

UCSI UNIVERSITY

Laurent Bleu Doctor-Patient Appointment System (LBDPAS)

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Authorship Declaration

Except where reference is made in the references, this report contains no material published elsewhere or extracted in whole or in part from a dissertation or report presented by me for another degree or diploma.

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Chapter 1: Introduction

1.1 Background

The advancement in the information and communication technologies has reshaped the usages of telephones. Telephones are transformed into mobile phones and mobile phones are transformed into smartphones. According to Canalys, 694.8 million units of smartphones were produced in a year. There are no doubts that smartphones get the popularity and the acceptance because of the features and the applications [1].

Smartphones captured the whole generations nowadays, basically it is a combination of multimedia, an internet devices and a touch screen phone. Except other features, one of the unique function in the smart phones are the applications, now anyone can make their own applications and use it for their own purpose or offered it to the public for example Facebook, WeChat, Grab and Uber. Smartphone's applications are Apple and android that consumers get it from the application store in their mobile devices.

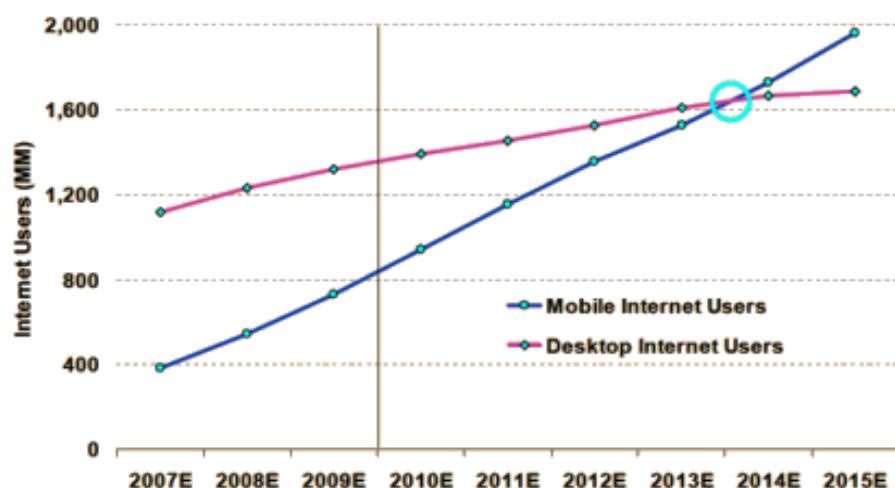


Figure 1: Mobile and desktops users. (Source: [2])

The above Figure 1 illustrated that the usage internet in the mobile phone is rapidly increasing which means that people are not really using the internet in the desktop. The world is revolving between the mobile and the access of the internet. Nowadays people can't even walk without

having the smart phone. Above you may find the most popular operating systems used in smartphones:

- 1- IOS (Apple)
- 2- Android (Samsung, HTC, NEXUS)
- 3- Windows OS.
- 4- Blackberry OS.

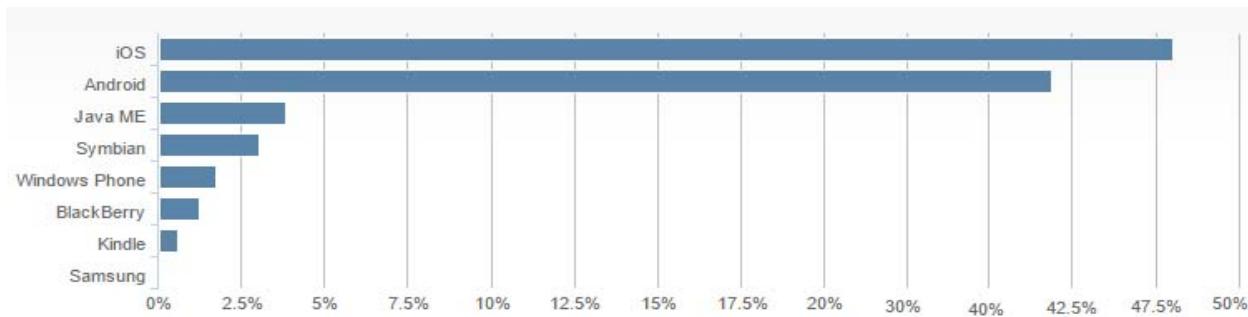


Figure 2: highly used operating systems. (Source: [3])

The Figure 2 demonstrate, apple and android are the mostly use operating system in 2014.

The applications available in the mobile are quickly becoming integrated into clinical practice by surgeons. The applications in the smartphones can be easily downloaded by the self-contained software applications. There are approximately 10,275 unique applications (existing and upcoming) in the application store (i.e. AppStore, PlayStore) named under the “Medical”, “Lifestyle”, “Fitness” and “Healthcare” categories. These applications are usually searched under the IOS, Android, Windows and Blackberry OS [1].

This research will focus on the application that will help the students and healthcare professions to set their appointments by using the android based operating system. This application will help the patients to make an appointment for doctor consultation and also can access their past medical histories and their prescription that has been prescribed by the doctor before. This will reduce the workload of the medical staffs and on the same time save the cost of the patients by calling the clinics to set their appointment.

The context of this study is UCSI clinic Laurent Bleu Clinic (LBC) and the target audience will be the students of the university and the profession that are currently working in the clinic. This application will be labeled as LBDPAS.

Laurent Bleu Doctor-Patient Appointment System (LBDPAS) is a mobile software application that integrates patients and doctors on the same platform which allows the users to set the appointments, and keep them updated with their status and latest check-up and medical histories. The application will be built around a robust scheduling system including day, week, month and the ability to schedule single or multiple appointments at the same time.

Initially this software will only accessible to the students and professions of UCSI university and later researcher will offered to other universities upon the success on the application created by the researcher.

By creating a mobile application that will try to help doctors, staff of the clinic and patients to make up appointments to reduce the workload and save the time of all the integrated parties. It will help to manage the information for previous appointments and the schedule timetable for doctor, staff administration and patients. Patients can access their past medical histories and their prescription that has been prescribed by the doctor before. Moreover, doctors can access the same site for their patients to check and review the medical history of the patients so that doctors do not need to refer the physical documentation all over again.



Figure 3: The application stakeholders

In this software application, the main users are doctors, patients and clinic staffs that has been shown in the above Figure 3. The application will also help the staff of the clinic to upload all the reports in the system so that patients and doctor can easily access the information and next time doctor can refer back through the software.

1.2 Problem Statement

From the point of clinical practice, cellphones offer a variety of benefits such that burn the burden of repetitive work. By using the cellphones, the paperwork will be reduced and it will be easier to access the information in the field. Many institutions have also been integrating mobile devices into their electronic health record system. Smart Phone Application in Clinical practice cell phones can also allow counselors to access past and current client functions. Among the numerous mobile application, this application will focus on the medical industry and help the users to get rid of the paper documentation. It will save time and make the life easier [4].

As the technology has advanced, researcher have begun to test this software designed to address specific clinical needs, so may not commercially available by only allowing the students and the doctors of UCSI university first. This application will remind the appointments for both the doctors and the patients about their consultations by notifying from the software that they have been set before.

In the context of Malaysia, Mobile Health Sdn Bhd (MH2U) is the first company that come up with the idea of MH2U that will transform the paper work to the online-based system. It can be a real challenge keeping the track of the patients records and the ongoing medical needs as paper or documentation can be misplaced but if the records are uploaded right away on the online software there is no way to misplaced the documentation or medical reports [5]. Researcher will use this as the grounded theory for this study.

In that case, researcher decided to create Laurent Bleu Doctor-Patient Appointment System (LBDPAS), an Android based application. With developing this mobile application, instead of going to the clinic to request to check your previous records or to make an appointment, users will be able to have everything combined in one application, where users can check operating/consulting hours' timetable for the clinic and set an appointment, also to check their previous records.

1.3 Aim

The aim of the project is to create a mobile application having a portal for patients where it can help and improve doctors-patients-interactive.

1.4 Objectives

The objective of LBDPAS is to study and implement a mobile application with login portal to support both doctors and patients, which can be as summarized below:

- Design an application to help doctors, medical staffs and patients by giving them convenience access to the information.
- Develop up-to-date computerized clinic system to replace the conventional manual based-systems.
- To design the application in order to help doctors, medical staffs and students of the UCSI university.

1.5 Justification

The objective of LBDPAS is useful application to increase patient-doctor-interactive. With building up the portable application, rather than heading up to the clinic and checking records or documents in-personnel, which with time you won't have the capacity to know whether any progressions. With the application, you will have the capacity to make it easier and have everything within the application. Where patients have the privilege to access previous records and it can check doctor's consultation hours and availability hours.

Furthermore, the application can help other clinics in educational institutions in Malaysia. This application will ease patient-doctor-interactive in a lot of ways. For example, if a patient needed a previous records/check-up for outside clinic purposes, or, if the patient needs to consult the doctor, instead of going there and waiting for the long queue, they will be able to access their records and set an appointment with the doctor through the application.

Since most of the clinics embrace manual practice to work and deal with their information's, it is an extraordinary chance to execute such frameworks in current clinics to enhance their overseeing proficiency and adequacy.

1.6 Scope

As the rapid change of the information technology, now hospital industry also need to enhance their patients record and make it highly confidential. As a fast-growing technology industry of information and communitarian technology (ICT), hospital can easily keep the patients records and on the same time it will help the patients to make the appointments and check the medical history.

Therefore, this application will help the patients and the doctor to manage their appointments and medical history. This project characterized into three components. The delimitation of this study is shown as below:

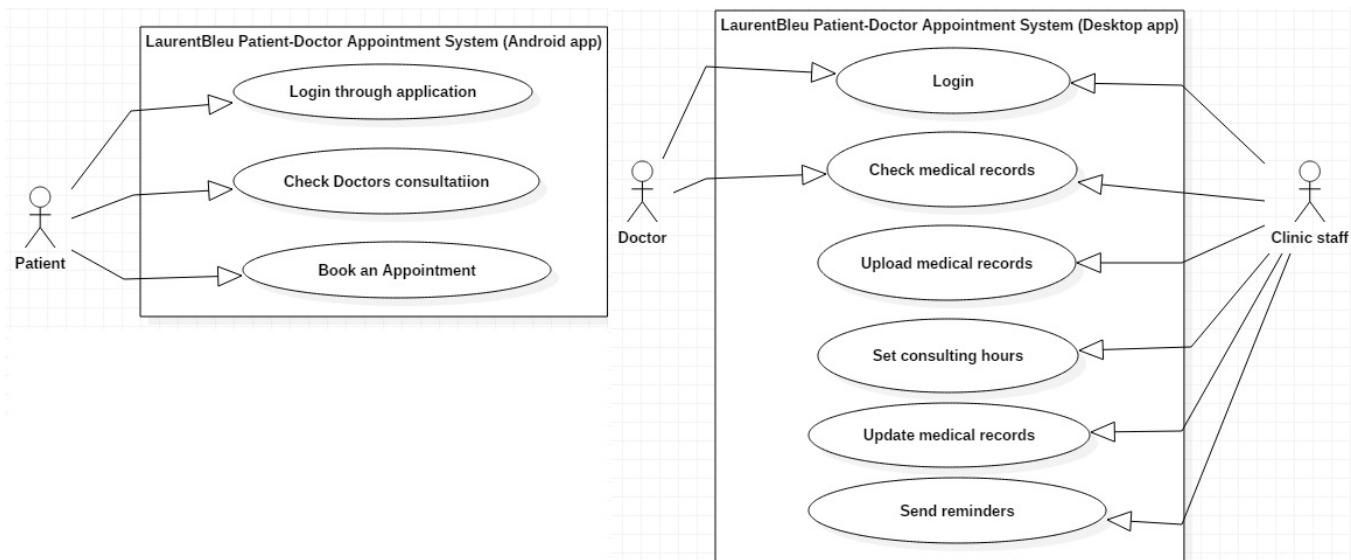


Figure 4: Stakeholders tasks

1.7 Approach and Deliverables

1.7.1 Approach

For every research, there must be some resources to support the study. For this application, Android Studio will be the main resource. The collected data from the source will be used as a guide in developing the application. The vital objective for this project is to make a software which can reduce the hospital workload as well as it will be more convenient for the patients to have access to their medical histories and make an appointment as this is the world of information communication technology (ICT) where half of the population are using technologies and internet Canalyse [1].

1.7.2 Deliverables

The end product will be an application that will run on Android smartphones-based-system. It will require having internet through Wi-Fi or data service or any type of internet connection. It can be accessible at any place. The patients will be able to login, view previous records and also select timing where users can set appointments with doctors, and also check previous medical history records.

1.8 Major Milestone

Table 1: Major milestone

No	Milestones	Date
1	Title Approval	4 th Feb
2	IP1 Completion	20 th Feb
3	Start developing the application	5 th May
4	Finish building the application	30 th June
5	Evaluation & Test the system	21 nd July
6	Project Summary	28 th July
7	IP2 Completion	7 th August



Figure 5: Gantt chart

1.9 Constraints and Assumptions

1.9.1 Constraints

Every research has limitations, following are the limitations of this study.

- Firstly, researcher have only 4 months to create a software so it will be time consuming as the researcher is very new to create this software and have no experience
- This application will be only for android users so other operating system users cannot access this application.
- The application created is only for UCSI university clinic, doctors and patients

1.9.2 Assumptions

As the application, will be developed for UCSI university environment, the target population will be able to have access to their previous medical records and doctor's timetables. This application requires users privilege (patient and clinic staff member) to have an access to the application.

1.10 Resources

While developing this project, there will be a specific required resources and tools to complete the project:

1.10.1 Software

- Android Studio
- NetBeans IDE 8.0.2
- SQLite
- Microsoft Word
- Windows 8.1 (Operating System)

1.10.2 Hardware

- Intel Core i5-4210U
- 2.40 GHz
- 1 TB
- 12 GB RAM
- NIVIDIA GEFORCE 840M Screen Card

1.10.3 Other resources

Researcher will refer some of the articles and books that will help the study success. The other data will get it from the online articles and library books to make the research useful and relevant to the software.

1.11 Major risk

Risks are uncertain events a probability of occurrence. Risk identification and management are the main concern in every project, below will find a list of risks with a probability that it can happen:

1.11.1 Technology risks

- Software failure
- System bugs
- Coding error

1.11.2 Resource risks

- Lack of accessibility to the resources

1.12 Project Plan

Table 2: Project plan

Task Name	Duration	Start	Finish
Requirement/Analysis	50 days	13/1/17	8/3/17
Proposal	37 days	13/1/17	20/2/17
Business Requirements	10 days	14/1/17	24/1/17
Technical Specifications	12 days	24/1/17	7/2/17
Test Strategy	14 days	8/2/17	22/2/17
Architecture Strategy	14 days	23/2/17	8/3/17
Design	37 days	8/3/17	15/4/17
Functional Design	13 days	8/3/17	21/3/17
Technical Design	11 days	22/3/17	1/4/17
Interface Design	13 days	2/4/17	15/4/17
Implementation	44 days	5/5/17	19/6/17
Code Development	30 days	5/5/17	3/6/17
Unit Test	5 days	4/6/17	8/6/17
Code Review	4 days	9/6/17	13/6/17
Code Migration	5 days	14/6/17	19/6/17
Testing	10 days	20/6/17	30/6/17
Integration Testing	5 days	20/6/17	25/6/17
System Testing	3 days	26/6/17	28/6/17
Performance Testing	2 days	29/6/17	30/6/17
Deployment	1 day	25/7/17	25/7/17
Application Release	1 day	25/7/17	25/7/17
Project Report Due	1 day	4/8/17	4/8/17
Viva Presentation	2 days	7/8/17	7/8/17

Chapter 2: Information Gathering

2.1 Literature Review

The knowledge of patient choice and behavior in care-seeking (what patients want) is important in the operation of managing a healthcare. Therefore, there has been a growing interest in increasing doctor-patient-interactive in the medical industry to increase the positive outcomes and provide a better patient experience through-out many ways, such as providing an easy access to doctors. (i.e. Patients can communicate with doctors wherever they are by an online platform “DoctorPocket”) [6]. Patient choice and behavior in scheduling an appointment is being affected by speed (in-clinic waiting) and quality (doctor of choice). There are several factors that have an impact on patients experience such as Patient mix (Patient preferences) and current practice operations (Appointment delay) [7].

2.1.1 Patient Preferences

Enhancing the patient experience of care maintain a flexibility for patients and provide them more benefits regarding how, where and when to pursue the treatment. As enhancing the patient experience became one of the major aims to improve the healthcare system, observing the patient preferences and involving it in the process of healthcare development such as scheduling system can offer a various of unlimited options compared to the traditional scheduling systems where patients told by the clinic when to come and whom to see [8].

When it comes to scheduling an appointment, patients have strong preferences such as appointment delay, flexibility of appointment times, doctor of choice and in-clinic waiting. Among all the factors appointment delay and doctor of choice considered to be more important than the others, because having a good patient care and communication is important to produce a good patient experience while choosing a doctor and setting an appointment [7].

2.1.2 Appointment Delay

One important factor patients consider when scheduling and appointment is the tradeoff between speed (access to care) and quality (continuity of care) [7]. Which is patient makes a choice of having fast access to care but see a doctor who is not their own. On the other hand, patient may have long relationship with the doctor which makes the doctor familiar with the patient’s situation were another doctor may lack the familiarity.

There have been many implemented strategies to balance between access to care and continuity of care such as operational management (OM) strategies. Open Access (OA) is common used method which aims to minimize the delay to care and optimizes the efficiency to improve the patients experience. OA method can be implemented by scheduling patients with doctors who have same day availability but may not be patient's own doctor [7]. The benefit of reducing appointment delay may have a negative impact on other values preferred by patient, such as decreasing the ability of patient to see their own doctor with access to same day appointment.

2.2 Data Collection

2.2.1 Laurent Bleu staff meeting

Laurent Bleu Doctor-Patient Appointment System (LBDPAS) is a scheduling system for UCSI university clinic, the researcher has conducted several meetings with the staff of the clinic to ensure the accuracy of the applications performance. Through the meetings with the staff of Laurent Bleu clinic the main idea that has been discussed is how to provide an appointment booking system (ABS) rather than or with the current appointment methodology that they are providing which is First Come First Serve (FCFS). Appointment booking system (ABS) is when the patients book their own appointments with the doctors based on provided consulting time slots by using an online platform or calling the clinic or attending physically to book an appointment [9].

2.2.2 Survey

Survey has been selected in term of getting to understand the acceptance of patients to the current manual appointment scheduling system. The survey will be distributed online randomly to a sample size of Laurent bleu clinic patients, calculated with the following formula:

$$\frac{\frac{z^2 \times p(1-p)}{e^2}}{1 + (\frac{z^2 \times p(1-p)}{e^2 N})}$$

Using the above formula, a population size of UCSI university is 10,000, confidence level is 95% and with margin of error of 14% yielded a sample size of 50 people [10]. The survey form is attached as Appendix A and the result of the survey is presented in Chapter 3.

2.3 Existing systems

2.3.1 DoctorOnCall (DOC)

As Mobile Health Sdn Bhd (MH2U) was the first company that came up with the idea of transforming the paper work to the online-based system in Malaysia [5]. DoctorOnCall was the first online medical video-consultation platform in the context of Malaysia that combined the video-audio technologies with the medical industry which allow the patients an effective access to Malaysia's top doctors [11]. As shown in Figure 5, briefly explain the steps to book an appointment via DOC.

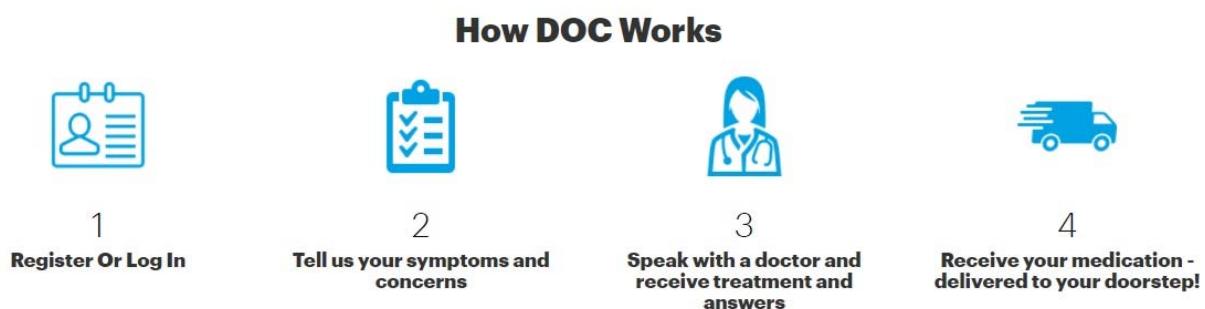
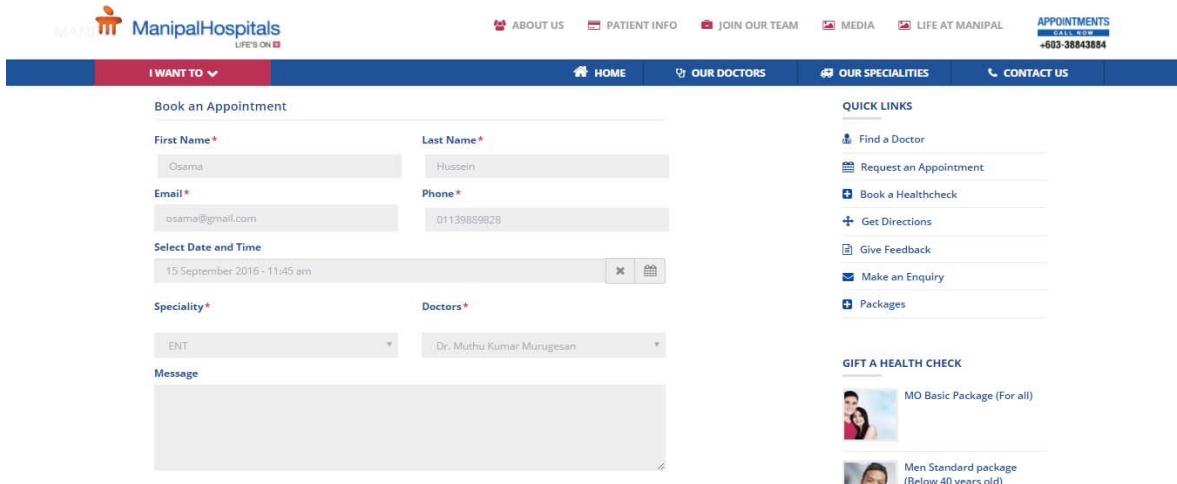


Figure 6: DoctorOnCall appointment scheduling process

2.3.2 Manipal Hospital Klang (MHK)

Manipal Hospital Klang is part of Manipal Health Enterprises (MHE), the hospital considered as one of the largest healthcare providers in Asia Pacific serving over 2 million patients worldwide. MHK offers an online booking appointment system which gives the patients the choice between booking an appointment with a specialized doctor in the requested field suggested by the hospital or allowing the patients to preview the available doctors' background which will give patients the choice to pick a doctor from their own preferences which will provide patients with more comfortable and flexible appointment scheduling experience as shown in Figure 6. Moreover, MHK provides the patients with the opportunity to book their HealthCheck at a flexible time with offering several age-based packages [12].



The image shows a screenshot of the Manipal Hospitals website's online appointment booking page. At the top, there is a navigation bar with links for 'ABOUT US', 'PATIENT INFO', 'JOIN OUR TEAM', 'MEDIA', 'LIFE AT MANIPAL', 'APPOINTMENTS' (with a 'CALL NOW' button and phone number '+603-38843884'), and 'CONTACT US'. Below the navigation bar, there is a section titled 'I WANT TO' with a dropdown menu. The main form area is titled 'Book an Appointment' and contains fields for 'First Name *' (Osama), 'Last Name *' (Hussein), 'Email *' (osama@gmail.com), 'Phone *' (011139889828), 'Select Date and Time' (15 September 2016 - 11:45 am), 'Speciality *' (ENT), 'Doctors *' (Dr. Muthu Kumar Murugesan), and a 'Message' text area. To the right of the form, there is a 'QUICK LINKS' sidebar with links to 'Find a Doctor', 'Request an Appointment', 'Book a Healthcheck', 'Get Directions', 'Give Feedback', 'Make an Enquiry', and 'Packages'. Below the sidebar, there is a 'GIFT A HEALTH CHECK' section with two options: 'MO Basic Package (For all)' (with a couple icon) and 'Men Standard package (Below 40 years old)' (with a man icon).

Figure 7: MHK online appointment scheduling

2.3.3 On-line Appointment System (OLAS)

On Line Appointment System (OLAS) is an online appointment scheduling that allow students to schedule their own appointments with the staff of Harvard International Office (HIO) to provide them with further information's regarding immigrating or health insurance related issues [13]. As well as students provided with the choice to make a call or visit the site in-order to schedule an appointment. As shown in Figure 7, Harvard university provided OLAS with scholar's services such as researchers and other scholar-related services.

<p>AT THIS TIME SCHEDULING IS UNAVAILABLE. PLEASE EMAIL YOUR ADVISOR TO MAKE AN APPOINTMENT.</p>	<p>AT THIS TIME SCHEDULING IS UNAVAILABLE. PLEASE EMAIL YOUR ADVISOR TO MAKE AN APPOINTMENT.</p>
<p>Students</p>	<p>Scholars</p>
<p>1ST TIME USER</p>	<p>1ST TIME USER</p>
<p>EXISTING USER</p>	<p>EXISTING USER</p>

OLAS, the [Online Appointment System](#), allows you to make your own appointment on-line with an advisor in the [HIO](#) to discuss immigration issues related to your studies or work at Harvard University. If you have trouble making an appointment on your own, please call the HIO front desk at 617-495-2789 or visit the HIO to schedule an appointment. Please note, many simple questions and processes do not require an appointment. There is an Advisor On-Call (AOC) during regular office hours (Monday to Friday, 9:00 a.m. to 3:00 p.m., except for holidays) to handle quick questions and to provide [travel](#) signatures.

Appointments regarding permanent residence for faculty and high-level researchers, health insurance information, spouse and family-related questions, and other matters not related to immigration should be made by telephone in order to be scheduled with the appropriate staff member. Please call our receptionist at 617-495-2789 to schedule these appointments.

Once an appointment is made successfully, you will receive a confirmation e-mail. Please be sure to read the e-mail prior to your appointment because it has important information such as what you may need to bring to the appointment.

Figure 8: OLAS login portal

2.4 Systems Analysis

Table 3: Systems comparison and analysis

	DoctorOnCall (DOC)	Manipal Hospital Klang (MHK)	On-line Appointment System (OLAS)
Interface	-Simple -Clean	-Reliable -Intuitive	-Intuitive -Simple -Clean
Platform	-Online Web System -Mobile store	Online Web System	Online Web System
Accessibility	Easy to access	-Easy to access	Easy to access

As shown in Table 4, the analysis and comparison of the used systems in Chapter 2 Literature Review. The three systems have been analyzed from three main perspectives which are the interface, platform and accessibility then later compared to each other. The comparison and analysis of the systems from interface perspective to measure whether the system's interfaces are complicated or user friendly. TechTerms defined the interface as user-friendly when it fulfills the 4 common attributes found in user-friendly interfaces, which are simple, clean intuitive and reliable [15]. The second factor in the comparison of the three systems is to identify the platform that they are being used on whether they are web-based systems or mobile-based systems or both systems. The last factor of the system is an important factor of leading the system to succeed in its objective, which is accessibility. Whether the user can have an easy access to the system platform which will make the user feel flexible and comfortable while using the system and improves the user experience.

Chapter 3: Analysis

3.1 Survey results

The survey was distributed on 50 people based on the results of the calculation in 2.2.2 *Data collection*. The survey was distributed equally on 25 males and 25 females as represented in Table 5, a mix of students and staff (Table 6) with an average age of 28.

Table 4: Responders gender

Gender	Number of responders
Male	25
Female	25
Total Sample size	50

Table 5: Responders occupation

Occupation	Number of responders
Students	32
Staff	17

The collected answers from responders has been analyzed to understand more the target user's preferences. Below you may find the highlighted questions and answers which are more relevant to the understanding of the targeted users preferences in Figures (9 – 14).

- 1) Have you ever experienced the services provided by Laurent Bleu clinic?

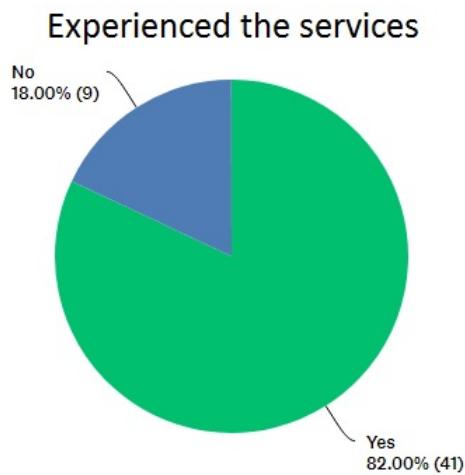


Figure 9: Experienced the services

Figure 9 represents the number of responders who have experienced Laurent Bleu clinic services. The chart shows that the majority of responders which is 82% which is 41 responders experienced Laurent bleu services, while 18% which is 9 responders didn't experience the services provided by the clinic.

- 2) How long does it take you in-clinic waiting to see the doctor?

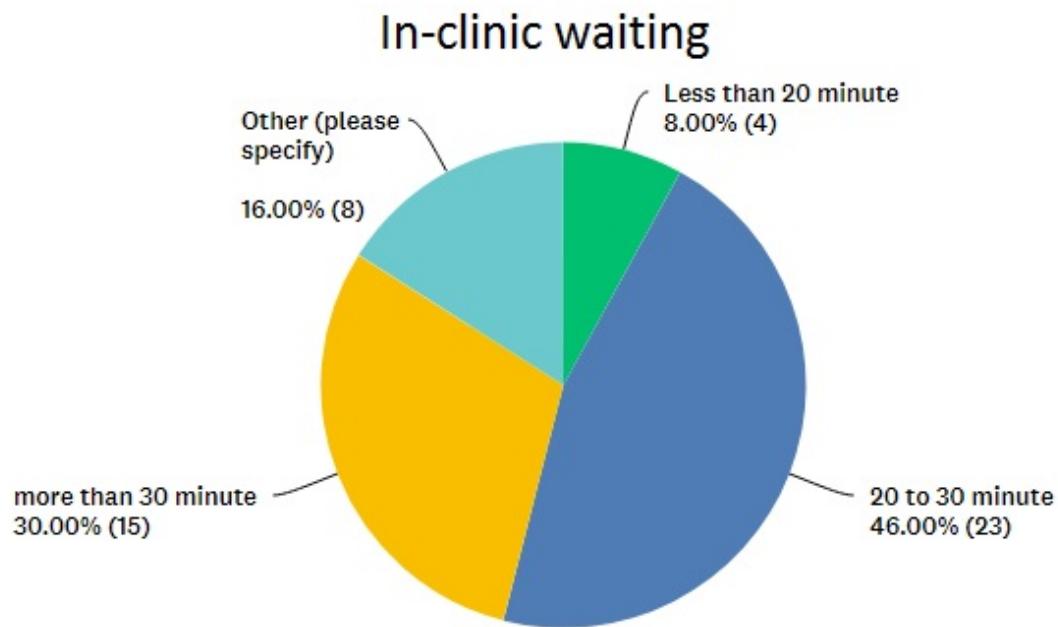


Figure 10: Patient In-clinic waiting

According to Figure 10, the number of responders 46% in total of 23 responders have 20 to 30 minutes in-clinic waiting, 30% which is 15 responders wait for more than 30 minutes in-clinic waiting and 8% of responders have a quick access to their appointment with less than 20 minutes waiting. Thus, according to the represented data the average in-clinic waiting that the patients face is between 20 to 40 minutes.

- 3) Are you satisfied with the current appointment scheduling system of Laurent Bleu clinic?

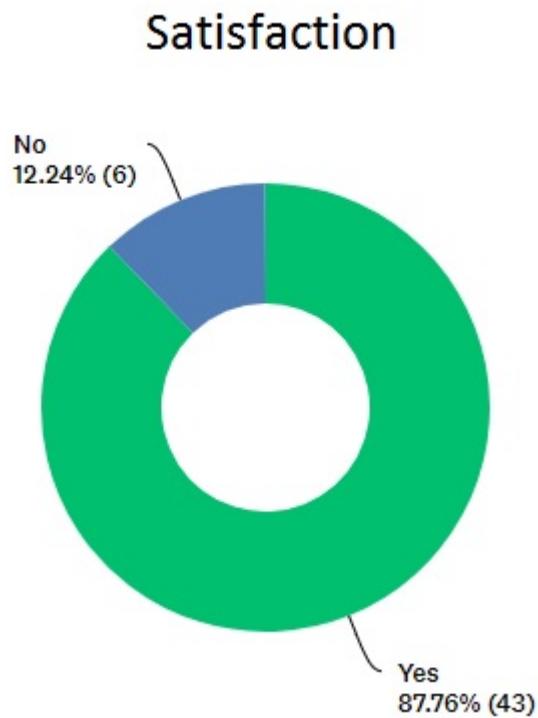


Figure 11: Satisfaction of current manual system

Figure 11 illustrate the number of responders who are satisfied with the current manual appointment scheduling system, 87.76% which represent 43 people were satisfied with the current performance of the manual system. On the other hand, 12.24% of responders which represent 6 people were not satisfied with the performance of the current manual system because of the long in-clinic waiting.

- 4) Do you think Laurent Bleu clinic requires an online appointment scheduling system to provide better services?

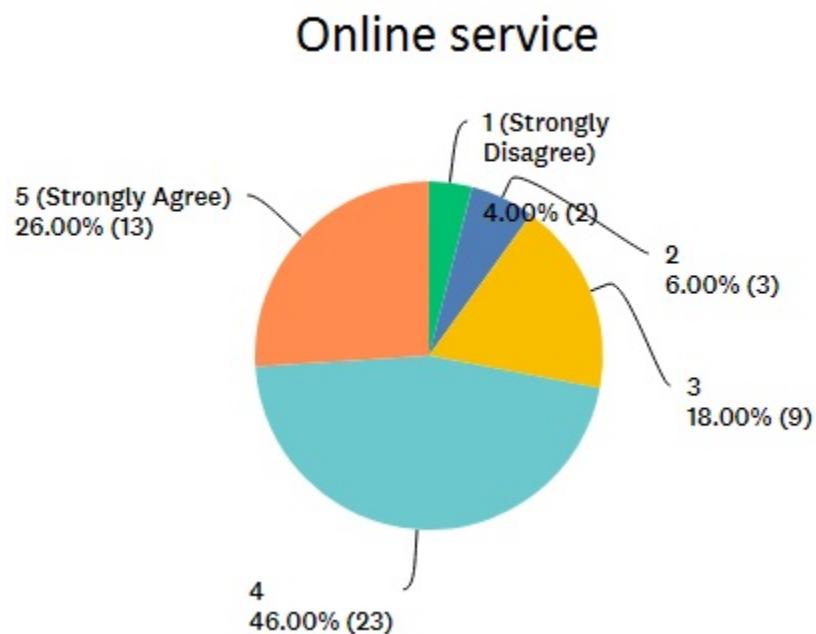


Figure 12: Responders opinion on online appointment scheduling system

Responders were asked to give their opinion on 1 (Strongly disagree) to 5 (Strongly agree) on Laurent Bleu clinic providing online appointment scheduling system as shown in Figure 12. Based on the above pie chart 72% which is 36 responders support the idea of providing an online appointment scheduling system, while 18% of responders were neutral that the providing an online appointment scheduling system won't affect their experience as Laurent Bleu clinic patients. On the other hand, 10% of responders were not agreeing with the idea of having an online appointment scheduling system replacing the manual system.

- 5) Do you think that quick and smooth appointment scheduling improve your experience as a patient of in-clinic waiting?

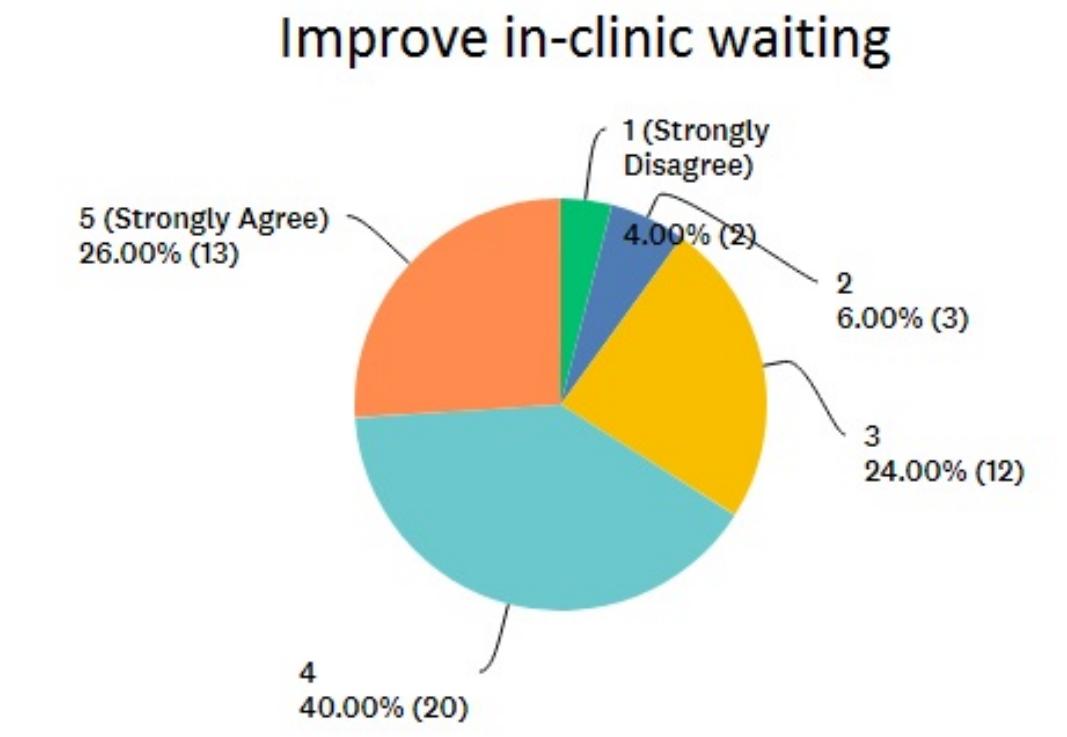


Figure 13: Responders opinion on online appointment scheduling system improve in-clinic waiting

Responders were asked to give their opinion on 1 (Strongly disagree) to 5 (Strongly agree) on Laurent Bleu clinic providing online appointment scheduling system as represented in Figure 13. 66% of responders says that having an online clinic appointment scheduling system will improve their patients experience by decrease in-clinic waiting time for the appointment, while on the other hand, 34% of responders thinks that having online appointment scheduling system won't bring any improvement to their experience as a patient in the context of in-clinic waiting.

- 6) Do you think patients need online appointment scheduling and medical history services?

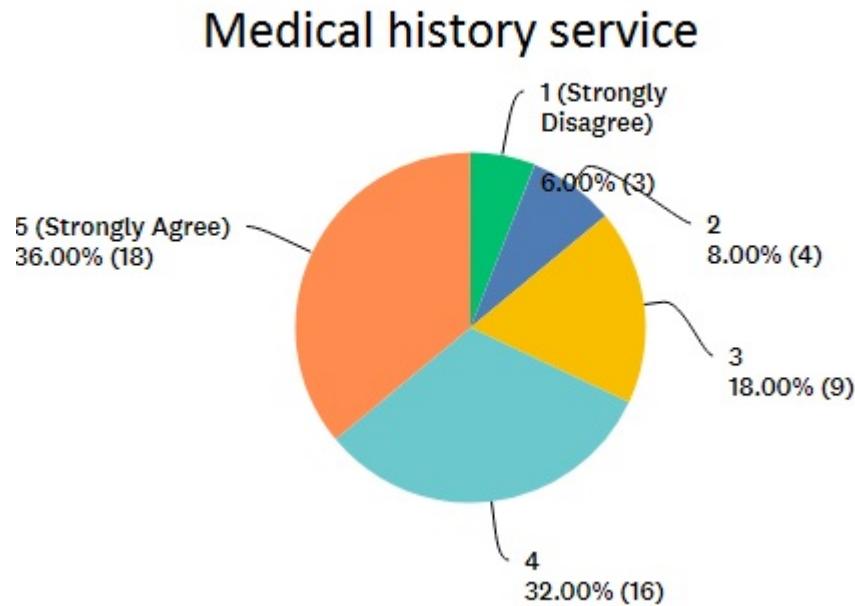


Figure 14: Responders opinion on providing medical history service

Figure 14 illustrate that the responders were asked to give their opinion on 1 (Strongly disagree) to 5 (Strongly agree) on Laurent Bleu clinic providing online appointment scheduling system. 68% of responders think that providing the online appointment scheduling system with service to check the previous medical history of the patient is very helpful and they agree with it, while 32% of responders says that providing such a service won't affect their patient experience with the clinic.

Chapter 4: Synthesis

4.1 Functional design

LBDPAS has three types of user's patients, doctors and clinic staff. The tasks and the actions that each user's type can perform will be illustrated in Figure 15.

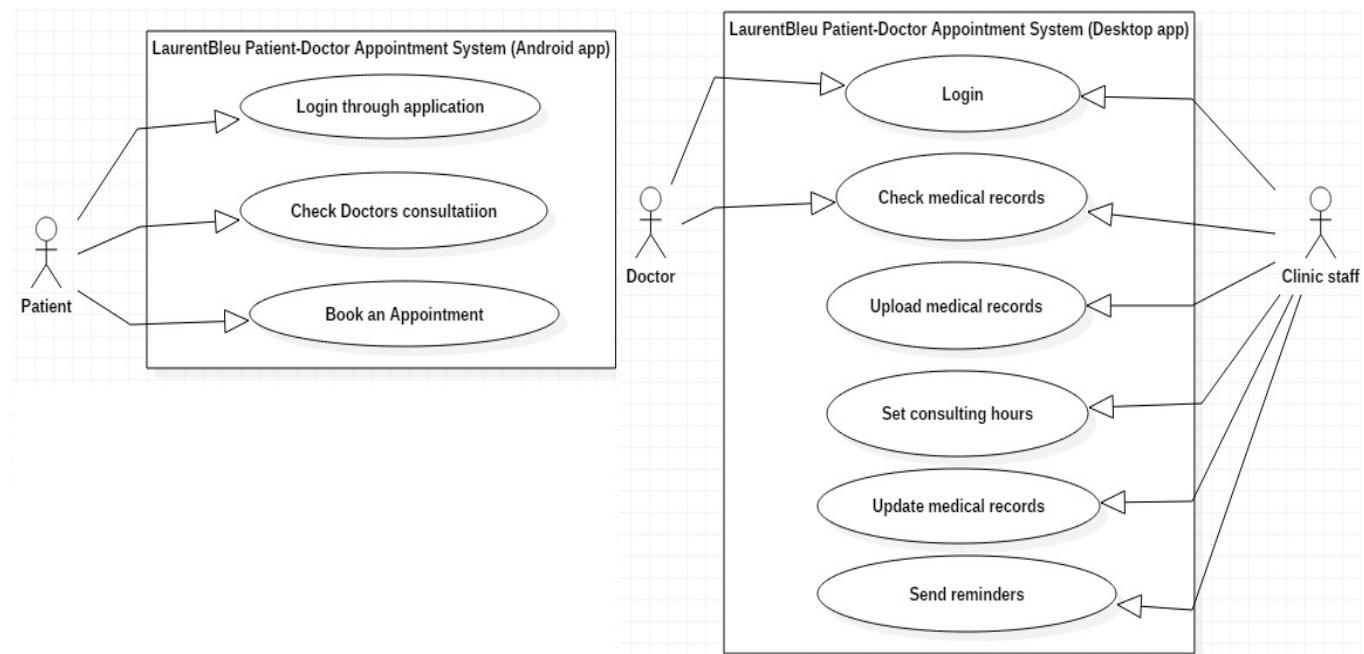


Figure 15: Stakeholder's use case Diagram

The description of each use case tasks and each user's type action performed will be briefly explained in *Table 6 and 7*.

Table 6: Use case description of LBDPAS (Android app)

User case	Description
Login Through application	Enter ID and password to login
Check doctor's consultation	Patients can view each doctor consultation hours
Book an Appointment	Patients can book an appointment with doctors within the selected time slot

Table 7: Use case description of LBDPAS (Desktop app)

User case	Description
Login	Enter ID and password to login
Check medical records	User can check medical history of specific patient
Upload medical records	User can Upload attachment to selected medical records
Set consulting hours	User can update/set Doctors consulting hours/Time slots
Update medical records	User can update medical records
Send reminders	User can send reminders to notify other users/patients with up-coming appointments

4.2 Technical design

4.2.1 Class diagram

Class diagram represents set of classes, interfaces and their relationships to address the static view of the system, as shown in *Figure 16*. *Table 8* will contain the description of the illustrated class diagram.

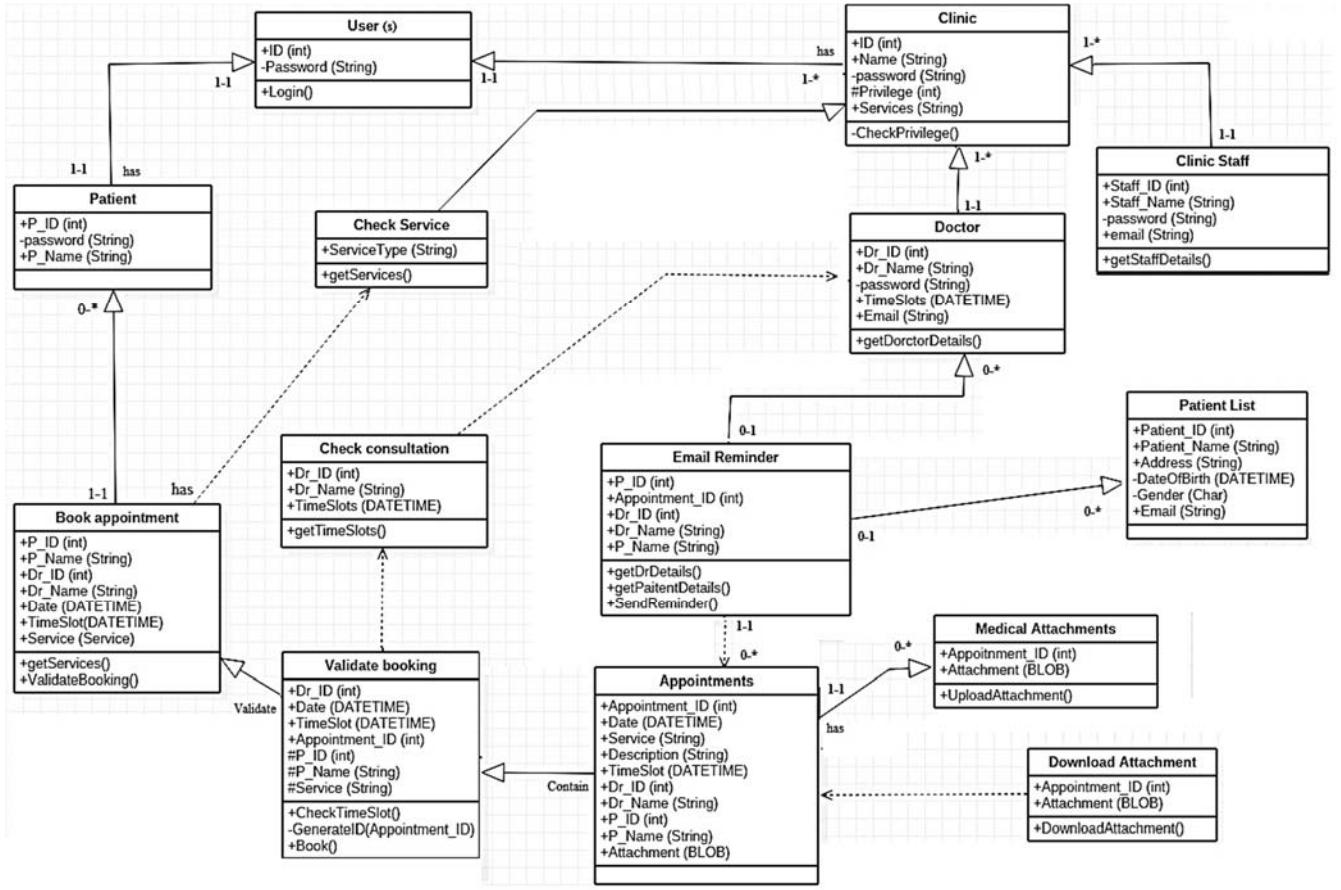


Figure 16: Class Diagram

Table 8: Class diagram description

Class Diagram	Description
	-Inheritance -Going from child class toward parent class
	-Dependency -Going from class which is dependent toward the class that is dependent on

4.2.2 Activity diagram

Activity diagram will illustrate the logic of the proposed system and the system workflow of the represented tasks in the use case showed in *4.1 Functional design* [14]. *Figure 17* will show the

process of LBDPAS (Android application) which is used by patients. The patient will be directed to the main menu after logging in successfully, the patient will be able to check the services provided by clinic and check the previous medical record were patients are able to download records into their devices. Also, patients can check doctor's consultation slots and book an appointment.

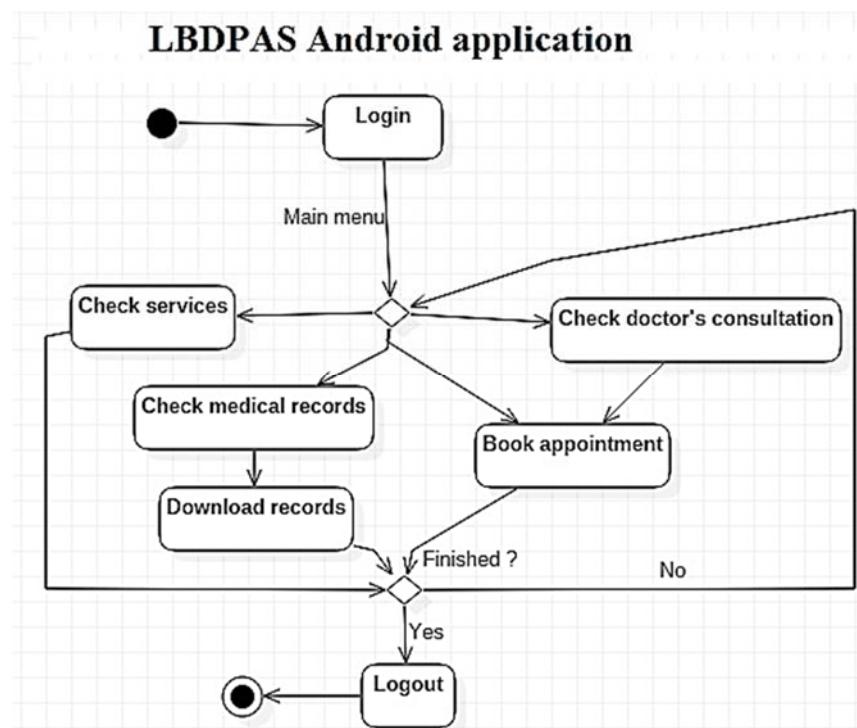


Figure 17: Activity diagram for LBDPAS Android application (Patients)

As for the desktop application side of LBDPAS which will be used by clinic staff and doctors, *Figure 18* will illustrate the workflow of doctors while navigating through the application and *Figure 19* will represent the process and the actions that a clinic staff can perform through the application.

LBDPAS Desktop application

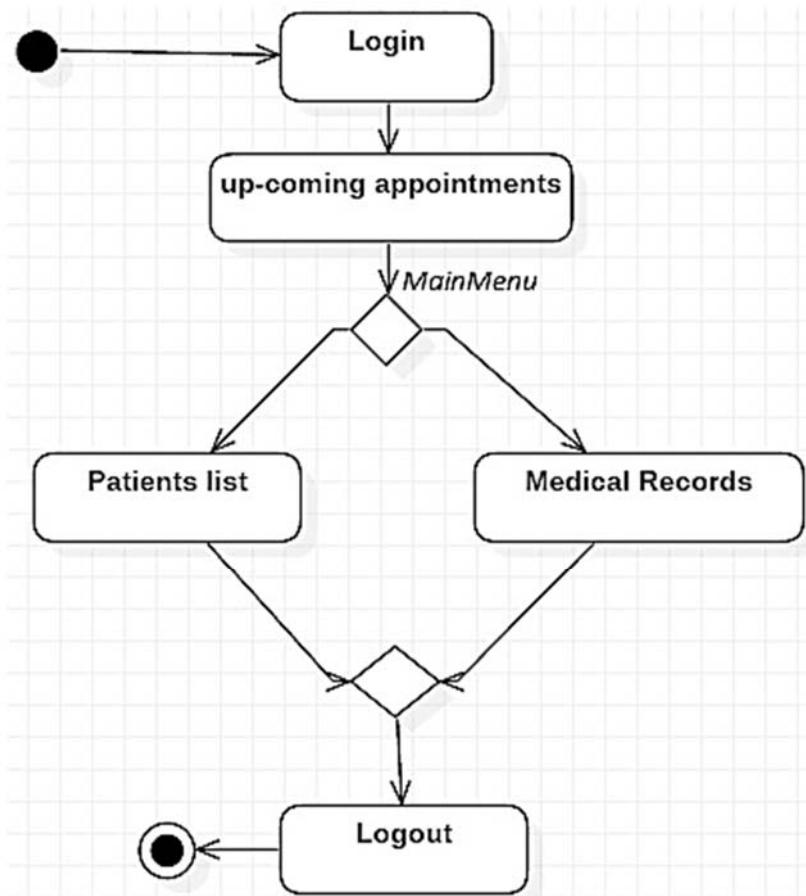


Figure 18: Activity diagram for LBDPAS Desktop application (Doctors)

As illustrated in *Figure 18*, when a doctor login in successfully to the system, doctor will be directed to main menu where doctor will be able to perform two actions which are viewing medical records (appointments) or view the patients list.

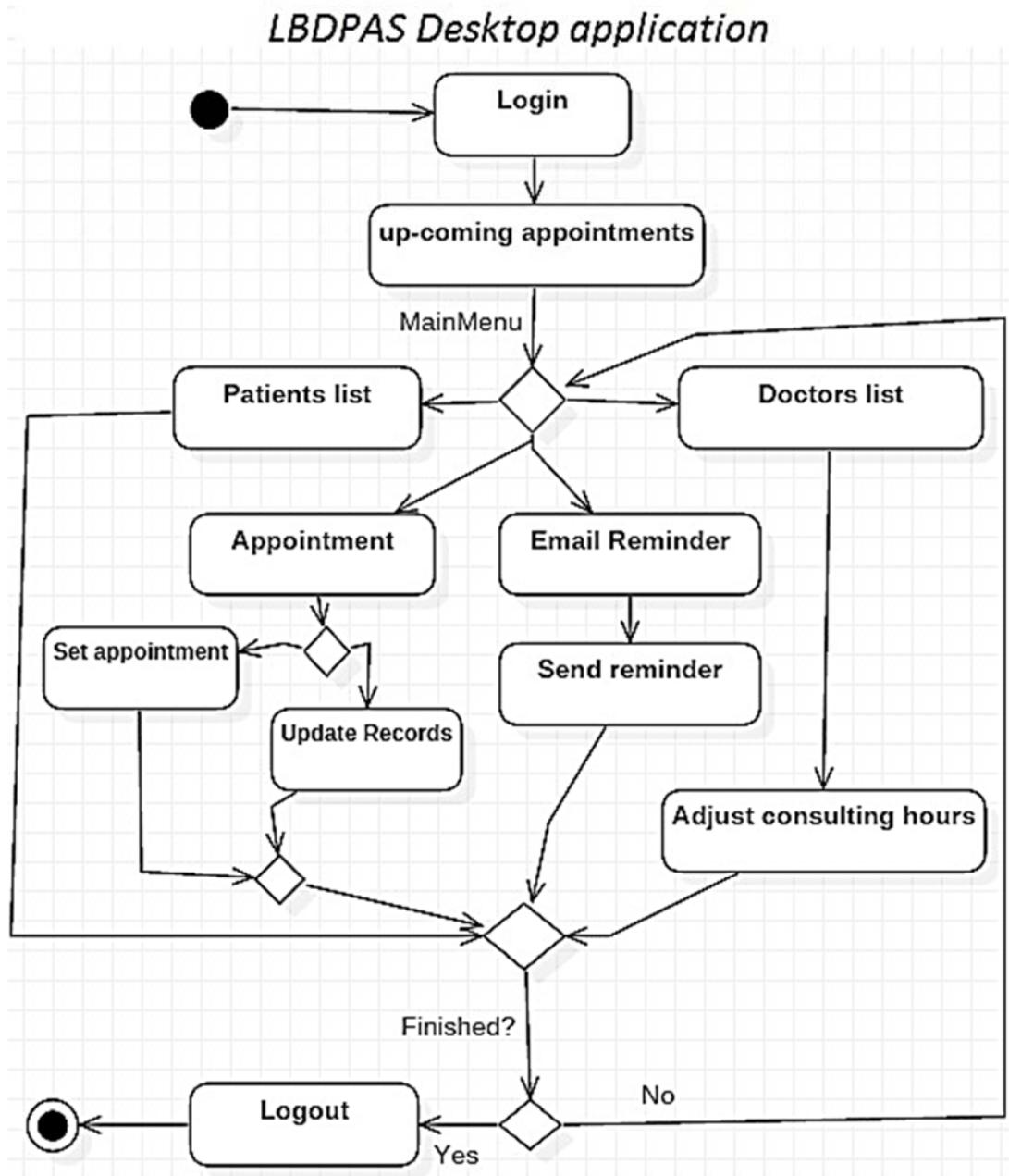


Figure 19: Activity diagram for LBDPAS Desktop application (Clinic staff)

Figure 19 represent the list of activities that clinic staff can perform when logged in to the system. The staff will be able to view patients list and doctor's list, clinic staff will have the privilege to adjust the doctor's consulting slots. Clinic staff will be able to view the clinic appointments and perform actions such as updating medical records (appointments) and set an

appointment for patients who attend physically at the clinic. Also, Staff will be able to send an email reminder to the doctors and patients for their appointments.

4.2.3 Database design

Database design is one of the important areas in system development. The accuracy of database design is important to operate a business because changing the design of the database once it's implemented can affect the performance and be time consuming. Normalization has been used to design the database up to third normal form (3 NF) during the design process to produce a consistence and cost-effective database also as well to reduce redundancy [16].

Entity Relationship diagram (ERD) is a technique to create a graphical representation of entities and their relationships, ERD can be considered as the blueprint for creating a database.

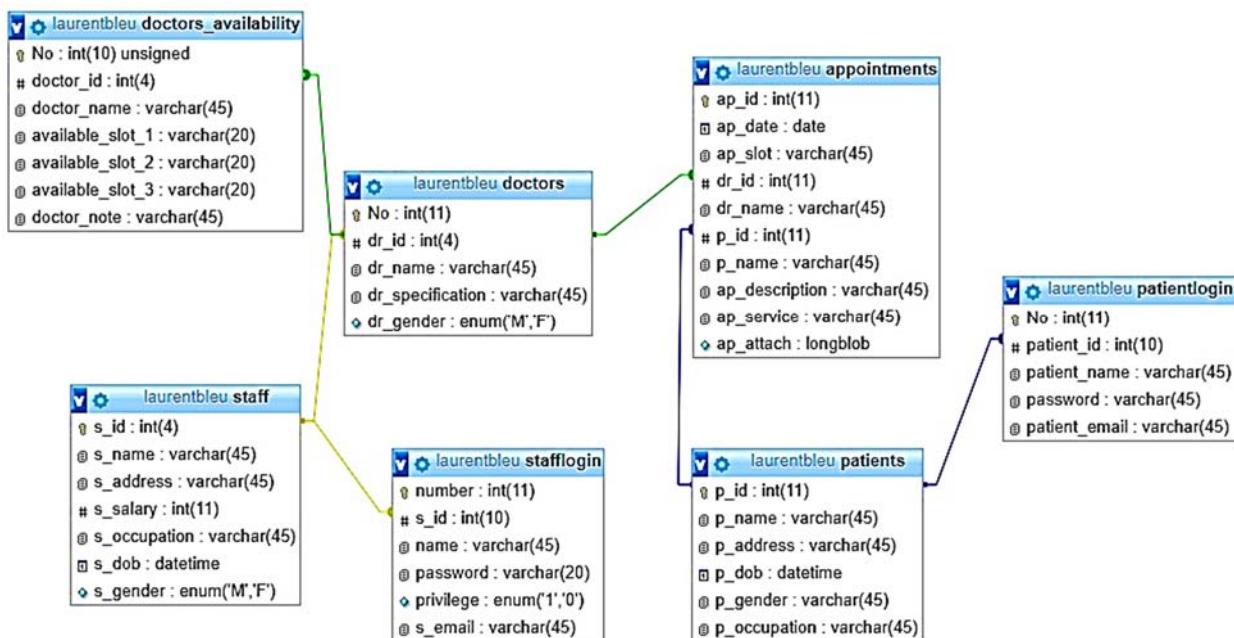


Figure 20: ERD of database design

As *Figure 20* illustrate the ERD diagram of the database design, were the relationship between the tables attributes is displayed. The lines connecting between the tables attributed represents the foreign key constraint. The database was design based on three tables staff, patients and appointments. These three tables are inter-connected with the other tables through the foreign

key constraint to ensure the accuracy of data inside each table. For example, a patient can't have a login details if he is not registered in the patients list. The main three tables structures will be illustrated in *4.5.3 MySQL*.

4.3 Interface design

In this section will show the interface design for both side applications of the proposed system Android and desktop applications, which will be more specified in showing each user interface which are patient, doctor and clinic staff. The main source code of the proposed system which is PHP, Java and SQL code will be shown in *4.5 Implementation*.

4.3.1 Android application

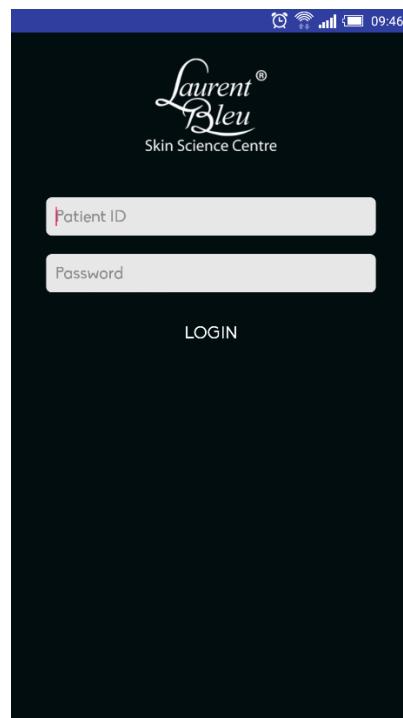


Figure 21: Login activity (Android)

Figure 21 shows the login activity for patients when they try access Laurent Bleu clinic system LBDPAS through the phone. This interface allows patients to login and give them access to Laurent Bleu Doctor-Patient Appointment System (LBDPAS).



Figure 22: Patient main menu (Android)

Figure 22 illustrate the patient main menu where the patient will be directed after he perform a successful login, the main menu will contain a brief information of the patient. The system will allow the user to perform simple actions directed through the main menu such as set appointment, medical history, checking doctors and services.

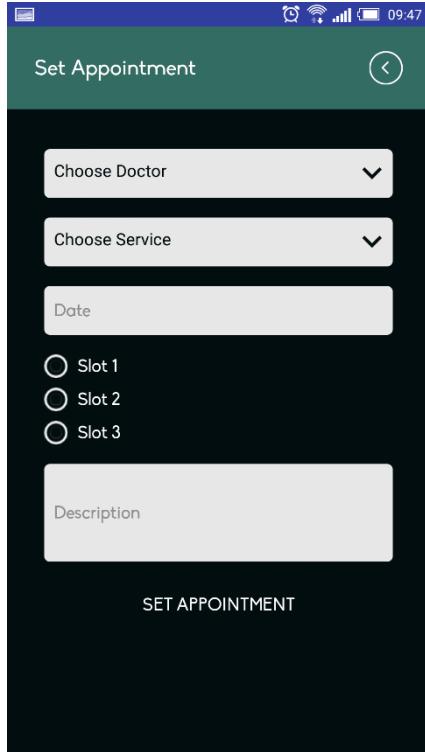


Figure 23: Set appointment activity (Android)

Based on the set appointment interface displayed in *Figure 23*, patient will be able to book an instant appointment. As the system will show the patient who are the available doctors that the patient can book an appointment with when selecting the spinner. Also, the system will show the consulting time slots of the selected doctor on the radio button as shown in *Figure 24*. *Figure 25* shows how patients can select the date of the appointment through date picker. *Figure 26* illustrate when how the system will reply when the patient books an appointment successfully. *Figure 27* represents what happened if patient tried to book a time slot with selected doctor that is already booked by another patient.

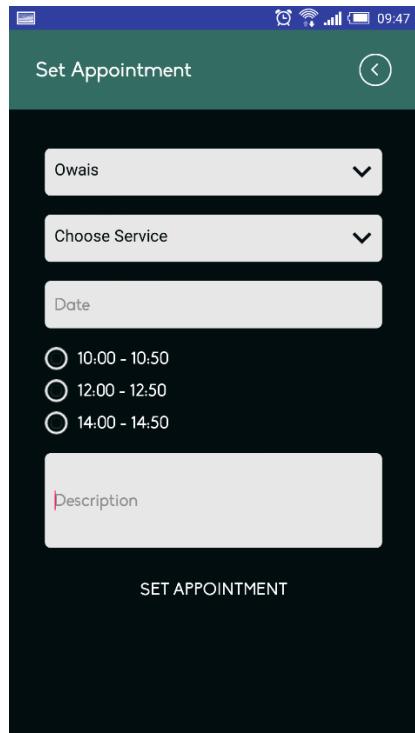


Figure 24: set appointment activity – selected doctor (Android)



Figure 25: Set appointment activity – select date (Android)

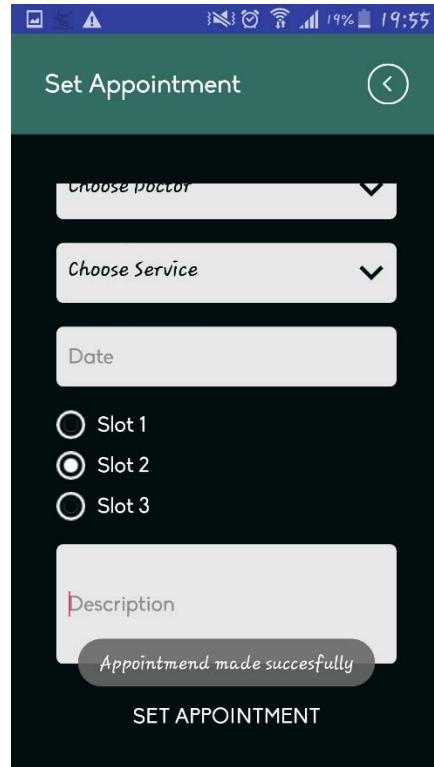


Figure 26: Set appointment – successful booking (Android)



Figure 27: Set appointment – appointment already booked (Android)

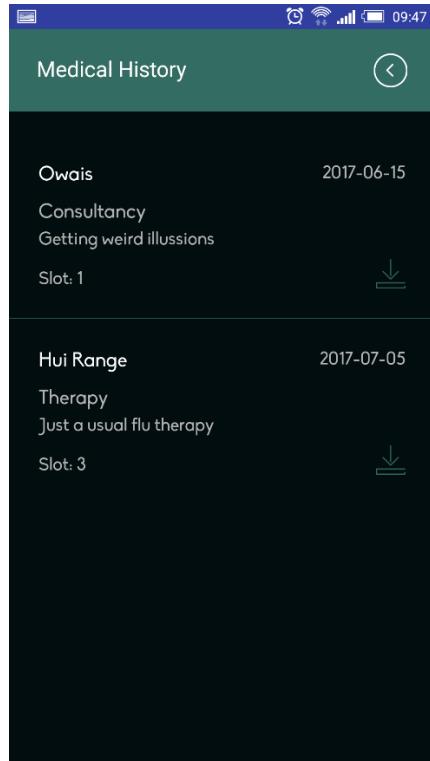


Figure 28: Medical history activity (Android)

As *Figure 28* shows the medical history activity where patients can check their previous medical records. This activity will allow patients to have a brief overview on their previous records (appointments) also will allow the patients to download the medical summary for that selected medical record as shown in *Figure 29*.

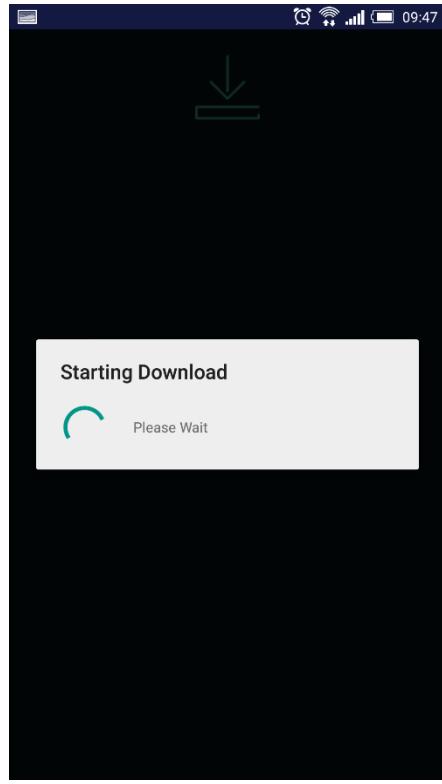


Figure 29: Medical history activity – download records (Android)

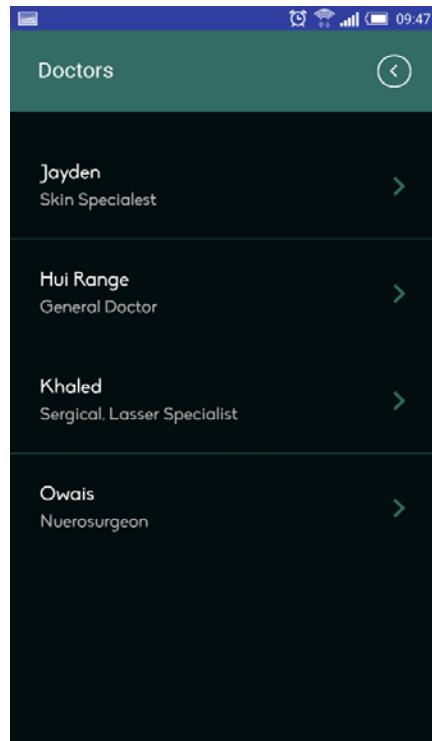


Figure 30: Check doctors (Android)

Figure 30 display the check doctors interface were patients can view the doctors who are working on the clinic. Patients can view some brief details of each selected doctor such as name, gender, specialist and consulting time slots as shown in *Figure 31*.

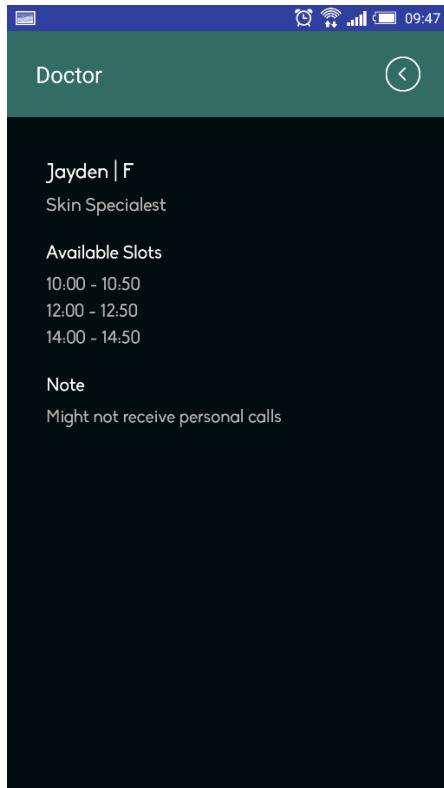


Figure 31: Check doctors – doctor details (Android)

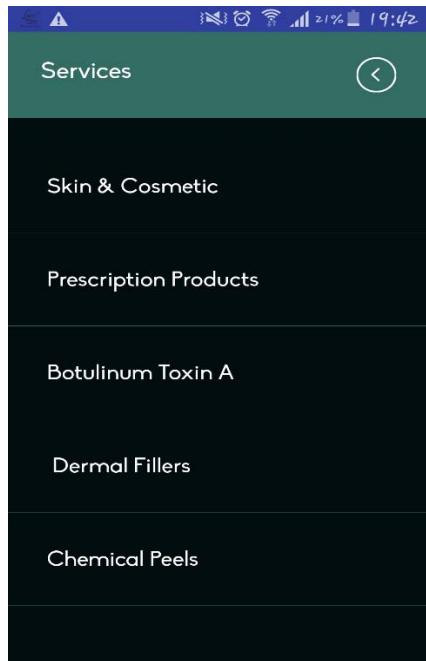


Figure 32: Check services (Android)

Figure 32 represent check services activity were patients can view the services provided by Laurent Bleu Clinic. Upon selecting (clicking) one service the patients can view the services description as show in Figure 33.

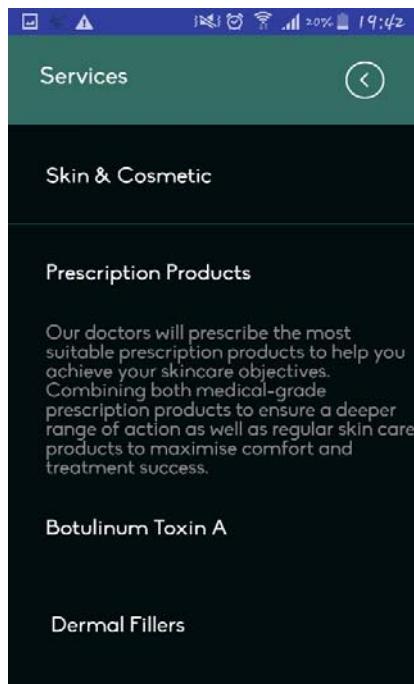


Figure 33: Check service – service details (Android)

When patients book an appointment successfully they will get a notification of the up-coming appointment's date. Also, each time they login in the application they will get notified with the up-coming appointment's date as presented in *Figure 34*.

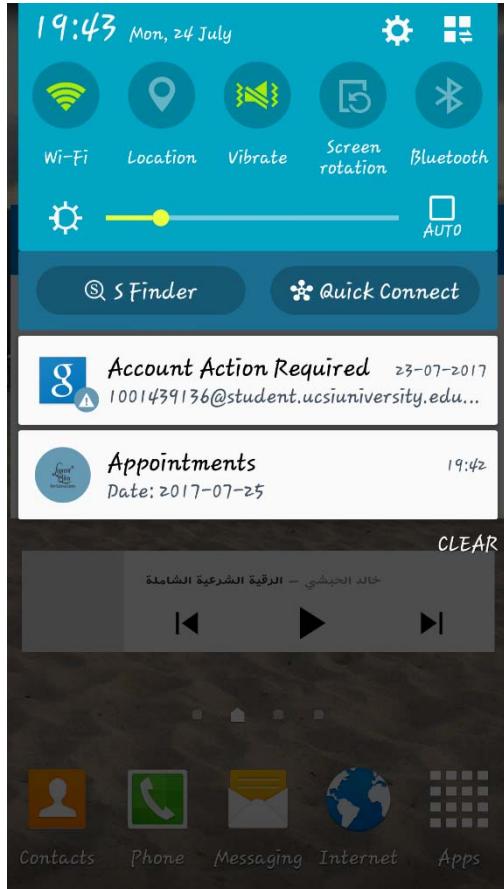


Figure 34: Notification of next appointments

4.3.2 Desktop application



Figure 35: Login activity (Desktop)

Figure 35 display the login activity that clinic staff and doctors will see when trying to access the clinic system. This interface allows clinic staff and doctors to login in and have access to Laurent Bleu Doctor-Patient Appointment System (LBDPAS). When the user login the system will determine whether the user is a clinic staff or a doctor. If the user was determined as a clinic staff it will show him to the staff side of the application which is shown in 4.3.2.2 *Clinic staff*. If the user was a doctor it will show him the doctors side of the application which is shown in 4.3.2.1 *Doctors*.

4.3.2.1 Doctors

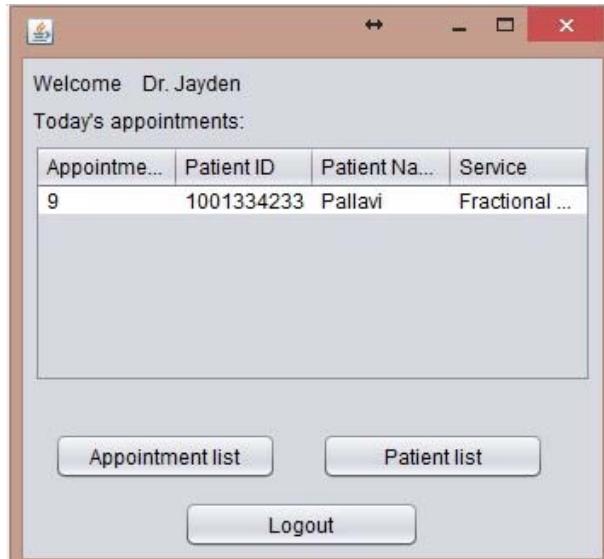
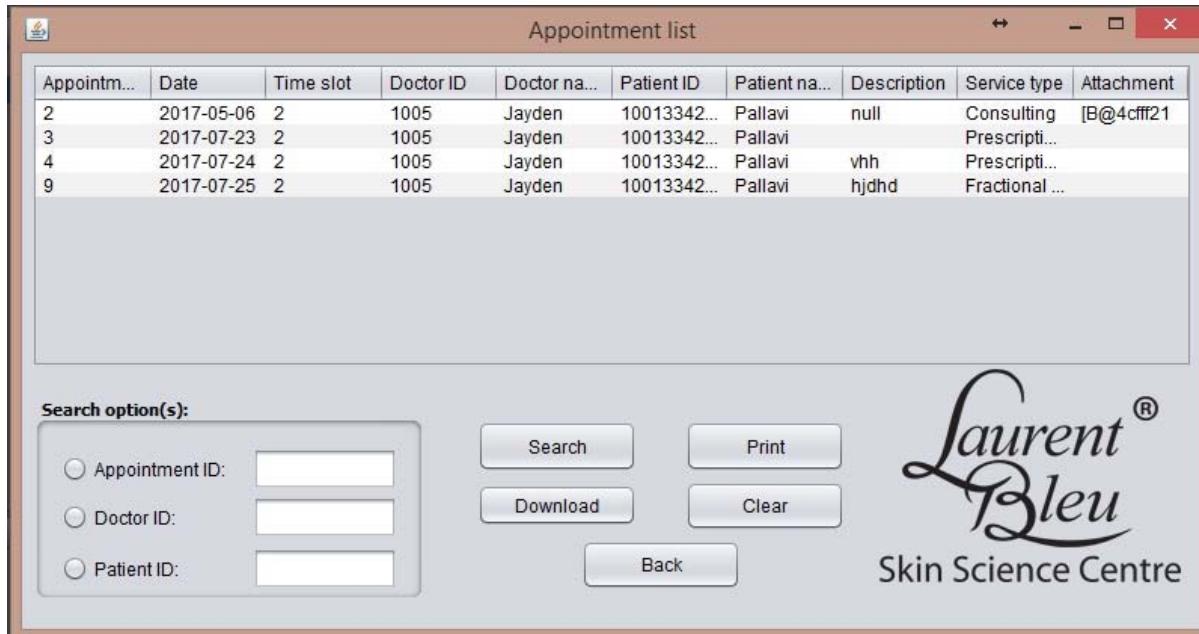


Figure 36: Doctor Menu (Desktop)

After logging in successfully in *Figure 35*, if the user was granted doctor privilege the system will show the user the doctor menu which displayed in *Figure 36*. Doctor menu contain the logged in doctor name and it shows him his appointments of the day. The doctor menu contains two actions which is opening patients list and appointment list.



The screenshot shows a Windows application window titled "Appointment list". The main area is a table with the following columns: Appointm..., Date, Time slot, Doctor ID, Doctor na..., Patient ID, Patient na..., Description, Service type, and Attachment. There are four rows of data:

Appointm...	Date	Time slot	Doctor ID	Doctor na...	Patient ID	Patient na...	Description	Service type	Attachment
2	2017-05-06	2	1005	Jayden	10013342...	Pallavi	null	Consulting	[B@4cff21
3	2017-07-23	2	1005	Jayden	10013342...	Pallavi		Prescripti...	
4	2017-07-24	2	1005	Jayden	10013342...	Pallavi	vhh	Prescripti...	
9	2017-07-25	2	1005	Jayden	10013342...	Pallavi	hjdhd	Fractional ...	

Below the table, there is a section titled "Search option(s):" with three radio buttons and input fields for Appointment ID, Doctor ID, and Patient ID. To the right of these buttons are "Search", "Print", "Download", and "Clear" buttons. A "Back" button is located at the bottom center. On the right side of the window, there is a logo for "Laurent Bleu Skin Science Centre".

Figure 37: Appointments list – doctor perspective (Desktop)

When the doctor views the appointments list it will show him his own appointments as shown in *Figure 37*. The doctor will be able to search the patients list based on appointment id and patient id and then print the result of the search as a portable document format (PDF) file as shown in *Figure 38, 39 and 40*. Also, the doctor will be able to download the attached documents with each appointment as shown in *Figure 41*.

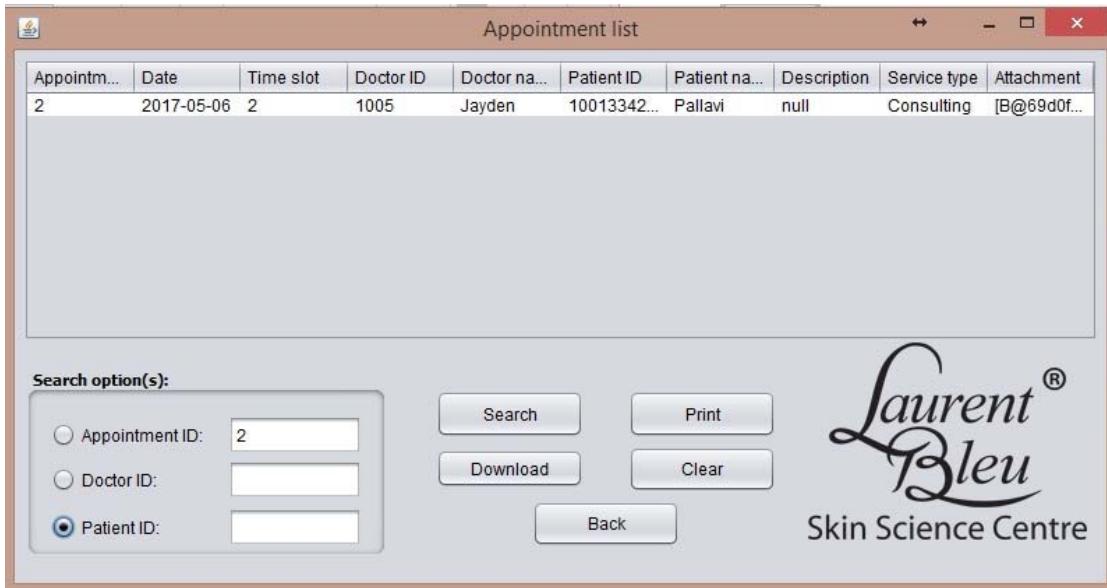


Figure 38: Appointment list – doctor perspective – search (Desktop)

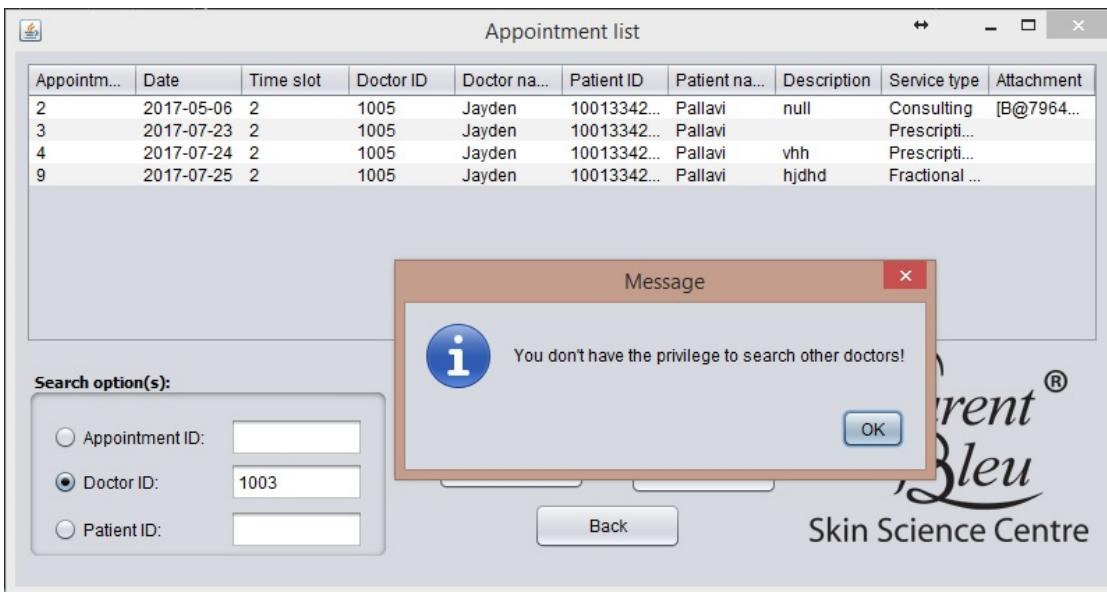


Figure 39: Appointment list - doctor perspective – can't search other doctors (Desktop)

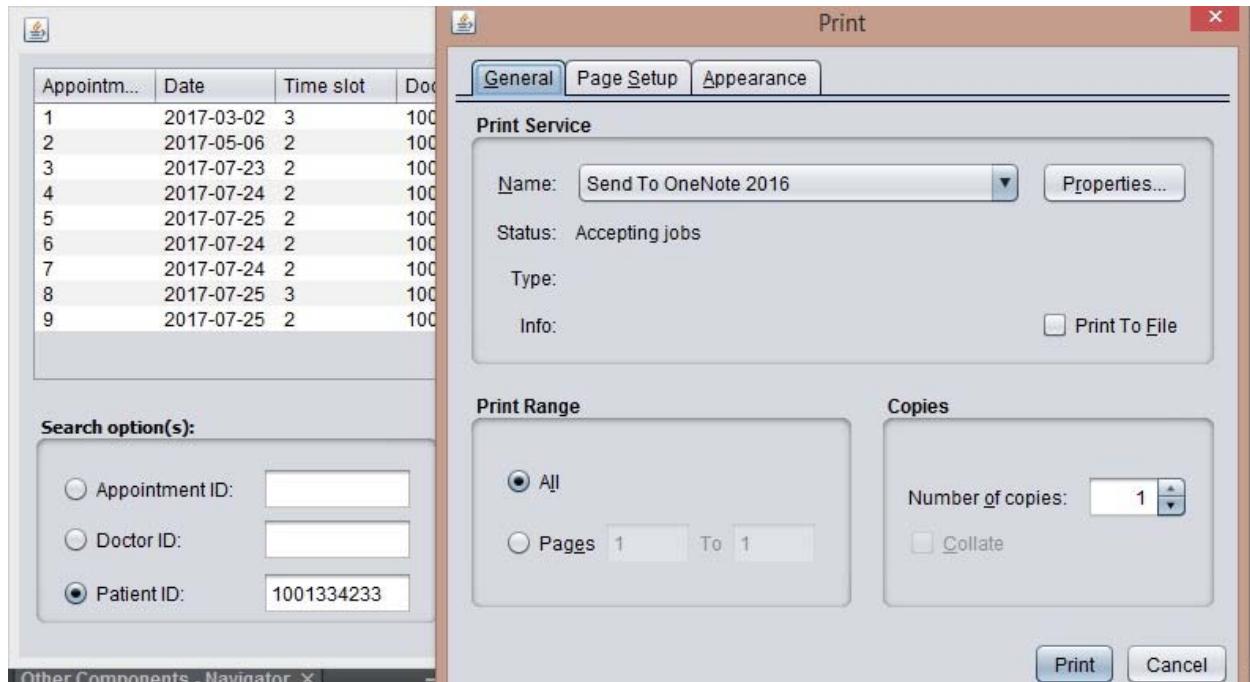


Figure 40: Appointment list – doctor perspective – printing (Desktop)

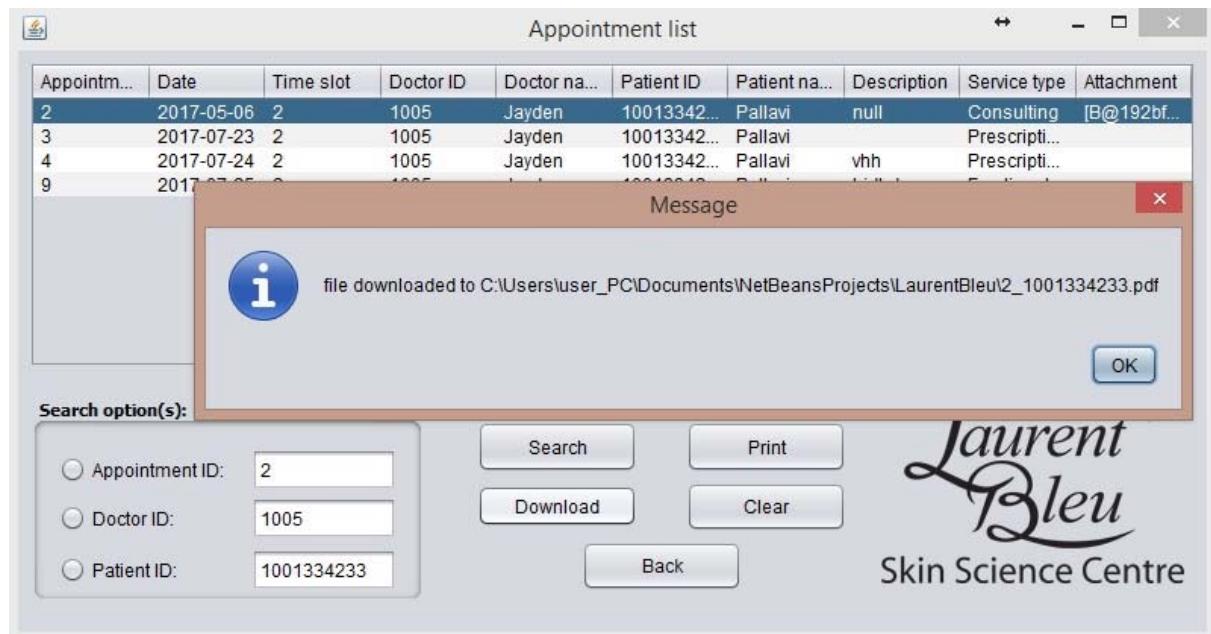


Figure 41: Appointment list – Download medical records (Desktop)

Figure 41 illustrate the process of downloading medical records of the selected appointment by the user. When download is completed it will shows a dialog that contains the downloaded path of the file and it will open the downloaded file.

The screenshot shows a desktop application window titled "Patients". The main area displays a table of patient information:

Patient ID	Name	Address	Date of birth	Gender	Occupation
100112669	Sayeda	Selangor, MY	1990-07-09 00:00...	F	Staff
1001334233	Pallavi	Selangor, MY	1993-06-05 00:00...	F	Student
1001336699	Lui	KL, MY	1996-09-11 00:00...	F	Staff
1001439136	Osama	KL, MY	1997-02-01 00:00...	M	Student

Below the table is a search interface labeled "Search option(s):" with four radio buttons and input fields for "Gender", "Occupation", "Address", and "Patient ID". To the right of the search buttons are "Search", "Print", "Clear", and "Back" buttons. The window has a watermark logo for "Laurent Bleu Skin Science Centre" in the bottom right corner.

Figure 42: Patient list (Desktop)

Figure 42 shows the patient list activity where doctor can view the list of patients who are registered in clinic. The doctor can perform simple actions on the patients list such as searching the list based on the provided search options and printing the table into portable document format (PDF).

4.3.2.2 Clinic staff

The screenshot shows a desktop application window titled "Staff Menu". The main area displays a table of "Today's appointments":

Appoint...	Doctor n...	Patient ID	Patient ...	Time slot
5	Khaled	100133...	Pallavi	2
8	Khaled	100133...	Pallavi	3
9	Jayden	100133...	Pallavi	2

Below the table are several buttons: "Email reminder", "Doctors", "Appointments", "Patients", and "Logout". The window has a "Welcome Lee" message at the top.

Figure 43: Staff menu (Desktop)

After logging in successfully, the user will be granted clinic staff privilege by the system and it will show him the staff menu as shown in *Figure 43*. Staff menu will contain the staff name and it will show him all the appointments of the day for all the doctors. The staff menu contains four actions that the logged in staff can perform which are sending reminders, adjusting doctor's availability, view patients list and manipulate appointments.

Doctors						
Doctor ID	Name	Time slot 1	Time slot 2	Time slot 3	Note	Available
1005	Jayden	10:00 - 10:50	12:00 - 12:50	14:00 - 14:50	available	1
1004	Hui Range	11:00 - 11:50	12:30 - 13:30	15:00 - 15:50	Make sure to...	0
1003	Khaled	11:30 - 12:20	13:30 - 14:20	16:00 - 16:50	Wont be arro...	1

Doctors:

Doctor ID:

Doctor Name:

Available slot 1:

Available slot 2:

Available slot 3:

Available: <Available>

Note:

Tool panel:

Laurent[®]
Bleu
Skin Science Centre

Figure 44: Doctor availability manipulation (Desktop)

Figure 44 shows manipulating availability of doctor activity. This interface allows the user to perform a simple manipulation such as updating and viewing the doctors consulting slots. As shown in *Figure 45* if the doctor is available to work in the clinic the system will change the doctor id section to green and if the doctor is not available the color will be red as shown in *Figure 46*.

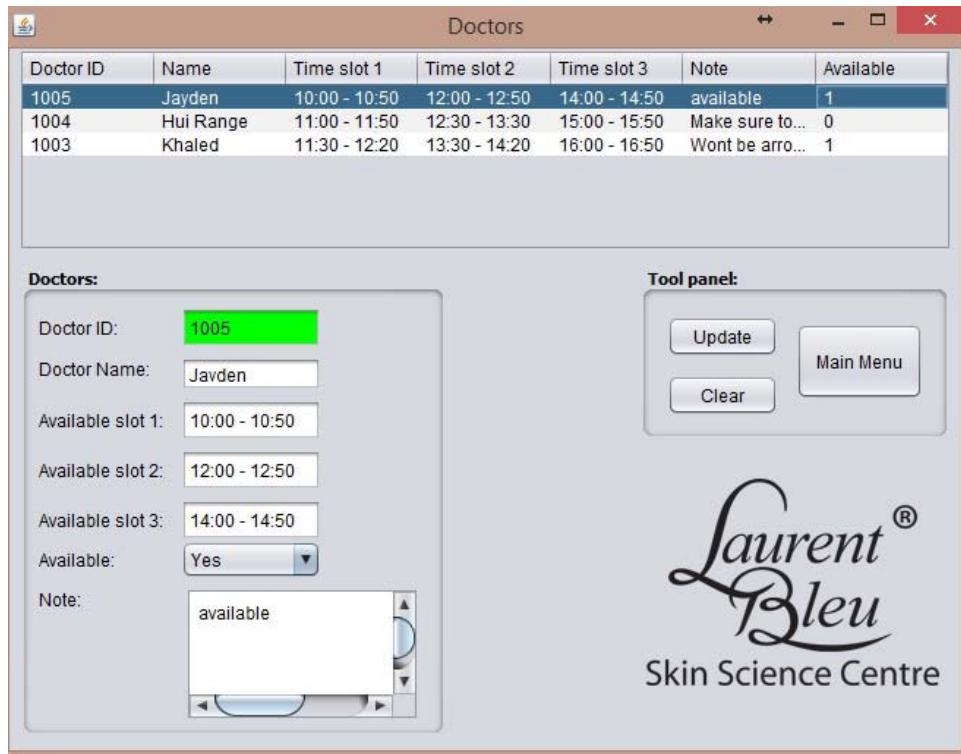


Figure 45: Doctor availability manipulation – available (Desktop)

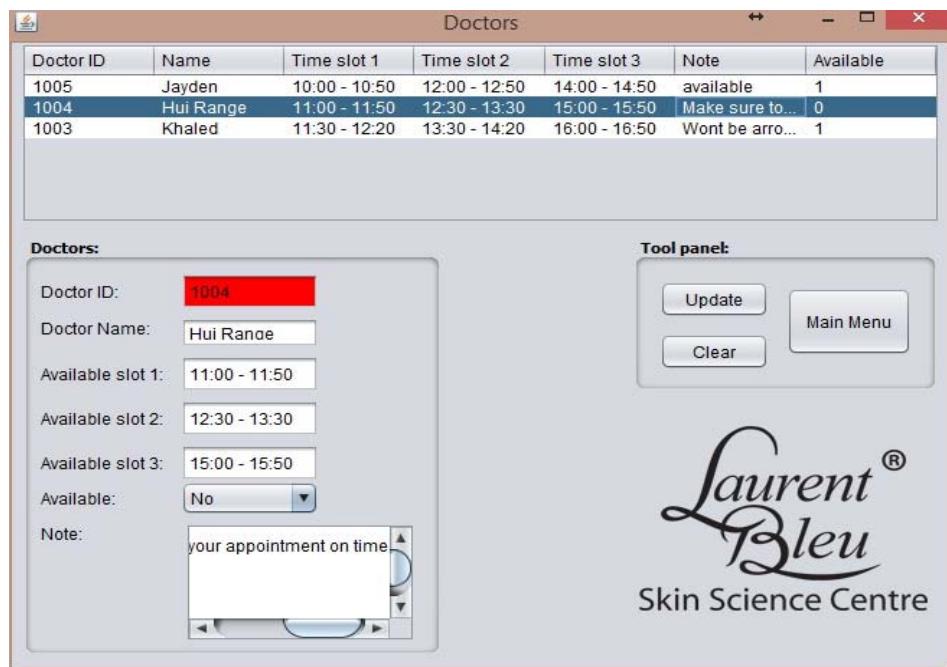


Figure 46: Doctor available manipulation – not available (Desktop)

The screenshot shows a Windows application window titled "Patients". The main area displays a table with the following data:

Patient ID	Name	Address	Date of birth	Gender	Occupation
100112669	Sayedha	Selangor, MY	1990-07-09 00:00...	F	Staff
1001334233	Pallavi	Selangor, MY	1993-06-05 00:00...	F	Student
1001336699	Lui	KL, MY	1996-09-11 00:00...	F	Staff
1001439136	Osama	KL, MY	1997-02-01 00:00...	M	Student

Below the table is a section titled "Search option(s):" containing four radio buttons and input fields:

- Gender: [input field]
- Occupation: [input field]
- Address: [input field]
- Patient ID: [input field]

Buttons for "Search", "Print", "Clear", and "Back" are also present. The logo "Laurent Bleu Skin Science Centre" is visible on the right side of the interface.

Figure 47: Patient list (Desktop)

Figure 47 show the patients list were clinic staff can view the list of patients who are registered in the clinic. The staff can perform a simple action such as searching based on the provided search options from the system and print the shown table on the interface to a portable document format (PDF).

Figure 48 illustrates the appointments activity interface. Within this interface the staff will be able to perform few actions to the appointments such as booking new appointment, updating an existing appointment details and deleting appointment. Also, staff will be able to access the appointment list where they will be able to perform search options, download medical summary and print the list of appointment as shown in Figure 41. Through this interface staff will be able to attach the medical summary to the medical record (appointment) as shown in Figure 49 and Figure 50.

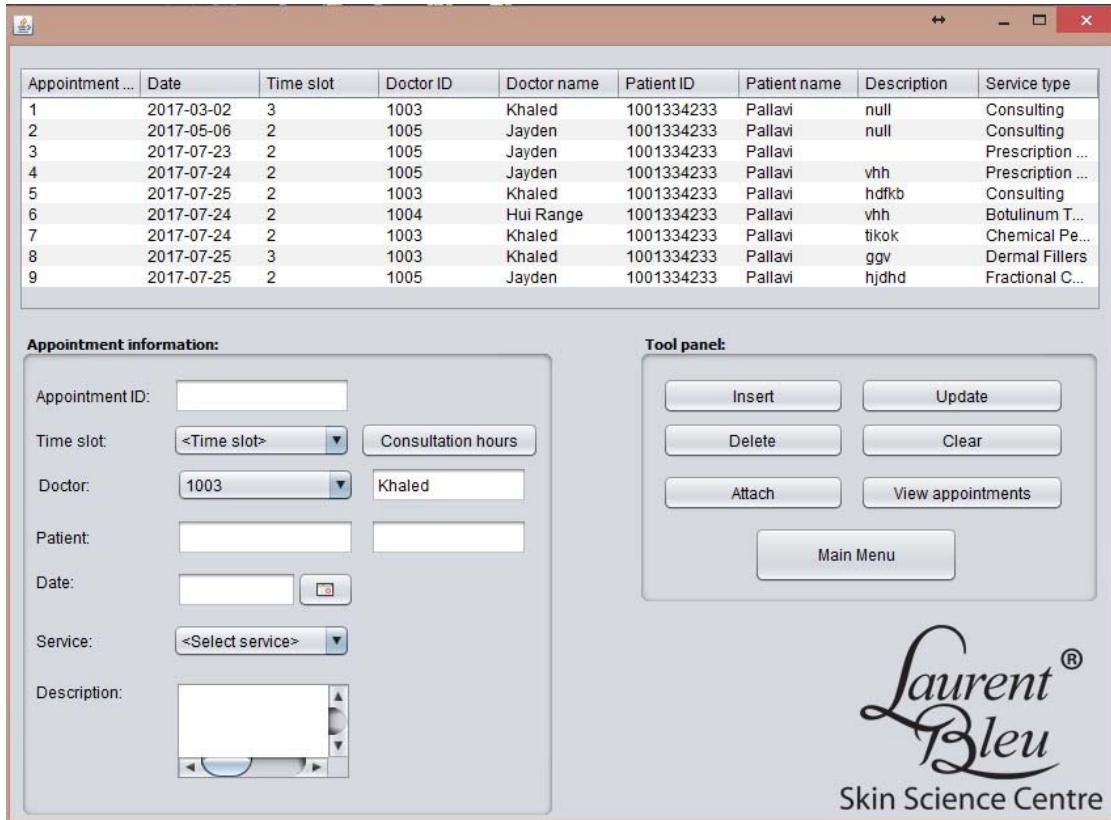


Figure 48: Appointments activity (Desktop)

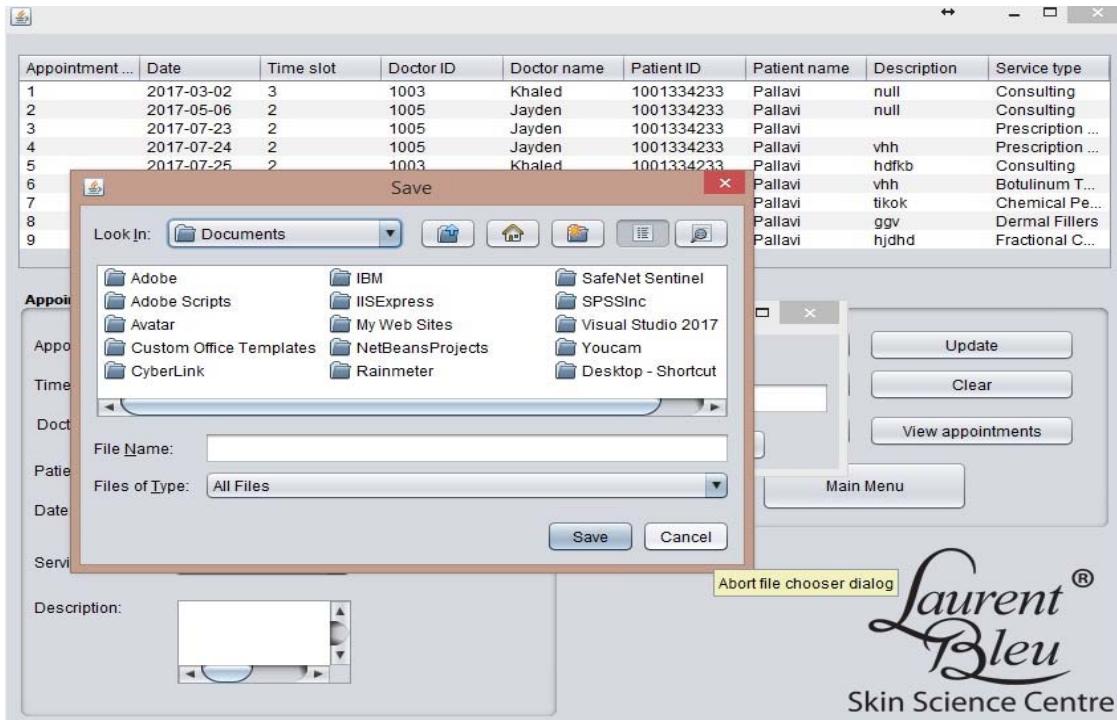


Figure 49: Appointments - Choosing attachment (Desktop)

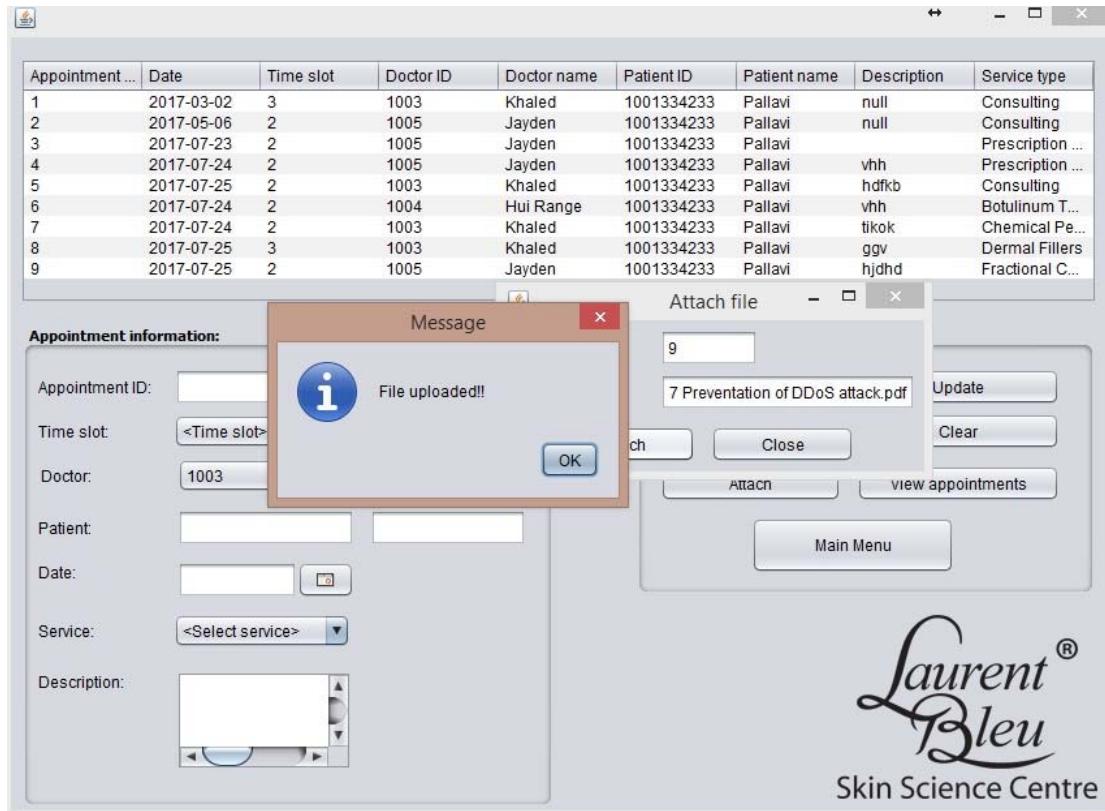


Figure 50: Appointment– Attachment uploaded (Desktop)

When the clinic staff are booking an appointment, they will be able to check the doctor consulting slots through a button. When the staff click the button to check the doctor consulting slots a small interface will appear as shown in in *Figure 51* which will show brief data about the selected doctor such as time slots, id and if he is available or not through the color of the doctor name text-field. If the color is green means that the doctor is available and if its red means the doctor is not available.

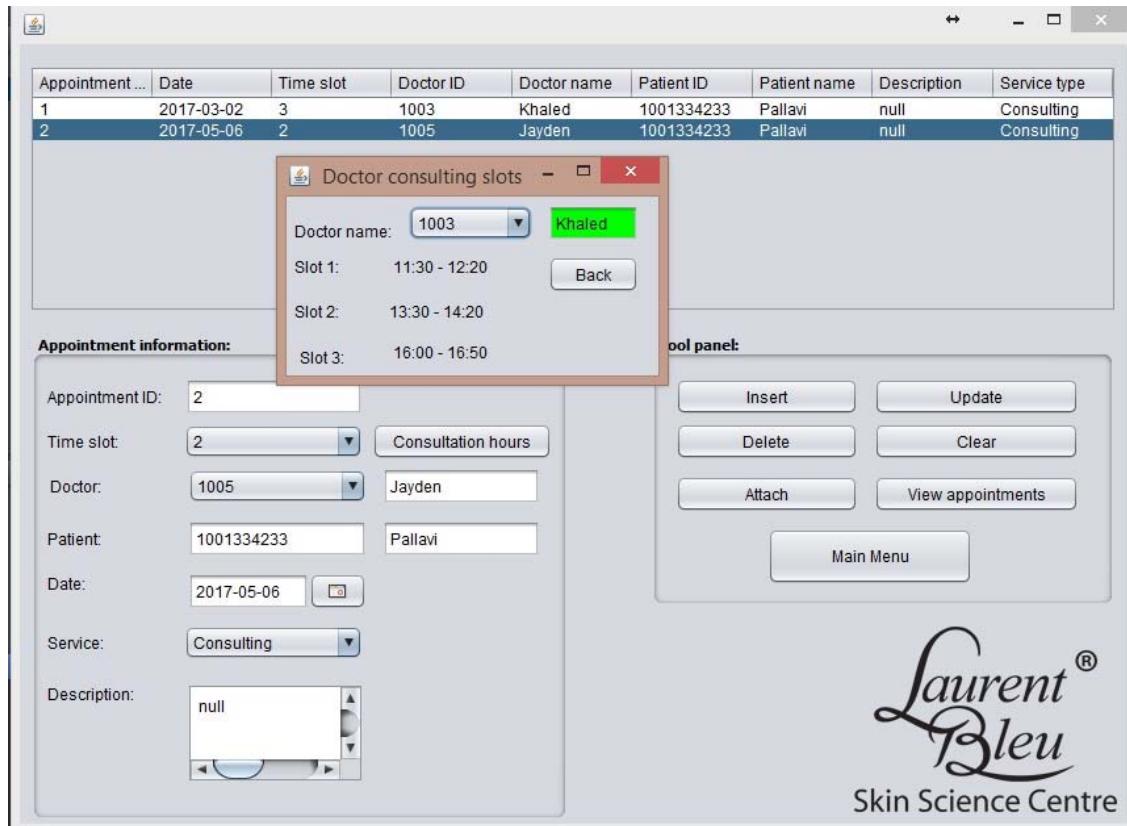


Figure 51: Appointments - doctor consulting (Desktop)

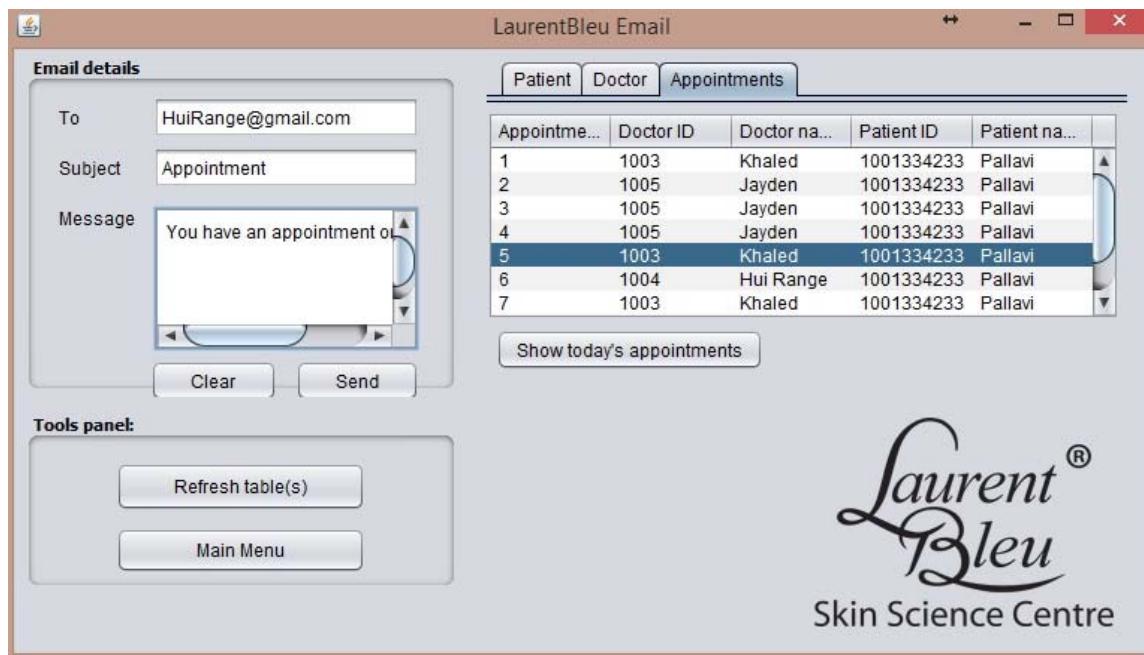


Figure 52: Email reminder (Desktop)

Figure 52 illustrates the email reminder activity where staff can check the list of patients, doctors and appointments. The staff will be provided with a filtering option when viewing the appointments list which is only showing the appointments of the day as shown in *Figure 53*. Email reminder interface will allow the user to be able to send an email without the need of accessing mailing service through browser (i.e. Google mail through google chrome) as represented in *Figure 54*.

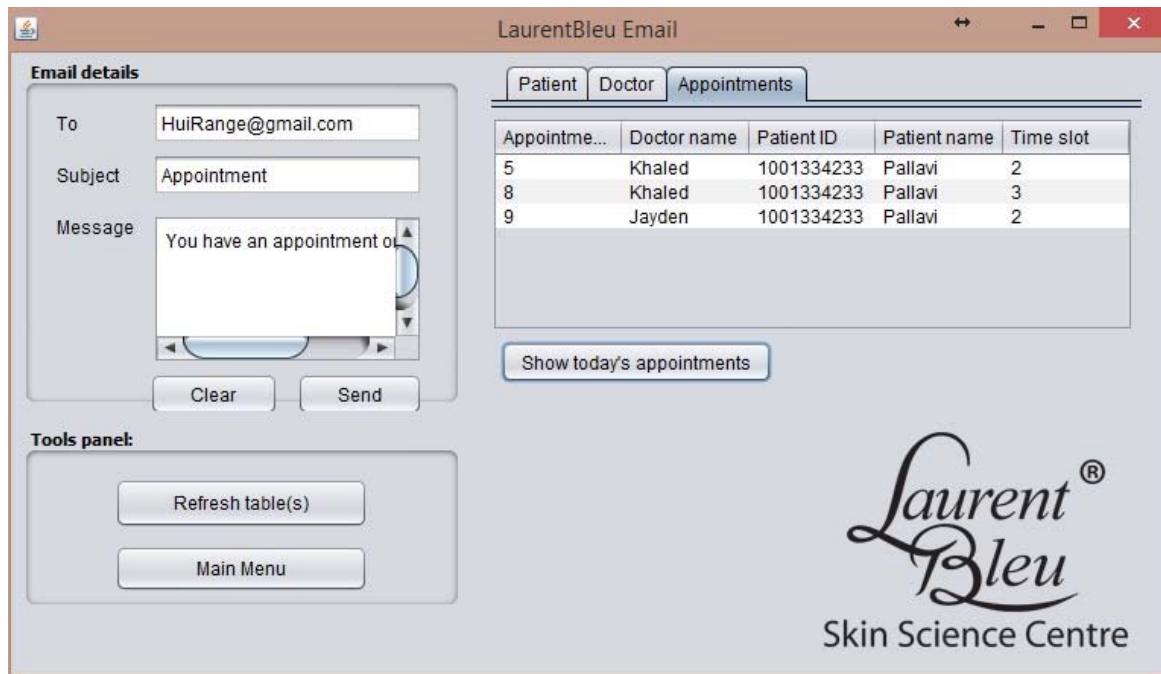


Figure 53: Email reminder – appointment of the day (Desktop)

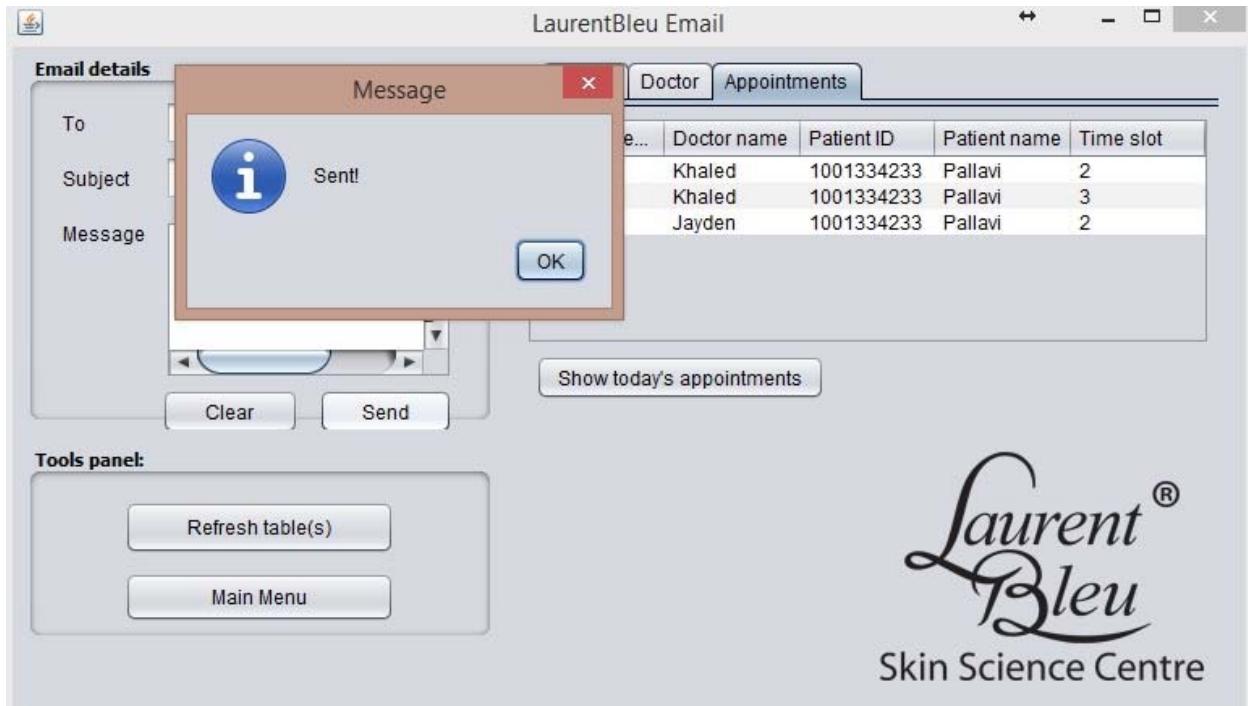


Figure 54: Email reminder – Sent email (Desktop)

4.4 System requirement

4.4.1 Functional requirement

Functional requirement is the events carried during the system operation which include specific functionalities represents what the system is supposed to accomplish. Behavior requirement is when the system uses the functional requirements, which is represented as a use cases in *4.1 Functional design*.

4.4.2 Non-functional requirement

- i. Execution quality
- Activity timeout: limited duration is given while interacting within activity.
- ii. Performance
- Processing time: calculation, import and export.
- iii. Capacity
- System is capable of storing documents as binary data within table rows in the server, to keep the attached document connected to the row it's attached to.

iv. Availability

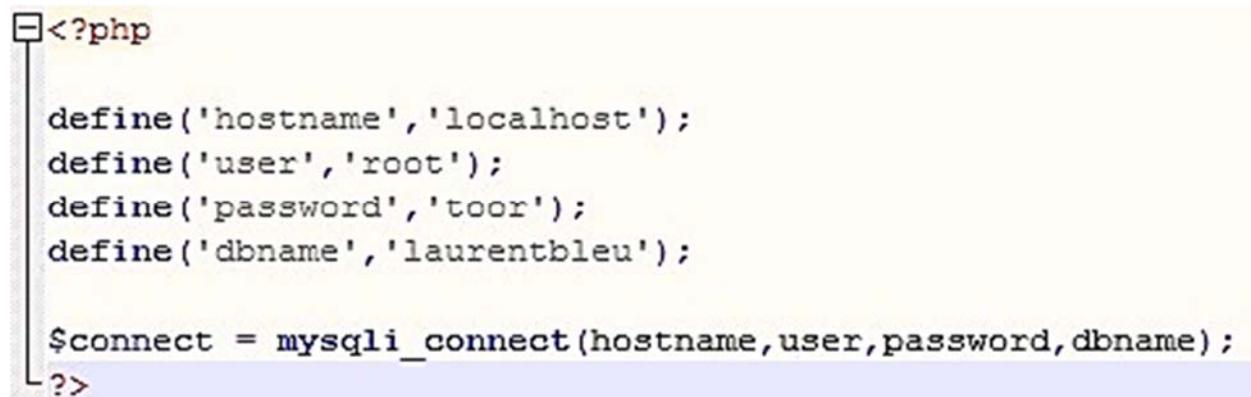
- Operating hours: patients can book an appointment after operating hours.

4.5 Implementation

This project was mainly developed under Java platform using Android studio and NetBeans IDE 8.2. The hosting service of the system is WAMP running apache server supporting MYSQL platform which is where the system database was developed using Structured Query Language (SQL) as developing language and Personal Home Page (PHP) as a medium to maintain connection between android application and the database in the server.

4.5.1 PHP

Personal Home Page (PHP) is a scripting language used in the use of the web such as web developing web applications or any application who deal with servers on the web. PHP has been used in this project to act as a medium of data exchange between android application and WAMP server. *Figure 55* illustrate the connection class that is used to connect the android application to the server.



```
<?php

define('hostname','localhost');
define('user','root');
define('password','toor');
define('dbname','laurentbleu');

$connect = mysqli_connect(hostname,user,password,dbname);
?>
```

Figure 55: PHP connection to database (Android)

```
<?php

if($_SERVER["REQUEST_METHOD"]=="POST")
{
    require 'connection.php';

    $patient_id = $_POST['patient_id'];
    $password = $_POST['password'];

    login($patient_id, $password);
}

function login($patient_id, $password)
{
    global $connect;
    $query = "Select * from patientlogin where patient_id= '$patient_id' and password = '$password' ";

    $result = mysqli_query($connect,$query);

    if(mysqli_num_rows($result)>0){
        $json['s'] = 'Logged in successfully';
        mysqli_close($connect);
    }else{
        $json['e'] = 'Incorrect Username/Password';
    }
    echo json_encode($json);
}

?>
```

Figure 56: PHP user login (Android)

Figure 56 shows the PHP code that is being used to perform the function of login for the user. The method POST used to retrieve data from the application and pass it to PHP scripting class.

```

<?php
require 'connection.php';
global $connect;
$id = $_POST['ap_id'];
$fileName = $_POST['fileName'];

$query = "select ap_attach from appointments where ap_id = '$id'";
$result = mysqli_query($connect, $query);
$number_of_rows = mysqli_num_rows($result);

if($number_of_rows > 0) {
    while ($row = mysqli_fetch_assoc($result)) {
        $name = $row['ap_attach'];
    }
}

file_put_contents('pdf/'.$fileName, $name);

header('Content-type: application/pdf');
header("Cache-Control: no-cache");
header("Pragma: no-cache");
header("Content-Disposition: inline;filename=myfile.pdf'");
header("Content-length: ".strlen($name));

echo $name;
?>

```

Figure 57: PHP download attachment file from database (Android)

Figure 57 represent the method that researcher has used in-order to download the binary long object (BLOB) files from the database into the server, and then downloaded through the projected code into the user's device.

Figure 58 shows the script used to book an instant appointment by the user through the android application. The projected PHP script act as a scheduler to ensure that there is no duplication in the appointments while booking as shown in *Figure 59*.

```

<?php
if($_SERVER["REQUEST_METHOD"]=="POST"){

    require 'connection.php';
    global $connect;

    $ap_date = $_POST["ap_date"];
    $ap_slot = $_POST["ap_slot"];
    $dr_id = $_POST["dr_id"];
    $dr_name = $_POST["dr_name"];
    $p_id = $_POST["p_id"];
    $p_name = $_POST["p_name"];
    $ap_description = $_POST["ap_description"];
    $ap_service = $_POST["ap_service"];


    $query1 = "SELECT ap_slot, ap_date, dr_id from appointments where ap_slot = '$ap_slot' and ap_date = '$ap_date' and dr_id = '$dr_id'";

    $result = mysqli_query($connect,$query1);

    if(mysqli_num_rows($result)>0)
    {
        $json['e'] = 'Appointment slot already taken';
        echo json_encode($json);
        mysqli_close($connect);
    }
    else
    {
        $query = "INSERT INTO appointments(ap_date, ap_slot, dr_id, dr_name, p_id, p_name, ap_description, ap_service) values('$ap_date', '$ap_slot', '$dr_id',
        '$dr_name', '$p_id', '$p_name', '$ap_description', '$ap_service')";

        if(mysqli_query($connect, $query)){
            $json['s'] = 'Appointment made successfully';
            mysqli_close($connect);
        }else{
            $json['e'] = 'Internal error';
        }
        echo json_encode($json);
    }
}
?>

```

Figure 58: PHP appointment booking (Android)

Figure 59 represents the SQL query from *Figure 58* that acts as scheduler. The SQL query filters the appointments table to check whether there is any existing appointment with the given data from the user or not, in order to determine whether to book the chosen slot for the user.

```

$query1 = "SELECT ap_slot, ap_date, dr_id from appointments
where ap_slot = '$ap_slot' and ap_date = '$ap_date' and dr_id = '$dr_id'";

```

Figure 59: PHP Instant appointment booking (Android)

4.5.2 NetBeans (Java SE)

```
import java.sql.*;
import javax.swing.*;  
  
public class JavaConnect {  
  
    Connection conn = null;  
    public static Connection ConnectDb() {  
  
        try {  
            Class.forName("com.mysql.jdbc.Driver"); // database directory  
  
            /** get connection from mySQL**/  
            Connection conn = DriverManager.getConnection("jdbc:mysql://localhost:3306/laurentbleu?aut" + "|reconnect=true&useSSL=false","root","toor");  
            return conn;  
  
        } catch (Exception ex){  
            JOptionPane.showMessageDialog(null, ex);  
        }  
  
        return null;  
    }  
}
```

Figure 60: Java connection class (Desktop)

Figure 60 illustrates the connection class that is created using Java SE programming language on NetBeans IDE to connect to the online database.

Figure 61 shows the source code of the activity upload, were user will be able to able medical records as a binary long object (BLOB) into the database. The user will choose the file through a file chooser and then pass the path to the database through a file input stream method.

```

private void btnChooserActionPerformed(java.awt.event.ActionEvent evt) {
    JFileChooser JFC = new JFileChooser();
    FileNameExtensionFilter filter = new FileNameExtensionFilter("doc", "docx", "pdf");
    JFC.addChoosableFileFilter(filter);
    int result = JFC.showSaveDialog(null); // show JFileChooser
    if (result == JFC.APPROVE_OPTION){
        File File = JFC.getSelectedFile();
        String filePath = File.getAbsolutePath(); // get file path
        txtPath.setText(filePath);
        s = filePath;
    }

    try {
        String sql = "Update appointments set ap_attach = ? where ap_id =?";
        pst=conn.prepareStatement(sql);
        InputStream is = new FileInputStream(new File(s));
        pst.setBinaryStream(1, is);
        pst.setInt(2, Integer.parseInt(ap_id.getText()));
        pst.executeUpdate();

        JOptionPane.showMessageDialog(null, "File uploaded!!");

    } catch (Exception ex){
        JOptionPane.showMessageDialog(null, "error, please check inputted data"+ex);
        ex.printStackTrace();
    }finally {
        try {

            pst.close();
            //conn.close();
        } catch (Exception ex){
            JOptionPane.showMessageDialog(null, ex);
            ex.printStackTrace();
        }
    }
}

```

Figure 61: Java upload files as BLOB into database (Desktop)

4.5.3 MySQL

Name	Type	Collation	Attributes	Null	Default	Comments	Extra
ap_id 	int(11)			No	None		AUTO_INCREMENT
ap_date	date			No	None		
ap_slot	varchar(45) utf8_general_ci			Yes	NULL		
dr_id 	int(11)			No	None		
dr_name	varchar(45) utf8_general_ci			Yes	NULL		
p_id 	int(11)			No	None		
p_name	varchar(45) utf8_general_ci			Yes	NULL		
ap_description	varchar(45) utf8_general_ci			Yes	NULL		
ap_service	varchar(45) utf8_general_ci			No	None		
ap_attach	longblob			Yes	NULL		

Figure 62: MySQL appointment table structure

Name	Type	Collation	Attributes	Null	Default	Comments	Extra
p_id  	int(11)			No	None		
p_name	varchar(45) utf8_general_ci			No	None		
p_address	varchar(45) utf8_general_ci			No	None		
p_dob	datetime			No	None		
p_gender	varchar(45) utf8_general_ci			No	None		
p_occupation	varchar(45) utf8_general_ci			No	None		

Figure 63: MySQL patient login table structure

Name	Type	Collation	Attributes	Null	Default	Comments	Extra
s_id	int(4)			No	None		
s_name	varchar(45)	utf8_general_ci		No	None		
s_address	varchar(45)	utf8_general_ci		No	None		
s_salary	int(11)			No	None		
s_occupation	varchar(45)	utf8_general_ci		No	None		
s_dob	datetime			No	None		
s_gender	enum('M', 'F')	utf8_general_ci		No	M		

Figure 64: MySQL staff login table structure

Figure 62 shows the table structure of appointments table were the primary key is marked with golden key with auto-incrementation and foreign key is marked with silver key. *Figure 63* shows table structure of patient table and *Figure 64* shows the table structure of staff table. *Figure 65* and *Figure 66* represents the user's data that will be used when trying to access both applications desktop and android.

patient_id	patient_name	password	patient_email
1001439136	Osama	123456789	osama@gmail.com
1001334233	Pallavi	123456789	pallavi@gmail.com
1001336699	Lui	123456789	Lui@gmail.com
100112669	Sayedha	123456789	Sayedha@gmail.com

Figure 65: MySQL patient login table

s_id	name	password	privilege	s_email
1001	Lee	123456789	0	lee@gmail.com
1002	Hui	123456789	0	Hui@gmail.com
1003	Khaled	123456789	1	khaled@gmail.com
1004	Hui Range	123456789	1	HuiRange@gmail.com
1005	Jayden	123456789	1	Jayden@gmail.com

Figure 66: MySQL staff login table

4.5.4 Android Studio (Java)

Android studio IDE was used to develop the proposed application on Android platform using Java programming language. In-order to help pass data within the application activities and the online database java script object nation (JSON) volley library was used to achieve the objective of the application.

```
public class Connection {  
    public String url = "http://192.168.0.165";  
  
    Connection()  
    {}  
}
```

Figure 67: Android studio connection class

Figure 67 shows the connection class which is used to establish connection between the android application and the server. The declared string shows the internet protocol (IP) of the server that is used in the proposed system.

```
public void downloadFile(){  
    downloadManager = (DownloadManager) getSystemService(Context.DOWNLOAD_SERVICE);  
    Uri uri = Uri.parse(con.url+"/lssc/pdf/"+output+".pdf");  
    DownloadManager.Request request = new DownloadManager.Request(uri);  
    request.setNotificationVisibility(DownloadManager.Request.VISIBILITY_VISIBLE_NOTIFY_COMPLETED);  
    Long reference = downloadManager.enqueue(request);  
    startActivityForResult(new Intent(getApplicationContext(), MedicalHistoryListActivity.class));  
    finish();  
}
```

Figure 68: Android studio download file

Figure 68 represent the method that is used to allow the user to download the attachments from the online database to the user's device. Download manager class was used to issue a request to get the attached file and download it to the download manager file in the user's device. Simply the attached files will be downloaded from the online database to file with the name “pdf” on the server and then will be downloaded through the download manager class to the user's device.

```
@Override
protected Map<String, String> getParams() throws AuthFailureError {
    HashMap<String, String> map = new HashMap<>();
    map.put("ap_date", date_txt.getText().toString());
    map.put("ap_slot", get_slot());
    map.put("dr_id", get_d_id.toString());
    map.put("dr_name", doctor_spi.getSelectedItem().toString());
    map.put("p_id", logged_in_user_email.toString());
    map.put("p_name", get_patient_firstname.toString());
    map.put("ap_description", "");
    map.put("ap_service", services_spi.getSelectedItem().toString());

    return map;
}
```

Figure 69: Android studio book appointment

Figure 69 shows how the data are passed from the android application to the server. The data are passed to a HashMap with the help of java script object nation (JSON) volley library to the PHP script displayed in *Figure 58* and *Figure 59* to perform the SQL statements to the online database. The method which is used to send and receive data between the application and the PHP script is POST method.

```
apply plugin: 'com.android.application'

android {
    compileSdkVersion 26
    buildToolsVersion "26.0.0"
    defaultConfig {
        applicationId "com.example.a.laurentbleu2"
        minSdkVersion 16
        targetSdkVersion 26
        versionCode 1
        versionName "1.0"
        testInstrumentationRunner "android.support.test.runner.AndroidJUnitRunner"
    }
    buildTypes {
        release {
            minifyEnabled false
            proguardFiles getDefaultProguardFile('proguard-android.txt'), 'proguard-rules.pro'
        }
    }
}

dependencies {
    compile fileTree(dir: 'libs', include: ['*.jar'])
    androidTestCompile('com.android.support.test.espresso:espresso-core:2.2.2', {
        exclude group: 'com.android.support', module: 'support-annotations'
    })
    compile 'com.mcxiaoke.volley:library:1.0.19'
    compile 'com.android.support:appcompat-v7:26.+'
    compile 'com.android.support.constraint:constraint-layout:1.0.2'
    compile 'com.android.support:design:26.+'
    testCompile 'junit:junit:4.12'
}
```

Figure 70: Android studio dependencies

Figure 70 illustrates the android application dependencies. The dependencies is where the developer can adjust the application programming interface (API) of the developed application and set the minimum API version that can runs the application and the targeted API version. In the context of the proposed system, the minimum API level is 16 and the targeted API is 26. Also, the dependencies show the used libraries within the development process of the project such as JSON volley library.

Chapter 5: Evaluation

5.1 System Evaluation

This chapter will cover system evaluation to the proposed system and measure the acceptance level to the system through distributed survey to Laurent Bleu clinic patients and staff. To ensure the accuracy of the proposed system to the clinic performance five questionnaires will be distributed to Laurent Bleu clinic staff and 25 questionnaires will be distributed among Laurent Bleu patients.

5.2 User's feedback

This section aims to illustrate the results of the survey that has been used to evaluate the proposed system. The responders of the evaluation survey have been asked to give their opinion on the system functionality, user friendly, helpfulness, proposed appointment booking method and the proposed service online medical records. The responders were asked to respond by rating the proposed method as excellent, good, satisfactory, below average and poor. The survey was distributed on patients, doctors and clinic staff as shown in *Table 9*.

Table 9: Targeted user types

User type	No. of Responders
Patient	10
Doctor	2
Clinic staff	3
Sample size (Total)	15

The number of responders had been decided through the formula used in 2.2.2 *Survey*, with population size of 50, confidence level 95% and margin error 29 yielded 15 as a sample size. The selected 15 responders who took place evaluating the proposed system, they also participated on the survey which had been conducted in 2.2 *Data collection*.

5.2.1 System function evaluation

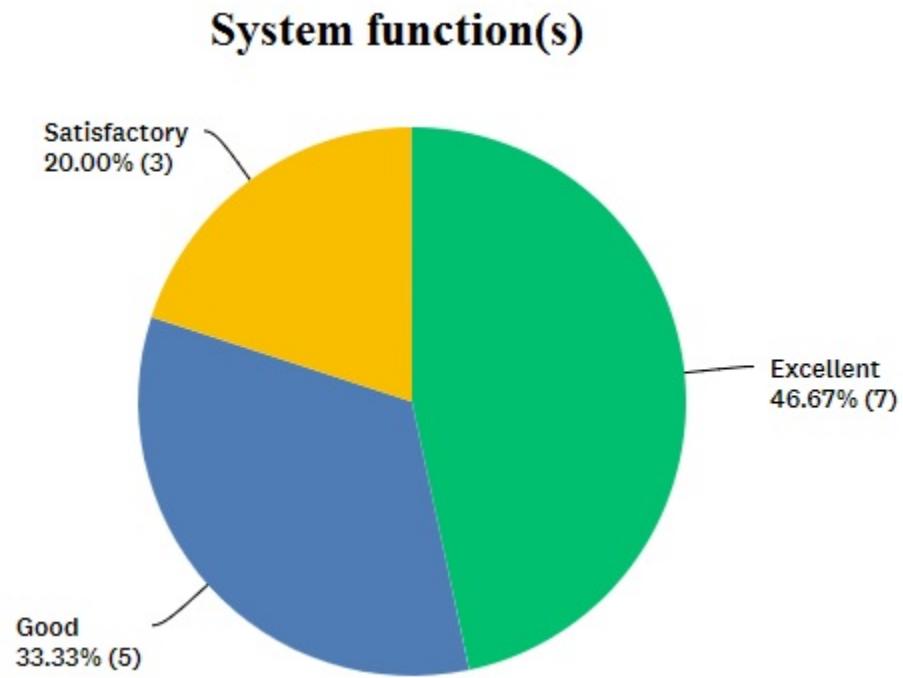


Figure 71: Evaluation of system function(s)

Based on *Figure 71* the majority of responders 46% had rated the system as excellent and 33.33% of responders said that the system functionalities are good, while 20% of responders rated the system functionalities as satisfactory. Thus, this shows that the responses are satisfied with the proposed system functionalities.

5.2.2 Evaluation of online appointment booking method

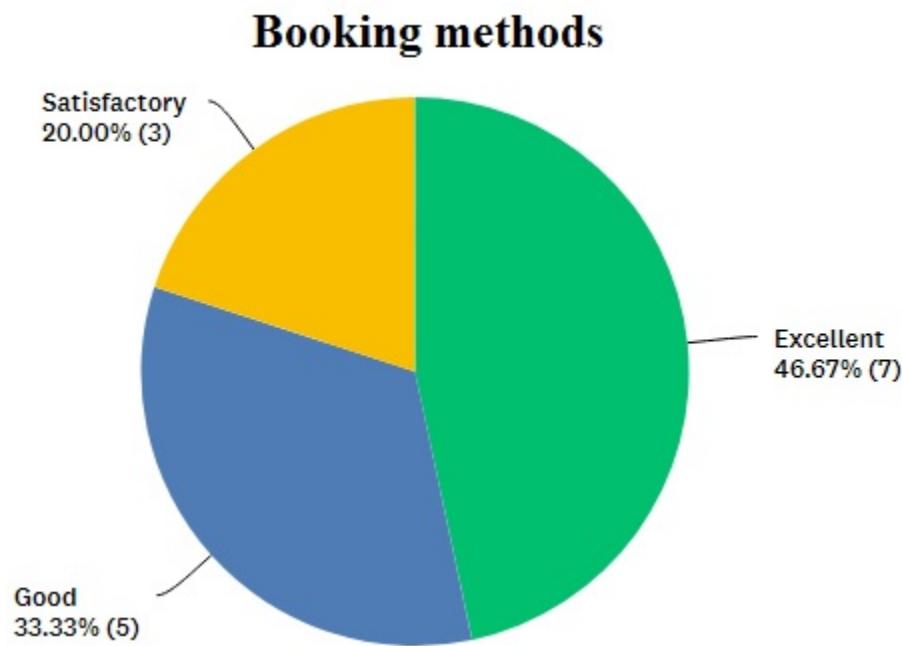


Figure 72: Evaluation of online appointment booking method

Figure 72 illustrate the satisfaction level of responders on the proposed system online appointment booking method for patients. 46.6% of responders rated the online appointment booking method as excellent and 33.33% of responders said that the online appointments booking method for patient is good while 20% which is 3 responders said that the booking method is satisfactory. Based on the collected responses, it shows that the appointment booking method that is proposed in the LBDPAS system is performing excellent.

5.2.3 Evaluation of proposed system friendliness

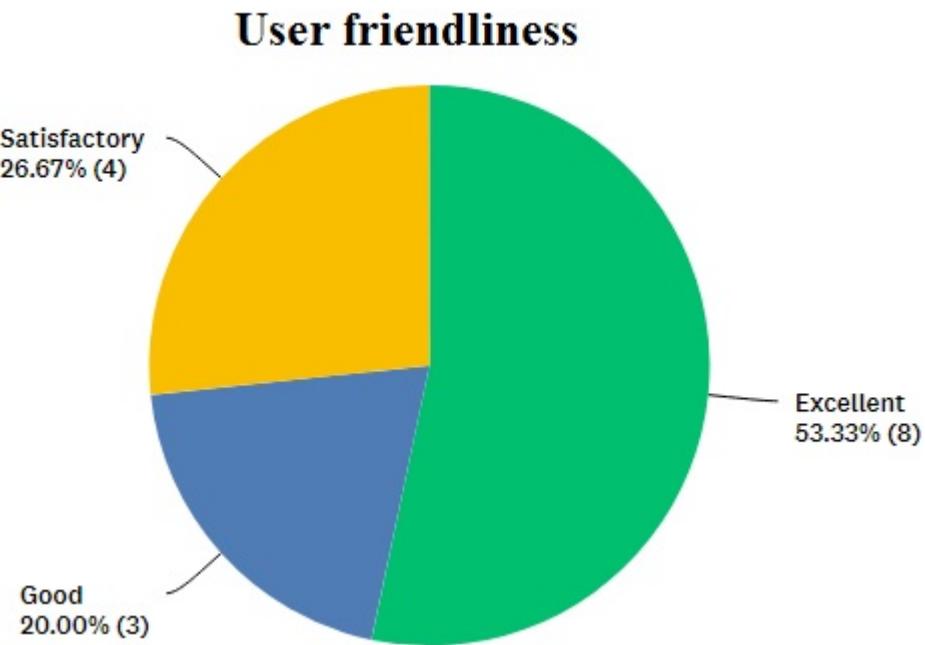


Figure 73: Proposed system user friendliness

As *Figure 73* shows that the majority of responders 53% said that the proposed system is user friendly and 26.67% of responders had said that they were satisfied with the system interaction and friendliness while 20% of responders had rated the system friendliness as good. According to the received respondents, it summarizes that the majority of responders had said that the system is user friendly and interactive.

5.2.4 Evaluating the proposed system helpfulness

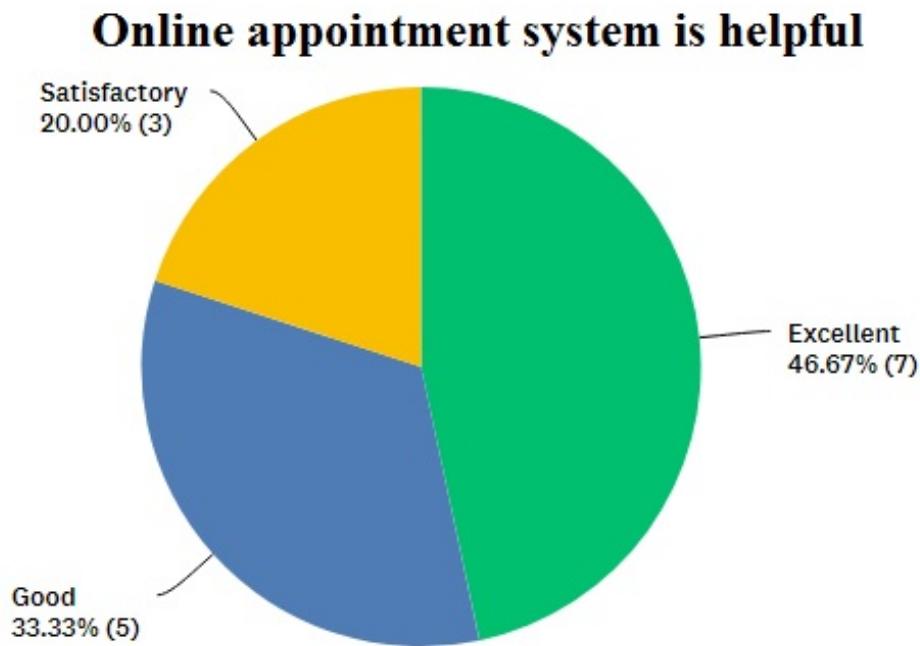


Figure 74: System helpfulness evaluation

As *Figure 74* represents the responder's evaluation for the system helpfulness in their daily life. The majority of responders which represent 46.6% had said that the system is excellent and had helped them in their daily routines. 33.33% of responders had rated the system as good as helpful while 20% of responders had rated the system as satisfactory and won't affect their daily routines. Thus, the collected responses show that the system is helpful in user's daily operations.

5.2.5 Evaluation of proposed medical records service

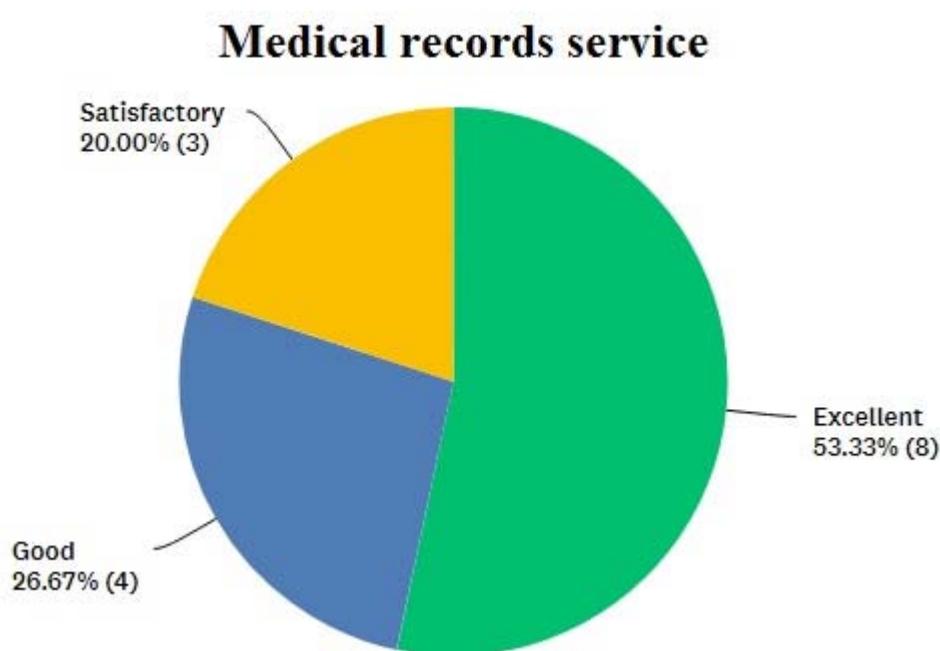


Figure 75: Evaluation of proposed medical records service

Based on Figure 75 the responders were asked to give their satisfaction on the proposed medical records service for patients and whether it affects their waiting experience as patients. 83.33% of responders had said that the proposed service is excellent and 26.6% of responders rated the proposed service as good while 20% of responders had said that the proposed service was satisfactory. The collected responses show that the responders were satisfied with the proposed medical records service and said that it was a time-saving method.

5.2.6 User's feedback conclusion

As analysis of the collect responses from user's evaluation survey. The majority of the received responses lead to that the targeted users were satisfied with the proposed system and its functionality. Based on the analysis of survey, researcher had concluded that the proposed system will improve the patient experience as in-clinic waiting and also as will improve the clinic practice within Laurent Bleu clinic in appointments perspective.

5.3 Unit Testing

Unit testing a software development process that tests the application units (smallest testable parts of the application). Every unit of the application is being tested to determine if these units are functioning well and if their performance is giving the desired output [17]. Also, to test if these functions have the capacity to handle errors while execution such as input validation.

In the context of Laurent Bleu Doctor-Patient Appointment System (LBDPAS), unit testing has been done to both android and desktop application. The results of the test to patients, doctors and clinic staff are shown below:

5.3.1 Patient

Table 10: Patient Unit testing results (Android application)

Unit	Purpose	Expected outcome	Evaluation
<u>Login Activity</u>	<ul style="list-style-type: none">-Test the authentication for username and password keyed in by user to access the application.-Pass the data entered by user to the next activities to be used in documenting the actions that user can perform.	<ul style="list-style-type: none">-User will be linked/moved into main menu activity if input is valid.-User will be able to perform actions within the application according to their respected username (ID)	<p>Success</p> <p>Success</p>
<u>Booking appointment</u>			
View doctor time slots	<ul style="list-style-type: none">-User will be able to select a specific doctor and view the consulting time slots of the selected doctor.	<ul style="list-style-type: none">-Show the user the specified consulting time slots provided from doctor.	Success

Book appointment	<ul style="list-style-type: none"> -The system will be able to detect whether the selected time slot by user is free or occupied before performing an action. 	<ul style="list-style-type: none"> -To provide the user with accurate scheduling experience and to help the application in decision-making process while booking. 	Success
<u>Check doctors</u>	<ul style="list-style-type: none"> -User will be able to preview doctor's details in-order to be able to take a decision for their next action. 	<ul style="list-style-type: none"> -Keep the user updated with the doctor's status such as time slots, doctor name, doctor id and note to show whether he is available or no. 	Success
<u>Medical history</u>	<ul style="list-style-type: none"> -Users will be able to preview their preview appointments (their medical history) and be able to download their medical records such as appointment's documentation. 	<ul style="list-style-type: none"> -Provide the users with quick and easy access to their medical history such as appointment's details and appointment's documentations which patients will be able to download it as a PDF format. 	Success
<u>Services</u>	<ul style="list-style-type: none"> -Users will be able to check all the services provided by Laurent Bleu clinic. 	<ul style="list-style-type: none"> -Allowing the user to review the services provided by the clinic with a brief description of each provided service. 	Success

5.3.2 Doctors

Table 11: Doctor Unit testing results (Desktop application)

Unit	Purpose	Expected outcome	Evaluation
<u>Login activity</u>	<ul style="list-style-type: none"> -Test the authentication for username and password keyed in by user to access the application. -Pass the data entered by user to the next activities to be used in the actions which will be previewed for users. 	<ul style="list-style-type: none"> -User will be linked/moved into main menu activity based on their authentication. -User will be able to view their work-related data based on their respected username (ID) such as appointments of the day. 	Success
<u>Doctor Menu</u>	-User will be able to view their appointments of the day.	-The system will keep the user updated with their schedule of appointments by showing them their appointments of the day.	Success
<u>Appointments</u>	-User will be able to view and manipulate their appointment list.	-The system will allow the user to be able to view, search and download data from the provided appointment list.	Success
<u>Patient list</u>	-User will be able to view and do simple manipulation to the patient list such as searching.	-The system will allow the user to be able to view and search data from the provided patient list.	Success

5.3.3 Clinic Staff

Table 12: Clinic staff Unit testing results (Desktop application)

Unit	Purpose	Expected outcome	Evaluation
<u>Login activity</u>	<ul style="list-style-type: none"> -Test the authentication for username and password keyed in by user to access the application. -Pass the data entered by user to the next activities to be used in the actions which will be previewed for users. 	<ul style="list-style-type: none"> -User will be linked/moved into main menu activity based on their authentication. -User will be able to view their work-related data based on their respected username (ID) such as appointments of the day. 	Success Success
<u>Staff menu</u>	-User will be able to view all appointments of the day.	-The system will keep the user updated with the appointments schedule for the doctors by showing them the appointments of the day.	Success
<u>Patient list</u>	-User will be able to view and do simple manipulation to the patient list such as searching.	-The system will allow the user to be able to view and search data from the provided patient list.	Success
<u>Appointments</u> Set Appointment	-User will be able to set an appointment between patient and doctor based on the offered time slots.	-The system will allow the user to be able to set/adjust an appointment between	Success

		patient and doctor using the provided variables from the system based on the offered time slots for doctor consulting.	
Upload attachment	<ul style="list-style-type: none"> -User will be able to upload medical records (i.e. Blood test, medical summary) to the selected appointment. -User will be able to view and perform simple manipulation to the provided list of appointments such as searching s specific status and downloading the selected medical records. 	<ul style="list-style-type: none"> -The system will provide the user the ability to upload the medical record as an attachment to the selected appointment. -The system will allow the user to be able to view, search and download data from the provided appointment list. 	Success
Appointment list	<ul style="list-style-type: none"> -User will be able to perform simple manipulation to the list of appointments such as updating the existing data. 	<ul style="list-style-type: none"> -The system will give the user the privilege to perform simple manipulation to the given appointment list like updating the existing data such as appointment description, appointment 	Success
Update medical records			Success

		note and appointment attachment (Medical record)	
<i>Email reminder</i>	-User will be able to send a reminder as an email to the patients and doctors to remind them of their appointments such as appointment of the day.	-The system will allow the user to have access to doctor and patient email addresses to be able to perform a single action which is send a reminder of their appointments.	Success
<i>Doctor list</i>	-User will be able to update/change the time slots and note of each doctor to keep the patient updated through the application.	-The system will provide the user with the privilege to manipulate and update the doctor status/note and consulting time slots to keep the system updated with the recent changes.	Success

5.4 Integration testing

This section will contain a description of the integration testing on the proposed applications. Integration testing simply is when multiple units of software which are already tested are combined such as database, desktop and android application. The check list of the integration testing for the proposed system Laurent Bleu Doctor-Patient Appointment System (LBDPAS) is illustrated in *Table 13.*

Table 13: Integration testing

Procedure description	Expected result	Actual result	Status
Login module on each application should connect to online database and check if user is valid	The application will be able to authenticate the user through online database	The application validates the user through connecting to the online database	Success
The user is able to upload files into the database through the desktop application	The desktop application will be able to pass files to the database as an attachment (BLOB)	The user is able to upload files to the online database through the desktop application	Success
The user will be able to download the files from the online database through android application	The android application will be able to retrieve the files download on the user device	The user is able to download files from the online database through the android application	Success
The user is able to change the information through the desktop application and update the online database at the same instance	Any changed information on the desktop application will update the online database at the same instance	The user is able to update the online database at the same instance through changing the information on the desktop application	Success
The server will be able to act as scheduler when booking an appointment	The server will act as scheduler to ensure that there is no duplication in booking an appointment	The user is able to book an appointment at the same instance through android application with the help of the server acting as scheduler	Success

5.5 System Testing

This section will cover the evaluation of the android and desktop applications based on the applications functionality and requirements. *Table 14* illustrates the checklist of the system testing of the developed applications.

Table 14: System testing for android and desktop applications

Condition	Evaluation
Is the application layout consistent at all times? (i.e. position of items in each activity is consistent)	Success
Do the applications interact with the database connection correctly?	Success
Do all the buttons function as expect?	Success
Will the user be able to go to the previous screen if needed?	Success
Do the applications minimize the user actions by using the list picker (i.e. Date picker)?	Success
Do the applications support data validation?	Success
Do the applications use a standard universal language (i.e. English)?	Success
Do the applications validate booking an appointment to avoid data duplication (i.e. validating dates and doctor details when booking an appointment to avoid duplication of appointments)?	Success

Chapter 6: Conclusions and Recommendations

The current era we are living in has been marked as the era of technology due to the technological development that had changed the way that society interact. At this digital stage of development, it opens up new opportunities and it transforms the way that data is being processed. Institutions and organizations has already evolved their procedures from manual hand-work to electronic material (eMaterials) and softcopies. As most of the industries has evolved to electronic platform such as electronic government (eGov) and electronic education (eLearning), the health industry is also evolving as we start to see web and mobile platforms to improve the patients experience. In the context of Malaysia mobile health Sdh (MH2U) was the very first to start with electronic health (eHealth) implementation [5].

Laurent Bleu Doctor-Patient Appointment System (LBDPAS) is one of the very first appointment systems that are developed to university clinics in the context of Malaysia as a mobile application for patients. According to the gathered information using the data collection techniques and studying existing systems around the globe and in Malaysia specifically. It concluded that developing such system in the current environment is more likely to increase the patients experience in general and decrease the workload upon the staff within the clinic.

Numerous number of tests have been conducted on the proposed system to ensure accuracy, usability and reliability of the system. The conducted tests are unit testing, integration testing and system testing, each tested unit has been documented in detail.

In conclusion, Laurent Bleu Doctor-Patient Appointment System (LBDPAS) is a desktop and android application that is designed to improve patients experience in booking appointments and reduce the workload on the clinic staff and doctors in the process of documenting the appointments.

6.1 Application Strength

- Reduce the workload on the clinic staff

Reduce the time and effort that the clinic staff has to put when booking or documenting appointments.

- Accessible for patients 24/7
Instead of catching the operating hours to check previous medical records or book an appointment. The proposed system will provide patients with access to the clinic services at any time.
- Reduce lost patients
Some patients decide to go to other clinics due to long in-clinic waiting for an appointment. With the proposed features of the system patients no longer have to face long in-clinic waiting time.
- Convenience and flexible
The application will allow users to book their appointments via online system, instead of the need of being on-hold of phone call or the need of attending physically to the clinic to book an appointment.

6.2 Application limitation

- Available for UCSI university students and staff only
The application is developed in the context of UCSI university. Therefore, any patients who attend the clinic who are not students nor staff of UCSI university they won't be able to use the proposed system.
- Available for Android platform users
The system is limited to Android platform users thus, it won't be available for other platforms users such as IOS users.
- User re-login
Each time the application is closed the user needs to re-login in-order to be able to use the application.

6.3 Future works

- Supported for IOS users

The number of IOS users is frequently increasing, were the system is only provided for Android users. One of the main goals to be soon served is to provide the IOS users with the ability to be able to use the proposed system.

- Auto-login

Auto-login is a common used function by other applications were the user don't have to login every time they want to use the application. For example, Facebook users don't have to login each time they try to access Facebook. The benefit of this function is to reduce the input that the user makes.

- Doctor-Patient live session

This feature will allow the user to have a live chat session with the doctor where they can describe their symptoms to the doctors. This feature will be time-saving for patients thus, it won't be necessary for them to attend physically to the clinic in-order to check-up their case.

- Developing the system for Laurent Bleu clinic in UCSI university

As the application was developed in the context of Laurent Bleu clinic in UCSI university with the help of Laurent Bleu clinic staff. The main future goal of this project is to be developed and used in Laurent Bleu clinic to improve the existing system and introduce new capabilities.

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Appendix A: LBDPAS survey form

Section A	
Experiences about the current manual system	
1. What is your gender?	
<input type="radio"/>	Female
<input type="radio"/>	Male
2. What is your age?	
<input type="radio"/>	16 to 19
<input type="radio"/>	20 to 24
<input type="radio"/>	25 to 34
<input type="radio"/>	35 or older
3. What is your current occupation?	
<input type="radio"/>	Student
<input type="radio"/>	Staff
<input type="radio"/>	Other (please specify)
4. Have you ever experienced the services provided by Laurent Bleu clinic?	
<input type="radio"/>	Yes
<input type="radio"/>	No
5. How long does it take you in-clinic waiting to see the doctor?	
<input type="radio"/>	Less than 20 minute
<input type="radio"/>	20 to 30 minute
<input type="radio"/>	more than 30 minute
<input type="radio"/>	Other (please specify)
6. Are you satisfied with the current appointment scheduling system of Laurent Bleu clinic?	
<input type="radio"/>	Yes
<input type="radio"/>	No

Section B

For each of the following questions, please select the answers that corresponds with your agreement on Online Based scheduling System for Laurent Bleu clinic.

Please answer ALL the questions.

(1=Strongly Disagree, 2= Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree)

7. Do you think Laurent Bleu clinic requires an online appointment scheduling system to provide better services?

- 1 (Strongly Disagree)
- 2
- 3
- 4
- 5 (Strongly Agree)

8. Do you think the online appointment scheduling system in Laurent Bleu needs to improve patient experience?

- 1 (Strongly Disagree)
- 2
- 3
- 4
- 5 (Strongly Agree)

9. Do you think that quick and smooth appointment scheduling improve your experience as a patient of in-clinic waiting?

- 1 (Strongly Disagree)
- 2
- 3
- 4
- 5 (Strongly Agree)

10. Do you think patients need online appointment scheduling and medical history services ?

- 1 (Strongly Disagree)
- 2
- 3
- 4
- 5 (Strongly Agree)

Appendix B: User evaluation form

1. What is your user type?

- Patient
- Doctor
- Clinic staff

2. Does the system work as accordingly?

- Excellent
- Good
- Satisfactory
- Below average
- poor

3. Is the system helpful in quick and comfortable appointment booking?

- Excellent
- Good
- Satisfactory
- Below average
- poor

4. Do you think that LBDPAS system is user friendly and easy to interact

- Excellent
- Good
- Satisfactory
- Below average
- Poor

5. Is online appointment booking service has improved your experience as LaurentBleu clinic patient

- Excellent
- Good
- Satisfactory
- Below average
- Poor

6. Do you think that the provided service checking medical history service is time saving

- Excellent
- Good
- Satisfactory
- Below average
- Poor

Appendix C: Turnitin Results

The screenshot shows the Turnitin Class Homepage. At the top, there is a navigation bar with links for Osama Hussein, User Info, Messages (1 new), Student, English, Help, and Logout. Below the navigation bar is the Turnitin logo. A horizontal menu bar includes Class Portfolio, Peer Review, My Grades, Discussion, and Calendar. A message banner at the top states: "NOW VIEWING: HOME > MAY-AUG 2017/IP2" and "Welcome to your new class homepage! From the class homepage you can see all your assignments for your class, view additional assignment information, submit your work, and access feedback for your papers. Hover on any item in the class homepage for more information." A "Class Homepage" button is highlighted in black. Below this, a descriptive text explains how to submit assignments and view feedback. A table titled "Assignment Inbox: May-Aug 2017/ IP2" lists one assignment: "May-Aug 2017: IP2 FYP". The table columns are Info, Dates, and Similarity. The assignment details are: Start 16-Jun-2017 9:09AM, Due 31-Aug-2017 11:59PM, Post 30-Aug-2017 12:00AM. The Similarity column shows 5% with a green progress bar. Buttons for Resubmit, View, and Download are available.

Assignment Inbox: May-Aug 2017/ IP2		
Info	Dates	Similarity
May-Aug 2017: IP2 FYP	Start 16-Jun-2017 9:09AM Due 31-Aug-2017 11:59PM Post 30-Aug-2017 12:00AM	5% <div style="width: 20px; height: 10px; background-color: #2e8b57;"></div>