

Online Scheduling System for Doctors and Patients in a Hospital

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Abstract

The outpatient department (OPD) of a hospital provides diagnoses for non-urgent patients that do not require them to be admitted for long periods. The department has multiple physical facilities and medical equipment with several doctors and consulting rooms, each is an expert in a specific field. This study aims to create an online scheduling system for the outpatient department of a hospital. It will be an online system that will assist the appointment system of the outpatient department of a hospital. This will benefit not only the hospital but also the patients in scheduling their appointments as the patient can check the doctor's availability. The waiting time of the patient will be lessened since the patient will only go to the hospital at their specified scheduled appointment. The list of appointments can also be viewed by the doctor to check how many patients are currently scheduled within the day.

Keywords

outpatient department, special situations, appointment system, appointments

1. Introduction

In special situations like a pandemic, there will be a lot of limits and regulations, especially during an enhanced community quarantine period. The country will be on lockdown during the said occasion, people will not be allowed to go outside unless necessary as mass gatherings and crowded places will be prohibited. Social distancing will be implemented that urges people to maintain a one (1) meter distance from each other. The project would provide improvement to the outpatient department of the hospital. Most especially during extreme situations where there are a lot of limits and regulations that urge people to stay indoors unless necessary. The senior citizens would be able to have a diagnosis and will be able to avoid exposure in crowded places. They would also be encouraged to use the appointment system since they do not have to wait for long queue times.

The common problem among many hospitals is the long waiting time particularly in the outpatient department which makes the waiting area congested. This is because of the traditional falling in line done by patients. In addition to that, there is also a scenario where the doctor arrives late, and some consultations are longer than the others. This causes the patients a lot of their time, that is why most of the patients usually go early in the morning because they believe that the earlier you arrive, the quicker your appointment will be done (Panaviwat Chalita 2014, Lohasiriwat Haruetai 2014, Thammaphornphilas Wipawee 2014). This results in congestion even before the service hour starts.

In light of the recent pandemic that shocked the world, every nation studied and analyzed how to prevent and lessen the spread of an infectious disease. The government then decided to release strategic guidelines to fight infectious diseases.

One of which is the restriction regarding the age, some people can go out but all persons under the age of twenty-one (21), elderly who are sixty (60) and above, and people at health risks cannot leave unless necessary. There were also requirements to which include a face mask to prevent the inhalation of the virus and quarantine pass to determine where they live and the age of the person. Mass gatherings were also prohibited during these times to prevent the spread. The reality is that most of the senior citizens and some infants also have other illness to overcome that is why the online scheduling system is an opportunity for them to take advantage because both of which are very susceptible

to the virus. It is not a good idea to let them get exposed to crowded places that is why the online appointment system, prevents the susceptible persons to be exposed to crowded places like the waiting area of an OPD department.

Long waiting periods are seen by the patients as a deterrent in obtaining services. Because waiting for a long time can be a source of stress for the patient. According to the study of MO Oche and H Adamu, "The three most common factors leading to long waiting time observed in this study were high patient load, few doctors, and record clerks". They have concluded that with the assistance of a computer simulation, scheduling appointments can reduce the waiting time of the patients. Aside from that, according to the Institute of Medicine, 90% of the patients should be addressed within 30 minutes (Oche MO and Adamu H. 2013).

1.1 Objectives

This research aims to improve the existing online scheduling system for doctors and patients in a hospital. Specifically, this research attempts to:

- (1) enable patients to set an appointment online, view their diagnosis and electronic prescription, pay online through PayMaya or GCash, and receive an SMS notification about their appointment.
- (2) enable doctors to view patients' medical records and store the diagnosis and electronic prescriptions of patients.
- (3) improve waiting time and provide convenience to patients in scheduling their appointments.

2. Literature Review

Related Studies

2.1 E-healthcare: Child Monitoring Health System (CHMS) with SMS functionality

The study is about the benefits of introducing a Child Health Monitoring System (CHMS) to provide a more effective way of tracking the health of children (G. S. Fuentes and G. L. D. Intal 2020). The researchers conducted the study at a private hospital that specializes in child care to develop a system that will facilitate communication between doctors and patients, especially if the doctor is away from the hospital or if an emergency is encountered at home. It will help medical assistants make their work quicker and more convenient, maximizing their workload and time. To determine the system requirements, the researchers conducted surveys and interviews with hospital administrators, staff, and patient parents.

The system would be able to store all the details about the patient such as medical records, checkup history, and other data gathered. The system allows up to ten (10) scheduled patients per day. The user of the system can schedule and cancel or re-schedule their appointment. They also get notified through SMS before and on the day of their appointment to avoid missing a scheduled appointment. Aside from that, the system has a health tip module that includes a list of common sicknesses at a specific child's age and also offers details about these sicknesses such as symptoms, cure, and prevention. The system can also generate reports about the patient which can be printed.

2.2 Design and Implementation of a Patient Appointment and Scheduling System

Current practices on scheduling an appointment and managing patient information are subject to human errors that lead to inefficient flow in the process (John Lekan, Akinode 2017). With manual registration, redundancy is inevitable since it is possible to register the patient again who has been in the clinic in the past because with manual registration, looking for a specific patient with a long list of information is a hectic job.

The automation of the appointment system in a hospital allows the outpatient to register their details, and book an appointment through the internet with the web application which will significantly increase the efficiency of the scheduling system. The scheduling system also allows the health practitioners to view and search for the patient's information in the past. The patient is also allowed to provide additional information before submitting the schedule to give the doctor to prepare.

The proposed system aims to minimize waiting times, prioritize appointments, and reduce the operation cost while it is enhancing the service quality. This also reduces unsatisfied patient numbers because this reduces patient waiting times and waiting-room congestion (John Lekan, Akinode 2017).

2.3 IMPACT OF OPD WAITING TIME ON PATIENT SATISFACTION

The study is all about the patients' satisfaction in the Outpatient Department (OPD) in a Tertiary Care Hospital (TCH) in Pune. It is a one hundred twenty (120) bedded multispecialty hospital fitted with high-tech technology and luxury facilities. It is a hospital accredited by NABH that prides itself on high-quality service and care. The aim of the study aims to analyze the waiting time in the OPD and assess its impact on patient satisfaction.

The researchers of the study started by observing and recording the patient details, the time of patient's entry, the time taken of the patient taken to move through different departments until exit. After that, the OPD patients were given a questionnaire on Patient Experience Feedback with a sample size of two hundred (200).

The results of the study showed that the average time a patient spends in OPD was found to be sixty (60) minutes. The great bottleneck that caused this high waiting time was found to be the average of forty (40) minutes of waiting for consultation. Data obtained during the survey also showed that thirty-three (33) percent of patients were waiting for the doctor for thirty to sixty (30-60) mins and thirty-two (32) percent of patients were waiting for more than an hour. It was one of the major causes of dissatisfaction among OPD patients that can be attributed to a decline in OPD numbers (Dr (Brig) Anil Pandit 2016, Er Lalit Varma 2016, Dr. Amruta. P. 2016).

2.4 Automated Patient Appointment Reminder for Cross-platform Mobile Application

Smart devices including smartphones and tablets are already available and accessible in our daily lives and they have become a necessity. The device is linked and shared through the Internet of Things (IoT). This paper is proposed to take advantage of the Internet of Things through smart devices, the paper aims to automate the patient appointment reminder because most of the hospital reminds their patients manually through telephone or SMS.

The web application is also capable to record the appointments of the patient and the medical processes which they concluded that the application reduced approximately two and seven-tenths (2.7) minutes compared to the usual recording which is paper-based (J. Chaiwongsai 2016, P. Preecha 2016, S. Intem 2016). The Cross-platform Mobile Application is usable by the top 3 most used mobile operating systems which are Android, iOS, and Windows phones however, the reminder function is only limited to android. The web application has 6 functions which are login, send a notification, message, appointment, manage appointment, and administrator web.

The application is proposed to conveniently aid in managing the appointments of the patient and healthcare practitioners. The web application is then evaluated by three (3) healthcare practitioners, and twenty (20) general users, by three (3) categories which are system ability, design of the system, and application satisfaction. The result of the evaluation provides 4.11 user satisfaction scores.

2.5 Smart Appointment Reservation System Application

The study is about a smart appointment reservation system. It is an online paperless application designed for patients to book their appointment within the scheduled appointment slots according to their preferences, with high flexibility and ease of use. The system serves in managing appointments and provides patients with the ability to cancel or reschedule appointments by integrating distributed clinical systems into a set of consistent and convenient services that can be accessed through a web browser.

The administrator reviews report from the patient handles the appointment schedule and maintains the patient details. Patients will receive the scheduled updates regarding appointment confirmation, delay in appointment schedules, and doctor unavailability through SMS alerts. This smart appointment system allows patients to provide feedback on the system to improve services.

Related Systems

2.6 The Filipino Doctor

In The Filipino Doctor, they have different categories of doctors and show what they specialize in and their appointment schedule. After selecting a doctor, patients can view the doctor's profile and request an appointment. Not all doctors on the website cater to the appointment system, only specific doctors are available for appointments.

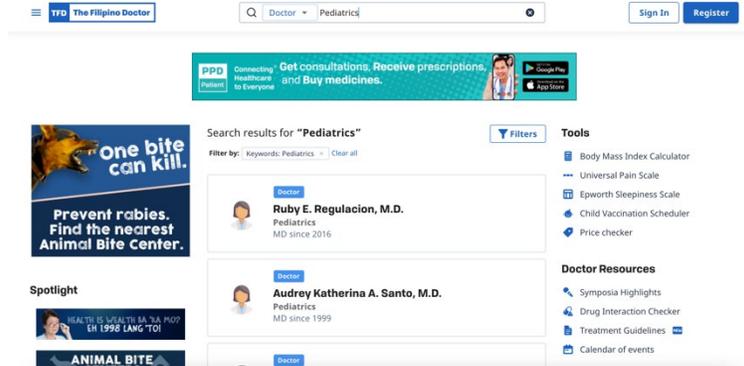


Figure 1: The Filipino Doctor

2.7 KonsultaMD

KonsultaMD provides online voice or video call consultation that lets you talk to doctors available in the application. It can also check the general information of the patient since users can register an account with their personal information. They require users to have an active subscription for consultations. They have different payment methods and informs you if there is a discount available. They also have mental health first aid support.

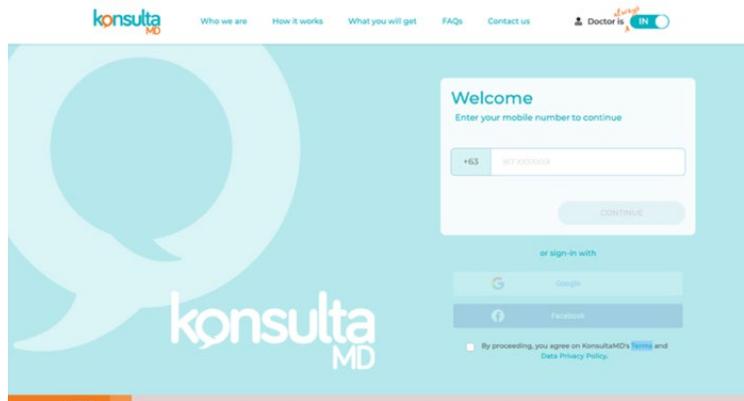


Figure 2: KonsultaMD

2.8 SeeYouDoc

SeeYouDoc is a website that conducts online consultations. It lets the user choose the doctor they prefer, book appointments, directly call the doctor if they are available, and receive the medical assistance the users need.

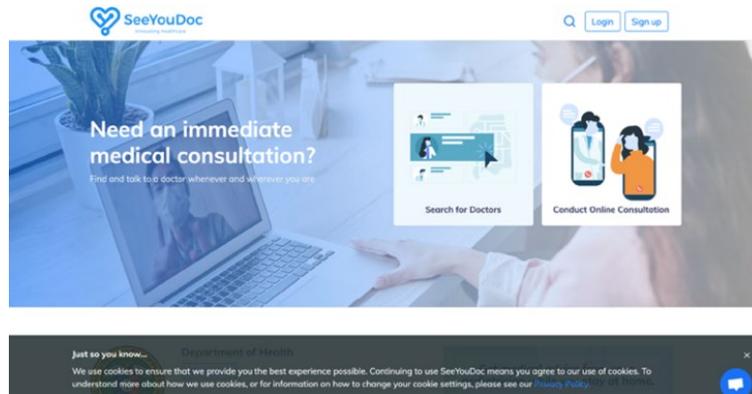


Figure 3: SeeYouDoc

2.9 Makati Medical Center

Makati Medical Center offers an online appointment form for different hospital services such as CT, MRI, Ultrasound, and others. It provides users the ability to choose the service, time, date, and mode of payment. After submitting the form, a service representative will call to confirm the appointment request.

Figure 4: Makati Medical Center

2.10 iCliniq

iCliniq provides different methods of online consultation. The user can send a query, and then wait for a doctor to respond to their question for free. To answer their medical concerns faster, the user may also chat, phone call, video call the doctor. They also have different health tools that users can use.

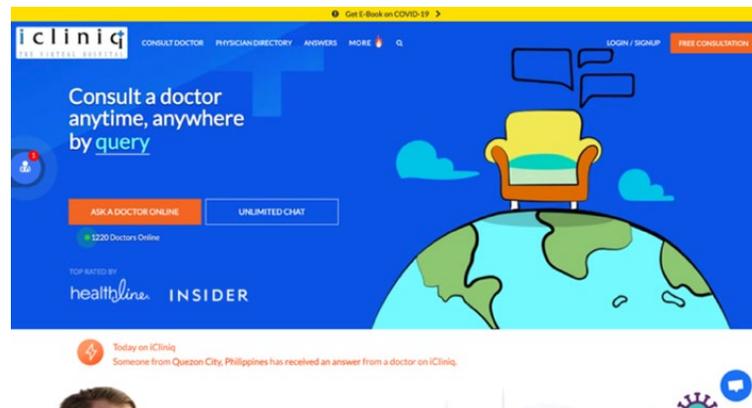


Figure 5: iCliniq

Gap Analysis

Table 1: Gap Analysis

Functionalities	The Filipino Doctor	KonsultaMD	SeeYouDoc	Makati Medical Center	iCliniq	Proposed
Hospital Appointment	√*	×	×	√	×	√
View list of doctors	√	√	√	×	√	√
e-Prescription	×	√	√	×	√	√
Online medical records	×	√	√	×	√	√
SMS notification	×	×	×	×	√	√
Online payment	×	√	√	×	√	√

* Not all doctors on the website are available for appointments.

The table above shows the features comparison of Related Systems and the proposed system.

- Hospital appointment – The proposed system will be able to schedule, manage, and view hospital appointments online.
- View list of doctors – The proposed system will give the patients the ability to view the doctors available.
- e-Prescription – The proposed system will enable the doctor to give his/her prescription online that can be viewed by the patient after the patient’s appointment.
- Online medical records – The proposed system will enable the patient to view his/her previous consultations.
- SMS notification – The proposed system will notify the patient a day before and on the day of his/her appointment.
- Online payment – The proposed system will enable the patient to pay for his/her appointment online through PayMaya or GCash.

3. Methods

3.1 Research and Development

Before the development of the system, the researchers conducted an online survey. As the researchers gather data, out of sixty-five (65) patients, forty-six and two-tenths percent (46.2%) answered that they are waiting for an average of one (1) to two (2) hours. This shows that the majority of the patients are waiting long enough to get weary, since the majority of the patient’s consultation takes only less than 30 minutes, which is also showed in the survey results. Which in turn shows that ninety-six and nine-tenths percent (96.9%) of the patients would prefer if the waiting time was shorter. Aside from that, out of six (6) doctors that the researchers have surveyed, the average shortest consultation time was ten and eighty-three tenths (10.83) minutes and their average longest consultation time was thirty and eighty-three tenths (30.83) minutes, which is still quicker than the waiting time patients experience.

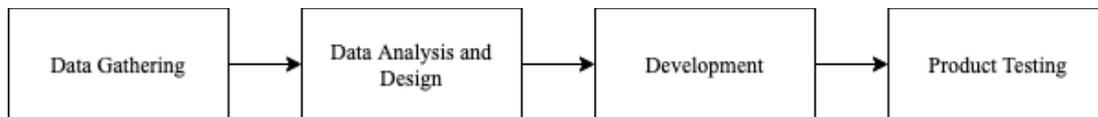


Figure 6: Research and Development Model

Research and Development also known as R&D is the method the researchers will be using in this proposed system. This method is usually used for innovating and developing new products and services.

3.2 Research Design

The research will be using an experimental quantitative method since it will be dealing with the analysis of data obtained with the use of the current online scheduling system.

3.3 Research Locale

The research will be conducted at a tertiary hospital, Unihealth-Paranaque Hospital & Medical Center, located at Dr Arcadio Santos Ave, San Isidro, Parañaque, 1700 Metro Manila as a base for their research.

3.4 Research Respondents

The participants of the study will be composed of 1 doctor, 2 hospital staff, and 12 patients from the outpatient department of the hospital, a total of 15 respondents.

3.5 Research Instrument

After using the proposed system, the participants will be given a System Usability Scale (SUS) questionnaire. This questionnaire is about their experience with the proposed system. The aim is to know how the usability of the proposed system differs from their current scheduling system.

4. Data Collection

The responses from the questionnaire given will be the source of data. All the responses from the questionnaires will be documented and will be used for improving the proposed system if needed.

4.1 Samples and Sampling Techniques

The selected respondents will be patients, doctors, and staff from the outpatient department. The researchers will use heterogeneous sampling since the diagnosis and illnesses of patients may differ from one another. The results of the respondents will be grouped by category: doctors, staff, and patients.

4.2. Statistical Treatment

To interpret the data gathered, the scores that the researchers received will be calculated per patient and doctor. The scale will be converted into a number first for each question.

Strongly Disagree: 1 point

Disagree: 2 points

Neutral: 3 points

Agree: 4 points

Strongly Agree: 5 points

$X = \text{Sum of the points for all odd-numbered questions} - 5$

$Y = 25 - \text{Sum of the points for all even-numbered questions}$

$\text{SUS Score} = (X + Y) * 2.5$

To compute for the score, subtract 5 from the sum of the points for all odd-numbered questions to get the value of X. And then subtract the sum of the points for all even-numbered questions from 25 for the value of Y. Add X and Y, then multiply it by 2.5 to get the SUS Score.

According to usability.gov, a SUS score above 68 is considered average, and anything below is considered below average. The table shown below is from uiuxtrend.com, which is a general guideline for interpreting the SUS score.

Table 2: SUS Score Guideline

SUS Score	Grade	Adjective Rating
> 80.3	A	Excellent
68 – 80.3	B	Good
68	C	Okay
51 – 68	D	Poor
< 51	F	Awful

5. Results and Discussion

The screenshots illustrate the user interface for creating an appointment in the DOS Online Sched system. The interface includes a sidebar menu with options like Dashboard, Appointments, Medical Records, and Settings. The main content area shows the 'Appointment Information' form, a summary of the appointment details, and a success message upon completion.

Step 1: Appointment Information

Progress: 25%

Step 1
Fill out the fields below
Note: Clicking next without selecting any option will show all available schedules.

Specialty:

Date: Clear

Time:

Buttons: Previous, Next

Appointment Summary

DETAILS	AMOUNT
Date: 2021-05-01 Sat	
Time: 01:00 PM	
Doctor: [Redacted]	
Hospital: Unimhealth Paranaque Hospital & Medical Center	
Fee:	P1,000.00
TOTAL AMOUNT DUE:	P1,000.00

Choose your mode of payment

Mode of Payment:

Options: Select an option, Cash on Appointment, GCash, PayMaya

Step 4: Transaction Summary

Success: Your appointment is set. You will receive an SMS reminder regarding your appointment details. [Click here to manage your schedule.](#)

DETAILS
Transaction ID: TSD067
Name: [Redacted]
Mobile Number: [Redacted]
Email: [Redacted]
Appointment: 2021-05-01 Sat, 01:00 PM

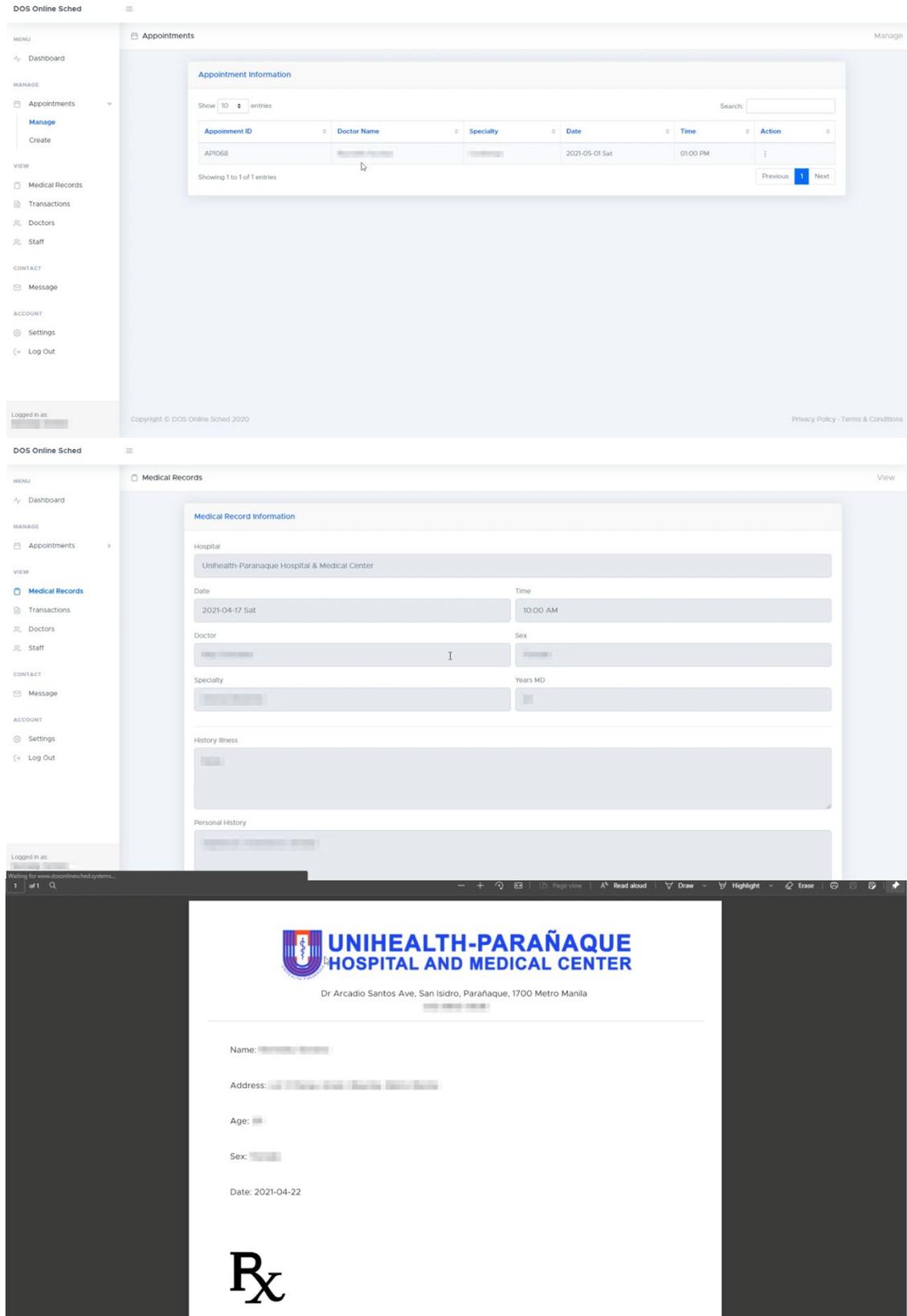


Figure 7: User Interface

Due to the COVID-19 outbreak, the researchers were not able to simulate the system in a hospital. However, the website was still tested by a doctor, hospital staff, and expected patients of the system.

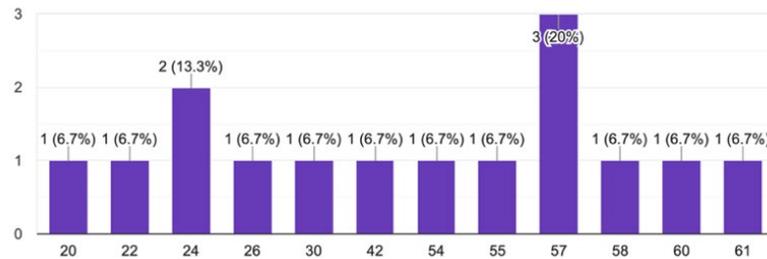


Figure 8: Participants Age

The figure above shows the age of all participants from the conducted testing. The website was tested by participants from ages 20 – 61.

Table 3: Total SUS Score

Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I think that I would like to use the website frequently	0	0	0	6	9
2. I found the website complicated	7	4	2	2	0
3. I thought the website was easy to use	0	0	2	7	6
4. I think that I would need assistance to use the website	2	1	6	5	1
5. I found the various functions in the website were well-integrated	0	0	3	7	7
6. I thought there was inconsistency in the website	11	3	1	0	0
7. I would imagine that most people would learn to use the website quickly	0	0	3	3	9
8. I found the website awkward to use	12	3	0	0	0
9. I felt confident using the website	0	0	2	5	8
10. I needed to learn a lot of things before I could get going with the website	4	2	6	2	1

Table 4: Participants SUS Score

Participant	SUS Score
1	90
2	62.5
3	72.5
4	97.5
5	100
6	95
7	77.5
8	77.5
9	80
10	70
11	80
12	67.5
13	70
14	65
15	87.5
Total	1192.5
Mean (Average)	79.5

The questions asked in the form were based on the System Usability Scale (SUS), which contains 10 items, half-positive and half-negative. The odd-numbered questions are categorized as positive tone, while the even-numbered are categorized as negative tone. According to J. Sauro, Ph.D., there are two major reasons why the questions in the form were in half-positive and half-negative tones. The first one is Reducing Acquiescent Bias which means to avoid participants from giving the highest rating automatically without reading all the questions that were asked. The second one is Reducing Extreme Response Bias, also related to the first reason, but the latter avoids either all high or all low rating responses. Because of the stated reasons, respondents are then required to analyze each question and potentially have a more thoughtful answer which can eliminate a bias response.

The participants of the testing were asked to answer a form after using the website to measure the reliability of the system. A total of 15 responses were recorded. Each response was computed according to the computation. As shown in the table, the total sum of the SUS scores is 1,192.5 with a Mean (Average) of 79.5 since there were 15 participants.

6. Conclusion

Compared to the manual appointment system that is currently being used by the hospital, the website will improve the appointment system of the outpatient department. According to the hospital, patients can schedule an appointment by calling or through walk-ins as long as there is an available doctor. With the website, patients can easily view all the available schedules of doctors and set an appointment. In terms of payment, the patient can pay on the day of their appointment or pay in advance through GCash or PayMaya. The website also sends an SMS notification to remind patients about their scheduled appointment. It reminds them of their appointment a day before and on the day itself.

Following the website's evaluation, the calculated average SUS score of the system is 79.5. Which is equivalent to B according to the SUS Score Guideline table. In terms of adjective rating, the system is rated as Good which means that the website is usable. After testing, the doctor and hospital staff gave feedbacks about the website. They have mentioned that the flow of the website is nicely done and it was easy to use. The expected patients who have tested the website says that they have not seen anything that could potentially confuse users, it is very well made, and does not limit those who are not tech savvy.

The doctor has also mentioned that the History of Illness and Personal History should also be added in the medical records section of the patient. These features were added after the testing. The researchers have also asked the doctor and hospital staff if the system will help in reducing the waiting time inside the hospital. They have mentioned that the system will help especially during a pandemic since everyone needs to adjust to the new normal. Aside from that, the hospital staff said that it will be less hassle for them, and it would be much easier since they do not need to manually count how many appointments are scheduled within the day.

The researchers came up with some ideas on what to improve in the system. The following are suggestions for improving the system's capabilities:

- Support for other online payment options such as credit cards and debit cards.
- Appointment system for hospital services (CT, MRI, Ultrasound, etc.).
- View the laboratory results of patients (X-ray, Blood test, Urine test, etc.).

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