks the functionalities of the system.

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