

## **Organ Donation Application for Top Glove and Global Doctor (Tggd) Medical Centre**

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**Abstract:** Top Glove Global Doctors Medical Centre (TGGD) is a one-stop mobile consideration place offering a total scope of clinical administrations. TGGD also received a license as an ambulatory care centre. Waiting for a long time to get a suitable organ donor specifically liver and kidney is really stressful especially during this Movement Control Order (MCO) period. TGGD Medical Centre has lack source for finding suitable organ donors and recipients. The operation unit is still using manual method which means all the documents and reports of the donors are kept in file and organized by the unit staff. To solve this issue, Organ Donation Application was developed for Top Glove and Global Doctor (TGGD) Medical Centre. This project attempts to design an android application for the organ donor to donate organs. The second objective is to develop a mobile application that can provide platform that can save time to reach desired organ donor. The final purpose is to evaluate an effective method to create awareness towards organ donation. The methodology used in developing this application system is Object-Oriented System Development (OOSD). The expected result will be to reduce time to find the suitable organ donor. This application consists of two modules which are Doctor module and Staff modul. To conclude, this application will increase the awareness among others to become a donor and also also benefits the medical centre to find a suitable organ donor in a short period.

**Keywords:** Mobile Application, Organ Donation Application, Email

### **1. Introduction**

Top Glove Corp Bhd launches its Top Glove Global Doctors Medical Centre (TGGD) 29 August 2017. It is a move for the world's biggest glove manufacturer to make an attack into the medical care business through a joint progress (JV) with Global Doctors which is a center chain. The aim is to serve the neighbouring society especially in on preventive medical care, TGGD is a one-stop mobile consideration place offering a total scope of clinical administrations enveloping analysis, perception, conference, therapy, mediation, restoration and full-layered dental offices on an outpatient premises.

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TGGD also received license from the Ministry of Health as an ambulatory care centre. The objective of TGGD is to provide a high quality medical care, specialist and dental services to the society in and around this area (Setia Alam). Since operation unit is still using manual appointment method because of that they are facing with some problems.

### 1.1 Problem Statement

The first problem is loss of data such as donor and patient report regularly missing because there is no database to store them. The second problem is there is lack online organ donation application to allow donor to donate their organ which is kidney and lungs. Because of that, patient who have failure in their organ need to search a suitable donor means take a long time. So, this will lead to delay of process in the hospital operation. The final problem is statistical review cannot be generated in the manual method for the number of donors who donated. So, hospital administrators facing difficulties to create report for future use such as audit purpose. So, this mobile application aims TGGD Medical centre that connecting the coordination and communication gap between patients and donors, we know that lot of patients die without access to a proper donor.

This organ application help TGGD Medical Centre to get a suitable donor in immediate time that maintains and secure the information of donors who are going to register. According to a thesis studied several interventions involving education and outreach have helped candidates successfully identify live donors [1]. Examples include house calls, champions, the Talking About Live Kidney and Lungs Donation social worker intervention and Explore Transplant training seminars. These interventions are time and resource intensive, and they all involve directly asking people to donate. Directly asking people about live donation remains difficult, even with adequate education and support. Problem statement of this application is the manual process of TGGD Medical Centre took a lot of time and energy. According to a past study it stated that, the existing manual process takes a lot of of time and man power [2]. So, the user needs to connect to the Internet to collect the donor information.

### 1.2 Objective

The objective to build this system are:

- To design an android application for the organ donor and recipient to donate and receive organs.
- To develop a mobile application that can provide a platform that can save time to reach the desired organ donor.
- To evaluate an effective method to create awareness towards organ donation.

## 2. Literature review

In developing the organ donation application, literature survey has been done in order to ensure that the system developed reflects both the advantage and disadvantage. The creation of android software is the process where new apps for devices available for Android are developed [3]. Google developed the Android Operating System [4]. It is driven by customer experience of the Linux kernel. The working framework is outlined for smartphones and tablet computers and permits clients to lock in with it through a touchscreen interface. The work on other existing applications that are as of now created is briefly clarified. Investigate and investigation on existing frameworks accessible in Google Play Store are valuable as a reference to urge more data and information in detail some time recently creating this application. The three applications are Mohan Foundation (MF) Giver Card Application, Give Life Application and Derma Organ Framework. In addition, it provides a comparative analysis

of all three applications and the application for organ donation. Identifying the positives and negatives of the application is the aim of carrying out evaluations and comparisons with existing applications.

## 2.1 Android Operating System

Android is one of the modern open source mobile operating system that is widely used globally mainly because of its flexibility and functionality. The Android operating system was created by Google [4]. Android operating system can be defined as mobile operating system that is based on Linux Kernel, Google developer and Open Handset Alliance. In mobile device market, Android operating is used not only by phones and even tablets, netbooks, game devices from numerous brand with their own touch unlike iOS which is used to release Apple brand products only [5].

## 2.2 Study of Existing Related Systems

The work on other current apps that have previously been built is briefly detailed in this section. Research and analysis of current systems in the Google Play Store may be used as a starting point for providing material information and knowledge before developing this app. The three applications are Mohan Foundation(MF) Donor Card Application, Donate Life Application and Derma Organ System, as shown in Table 1. In addition, it provides a comparative analysis of all three applications and the application for organ donation. Identifying the positives and negatives of the application is the aim of carrying out evaluations and comparisons with existing applications. It can also be used as a reference for the development of a better application.

**Table 1: Comparison table of Organ Donation Application with three existing system**

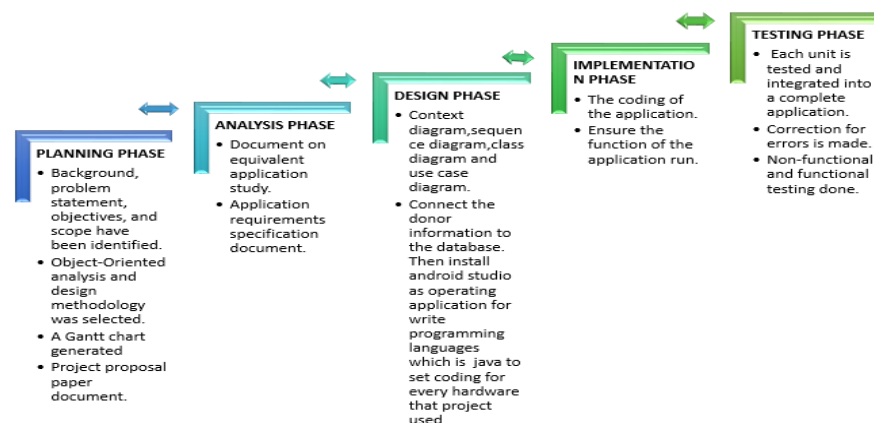
<i>Application/ Features</i>	<i>MF Donor Card</i>	<i>Donate Life</i>	<i>Derma Organ</i>	<i>Organ Donation Application</i>
User	Individual	Individual, Admin	Individual, Admin	Individual, Admin
Language	English	English	Malay, English	English
User Support System (Administrator)	Yes	Yes	Yes	Yes
Login / Register	Yes	Yes	Yes	Yes
Database	Yes	Yes	Yes	Yes

### 3. Methodology

Methodology explains the systematic, theoretical analysis of methods applied to develop Organ Donation Application. It encompasses theoretical analysis of process and principles associated with a branch of knowledge. In this chapter, the development process of website will also be discussed in more detail. Organ Donation Application is developed using Software Development Object Orientation methodology approach or better known as Object-Oriented System Development (OOSD) methodology.

#### 3.1 Object-Oriented System Development

An object-oriented software consist of a set of objects that interrelate with one another. OOSD is a user case driven approach that emphasizes object-oriented requirement analysis, object-oriented design and object-oriented implementation as three major phases because of the impact they have on development of system [6]. Object-Oriented Analysis analyses the user's need through methods and translate it into system and user requirement. Object-oriented Design plans a system of interacting objects to solve software problem [7]. Object Oriented Software Development (OOSD) comprises five phases (refer to Figure 1) such as planning phase, analysis phase, design phase, implementation phases and testing phase to develop a complete software system development.



**Figure 1: Phases of Object Oriented Software Development implemented in proposed application.**

#### 3.2 Technology Approach

##### 3.2.1 Android

The process of developing new apps for Android devices is known as android software development. It is based on consumer feedback on the Linux kernel. The operating system is developed for smartphones and tablet computers, and it uses a touchscreen interface to interact with users. Software engineering for mobile devices faces significant challenges due to the unique characteristics of this operation. The need to manage with many platforms, standards, protocols, and network technologies, as well as limit device capabilities despite its continual progress and business time needs, are only a few of the problems that must be overcome. Because of this, mobile app development differs significantly from traditional app development. Android is a smartphone operating system based on a modified version of Linux. Android has been through several versions. Android features are open source and generally available for development, there is no preset hardware or software modification

set. Storage, 10 networking, media support, multi-tasking, multi-touch, flash, and internet browsing capabilities are all characteristics that Android supports.

### 3.2.2 PHP Programming Languages

PHP is a web programming language used to write out the foundation of a web application. It is open source and free to use. In this project, the system code had built using PHP from scratch. PHP from scratch able to make developer more understand on how their coding works.

### 3.2.3 MySQL Database

MySQL is one the most popular and most used databases because of several characteristics that allows it to stand out among others. MySQL has a wide inventory of servers and provides master-slave replication configurations that allows gives the server its high accessibility at all times.

## 3.3 System Development Workflow

Seven main phases need to carry in the process of development of this system. Table 2 detail out the task and output for each phase. Topic will clarify more clearly on the concept, roles and benefits of the technology and approach. The timeline based on prototyping process has built.

**Table 2: Task and output for each phase**

Phases	Activities	Results
Planning	1) Determine and propose the project's title. 2) Define the context, problem description, objectives, and scope of the project. 3) Identify the methodology that was employed. 4) Provides task and timeframe timetables. 5) Prepare a proposal for a project.	1. It has been determined what the background, problem description, objectives, and scope are. 2. A structured object-oriented design technique was used. 3. Gantt Chart is produced. 4. Documentation for a project proposal.
Analysis	Gather data and draw comparisons to similar apps. 2) Examine the criteria of the application. 3) Examine the necessary hardware and software requirements. Choose the programming language that will be used.	1. Write a report on a similar application study. 2. Document describing the application's requirements.

**Table 2: (cont)**

Phases	Activities	Results
Design	1)Contextual diagrams, sequence diagrams, and class diagrams should all be designed. 2) Making a convenient diagram of the Organ Donation Application as a prototype.	1.A context diagram, a sequence diagram, a class diagram, and a use case diagram are all examples of diagrams. 2. Connect the database to the donor information. Then install phpmyadmin as an operating system for writing programming languages, such as java, to establish coding for all of the project's hardware.
Implementation (Prototype)	Develop 3 prototypes Coding the program using PHP Connect MySQL to the system.	Prototype 1 Prototype 2 Prototype 3
Prototype	Develop Prototype 1 of Iteration 1 Develop Prototype 2 of Iteration 2 Develop Prototype 3 of Iteration 3	Prototype 1 (interfaces of all use cases) Prototype 2 (a database connection between interfaces and database) Prototype 3 (navigation between interfaces)
Implementation (Application)	Develop an application Create the test case list Testing the system function Fixed bug and error	Application Test cases

#### 4. Analysis and design

Analysis and design are discussed in this chapter that will be used in developing the Organ donation application. In this chapter, the system requirements analysis will be explained clearly. Data flow diagrams will be built based on the analysis of system requirements that have been made so that system requirements will be easier to understand logically, structured and clear. The diagram that has been produced will be used as a reference in developing the Organ donation application. In addition, in this chapter also the system database design and system interface design will be generated and explained in detail. Finally, a summary of the chapter will be placed at the end of this chapter.

##### 3.4 System Requirement Analysis

System requirement analysis consists of two categories which are functional requirement and non-functional requirement. Functional requirements refer to the task or function that needs to be performed and also the task that is prohibited for the system. As for the non-functional requirement, it refers to the systems operation's capabilities and the constraints that will increase the systems performance.

### 3.4.1 Functional Requirement Analysis

Functional requirements describe on what the system should operate, consist and function. The functional requirements for each use cases presented in the following:

**Table 3: Functional Requirement**

No	Use cases	Functional Requirement
1.	Register	The application should allow the staff to register in doctor page. The system should allow the doctor to edit and makes changes on the current data of staff.
2.	Log in	The system should allow the doctor, staff log in into the system by inserting correct username and password The system should detect if user enter the wrong password or username
3.	Assign suitable donor and recipient.	The system should allow the doctor to assign suitable donor and recipient according to their blood group and organs.
4.	Create new donor and recipient	The system should allow the staff to register donor and staff. The system should allow the doctor to view the donor and recipient details.
5.	Donor and staff details	The system should allow the staff to insert, edit and delete the donor and staff detail The system should allow the doctor to view the details.

### 3.4.2 Non-Functional Requirement Analysis

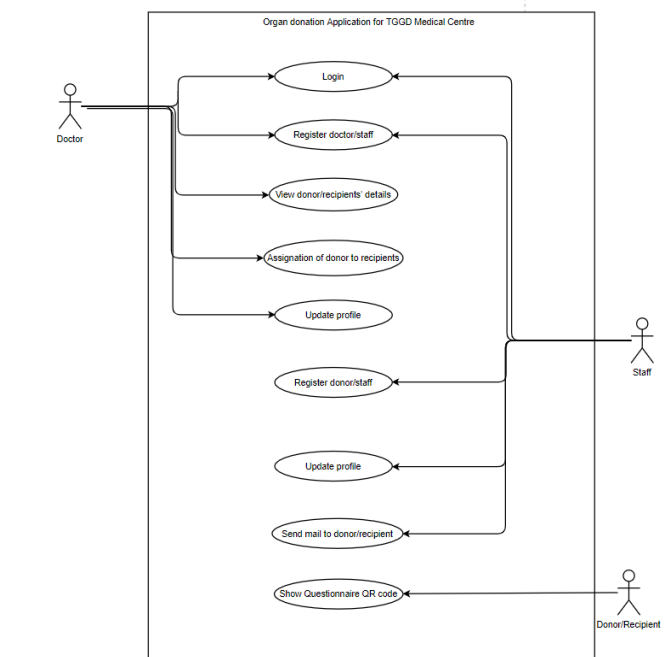
Non-functional requirement is a specification that explain the ability of the system operation and constraints. The non-functional requirements are shown in Table 4.

**Table 4: Non-Functional Requirement**

Reliability	Application should be usable for visually impaired people
Availability	Application should be available in English languages
Scalability	Application should follow Responsive Web Design rules
Operational	The system required less time to update and the system required to updated easily

### 4.3 Use case diagrams

A use case diagram shows the interaction among the elements of a system. Figure 4.1 shows the use case model of admin for Organ Donation Application which define the interaction between the admin, staff, donor, recipient and proposed application.



**Figure 2: Use case of Organ Donation Application**

### 4.4 Sequence diagram

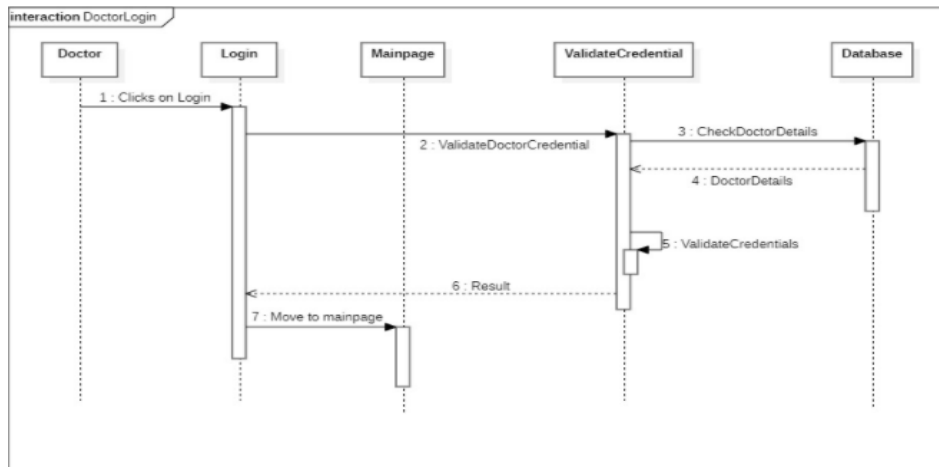
Sequence diagrams are used to view the relationships involved in this application in detail.

#### 4.4.1 Doctor login sequence diagram

Figure 4.2 shows the admin login diagram. During this process doctor need to login in order to use this application. They need to enter username and password to continue to the home page. Doctor also need to create their account as an admin. They also can edit and delete their account. After login, they



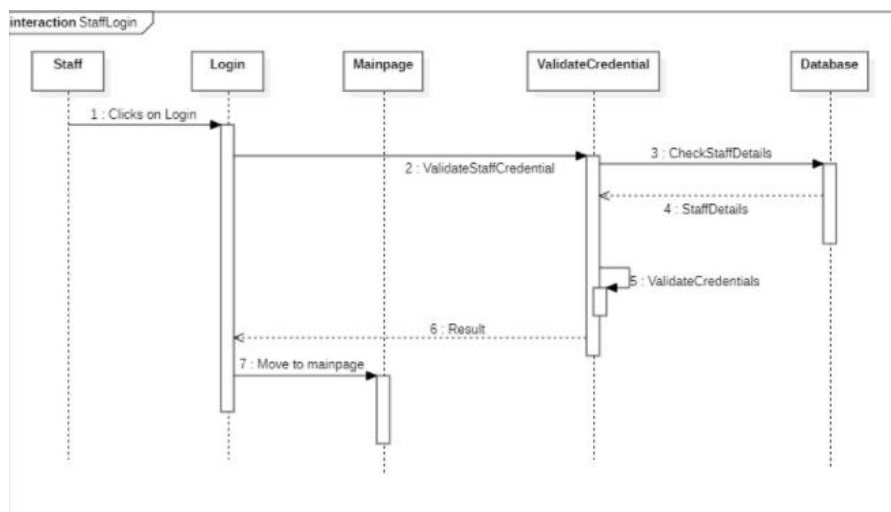
can view donor recipient details. The user's data is save to phpmysql database. Internet connection is required for the application to function properly.



**Figure 3: Sequence diagram for doctor login**

4.4.2 Staff login sequence diagram

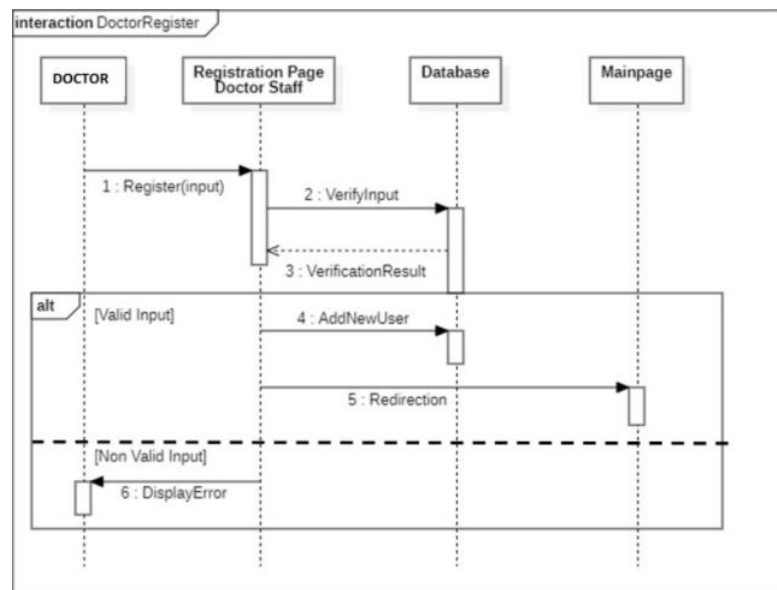
Figure 4.3 shows a sequence diagram for staff login. During this process staff need to login in order to use this application. They need to enter username and password to continue to the home page. They also need to create their account in admin page. They also can edit and delete their account. After login, they can add donor recipient details. The user's data is save to phpmysql database. Internet connection is required for the application to function properly.



**Figure 4: Sequence Diagram for staff login**

4.4.3 Register doctor sequence diagram

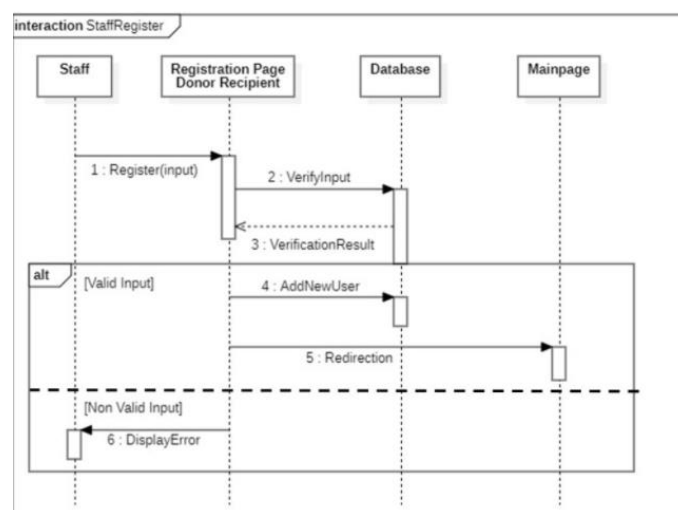
Figure 4.4 shows register doctor diagram where doctor need to register in the database. After that, they login in the login page for doctor.



**Figure 5: Sequence Diagram for register doctor**

#### 4.4.4 Staff register sequence diagram

Figure 4.5 shows a sequence diagram for staff register where staff need to register in the admin page. After that, they login in the login page for staff.



**Figure 6: Sequence Diagram for staff register**

#### 4.4.5 Staff main page sequence diagram

Figure 4.6 shows a sequence diagram for staff main page where staff after login they can create account for donor and recipient. The verify data will send to database.

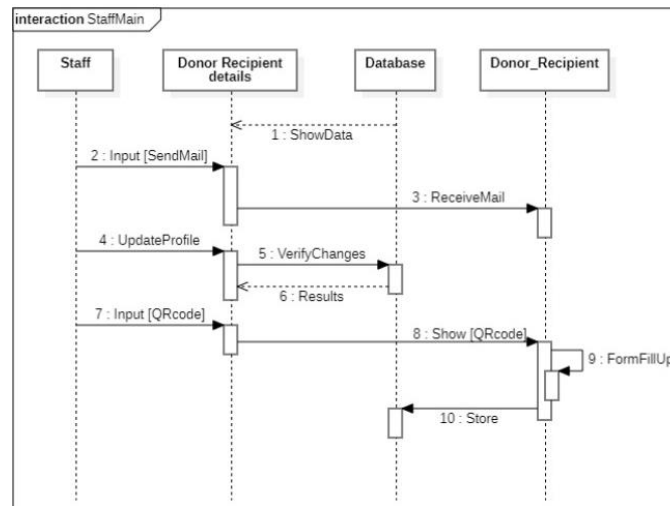


Figure 7: Sequence Diagram for staff main page

#### 4.4.6 Doctor main page sequence diagram

Figure 4.7 shows a sequence diagram for doctor main page where after doctor login. Doctor can view the statistics. Doctor also can view donor and recipient details which already registered and stored in the database.

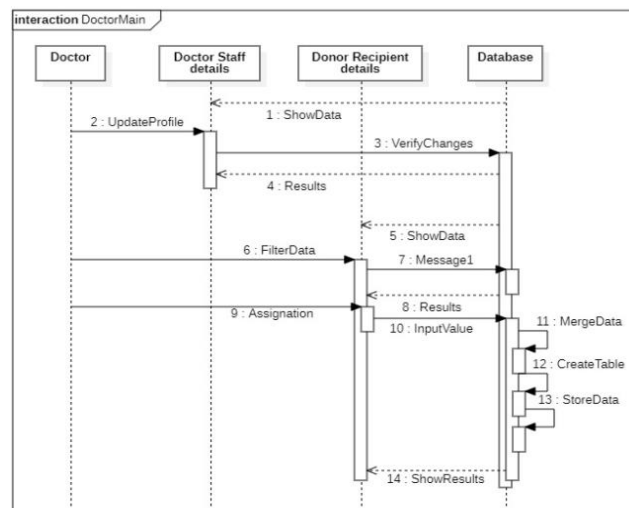
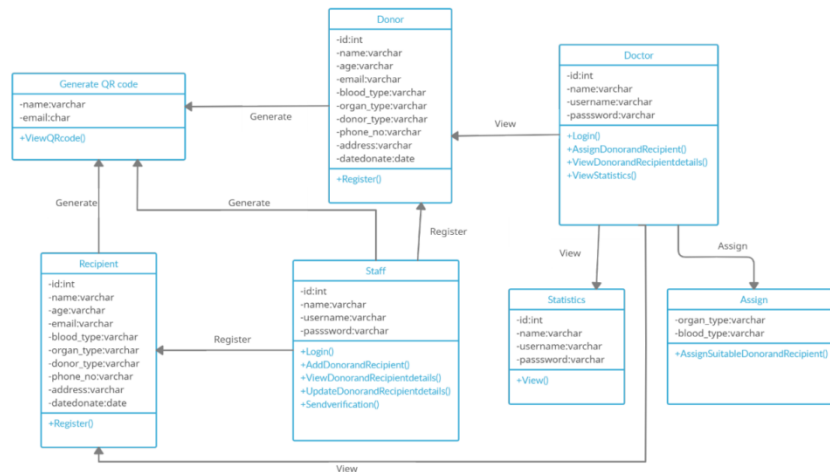


Figure 8: Sequence Diagram for doctor main page

#### 4.5 Class diagram

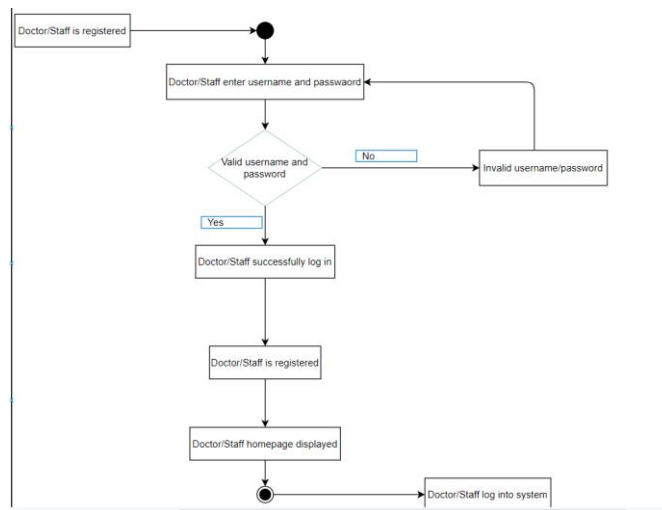
A class diagram static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations, and the relationships among objects. In a class diagram, the classes are arranged in groups that share common characteristics. Figure 4.8 shows the class diagram of the proposed system.



**Figure 9: Class Diagram of proposed system**

#### 4.6 Activity diagram

Activity diagram is one of the essential part in UML to explain the features of the system. Activity diagrams flows from one to another activity to clearly show us the navigational structure of the application. The activity box is depict through rectangular boxes and diamond-shaped box shows the decision the box. The flow from one activity to another can be sequential, branched, single, concurrent and parallel. Activity diagram is a very important advanced version of flow chart that model the system. Figure 4.9 below shows the activity diagram for doctor and staff login.



**Figure 10: Activity Diagram for doctor and staff login**

Figure 4.10 below shows the doctor main page activity diagram for the proposed application.

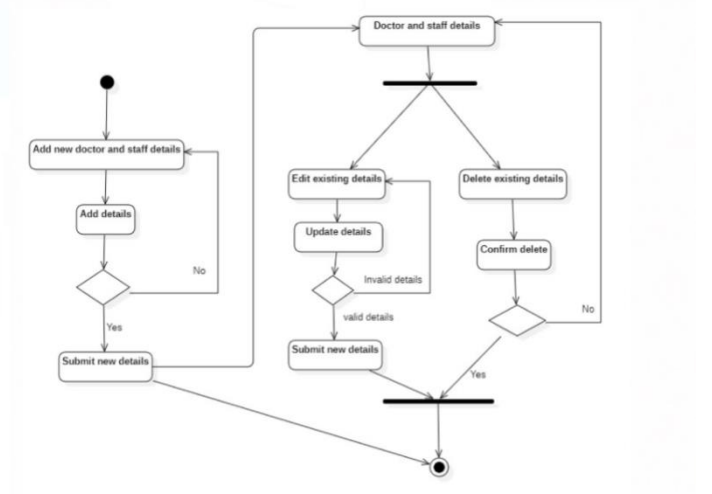


Figure 11: Activity Diagram for doctor main page

Figure 4.11 below shows the staff main page activity diagram for the proposed application.

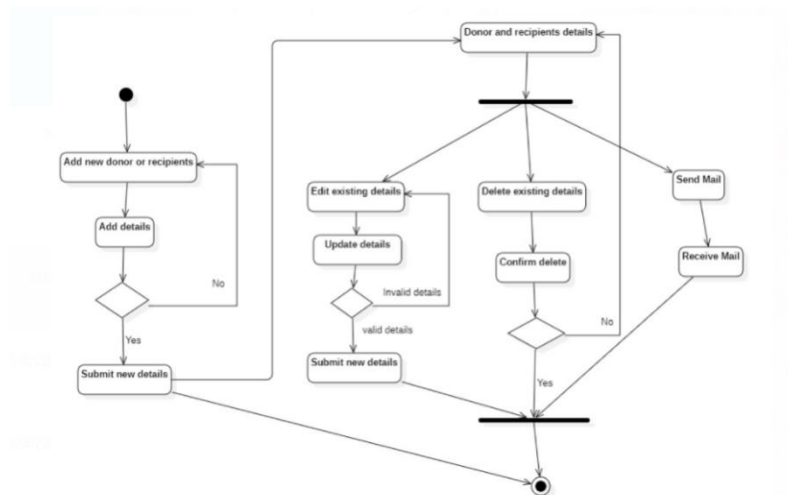


Figure 12: Activity Diagram for staff main page

#### 4. Implementation and Testing

System testing is carried out to check that the produced system's functioning is entirely consistent with the designed requirement specification. Several test records were created at this stage to ensure that the system functions as planned. Before beginning the system installation procedure, any issues discovered during the testing phase will be corrected. Organ donation application for Top Glove and Global Doctors (TGGD) Medical Centre is an application that developed with PHP and JavaScript programming languages written in MySQL software to produce designs interface. The system is then connected to a database phpmyAdmin to allow users and system developers to enter data into the system.

##### 5.1 Database Connection

The phpmyadmin database has been selected as the data storage location for Organ donation application for Top Glove and Global Doctors (TGGD) Medical Centre. Figure 13 shows the program code for the connection of database to Organ donation application for Top Glove and Global Doctors (TGGD) Medical Centre by using Java script and PHP language program. The program code has been placed on each page contained in the system so that the database can be read and written from the system.

```
<?php
$conn = new mysqli("localhost", "root", "", "organdonor") or die(mysqli_error());
```

**Figure 13: Source code for phpmyadmin database connection**

### 5.3 Testing

Functional system testing is used to test and document the organ donation application during the testing phase. Testing is necessary to determine whether the application contains any errors and to guarantee that the application meets the project's requirements.

#### 5.3.1 Functional Testing

Functional testing is done to test whether all the functions and features of the module in this application works as expected. Test plans is categorised according to the related test cases of each modules to check the interface, database and functionality of the application. Test report of the functional testing done on every module will be recorded in the test plan. The result has been recorded by executing suitable test cases, validate the output and comparing the actual output with expected output stated in system analysis design phase.

#### 5.3.2 Test Plan

Following the implementation of the suggested application, the test plan is carried out. It can be used to determine whether the application meets the project's criteria. Tables 6 to 16 illustrate the test plan for all of the functions in the organ donation application.

Table 6 shows the test plan for user login page. This module is able to test with input of user's username and password. Table 7 shows the test plan for staff registration page. In this page staff register them. Table 8 shows the test plan for assign suitable donor and recipient. In this activity, doctor assign suitable donor and recipient with same blood group and organ. Table 9 shows the test plan for register donor and recipient details. In this page, staff registers donor and recipient. Table 10 shows the test plan for update donor and recipient details. In this activity, staff can update donor's or recipient's details. Table 11 shows the test plan for delete donor and recipient details. In this page staff can delete donors and recipient information. Table 12 shows the test plan for scan QR code. In this activity user can scan Qr code to answer the questions. Tables 13 shows test plan for generate QR code. In this page, staff can view how many people did answer the questions. Table 14 shows the test plan for generate email verification. In this page, staff send verification message to check whether it is valid or invalid email address. Table 15 shows the test plan for view statistics. In this page, doctor can view the statistics of how many people donate and receive their organ. Table 16 shows the test plan for assign donor and recipient. In this page, doctor enter blood group and organ, it arranged according to it.

**Table 6: Test plan for Login**

No.	Test Cases	Expected Output	Actual Output
1.	Enter valid email address and password	Login is successful and a message box with the	As expected

		message "Login Successful" will be displayed.	
2.	Enter invalid email address and valid password	If login is unsuccessful, a message box with the message "Invalid username or password" will appear.	As expected
3.	Enter valid email address and invalid password	If login is unsuccessful, a message box with the message "Invalid username or password" will appear.	As expected
4.	Enter invalid email address and password	If login is unsuccessful, a message box with the message "Invalid username or password" will appear.	As expected

**Table 7: Test plan for Staff registration**

No.	Test Cases	Expected Output	Actual Output
1.	Register using correct username and password	Registration successful and display in create new staff account page.	As expected
2.	Click delete button	Warning message is displayed to confirm the deletion.	As expected
3.	Click edit button	Changes will occur after change password or username.	As expected

**Table 8: Test plan for assign suitable donor and recipient**

No.	Test Cases	Expected Output	Actual Output
1.	Click a type of organ and blood type	List out all the donor and recipient details according the specific organ and blood group	As expected
2.	Click assign button	Assign a donor to a suitable recipient.	As expected

**Table 9: Test plan for register donor and recipient details**

No.	Test Cases	Expected Output	Actual Output
1.	Insert valid details about the donor and recipient	Details of donor and recipient successfully appear in the table.	As expected
2.	Leaves empty fields without filling up	Failure message is shown and prompt users to fill in the blank	As expected
3.	Internet Problems/ No connection	Failure message is shown and add event action is rejected	As expected

**Table 10: Test plan for update donor and recipient details**

No.	Test Cases	Expected Output	Actual Output
1.	Click edit button	A update information successfully appear in the table.	As expected

2.	No connection/ Internet problems	Failure is shown.	As expected
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**Table 11: Test plan for delete donor and recipient details**

No.	Test Cases	Expected Output	Actual Output
1.	Click delete button	The deleted person details will not appear in the table.	As expected
2.	Internet problems/No connection	Failure message is shown and delete event action is rejected	As expected

**Table 12: Test plan for scan QR code**

No.	Test Cases	Expected Output	Actual Output
1.	Allow permission on phone camera setting	The scan QR code page able to access phone camera and scan QR code	As expected
2.	Disallow permission on phone camera setting	The scan QR code page not able to access phone camera and scan QR code	As expected
3.	Scan QR code	The questionnaire appears	As expected
4.	Scan invalid QR code	No data recorded message appears	As expected

**Table 13: Test plan for Generate QR code**

No.	Test Cases	Expected Output	Actual Output
1.	Complete the questionnaire	The QR code generated and stored in user history page	As expected
2.	Incomplete the questionnaire	No QR code generated	As expected

**Table 14: Test plan for generate email verification**

No.	Test Cases	Expected Output	Actual Output
1.	Enter valid email address	A verify message send to the email address	As expected
2.	Enter invalid email address	No message will be sent	As expected

**Table 15: Test plan for view statistics**

No.	Test Cases	Expected Output	Actual Output
1.	Enter valid email address	A verify message send to the email address	As expected
2.	Enter invalid email address	No message will be sent	As expected

**Table 16: Test plan for assign donor and recipient**

No.	Test Cases	Expected Output	Actual Output
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1.	Enter blood group and organ	The name of donor and recipient arranged based on the blood group and organ	As expected
2.	Enter submit button	Redirect to assign details page	As expected

### 5.3.3 User Acceptance Testing

User acceptance testing is very crucial to test the functionalities of the application by letting the users to use the application and determine their satisfaction level with the application. This testing helps the developers to recognise the limitations and shortcomings of the application. The data is collected, analysed, and depicted in the graph form to provide an overview of the user acceptance testing on the application. Table 17 shows the result of users' feedback regarding the features according to the module and interface of Organ Donation application.

**Table 17: User acceptance testing result**

No	Acceptance Requirement	Test Result (Number of people)	
		Accept	Reject
1	Registration module working well.	2	
2	Login module working well.	2	
3	Donor and recipients details module	2	
4	Staff, donor and recipient update profile	2	
5	Assign module	1	1
6	Email verification module	2	
7	Buttons in the application are functional.	2	
8	Colours and graphics are appropriate	2	
9	Interface is attractive	2	
10	Application are user friendly	2	

Based on the result from the table () it is clearly shown that Organ Donation Application. Works as per required and users are satisfied with the application.

## 5. Conclusion

The success of a project is measured through the ability to successfully achieve the predefined objective of the project. Organ Donation application has been successfully developed and tested according to goals set in the planning phase. This application benefits the doctors to find suitable donor at emergency time. This application plays a significant role in finding a suitable donor and receiver on time.

Doctors and staffs can manage and update their personal information. Doctors can view the statistics number of donor and recipient. Doctors also can view the donor and recipient details. Doctors will be able to assign suitable donors to recipients. For staffs, they can manage and update donors and recipient details. Staffs also send verification message to donors and recipients to check whether the email they registered valid or invalid. Donors and recipients can answer the questionnaire by scanning the QR code.

Although the application achieve the predefined objectives, several application's constraints discovered in this application. Improvements are important to keep the system updated and receive

great response from the users. This application can be improved in terms of interfaces, functionalities and performance. Moreover, this application is limited to Android smartphones only as it is developed on Android Studio. In future, developing this application into an iOS based application will benefit more users. This application can be registered and login using username and password only. In future, integrating the login and registration with Facebook and Google account could save more time for the user.

In conclusion, Organ Donation application has proven to achieve the predefined objectives, scope, system requirements and user requirement. The limitations of the application can be overcome by putting further efforts to improve and add features that help to satisfy the users with better performance and functionality.

### **Acknowledgement**

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