DIMS: A MOBILE BASED DENTAL INFORMATION MANAGEMENT SYSTEM OF MAGLINTE DENTAL CLINIC BILAR, BOHOL

College of Technology and Allied Sciences
BOHOL ISLAND STATE UNIVERSITY
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DIMS: A MOBILE BASED DENTAL INFORMATION MANAGEMENT SYSTEM OF MAGLINTE DENTAL CLINIC BILAR, BOHOL

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Bachelor of Science in Computer Science

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APPROVAL SHEET

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ABSTRACT

The study aimed to develop a Mobile Based Dental Information Management System of Dr. Maglinte Dental Clinic, Bilar, Bohol. Presently, the clinic is using manual method in data management and report generation. The analysis and development of the system is guided by determining the existing operation and procedures of the establishment. The analysis found out that the present system encountered various problems such as lack of proper record keeping and data storage, redundancies in the entries of data, and time-consuming in the retrieval of files. Based on the problems identified at the clinic, the management needs a mobile application of recording to prevent losses and misplacement of data. The application offers modules for acquisition, administration, data management and implements business intelligence for Maglinte Dental Clinic. Functionality test with the system usability was performed to the identified users. The test and evaluation results indicated that the application was highly acceptable and usable. With this, it was highly recommended to implement the DIMS: A Mobile Based Dental Information Management System of Maglinte Dental Clinic Bilar, Bohol.

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Chapter 1

THE PROBLEM AND ITS SCOPE

Rationale

Almost the entire human innovation nowadays, from the standpoint of its efficiency and expediency, is conditioned by the existence of information systems. Most information systems are oriented to management and decision-making, including health information systems. System of health form is one of the most important segments of society and functioning as a compact unit. Increasing requirements for reducing health care costs while preserving or improving the quality of services provided represent a difficult task for the health system (Masic, 2012).

Dental Clinic is an establishment that provides health medication and treatment for all types of dental patients. Surely, every day there would be people who seek dental services from a dentist in a Dental Clinic. But, how can Dental Clinic provide faster, and more efficient services when Dental Clinics today are still resorting to using the traditional method in their daily operations?

Traditional methods only imply that patients need to fill up manually their registration details into document files. These files would then be placed into a box or rack with little to no sortation. These files would be stocked for a longer period

of time and mistakes committed back then would no longer be traced and corrected.

With today's level of technology, it has provided an effective tool for developing a more advance, and systematic Dental Information Management System. Dental Information Management System is designed to allow Dental Clinics use highly efficient management tools, computerized and systematic handling of patient records on their treatment records.

Maglinte Dental Clinic is a Dental Clinic situated on Poblacion, Bilar, Bohol, owned by Doc. Lister Anthony Maglinte - a Doctor of Dentistry. Maglinte Dental Clinic is one of the only two dental clinics in town, and it was founded to aid the dental needs of the townspeople. According to the clinic dentist & owner, the problems currently encountered in the clinic operations of Maglinte Dental Clinic include: 1) no centralized scheduling for patient appointments; 2) manual records keeping; 3) increasing number of patients' dental records that needs more effort to maintain; and 4) loss of patients' dental records.

With the problems identified in Maglinte Dental Clinic, the researchers intended to develop a Mobile Dental Information System that would be accessible to Mobile platforms. This would solved the high cost and accessibility problems that were present in the PC-based Dental Information System. Aside from being more accessible, portable, and scalable, this system would also provide an appointment feature, patient dental charts, management of services, management payments and income, a secure database in the cloud, notifications, and a centralized handling of patient information.

Literature Background

The development of the system was supported by Republic Act No. 10173, which is also known as the *Data Privacy Act of 2012*. This is an act protecting individual's personal and communication systems in the government and the private sector, creating for this purpose a national privacy commission and other purposes. It also applies to the processing of all types of information and to any natural person involved in personal information processing, including those personal information controllers and processors who, although not found or established in the Philippines. It also recognizes the importance of providing information and communications technology to attain free, easy, and need to protect the integrity of devices, databases, the confidentiality, and availability of information and data stored therein. The state shall adopt a computerized process on how to prevent and provide arrangements for fast and reliable information.

The aforementioned article supports the secure handling of vital information of patients and system users. Thus, the researchers would give priority in handling vital information that should remain private throughout the development and use of the system.

The maintenance and proper handling of records in the mobile system was guided by the theory of *Edgar F. Codd's Relational Database Management System Theory*. This is a standard method by which information is organized and retrieved from computers. It treats the collection of data items organized as a set of formally described tables for which data can be accessed easily. The theory is based on

the ideas that contain the data and interface tools with which can manipulate the data. Having a systematic and well-structured database is the backbone to ensure the proper handling, managing, and recording of information in an Electronic Dental Record System.

Another theory applied in the study is the Principle of Automation theory. which is concerned with the findings of efficient computational ways to perform human tasks (Denning. 2007). This principle is used to emphasize that there is always a more efficient way of performing human tasks applicable in the management of patient data smoothly with less time consumed.

There are numerous related systems that are running in different organizations and institutions. Among these significant studies were:

1. Patients Medical and Dental Record System of BISU Bilar Clinic. The PMDRS of BISU Bilar, the developers focused on University's Patient Medical records and Patients' Dental Records of the clinic. The system has a wide scope but it has some lacking features needed in a university dental clinic, specifically the lack of keeping the patients' dental chart records and appointments. This system relates to our study in terms of handling the patient's data recording and retrieving records efficiently (Bolanio, 2018).

2. Patient Record Management and Billing System. The patient's record management and billing system in Cong. Simeon Toribio Memorial

Hospital of Carmen, Bohol. The developers concentrate more on the current processing system of the hospital recording patient charges, calculating the patient's bill, and generating reports. It is similar to the developed system with the use of a database in storing and retrieving patients' billing information. This system relates to our study in terms of patient registration that provide an efficient way of recording, updating, and retrieving records, but the study covers the record of patients that involve different transactions (Bontog, 2011).

3. Patient Management System. The main aim of the project is to provide a paperless and providing low-cost reliable automation of a reliable existing system (Amofa 2016). It aimed to computerized all details regarding patient details and hospital details and scheduling the appointment of patient with doctors to make it convenient for both. This is similar also because we aimed to provide paperless record keeping to our clients to avoid any loss of data.

The existence of these systems would serve as the basis for the researchers to improve the present system. It would help and guide the researchers on how to develop the DIMS: A Mobile Based Dental Information Management System of Maglinte Dental Clinic, Bilar, Bohol.

THE PROBLEM

Statement of the Problem

The primary purpose of this study was to develop a mobile-based dental information management system for Maglinte Dental Clinic, a dental establishment in the town of Bilar, Bohol.

Specifically, the study sought to answer the following:

1. What are the operations and processes involved in Maglinte Dental Clinic?
2. What are the problems and needs of the Maglinte Dental Clinic in the management of records?
3. What features can be offered to improve the existing system of Maglinte Dental Clinic?
4. What is the level of system acceptability as perceived by the target users?
5. What is the economic performance of the system in terms of initial investment and annual operating costs?

The proposed system is to be called DIMS - Mobile Dental Information Management System. The DIMS is developed with the following features:

1. Integrate a networking mechanism to use one centralized server for all the users in Maglinte Dental Clinic, including the dentist/owner, staff, and dental patients.
2. Design and implement the following modules:
    a. acquisition;
    b. data management; and

c. administration.

3. Implement business intelligence techniques for decision support to the dental clinic.

Scope and Delimitation

The study was called DIMS: A Mobile-Based Dental Information Management System of Maglinte Dental Clinic, Bilar, Bohol. The development of the proposed system focused on the following modules:

- **Centralization** – This would facilitate a fully integrated dental information management system with modular components and methodology, portable, mobile-based, and caters to the specific needs of the clinic in the handling and management of records and information.
- **Acquisition** - This module would handle the storing, processing, analyzing, searching, and retrieving of users' and patients' data and information.
- **Data Management** - This module would manage and organize the data, including management of patient appointments, patients' dental records, services, payments, and expenses.
- **Administration**- This function would provide administrative tools for system maintenance and management of users, security, and privacy.

- **Reports**- The system would provide electronic reporting to serve the strategic management of Maglinte Dental Clinic. This would provide printable data like payment receipts and dental certifications. The system would also provide data visualization, the graphical reporting technique for the total number of registered patients – categorized by gender, and yearly and monthly clinic income, and expenses report.

The study was limited only to the standard operation and procedures of handling patient information carried out by the Maglinte Dental Clinic of Bilar, Bohol. The users of the system were limited to the owner, staff, and patients for the confidentiality of information.

Significance of the Study

The development of the DIMS: A Mobile-Based Dental Information Management System of Maglinte Dental Clinic, Bilar, Bohol would bring forth a strategic point for managing the clinic's essential data and information.

Furthermore, the system would provide benefits to the following individuals:

Dental Clinic Owner/Dentist. The dental clinic's owner/dentist could set patient dental charts, and patient treatment records, and add prescription and dental certifications. The dental clinic's owner/dentist would also have an organized appointment for patients.

Dental Clinic Staff/Secretary. The dental clinic's staff/dentist would easily record, log, organize and update patients' basic information, management of patients' appointments with the clinic dentist, and utilize the management of available and offered clinic services/procedures, and medicines.

Dental Patients. Patients would create their accounts to access the dental clinic patient app. He/She would have easy access in recording her basic information, setting an appointment request, and viewing his/her treatment records, dental charts, tooth status, receipts, and dental certification. He/she would also benefit from the app's notification feature to ensure that he/she would be updated to his/her appointments changes and updates.

Researchers. This study would improve the researchers' interpersonal relationships and would help them become better communicators, through interviews. It would also improve their reasoning and analytical ability, as well as their knowledge in programming and design. It would also function as a stepping stone in their future job application for such abilities.

Future Researchers. This program could be an instrument for future researchers in which it could help them add the ideas presented in the study and might be used as a reference data in conducting new research and solving one of the society's major problems that was evident in today's generation.

RESEARCH METHODOLOGY

Development Framework

Figure 1 below presents the conceptual diagram of the study that represents the principle of input-process-output. The inputs are the information that were collected by the clinic's staff or dentist. The process includes data recording, data management, administration, and reports. The output provides decision support to the administration.

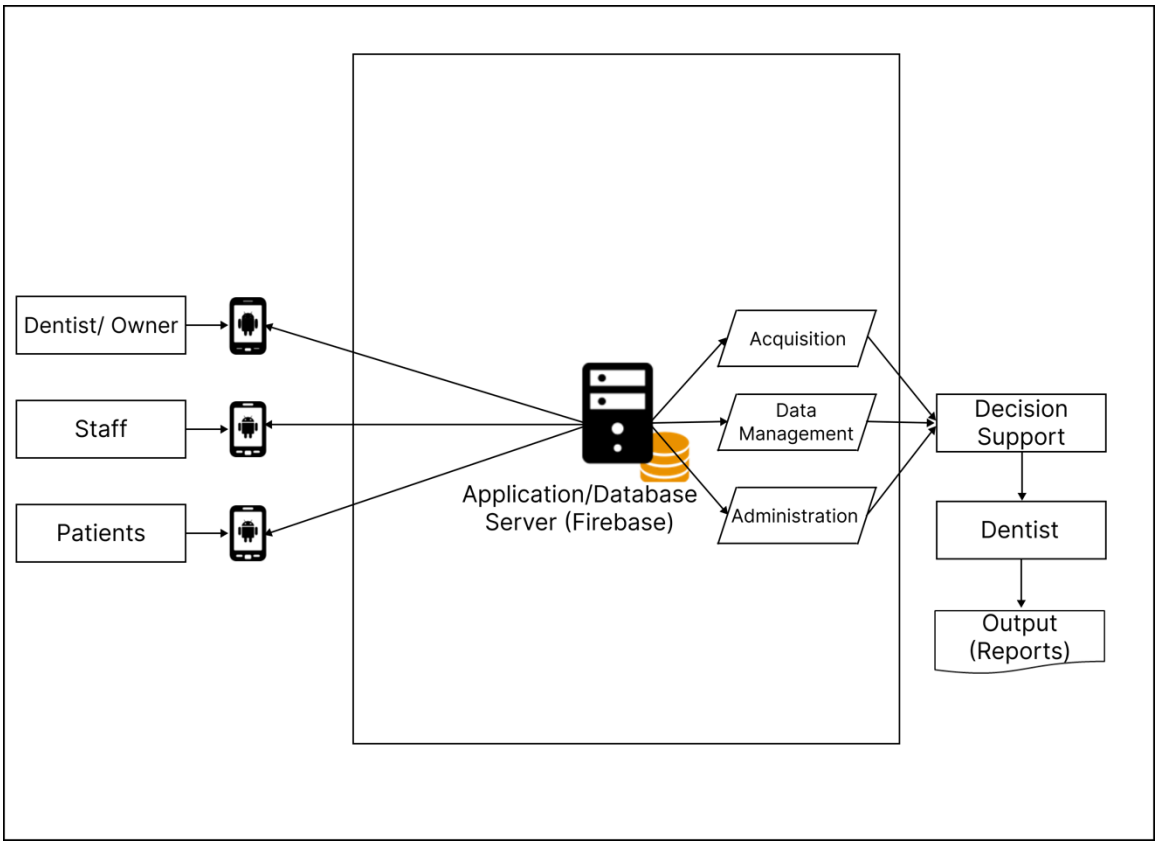


Figure 1. Conceptual Diagram of the Study

Block Diagram

Figure 2 shows the block diagram of the study DIMS: A Mobile Based Dental Information Management System of Maglinte Dental Clinic, Bilar, Bohol. It covers the specification of the basic functionality of the system that represents the work process of the Dental Clinic Dentist, Staff, and Dental Patients. The other function of the system is the generation of reports.

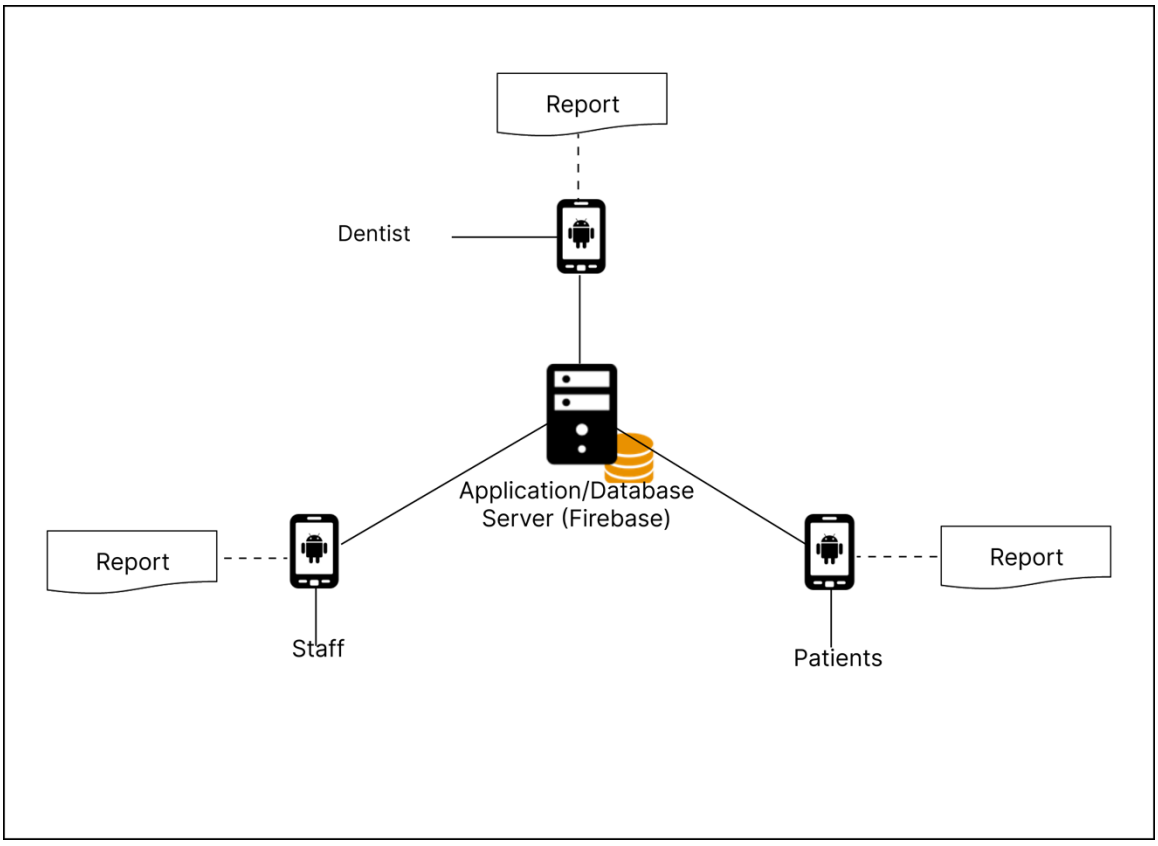


Figure 2. Block Diagram of the Study

Development Model and Approaches

The study used Rapid Application Development (RAD) with four phases to be strictly followed. In the early stage of Analysis and Design, the researchers and clients cooperated to identify the development's goals and aspirations, as well as current and potential problems that must be addressed during construction. The researchers also traced for any existing system to be the central point of the study, and gather the data by an interview with the respondents. To gather sufficient information for designing the system, document review and observation of procedures were done specifically in data acquisition and data management.

The prototype cycle was covered in the second stage. Through several prototype iterations, the developer fully worked out the user design. Clientele collaborated with the developer. The system was presented to the dental staff and the dentist to ensure that the needs were met at every stage of the design process. It covered the review of the system's usability and functionality to see if it adheres to the procedures, and suggesting additional inputs and recommendations.

The testing phase which was the third stage followed extensive prototyping and cutting-edged design. The beta system was presented to the dental dentist and staff to ensure that everything was running smoothly and that the clientele's expectations and goals were met. For the system's usability, the developers provide guide questions to fully assess all of its features.

The final stage was the implementation, wherein the completed program was deployed. The dental staff and the dentist were allowed to use the newly developed system. Data conversion, final tests, and user training were all done by the developers. While the developer and clients continue to look for bugs and potential problems that need to be addressed right away, the finalization was completed.

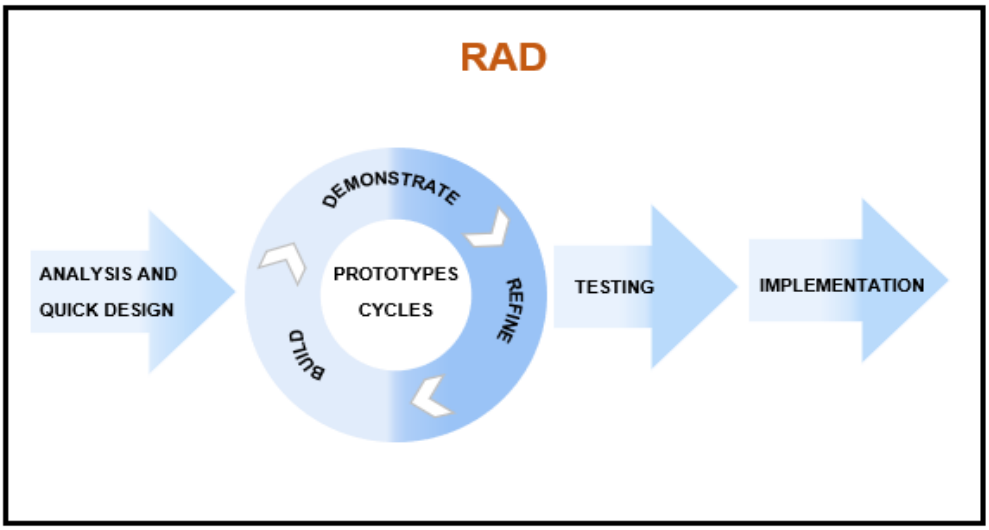


Figure 3. Rapid Application Development Model (RAD) Diagram

Adopted from EtonDigital (2012), http://www.etondigital.com/services/rapid-application-development/

Software Development Tools

The following were the tools used in the development of the DIMS: A Mobile Based Dental Information Management System of Maglinte Dental Clinic, Bilar, Bohol.

1. Android Smartphone (Xiaomi Redmi 9) – It is a mobile device made by Xiaomi, which is also powered by Google's mobile operating system

Android, with android version 11. This device was used to run and test the app, and also open the firebase website server remotely.

2. **Android Studio** – It is the official IDE (Integrated Development Environment) for mobile development, based on IntelliJ. It is the IDE used by the researchers to develop the DIMS: A Mobile Based Dental Information Management System of Maglinte Dental Clinic, Bilar, Bohol.
3. **Flutter** – It is an open-source Software Development Kit, a framework used by the researchers to develop the DIMS.
4. **Dart** – It is the programming language used in flutter in developing crossed-platform applications.
5. **GitHub** – It is the technology used by the researchers for version control in developing the mobile app. IT is used to track changes, commits, branches, and mergeability of the codes.
6. **Firebase** – It is a Google-Blacked application development software that enables developers to develop iOS, Android, and Web Apps. Firebase provides tools for tracking analytics, reporting and fixing app crashes, and creating market and product experiments.
7. **Cloud Firestore** – It is a no-SQL (Structured Query Language) database, is the database used by the researcher in developing the mobile app. The database provides real-time updates on data changes.
8. **Firebase Authentication** – It is a firebase tool for handling user authentication, Google authentication, Facebook authentication, and Email authentication.

9. **Firebase Messaging** – It is a firebase tool that is responsible for creating and sending real-time notifications to users.
10. **Figma** – It is a design tool that the researchers used for generating and designing the study's diagrams: 1) the conceptual diagram, 2) contextual diagram, 3) top-level of the present system, 4) use case diagram, 5) block diagram, and 6) the program hierarchy.

Environments and Participants

The study was conducted at the Maglinte Dental Clinic located in Poblacion, Bilar, Bohol. It is 1.5km away from Bohol Island State University – Bilar Campus. The Maglinte Dental Clinic is open every Saturday from 8:00 am to 5:00 pm. Maglinte Dental Clinic has an estimated at least one (1) patient per day and has two working forces, the dentist, and the staff.

The participants of the study were the clinic dentist, staff, and clinic patients. They are the one who provides us with data and helped the researchers to make the system successful. The dentist provided the data on the patients' dental information and reports. The clinic staff provided a detailed flow on how the data were collected, kept, and utilized in the clinic.

Data Collection

The researchers sent a letter request to the owner. The researchers conducted a personal interview with the indicated respondents, asking them guide questions and seeing the clinic's actual process. The researchers requested that

some forms used by the dental clinic be provided as a reference for understanding the process flow and adding potential features for the system's development.

The target respondents of the study were the seven (7) respondents who were classified as one (1) dentist/owner, one (1) staff/secretary, and five (5) patients.

Table 1. Distribution of Respondents

Respondents	**Frequency**
Maglinte Dental Clinic Dentist	1
Maglinte Dental Clinic Staff	1
Dental Patients	5
Total	7

Table 2 shows the interpretation of the results used for system usability. In the system usability, the rating was done based on the System Usability Guidelines developed by MIT Information Services Technology.

Table 2

Interpretation Guide of the System Usability

Weight	Range	Description	Interpretation
7	6.4 - 7.0	Strongly Agree	The respondents strongly believe and confident that the system is very usable.
6	5.5 – 6.3	Agree	The respondents believe and confident that the system is usable.
5	4.6 – 5.4	Tend to Agree	The respondents tend to believe that the system is usable.
4	3.7 – 4.5	Neither Agree nor Disagree	The respondents are neutral in trusting that the system is usable.
3	2.8 – 3.6	Tend to Disagree	The respondents tend not to trust that the system is usable.
2	1.9 – 2.7	Disagree	The respondents believe that the system is not usable.
1	1.0 – 1.8	Strongly Disagree	The respondents strongly confident that the system is not usable.

To determine the general acceptability of the system, the average weighted mean or the weighted mean score was computed to evaluate/assess the system acceptability level using the following formula:

$$WMS = \frac{1f1 + 2f2 + 3f3 + 4f4 + 5f5}{N}$$

Where:

WMS=Weighted Mean Score

f^1 = frequency of respondents given a rate of 1

f^2 = frequency of respondents given a rate of 2

f^3 = frequency of respondents given a rate of 3

f^4 = frequency of respondents given a rate of 4

f^5 = frequency of respondents given a rate of 5

n = total number of respondents

1, 2…5 = constant (rating to the service provided)

The range of the interpretative guide for usability was computed by getting the interval value. The table above shows the interpretative guide that was used to describe the usability of the system.

OPERATIONAL DEFINITION OF TERMS

To ensure thorough understanding, the terminologies and acronyms used or mentioned in this study were further defined operationally to ensure complete understanding below:

Business Intelligence (BI) - It is the ability of an organization/business establishment to collect, maintain, and organize knowledge. It aims to support better business decision-making.

Database. It is a computer program that stores the collection of data, generally stored, and accessed electronically from a computer system. Where databases are more complex, they are often developed using formal design and modeling techniques.

Dentist. It is also known as a dental surgeon, is a medical professional specializing in dentistry, the diagnosis, prevention, and treatment of disease and collections of the oral cavity.

Dental Certificate. It is a certificate that is given to the patients to served as the proof of treatments and procedures rendered.

Dental Clinic. It refers to the Maglinte Dental Clinic, a dental clinic in Bilar, Bohol.

Dental Staff. It refers to the person who is assigned by the dentist to handle the recording and organizing of patient's basic information, and treatment records, assist the doctor in conducting a procedure, record and handle the patient payments, and giving of medicine and dental certificates.

Medicine. It refers to the medicines given to the patient by the dentist for medication, only if medication is needed after undergoing a dental health service.

Patients. It refers to the dental patients, who avails certain dental health services offered by Maglinte dental clinic.

Patient Dental Chart. It refers to the graphical representation of patient dental tooth chart, tooth records and treatment history, and tooth conditions. Mixed dental chart was used, where the pediatric tooth chart (labeled from tooth A to Z), and adult tooth chart (labeled from tooth 1 to 32) were combined to address the compliance of tooth charting standardization that was practiced in the Maglinte Dental Clinic.

Prescription. It refers to the list of medicines and direction of usage given to the patients before or after patients' availment of procedures or treatments.

Chapter 2

PRESENTATION, ANALYSIS, AND INTERPRETATION

Existing Operation and Processes

Maglinte Dental Clinic in Bilar, Bohol opens from 8:00 AM to 5:00 PM every Saturday. Maglinte Dental Clinic still uses a manual system for recording and monitoring patient information. The clinic patients were needed to come in the clinic in order to schedule appointments with the doctor.

A. Inquiry Process

In inquiring about the services of Maglinte Dental Clinic, dental patients shall go to the clinic, patients will then be accommodated by the dental staff about their queries regarding the services they would like to avail of and know their corresponding amounts. Common dental services includes tooth extraction, tooth filling, invisalign, dental veneers, ventures, teeth cleaning, teeth whitening, bridgework, and dental crown. At present, the clinic is using a manual system in storing and recording dental patients' records and information.

In inquiring about the amount of a certain dental service, the price may vary according to the difficulty of the service, and the patient's set of teeth – a patient may have an adult set of teeth, a pediatric set of teeth, or a mix of both. For a patient that has an adult tooth, which is the subject of a certain service, the price may go higher than that of a pediatric one.

B. Recording of patient data

Upon availing of certain services, the staff shall ask for the patient to fill up the dental record sheet with the patient's personal information, and/or medical records if necessary. That information includes such as the patient's name, address, records of allergies, birthday, and patient contact email and number. These records are then arranged in the filing cabinet.

C. Availment of Services

Availing of a certain dental service, a patient shall go to the staff and arrange the time and/or date of when to undergo the procedure. If there's a long queue of patients, arranging when to undertake the service may take another day or longer time. There is a strict rule that only one patient is allowed in the dental clinic operating room.

When it is the patient's turn to undertake the procedure, the dentist may ask further questions concerning the patient's procedure to avail, the dentist may change the procedure when whatever is the best for the patient, for instance, the dentist may not extract a molar when it can be restored with a tooth filling.

D. Availment of Medicines

After a successful procedure, the dentist may prescribe the patient a list of medicines to take depending on the procedure rendered. When the clinic has a stock of the prescribed medicines, the patient has an option to buy from the clinic

or go to another pharmacy. After that, the staff will handle the process of giving the patient the complete details of the amount to be paid, then the patient shall pay it cash.

E. Generation of Reports

The patient may also request a dental certificate, upon the doctor's approval and signature. The patient record will be retrieved, and the necessary data will be written in the requested form.

Data Flow Diagram

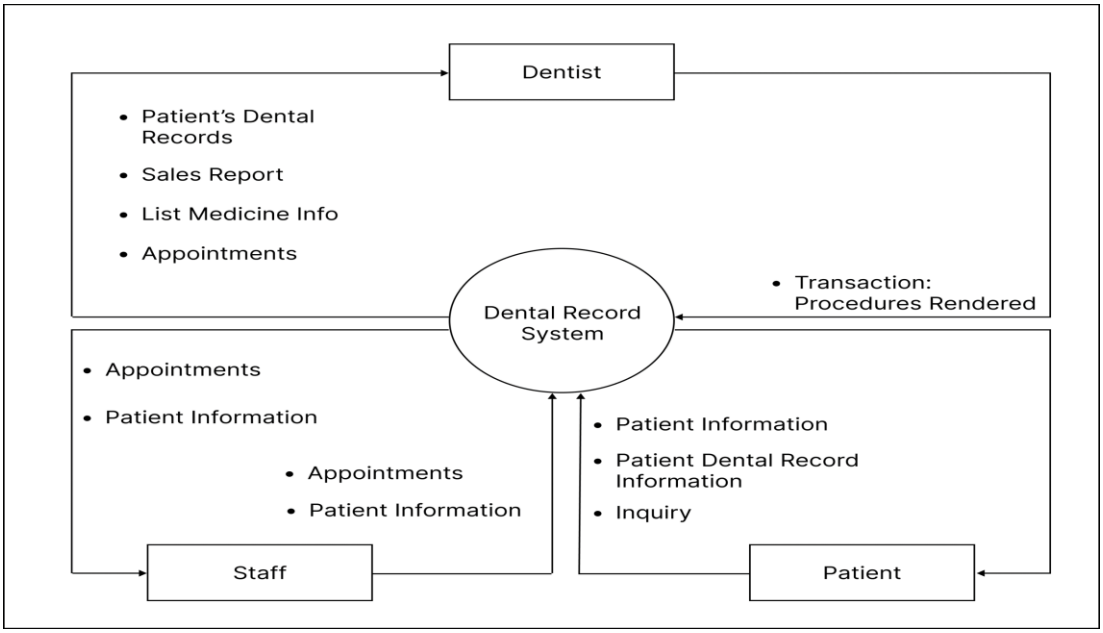


Figure 4. Contextual Diagram of the Present System

Event Specifications:

Event List:

1. Inquiry Process
2. Recording of patient data
3. Availment of Services
4. Availment of Medicines
5. Generation of Reports

Event List Diagram

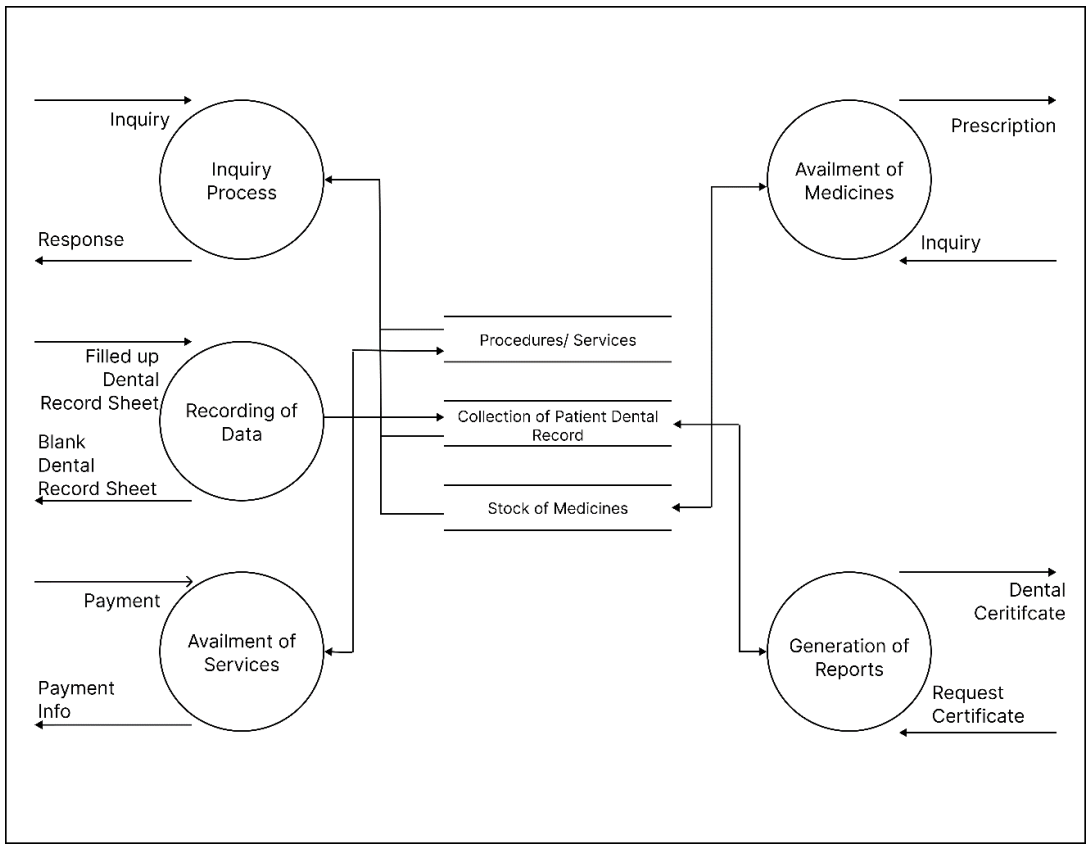


Figure 5. Top Level of the Present System

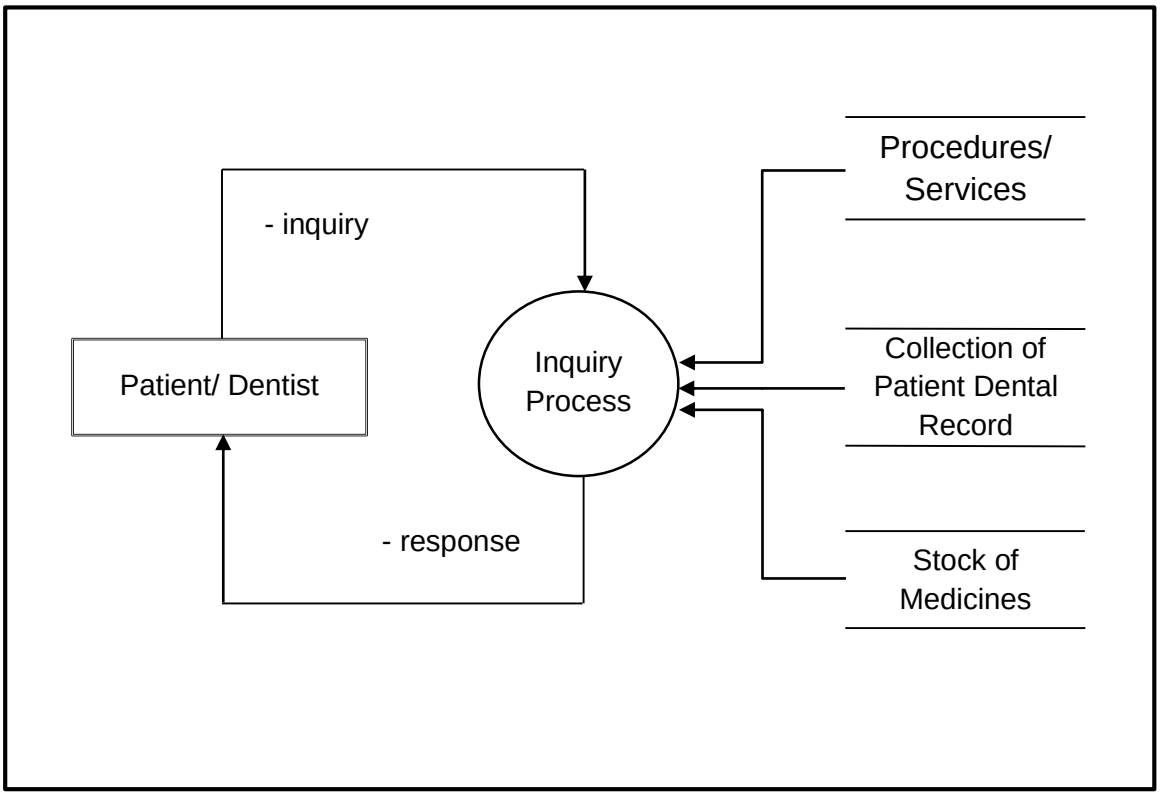


Figure 6. Inquiry Process (Event 1)

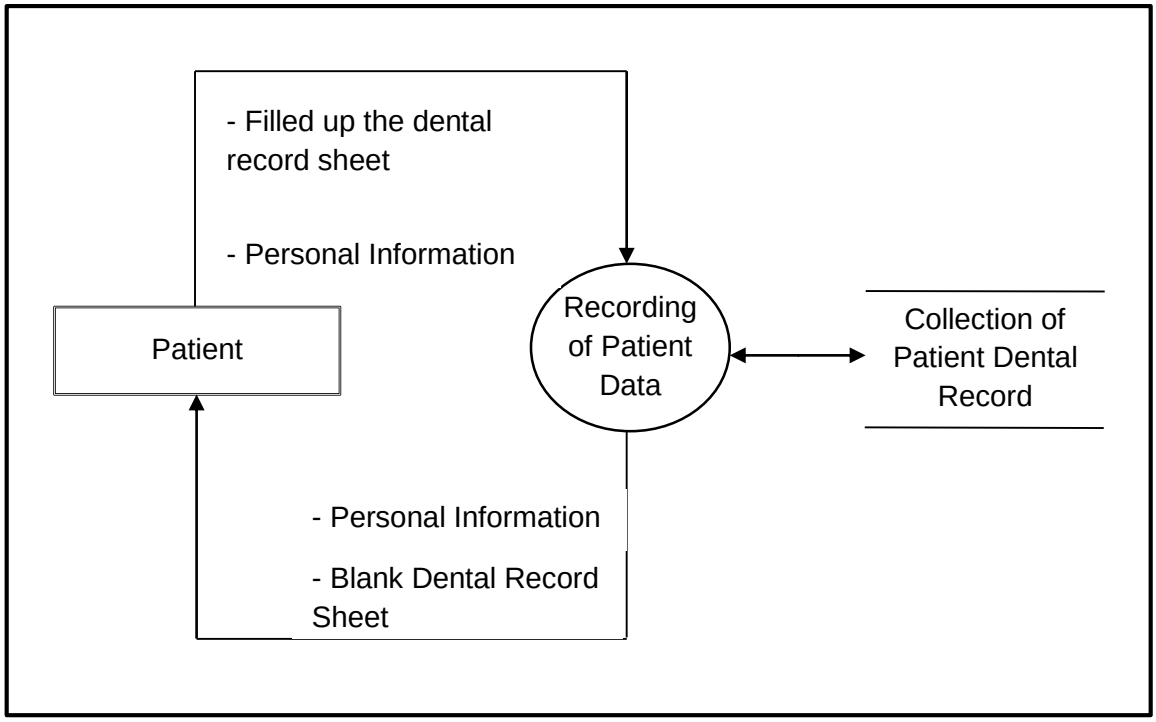


Figure 7. Recording of Patient Data

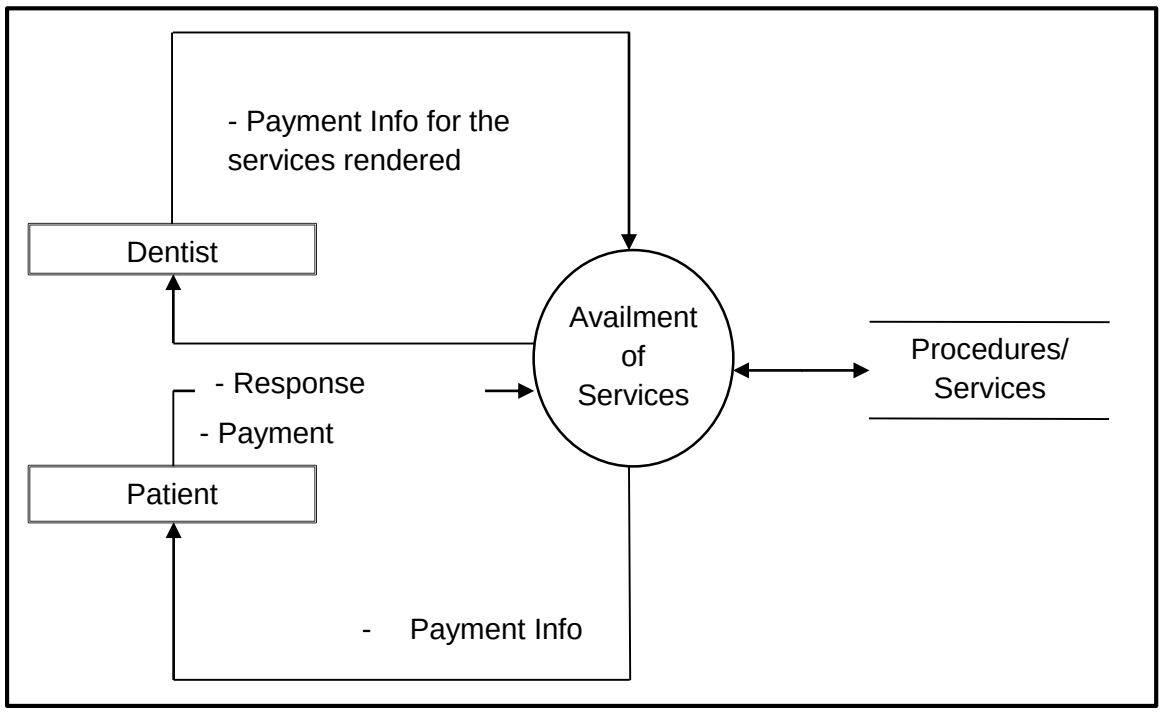
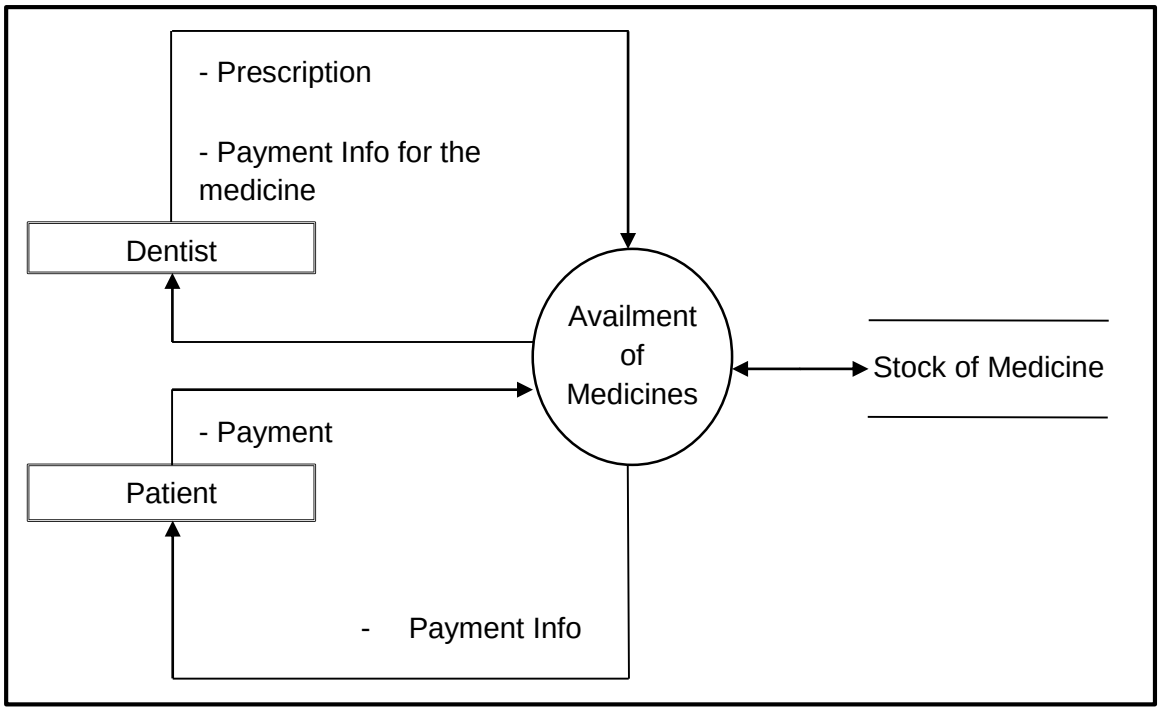
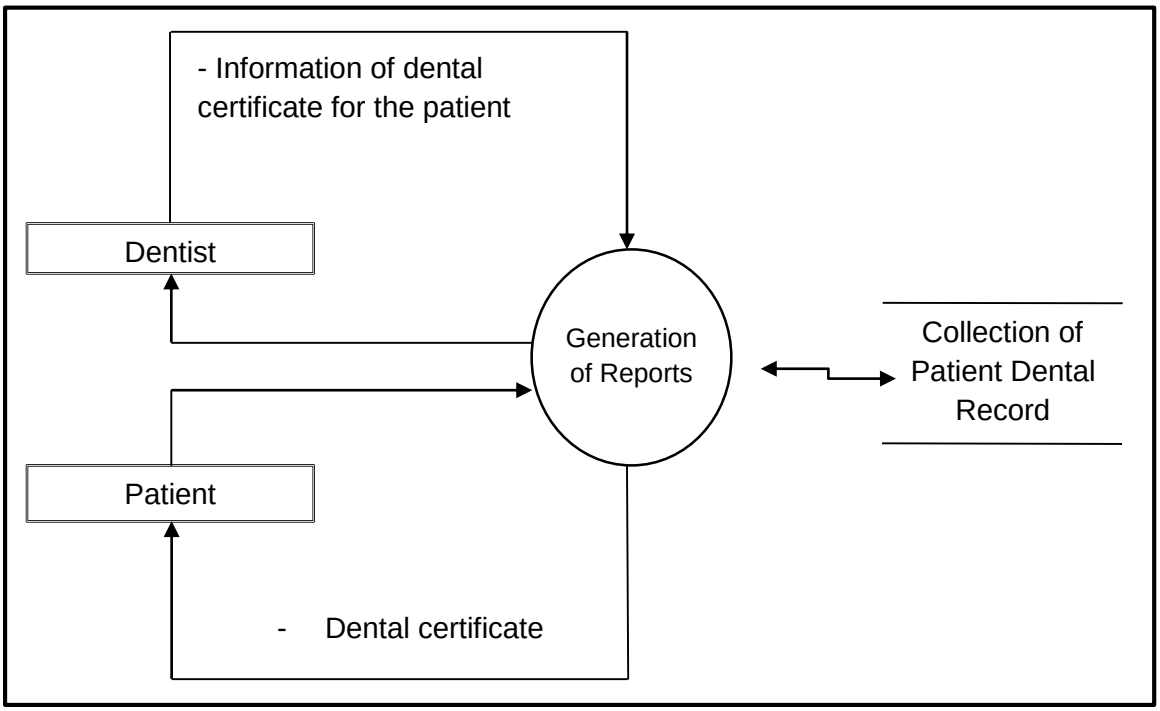


Figure 8. Availment of Services (Event 2)



Figured 9. Availment of Medicines



Figured 10. Generation of Reports

Needs of the Existing Operation

Based on the identified problems with consideration of the existing system in the management of Maglinte Dental Clinic, the researchers had observed and identified the following needs:

1. There must be a secure system that would prevent the leaks of sensitive information of the dentist, staff, and the patients.
2. Provide a secure database that would provide a real-time update to ensure the syncing of information across users and devices.
3. Improve the management of patients, and records, getting rid of dental record sheets as a medium for recording and storing patient's data.

4. Develop a dental record system that is portable and that is running on mobile android platforms.

DIMS: A Mobile Based Dental Information Management System of Maglinte Dental Clinic Bilar, Bohol

The researchers gathered all the data and information of the current system of Maglinte Dental Clinic and developed the “DIMS: A Mobile Based Dental Information Management System of Maglinte Dental Clinic Bilar, Bohol”, a mobile system that would handle appointments, medical and patients’ record and information, payments for services and medicines, patient’s dental chart, and notifications.

A. Administration

In the administration, authorized people need to log in to access the system. The authorized people must enter the email, and the password in the log-in form to be able to access the system. This log-in system is used for security reasons to avoid intruders accessing the data that may cause a breach or the loss of the patient’s personal information. Each has corresponding required information that shall be stored in the user collection.

B. Acquisition

The new system can record all patient information, and generate a unique id for every patient that identifies the patient entity. All patient data will be saved to a

collection named – “patients”. Saved data can also be viewed, updated, and deleted by the staff or by the dentist.

C. Data Management

In the data management process, the staff is responsible for recording the patient’s dental records and personal information. The staff is also responsible for identifying if there is an existing record of patient's information to avoid redundancy of records. The doctor is responsible for updating the dental record and dental chart of the patient and giving prescriptions to the patient after rendering a service or procedure.

D. Generation of Reports

The new system would provide reports on sales revenue, record of expenses, and patients data including the total patients who are registered on the app, patient’s age bracket, and patient’s gender.

Used Case Diagram

According to Erikson and Penker (2000), a use case diagram describes specific usage of the system by one or more actors. The use case is a list of actor or event steps typically defending the interactions between a role (known in the Unified Modelling Language as an actor) and a system to achieve a goal.

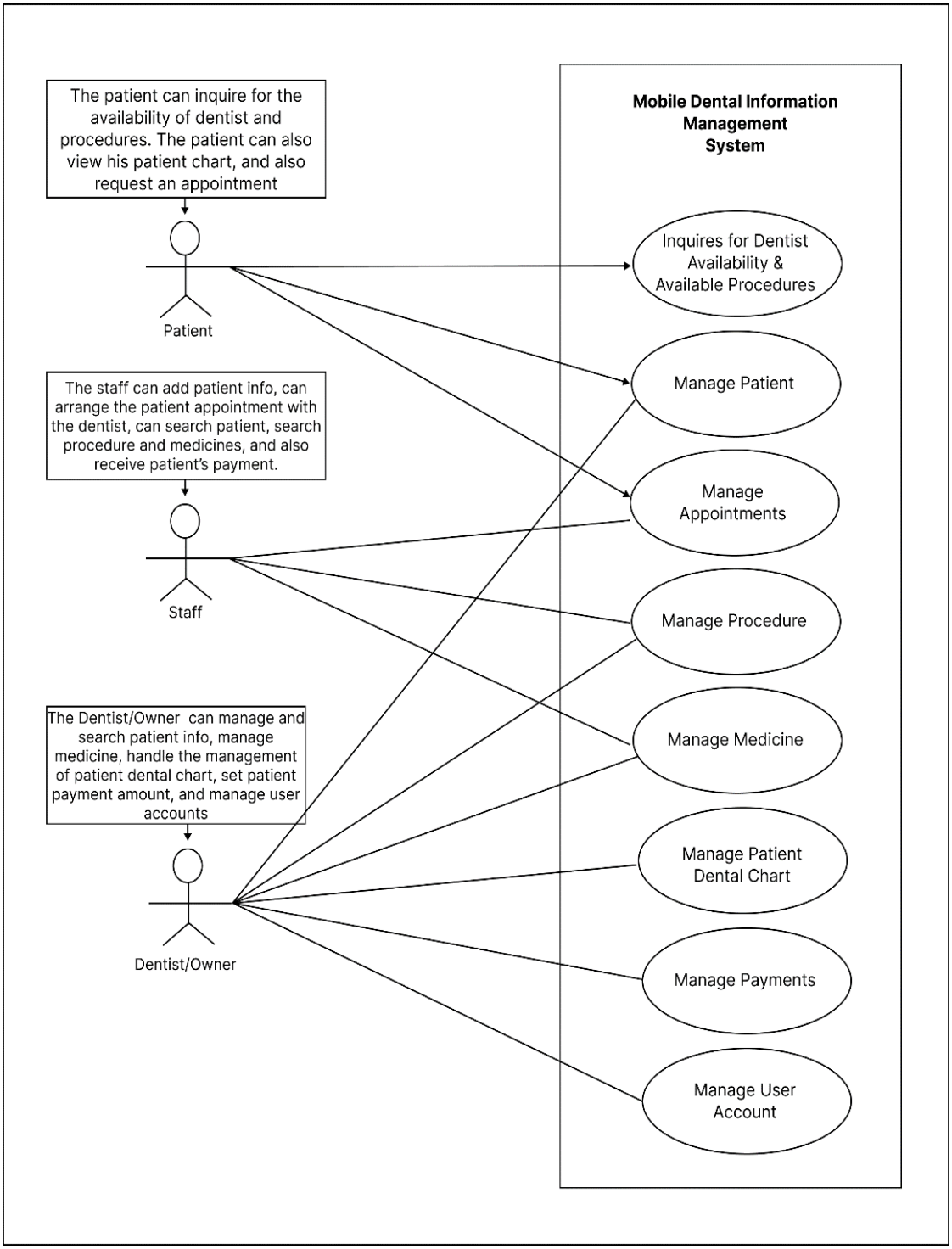


Figure 11. Use Case Diagram of DIMS: A Mobile Based Dental Information Management System

Use Case Narrative

Use case narrative describing a use case that requires both frame context of the use case and represents the dialog between the user (actor or use case) to achieve a goal of observable value. It must provide more elements than a simple sequence of user to system interactions. In every use case narrative, there are pre-conditions, processes, and post-conditions

Table 3. Inquiry on Dentist Availability, and Dental Procedures Available

Use case name	Inquiries for Dentist Availability, and for Available Procedures
Actor	Patient
Precondition	Patient is already logged in
Description	Allows the patient to view the dentists' availability and the available procedures.
Typical Course of Action	
Actor Action	**System Response**
Step 1 User selects Navigation Drawer	**Step 2** Display list of actions and menu
Step 3 User selects "View Clinic Personnel" button.	**Step 4** Display the list of Dentist and Staff, and their availability status, i.e active, on vacation, and or away. **Go back to Step 2**
Step 5 User selects "View Clinic Offered Procedures" button.	**Step 6** Display the list of clinic's offered procedures
Alternate Paths • None	

Table 4. Manage Patient (Dentist/Owner and Staff/Secretary)

Use case name	Manage Patient
Actor	Dentist/Owner and Staff/Secretary
Precondition	Dentist/Owner and Staff/Secretary is already in patient module
Description	Allows the Dentist/Owner and Staff/Secretary to Add, Edit, Update and View patient information
Typical Course of Action	
Actor Action	**System Response**
Step 1 User selects Patients tab.	**Step 2** Display patients list with “Add Patient” button.
Step 3 User selects “Add Patient” button.	**Step 4** Display patient form with “Save” button
Step 5 The user fills-up the form and click a button	**Step 6** If user, click “save” button. The system restores the data into the database and a message will display “success New Patient Added!” **Go back to Step 2**
Step 7 User selects a Patient in the patients’ lists.	**Step 8** Display Patient Info menu with “Call”, “Text”, “Edit”, “Dental Chart”, “Appointments”, “Payments”, and “Dental Certificate” button.
Step 9 User selects a button.	**Step 10** If the user clicks “Call” button. **go to Step 11** If the user clicks “Text” button. **go to Step 13** If the user clicks “Edit” button. **go to Step 15** If the user clicks “Dental Chart” button and display patients dental chart. **go to Step 17** If the user clicks “Appointments” button and displays patient’s appointment lists with “Add Appointment” and “Update status” button. Then **Go to Step 21**

	If the user clicks “Payments” button. **go to Step 27** If the user clicks “Dental Certificate” button. **go to Step 31**
Step 11 The user confirms phone number and click “Call” or “Back” icon.	**Step 12** If the user chooses “Call” icon, the system starts dialling. If the user click “Back”, navigation bar. **go back to Step 8**.
Step 13 The user chooses a message application (default message phone app or messenger).	**Step 14** If the user chooses “Default Messages” app, the system redirects to create and send a message. If the user chooses “Messenger” app, the system redirects to create and send a message. If the user clicks “Back”, navigation bar. **go back to Step 8**.
Step 15 The user edits the patient information and click update button	**Step 16** The system restores the updated data into the database, a message “Successfully Updated” will display. **Go back to Step 8**
Step 17 User selects a tooth, add tooth condition and dental notes with “Add Payment & Billing” button.	**Step 18** If the user clicks “Add Payment & Billing” button, the system displays Add Payment Form.
Step 19 The user fills-up the form and click “Save Payment” button.	**Step 20** The system display a message “You are trying to save a payment record. Are you sure to continue this action?” If the user selects “Cancel”, **go back to Step 19.**

	If the user selects “Confirm”, the system restores the data into the database and displays a message “Payment Saved!” and a receipt. If the user clicks “Back” navigation bar. **go back to step 8.**
Step 21 The user clicks a button.	**Step 22** If the user clicks “Add Appointment’ button. The system display Add Schedule form with “Cancel” and “Save” button. **Proceed to Step 23** If the user clicks “Update Status” button. The system displays appointment status. **Proceed to step 25.**
Step 23 The user fills-up the form and click a button.	**Step 24** If the user clicks “Cancel” button, **go back to step 21.** If user clicks “Save” button, the system, restore the data into the database. **Go back to step 21**
Step 25 The user selects a status and click a button.	**Step 26** If the user clicks “Cancel” button, **go back to step 21** If the user clicks “Done” button, the system restore the data into the database and display a message “Success! Appointment status was updated”. **Go back to step 21.**
Step 27 The user views the lists of Patients Payments and payment receipt and select a button.	**Step 28** If the user clicks “View Receipt” button. The system display payment receipt. **Go back to step 27.** If the user clicks “Add Billing/Payment” button, the system displays Add Payment form with “Save Payment” button.
Step 29 The user fills-up the form and click “Save Payment” button.	**Step 30**

	The system displays a message “You are trying to save a payment record. Are you sure to continue this action?” If the user selects “Cancel”. **go back to Step 29.** If the user selects “Confirm”, the system restores the data into the database and displays Payment Receipt. If the user clicks “Back” navigation bar, **go back to Step 8.**
Step 31 The user views the lists of Patient Dental Certificate and can view certificate document and select a button.	**Step 32** If the user clicks “View Certificate Document” button, the system displays a document reader. If the user clicks “Add Dental Certificate” button, the system displays Add Dental Certificate form with “Save & Generate PDF” button.
Step 33 The user fills-up the form and click “Save & Generate PDF” button.	**Step 34** The system restores the data into the database and a message will display “Certificated Added. Open it Now! **go back to Step 31.** If the user clicks “Back”, navigation bar. **go back to Step 8**. If the user clicks “Back”, navigation bar. **go back to Step 2**.
Alternate Paths Step 5, 15, 19, 23, 27, 31 • If information is not filled, a message “The field is empty” in each label will display.	

Table 5. Manage Patient (Patient)

Use case name	Manage Patient
Actor	Patient
Precondition	Patient is already in patient module
Description	Allows the Patients to View, Edit and Update patient information

Typical Course of Action	
Actor Action	**System Response**
Step 1 User views Patient Information menu.	**Step 2** Display Patient Info menu with “Edit”, “Dental Chart”, “Prescription”, “Appointments”, “Payments” and “Dental Certificate” button.
Step 3 User selects a button.	**Step 4** If the user clicks “Edit” button. **Go back to Step 5.** If the user clicks “Dental Chart” button. **go to Step 7.** If the user clicks “Prescription” button. **go to Step 9.** If the user clicks “Appointments” button. **go to Step 11.** If the user clicks “Payments” button. **go to Step 13.** If the user clicks “Dental Certificate” button. **go to Step 17.**
Step 5 The user edits the information and chooses Save button.	**Step 6** The system saves the data into the database and a message “Successfully Saved” will display. **Go Back to Step 3.**
Step 7 The user selects tooth and add condition then chooses Save Button.	**Step 8** The system saves the data into the database. **Go Back to Step 3.**
Step 9	**Step 10**

The user views the patient prescription.	The system displays the prescription of the patients. **Go Back to Step 3.**
Step 11 The user views the patient appointment.	**Step 12** The system displays the appointment schedule of the patient. **Go Back to Step 3.**
Step 13 The user views the List of Patient Payment.	**Step 14** The system displays the Patient Payment with “View Receipt” button.
Step 15 Click “View Receipt” button	**Step 16** The system displays the patient’s payment receipt with “Download Image” and “Download pdf” button, **go back to Step 3.**
Step 17 The user views the Patient Certification and click “View Certificate Document”.	**Step 18** The system displays the Patients Certificate, **go to Step 1.**
Alternate Paths Step 5 • If information is not filled a message “The field is empty” in each label will display.	

Table 6. Manage Appointment (Dentist/Owner and Staff/Secretary)

Use case name	Manage Appointment
Actor	Dentist/Owner and Staff/Secretary
Precondition	Dentist/Owner and Staff/Secretary is already in appointment module
Description	Allows the Dentist/Owner and Staff/Secretary to Add, Update and View Clinic Appointments
Typical Course of Action	
Actor Action	**System Response**
Step 1	**Step 2**

User selects Appointments tab.	Display the Clinic Appointments calendar with “Add Appointment” button.
Step 3 User clicks “Add Appointment” button.	**Step 4** Display patients list with “Add Patient” button. If user select “Add Patient” button, **proceed to Step 5.** If user select Patient in the patients list, **proceed to Step 7.**
Step 5 User fills-up the form and click “Save” button	**Step 6** The system restores the data into the database and a message will display “Success! New Added”. **Go back to Step 4**
Step 7 User fill-up the Add Schedule form and click a button.	**Step 8** If the user clicks “Cancel” button, g**o back to Step 4.** If user clicks “Save” button, the system restores the data into the database and a message will display “Appointment Added”. **Go back to Step 2**
Alternate Paths Step 5 and 7 • If information is not filled a message “The field is empty” in each label will display.	

Table 7. Manage Appointment (Patient)

Use case name	Manage Appointment
Actor	Patient
Precondition	Patient is already in appointment module
Description	Allows the Patient to Add and View Clinic Appointments
Typical Course of Action	
Actor Action	**System Response**
Step 1	**Step 2**

User selects Appointments button.	Display the list of Patient Appointments with “Add Appointment Request” button.
Step 3 User clicks “Add Appointment Request” button.	**Step 4** The system displays Add Schedule Form with “Cancel” and “Save” button.
Step 5 User fills-up the form and click a button.	**Step 6** If user clicks “Cancel” button. **Go to Step 2** If user clicks “Save” button, the system restores the data into the database and a message “Success Appointment Request was added. Waiting for approval by the dentist” will display. **Go back to Step 2**
Alternate Paths Step 5 • If the information is not filled a message “The field is empty” in each label will display.	

Table 8. Manage Procedure (Dentist/Owner and Staff/Secretary)

Use case name	Manage Procedure
Actor	Dentist/Owner and Staff/Secretary
Precondition	Dentist/Owner and Staff/Secretary is already in procedure module
Description	Allows the Dentist/Owner and Staff/Secretary to View and Add dental procedures.
Typical Course of Action	
Actor Action	**System Response**
Step 1 User selects Procedures tab.	**Step 2** Display the procedures list with “Add Procedure” button.
Step 3 User clicks “Add Procedure” button.	**Step 4** Display Add Procedure form with “Save” button.
Step 5	**Step 6**

User fills-up the form and click a button.	If user clicks “Save” button, the system restores the data into the database and a message will display “Successfully Saved”. **Go back to Step 2**
Alternate Paths Step 6. If user clicks “Save” button, go back to Step 2. Step 5 • If the information is not filled a message “Please fill out the required information” in each label will display.	

Table 9. Manage Procedure (Patient)

Use case name	Manage Procedure
Actor	Patient
Precondition	Patient is already in procedure module
Description	Allows the Patient to View dental procedures.
Typical Course of Action	
Actor Action	**System Response**
Step 1 User selects Procedures tab.	**Step 2** Display the procedures list.

Table 10. Manage Medicine (Dentist/Owner and Staff/Secretary)

Use case name	Manage Medicine
Actor	Dentist/Owner and Staff/Secretary
Precondition	Dentist/Owner and Staff/Secretary is already in medicine module
Description	Allows the Dentist/Owner and Staff/Secretary to View and Add dental medicine.
Typical Course of Action	
Actor Action	**System Response**
Step 1 User selects Medicine tab.	**Step 2** Display the drug list with “Add Medicine” button.
Step 3 User clicks “Add Medicine” button.	**Step 4** Display Add Medicine form with “Save” button.
Step 5	**Step 6**

User fills-up the form and click a button.	If the user clicks “Save” button, the system restores the data into the database and a message will display “Successfully Saved”. **Go back to Step 2**
Alternate Paths Step 5 • If the information is not filled a message “Please fill out the required information” in each label will display.	

Table 11. Manage Medicine (Patient)

Use case name	Manage Medicine
Actor	Patient
Precondition	Patient is already in medicine module
Description	Allows the Patient to View dental medicine.
Typical Course of Action	
Actor Action	**System Response**
Step 1 User selects Medicine tab.	**Step 2** Display the drug list

Table 12. Manage Patient Dental Chart (Dentist/Owner)

Use case name	Manage Chart
Actor	Dentist/Owner
Precondition	Dentist/Owner is already in dental chart module
Description	Allows the Dentist/Owner to View and Update Dental Chart.
Typical Course of Action	
Actor Action	**System Response**
Step 1 User selects Patients tab.	**Step 2** Display patients list with “Add Patient” button.
Step 3 User selects a Patient in patient’s lists.	**Step 4** Display Patient Info menu with “Call”, “Text”, “Edit”, “Dental Chart”, “Appointments”, “Payments”, and “Dental Certificate” button.

Step 5 The user clicks “Payments” button.	**Step 6** If user clicks “Save” button, the system restores the data into the database and a message will display “Successfully Saved”. **Go back to Step 2**
Alternate Paths Step 5 • If the information is not filled a message “Please fill out the required information” in each label will display.	

Table 13. Manage Payments (Dentist/Owner and Staff/Secretary)

Use case name	Manage Payment
Actor	Dentist/Owner and Staff/Secretary
Precondition	Dentist/Owner and Staff/Secretary is already in payment module
Description	Allows the Dentist/Owner and Staff/Secretary to View, Update and Add payments.
Typical Course of Action	
Actor Action	**System Response**
Step 1 User selects Patients tab.	**Step 2** Display patients list with “Add Patient” button.
Step 3 User selects a Patient in patient’s lists.	**Step 4** Display Patient Info menu with “Call”, “Text”, “Edit”, “Dental Chart”, “Appointments”, “Payments”, and “Dental Certificate” button.
Step 5 The user clicks “Payments” button.	**Step 6** The system displays the lists of Patient Payments and "Add Billing/Payment” button.
Step 7	**Step 8**

The user clicks “Add Billing/Payment” button.	The system displays Add Payment form with “Save Payment” button.
Step 9 The user fills-up the form and click a button.	**Step 10** If user clicks “Save Payment” button, the system displays a message “You are trying to save a payment record. Are you sure to continue this action?” If the user selects “Cancel”, **go back to Step 9.** If the user selects “Confirm”, the system restores the data into the database and display a message “Payment Saved!” and a receipt. If the user clicks “Back” navigation bar, **go to Step 2.**
Alternate Paths Step 9 • If the information is not filled a message “Please fill out the required information” in each label will display.	

Table 14. Manage Payments (Patient)

Use case name	Manage Payment
Actor	Patient
Precondition	Patient is already in payment module
Description	Patient to View payments.
Typical Course of Action	
Actor Action	**System Response**
Step 1 User selects Payments button.	**Step 2** Display list of patient’s payment with “View Receipt” button.
Step 3 User clicks “View Receipt” button	**Step 4** Display Patient Receipt

Table 15. Manage Account (Dentist/Owner)

Use case name	Manage Account
Actor	Dentist/Owner
Precondition	Dentist/Owner is already in account module
Description	Allows the Dentist/Owner to View, Edit and Update account.
Typical Course of Action	
Actor Action	**System Response**
Step 1 User selects Home tab.	**Step 2.** Display the Home menu with User Account icon, Notification and Logout icon, Shortcuts and Today's Appointment.
Step 3 User clicks "User Account" icon.	**Step 4.** Display the user information with "Edit User Info" button.
Step 5 User clicks the "Edit User Info" button.	**Step 6** The system displays User Info form with "Update" button.
Step 7 The user fills-up the form and click a button.	**Step 8** If the user clicks "Update" button, the system updates the data into the database and display a message "User Updated!", **go back to Step 4.**
Alternate Paths Step 7 • If the information is not filled a message "Please fill out the required information" in each label will display.	

Table 16. Manage Account (Patient)

Use case name	Manage Account
Actor	Patient
Precondition	Patient is already in account module
Description	Allows the Patient to View, Edit and Update account.
Typical Course of Action	
Actor Action	**System Response**
Step 1	**Step 2**

User clicks the “Edit User Info” button.	The system displays User Info form with “Update” button.
Step 3 The user fills-up the form and click “Update” button.	**Step 4** If the user clicks “Update” button, the system updates the data into the database and display a message “User Updated!”, **go back to Step 2.**
Alternate Paths Step 2 • If the information is not filled a message “Please fill out the required information” in each label will display.	

Database Design

Database design is the process of producing a data model of the database. This data model contains all the needed logical and physical design choices and physical storage parameters needed to generate a design in a data definition language, which can then be used to create a database.

System design is the process of defining the components, modules, interfaces, and data for system to satisfy specified requirements of Dental Information Management System of Maglinte Dental Clinic, Bilar, Bohol. And the researchers aim to create a new system which would be used in the Office.

In order to meet the client's needs, various improvements were made to Maglinte Dental Clinic's database management system. The goal of this design was to provide a solution to the problem identified and to assist the end users in retrieving the records quickly and saving time.

Class Diagram

In Figure 12 is a class diagram in the Unified Modeling Language (UML). UML is a form of static structure diagram that shows the system classes, their attributes, operations (or methods), and interactions among the classes to explain the structure of a system.

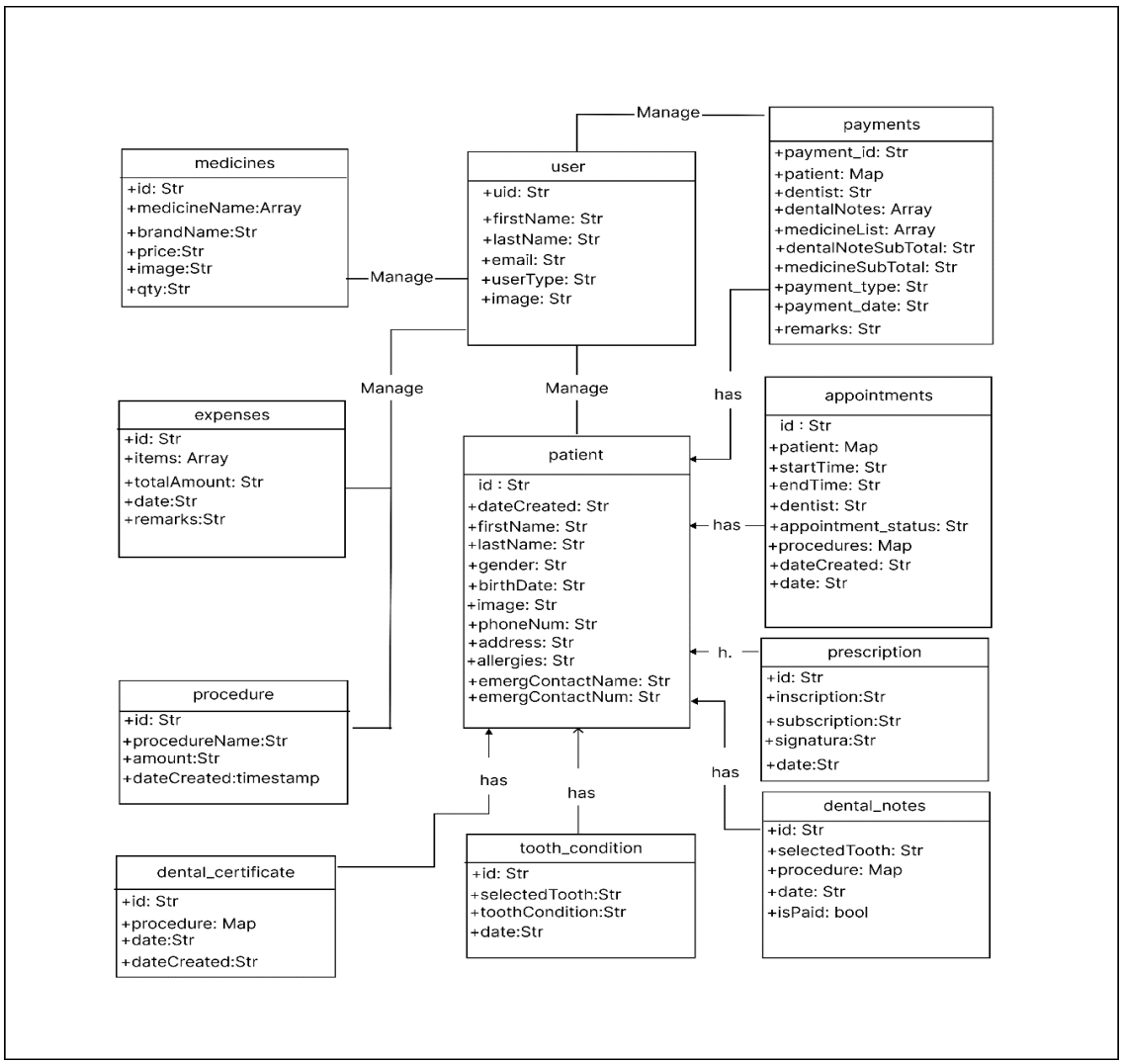


Figure 12. Class Diagram of the system

Data Structure

The following tables below were the database tables that were used in storing the information that was inputted in the system together with a collection of requirements that facilitate searching, sorting, and similar activities. It is easy for users to access and work with the data they need in appropriate ways. It is a particular way of organizing data in computer so that it can be used effectively.

Table 17. System User

User Information

Field No.	Field Name	Type	Description
1	uid	String(50)	User Id
2	firstName	String(100)	First Name
3	lastName	String(100)	Last Name
4	email	String(100)	Email
5	userType	String(8)	Dentist or Staff
6	image	String(500)	Image String Url
7	phoneNum	String(11)	User Contact No.

Table 18. Appointments

Appointment Information

Field No.	Field Name	Type	Description
1	Id	String(50)	User Id
2	patient	Map	Patient Account
3	startTime	Date	Appointment Start time
4	endTime	Date	Appointment End time
5	dentist	Map	Selected Dentist Info
6	appointment_status	String(15)	Status of Appointment
7	procedures	Array	Selected Procedure
8	dateCreated	Date	Date Created
9	date	Date	Date of Appointment

Table 19. Expenses

Expenses Information

Field No.	Field Name	Type	Description
1	Id	String(50)	Expense id
2	items	Array	Items purchased
3	totalAmount	String(20)	Total Amount
4	date	Date	Date of Expenditure
5	remarks	String(100)	Remarks

Table 20. Medicines

Medicine Information

Field No.	Field Name	Type	Description
1	Id	String(50)	Medicine Id
2	brandName	String(50)	Brand Name
3	dateCreated	Date	Date Created
4	image	String(500)	Image
5	medicineName	String(100)	Medicine Name
	price	String(20)	Price
	qty	String(8)	Quantity

Table 21. Patients

Patient Information

Field No.	Field Name	Type	Description
1	Id	String(50)	Patient Unique Id
2	address	String(300)	Address
3	allergies	String(300)	Allergies
4	birthDate	Date	Birth Date
5	dateCreated	Date	Date Created
6	emergencyContactName	String(200)	Emergency Contact Name
7	emergencyContactNumber	String(11)	Emergency Contact Number
8	firstName	String(100)	Firstname
9	fullName	String(200)	Fullname
10	gender	String(6)	Gender
11	image	String(500)	Image URL

Table 22. Payments

Payment Information

Field No.	Field Name	Type	Description
1	payment_id	String(50)	Payment Id
2	patient	Map	Patient
3	dentist	String(200)	Dentist
4	dentalNotes	Array	Dental Notes
5	medicineList	Array	Medicine List
6	dentalNoteSubtotal	String(20)	Dental Note Subtotal
7	medicineSubtotal	String(20)	Medicine Subtotal
8	payment_type	String(50)	Payment Type
9	payment_date	Date	Payment Date
10	remarks	String(200)	Remarks

Table 23. Procedures

Procedure Information

Field No.	Fieldname	Type	Description
1	Id	String(50)	Procedure Id
2	pocedureName	String(200)	Procedure Name
3	Amount	String(20)	Procedure Amount
4	dateCreated	Date	Date Created

Table 24. Dental Note

Dental Note Information

Field No.	Field Name	Type	Description
1	Id	String(50)	Dental Note Id
2	selectedTooth	String(1)	Tooth Label
3	procedure	Map	Procedure Rendered
4	date	Date	Date
5	isPaid	Boolean	Is The Rendered Procedure Paid

Table 25. Tooth Condition

Tooth Condition Information

Field No.	Field Name	Type	Description
1	Id	String(50)	Tooth Condtion Id
2	selectedTooth	String(1)	Tooth Label
3	toothCondition	String(100)	Tooth Condition
4	date	Date	Date

Table 26. Prescription

Prescription Information

Field No.	Field Name	Type	Description
1	Id	String(50)	Prescription Id
2	inscription	String(200)	Medicine
3	discription	String(200)	Quantity of medicine
4	signatura	String(300)	Instruction to patient
5	date	Date	Date when the prescription was given

Table 27. Dental Certification

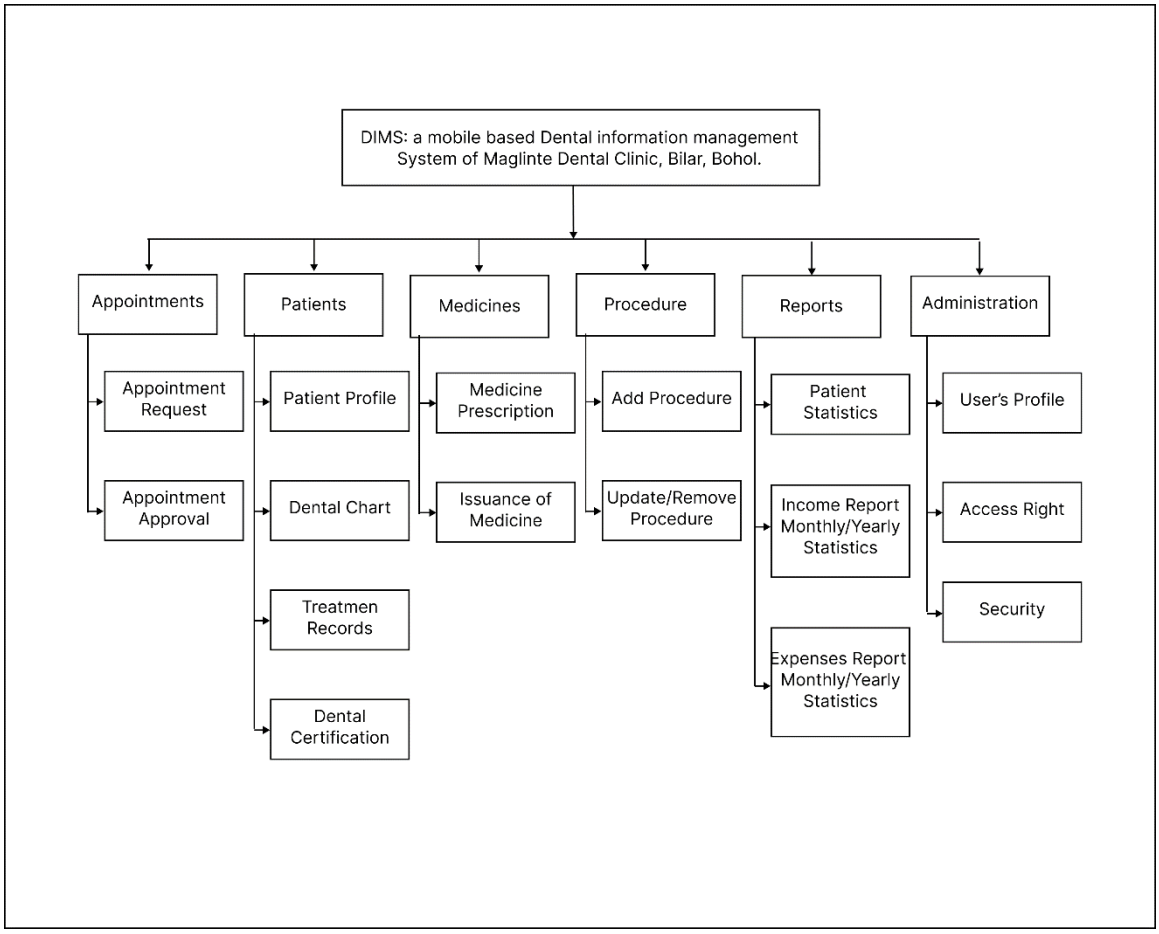
Dental Certification Information

Field No.	Field Name	Type	Description
1	Id	String(50)	Dental Note Id
2	procedureName	String(200)	Procedure Name
3	date	Date	Certification Date
4	dateCreated	Date	Date Created

Program Hierarchy

A program hierarchy is a chart that shows the breakdown of the system to the lowest manageable levels. Each Module is represented by a box, which contains the module. Program hierarchy is used to specify the high-level design or architecture of a computer program.

Figure 13. Program Hierarchy



Functional Requirement

The functional requirement specifies a software system's or component's function. A function is made up of three parts: inputs, behavior, and outputs. Calculations, technical details, data manipulation and processing, and other specific functionality that describes what a system is expected to perform are examples of functional requirements. The functional requirements were defined with the help of a prototype. Through constant collaboration with the Maglinte Dental Clinic's staffs, a working prototype was produced to strategically capture

functional requirements. The functionalities mentioned were based from existing standards requirements of the Electronic Dental Record System with the approval and coordination of the owner of Maglinte Dental Clinic as follows:

Process Log-in

FREQ 1: Access to the system should allow authorized Owner/Dentist, Staff/Secretary and Patients of the clinic only.

FREQ 2: All gathered information should be saved and secured.

Process Inquiry

FREQ 3: The system should allow the recording of patient's information.

FREQ 4: The system should allow the sorting of patient's information.

Process Recording Patient Admitted

FREQ 5: The system should allow the in-charge personnel to record the admitted patients.

Process Recording Medicine

FREQ 6: The system should allow the in-charge personnel to record all the purchased and released medicine.

FREQ 7: The system should allow the in-charge personnel to search medicine availability.

FREQ 8: The system should allow to give signal if there is unavailability or unavailable stock of medicine.

Process Patient Update Information

FREQ 9: The system should allow the in-charge personnel to update patient’s information records.

FREQ 10: The system should provide medicine report.

FREQ 11: The system should provide the statistical reports for decisions.

Non-Functional Requirement

A non-functional requirement specifies criteria that can be used to evaluate a system's functioning rather than specific actions. Functional requirements, on the other hand, describe specific behaviors or functions. The system design includes a plan for implementing functional requirements.

1. The system should be implemented with internet connection.
2. The system must run on an Android mobile device.

Test Case

A test case is a detailed procedure that fully tests a feature or an aspect of a feature under which a tester will evaluate whether an application or software system is working correctly or not. It is also a set of input values, evolution preconditions, results and executions, developed for a particular objective or test condition.

These are the scenarios that were tested during the acceptance testing. The test cases strategy is to allow people to utilize the system while following the instructions to test the proposed system. To be regarded successful, the system must also produce the predicted outcome in each test case. This test case functions as a set of instructions for using the system.

Test Case 1:

Module: User Registration and Log-in

Severity: 1

Instructions:

1. User account registration
2. Input email and password
3. Account setup

Expected Result:

1. User can access the modules of the system.

Test Case 2:

Module: Adding Patient

Severity: 1

Instructions:

1. On the main menu, select “Patients”.
2. Click “Add” button.
3. Input detailed information.
4. Click “save” button for confirmation

Expected Result:

- It should be successfully saved
- The newly added Patient should be displayed.

Test Case 3:

Module: Adding Appointment

Severity: 1

Instructions:

1. On the main menu, select “Appointment”.
2. Click “Add Appointment”.
3. Select patient.
4. Input detailed information.
5. Click “Save” for confirmation.

Expected Result:

- It should be successfully saved.
- The newly added Appointment should be displayed.

Test Case 4:

Module: Adding Procedure

Severity: 1

Instructions:

1. On the main menu, select “Procedures”.
2. Click “Add Procedure”.
3. Input detailed information.
4. Click “Save” for confirmation.

Expected Result:

- It should be successfully saved.
- The newly added Procedure should be displayed.

Test Case 5:

Module: Adding Medicine

Severity: 1

Instructions:

1. In the main menu, select “Medicine”.
2. Click “Add Medicine”.
3. Input detailed information.
4. Click “Save” for confirmation.

Expected Result:

- It should be successfully saved.
- The newly added Medicine should be displayed.

Test Case 6:

Module: Adding Dental Note

Severity: 1

Instructions:

1. In the main menu, select “Patients”.
2. Select patient.
3. Click “Dental Chart”.
4. Select tooth.
5. Click “Dental Notes”.
6. Input detailed information.

7. Click “Save”.

Expected Results:

- It should be successfully saved.
- The newly added Dental Note should be displayed.

Test Case 7:

Module: Adding Payment

Severity: 1

Instructions:

1. In the main menu, select “Patients”.
2. Select Patient.
3. Select “Payments”.
4. Click “Add Billing/Payment”.
5. Input detailed information.
6. Click “Save Payment” for confirmation.

Expected Results:

- It should be successfully saved.
- The newly added Payment should be displayed.

Test Case 8:

Module: Adding Expenses

Severity: 1

Instructions:

1. In the main menu, select “Add Expenses” from shortcut.
2. Input detailed information.

3. Click “Add Item”.
4. Input detailed information.
5. Click “Add” for confirmation.
6. Click “Save Expenses”.

Expected Result:

- It should be successfully saved.
- The newly added Add Expenses should be displayed.

Test Case 9:

Module: Adding Prescription

Severity: 1

Instructions:

1. In the main menu, select “Patients”.
2. Select patient.
3. Click “Prescription”.
4. Click “Add Prescription”.
5. Set prescription date.
6. Click “Add Prescription Item”.
7. Input detailed information.
8. Click “Done”.
9. Click “Save”.

Expected Result:

- It should be successfully saved.
- The newly added Prescription should be displayed.

Test Case 10:

Module: Adding Dental Certificate

Severity: 1

Instructions:

1. In the main menu, select “Patients”.
2. Select patient.
3. Select “Dental Certificate”.
4. Click “Add Dental Certificate”.
5. Input detailed information.
6. Click “Save & Generate PDF”.

Expected Result:

- It should be successfully saved & generate PDF.

Technical Requirements

Hardware, software, and peopleware were the three essential requirements that were needed in the implementation of the Mobile Electronic Dental Record System. In a newly developed system, these three systems requirements must be recognized and must worked together. This system's endurance and capabilities were useful because it could last for a long time.

The hardware component refers to the physical part of the Mobile Phone. The display, microphone, speaker, SIM card, battery, USB port, memory unit, camera, network connectivity and Bluetooth/GPS features are all part of it.

However, there were only 2 (two) components that helped with data processing. The System on Chip (SoC) or CPU, as well as Random Access Memory (RAM) were the components.

The term software is frequently used to refer to a computer application. On the other hand, it is a set of instructions that the computer needs in order to process, store, and retrieve data. Without software, the computer can’t do anything useful. The programming language that the researcher will employed in the creation of the Mobile Electronic Dental Record System was also referred to as software.

People were referred to as mobile phone users. The Dentist, clinic staff and dental patients were the system users in the proposed DIMS: A Mobile Based Dental Information Management System of Maglinte Dental Clinic, Bilar, Bohol. The Staff could add and would update patient's appointments. The Dentist would add and update the patient's dental chart, as well as their teeth condition and prescription. Both the Dentist and the Staff would add and remove medicine that was purchased and dispensed.

Minimum Hardware Specifications

This covers the minimum hardware requirements for the system to work as intended and expected. These specifications were chosen based on what is already available on the market and what most mobile phone systems provide.

Table 28

Minimum Android Hardware Specifications

Component	Specification
CPU	Dual Core and Up
RAM	2Gb
ROM	4Gb
Connectivity	Wifi and 3G

Minimum Software Requirements

To function properly, the Mobile Electronic Dental Record System requires a variety of software. These software's are listed below, along with their specifications. The specifications mentioned were based on the Android units used in the system's development.

Table 29

Minimum Software Requirements

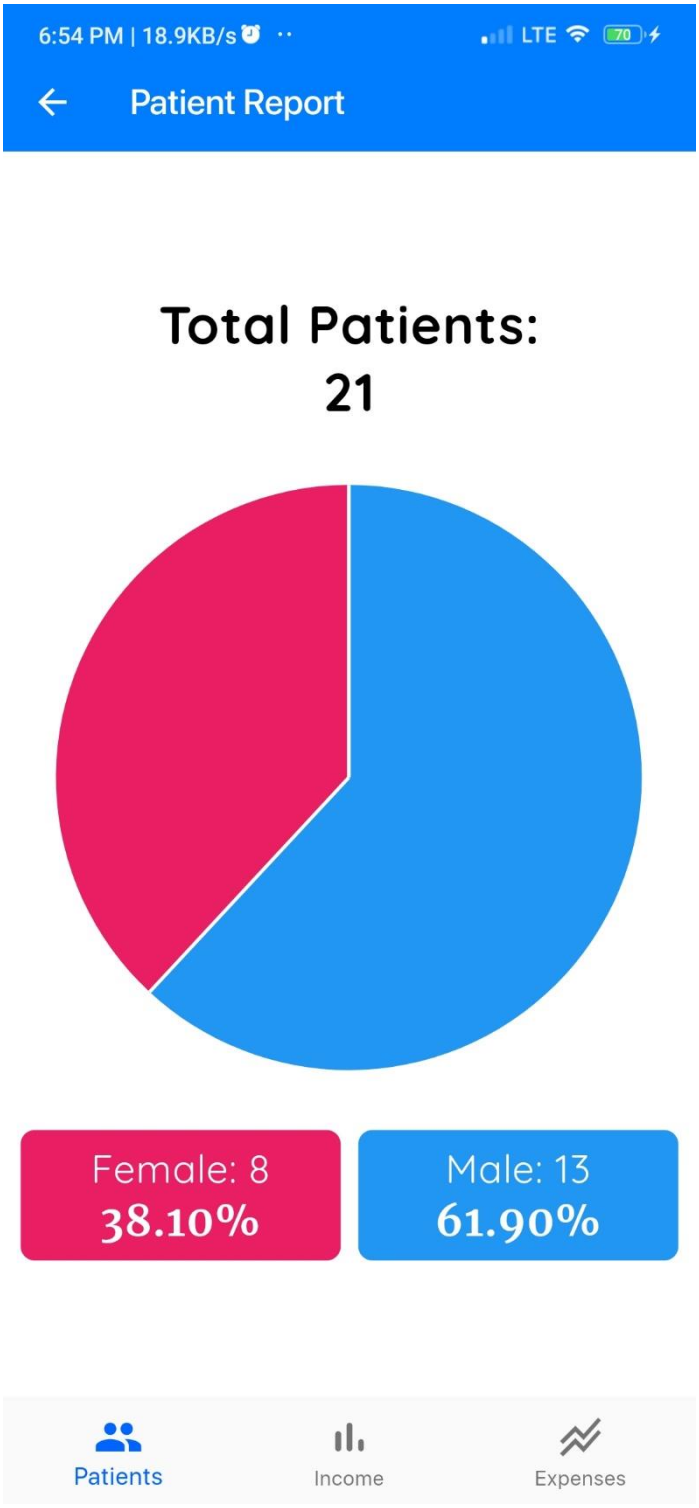
Component	Specification
Operating OS	Android
Android Version	Android 5.0 Lollipop and up

Business Intelligence Integration

In the existing theories, business intelligence means the ability of an organization to collect, maintain and organize knowledge. It aims to support better business techniques and decision-making with solutions that take business intelligence (BI) to a whole new level and getting the right information. The system integrated business intelligence specifically in the query and reporting component ensures the accuracy and consistency of the data in the report.

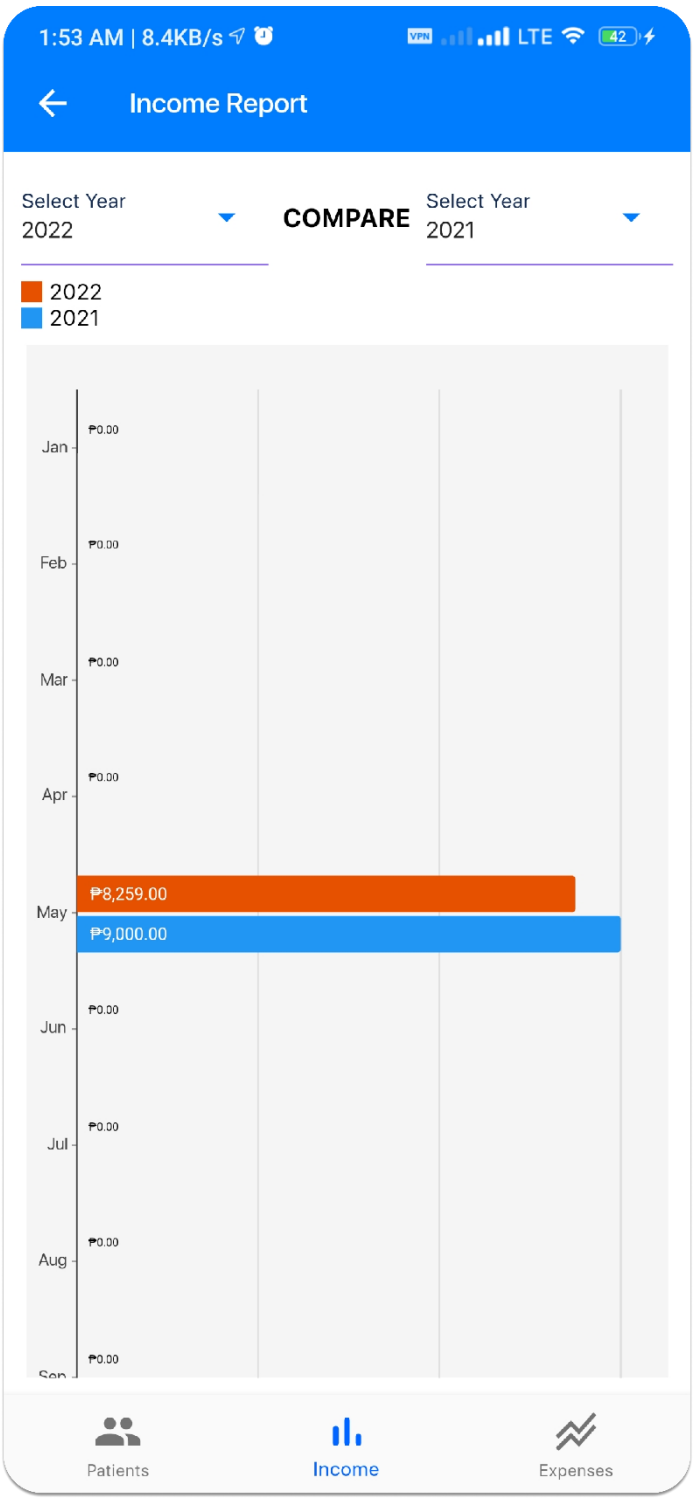
The developed system is capable of analyzing data and generating statistical reports. Automated representation of information allows real time data representation. These generated tabular reports maybe used by the Maglinte Dental Clinic Dentist/Owner and Staff as basis for monitoring of accomplished transaction.

Preview 1 below shows the Patient Report of the app.



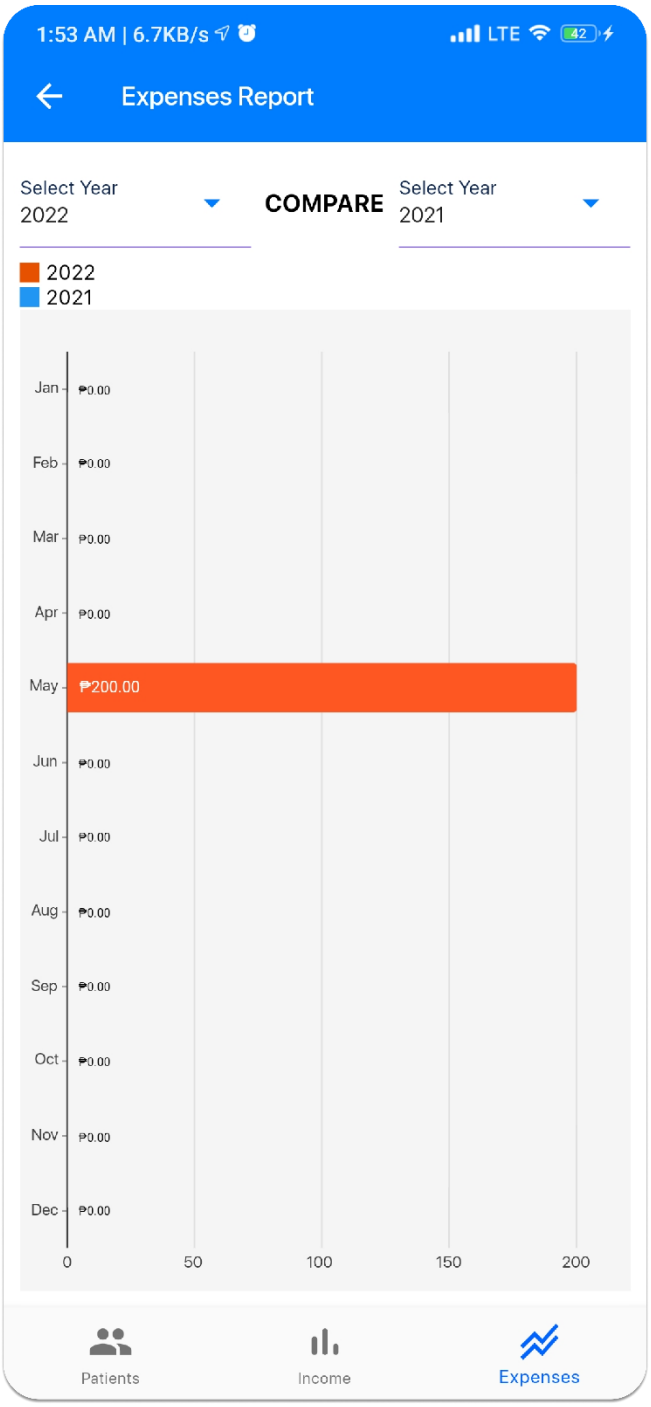
Preview 1. Patient Report

Preview 2 below shows the Income Report of the app



Preview 2. Income Report

Preview 3 below shows the Expenses Report of the app

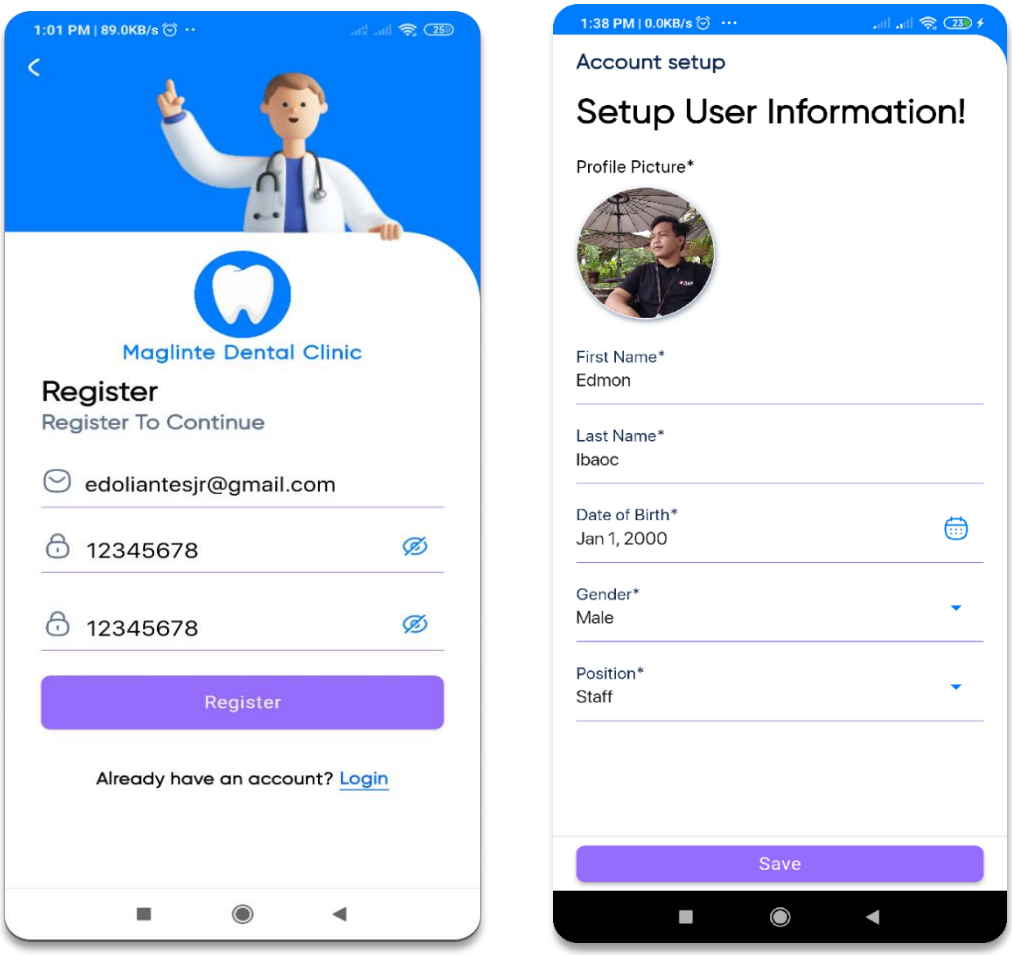


Preview 3. Expenses Report

Screen Layout

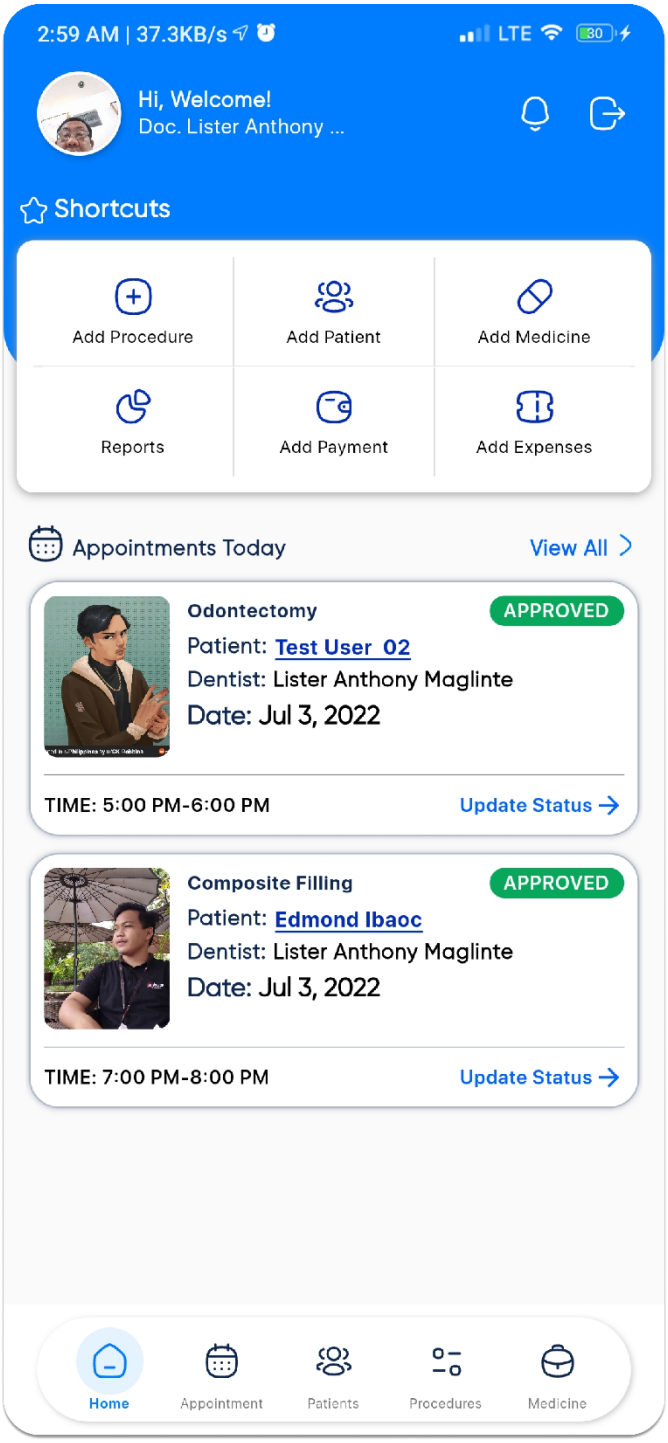
The Screen layout describes the design of graphical user interfaces. It includes a wide variety of applications where screens or displays can be used as part of human-machine interaction and should be distinguished from the functions of a graphical user interface" (ryte.com, 2020). Screen Layout is one of the many attributes of the system's user-friendliness. It should be designed in such a way to navigate the system quickly, easily, and it should provide clear recognition of the task of the users need to perform.

Preview 4 below shows the User Setup View of the app.



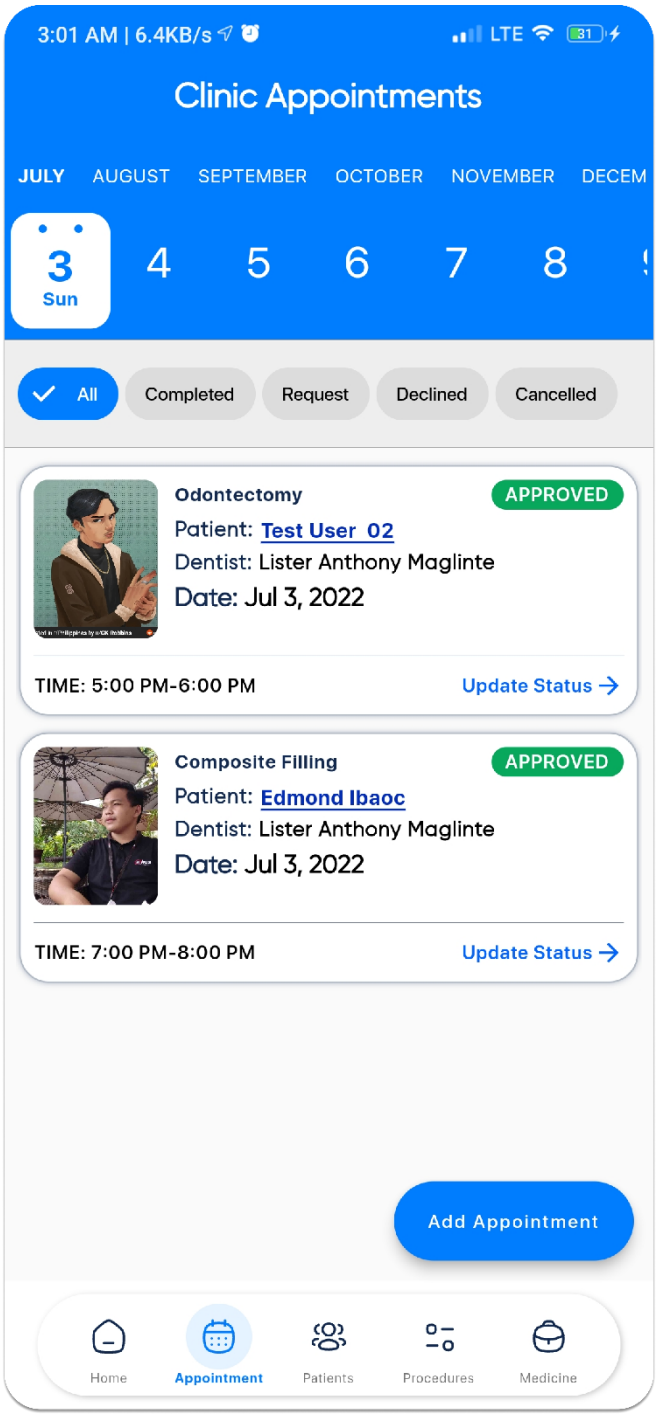
Preview 4. User Setup Page

Preview 5 below shows the Home View of the app.



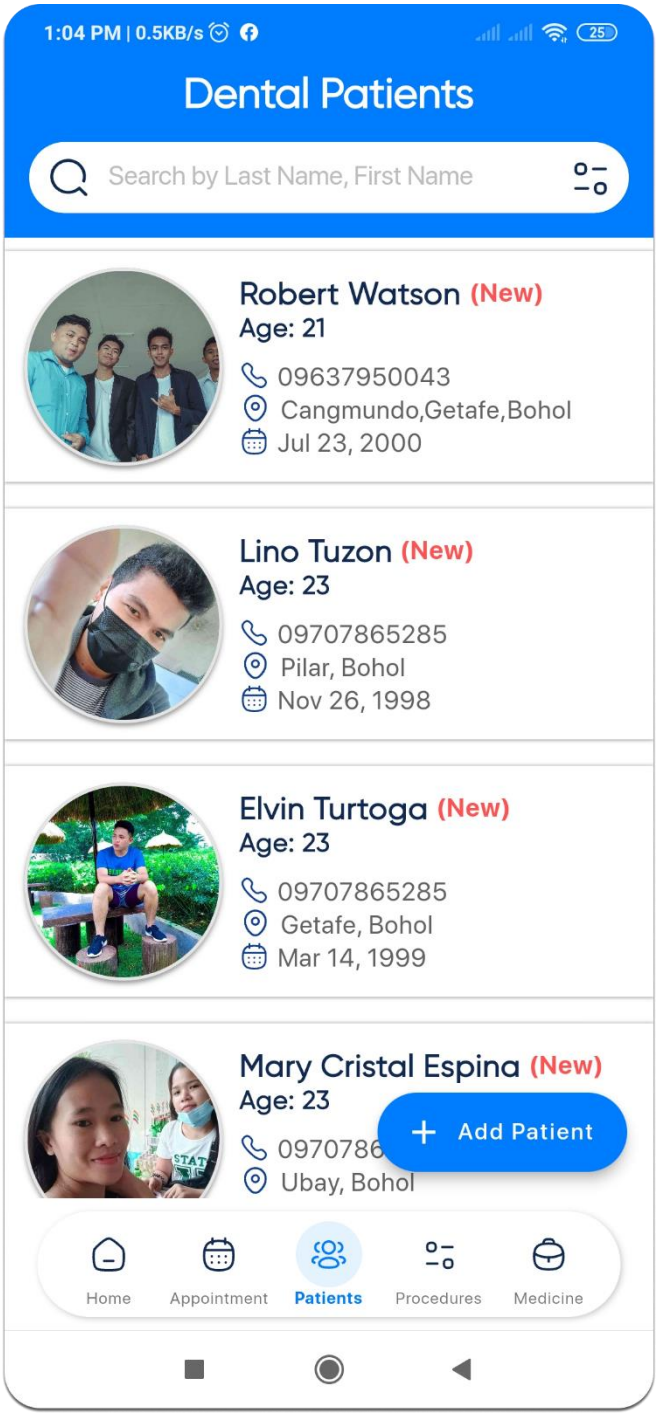
Preview 5. Home Page

Preview 6 below shows the Appointment View of the app.



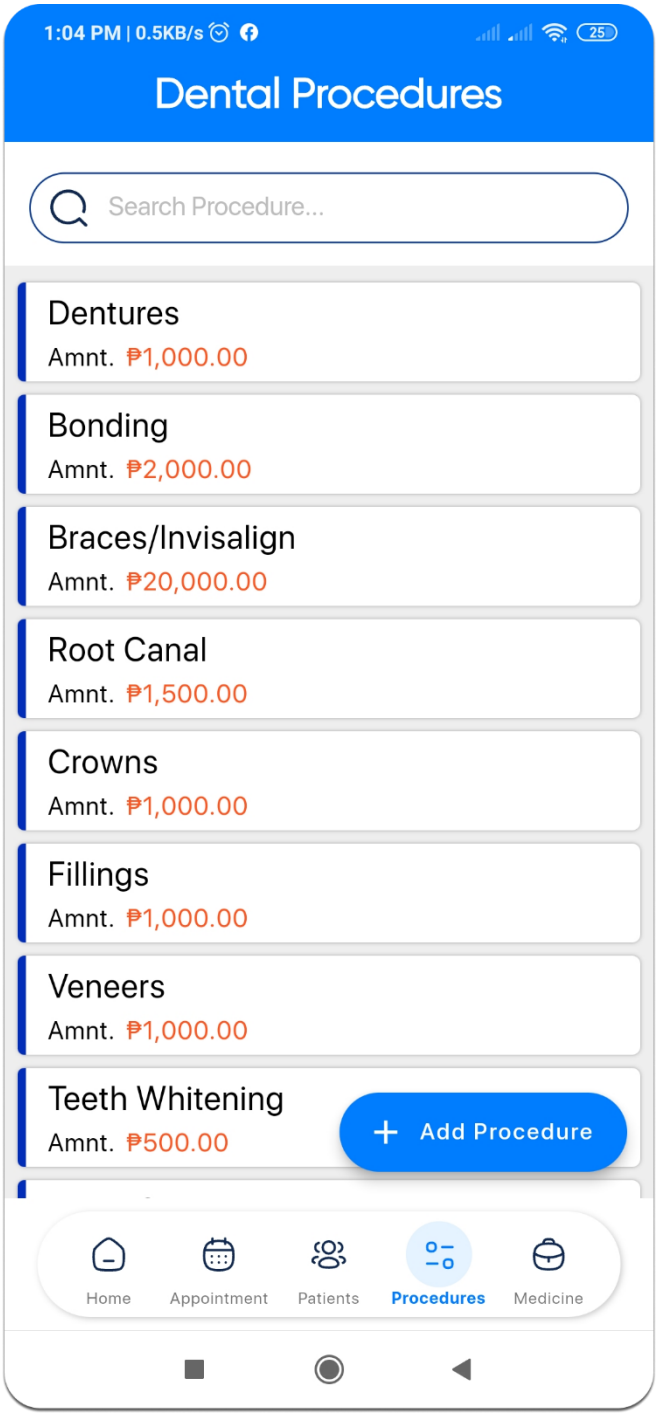
Preview 6. Appointment Page

Preview 7 below shows the Patient View of the app.



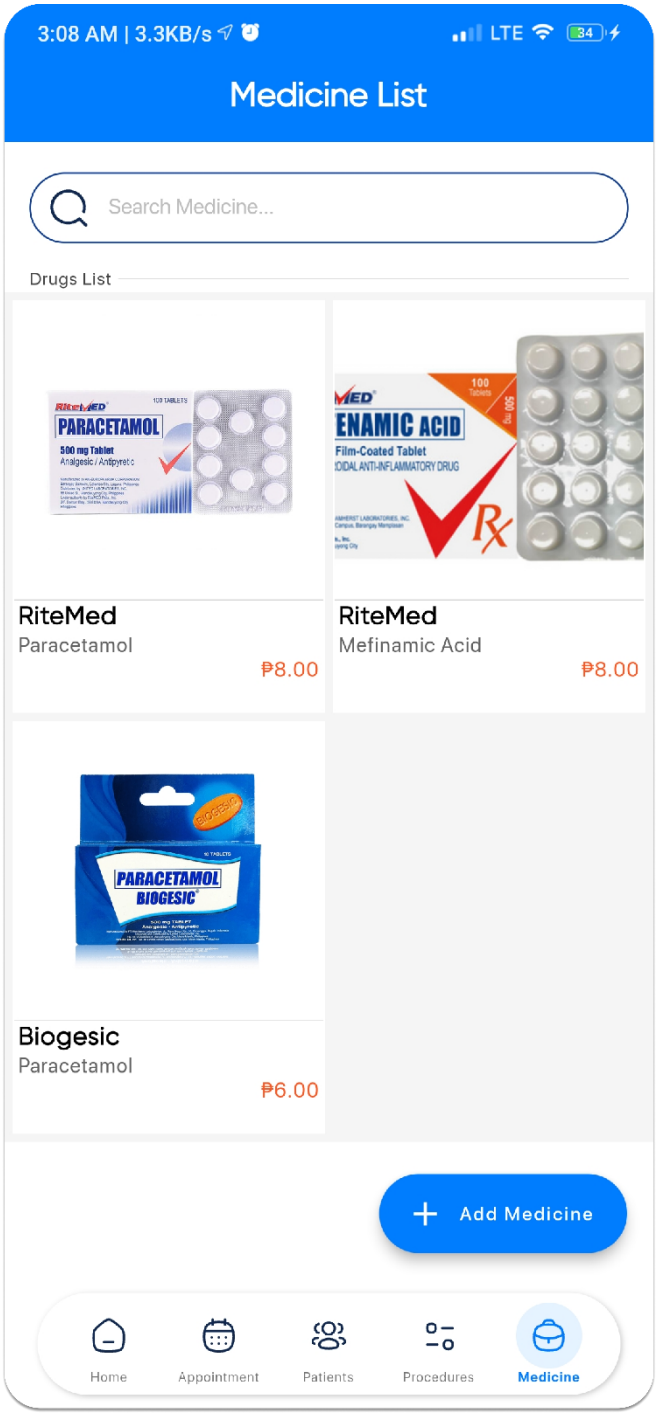
Preview 7. Patient Page

Preview 8 below shows the Procedure View of the app.



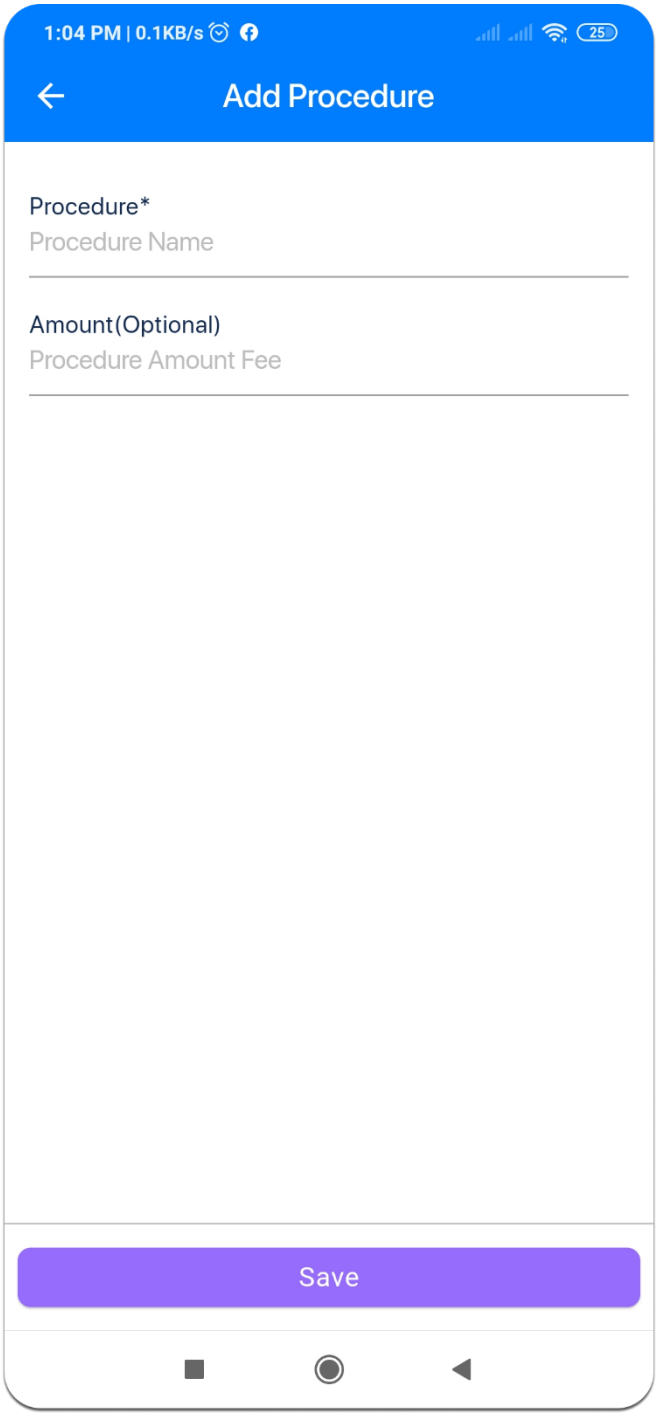
Preview 8. Procedure Page

Preview 9 below shows the Medicine View of the app.



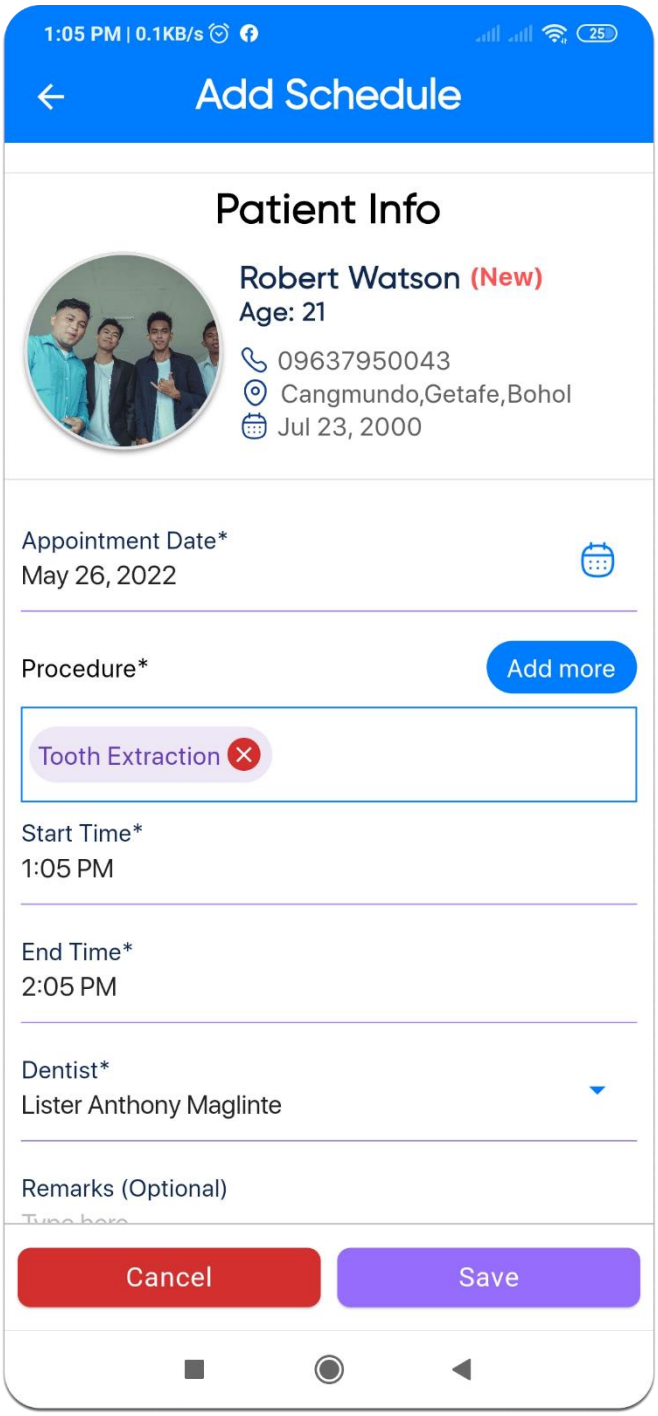
Preview 9. Medicine Page

Preview 10 below shows the Add Procedure View of the app.



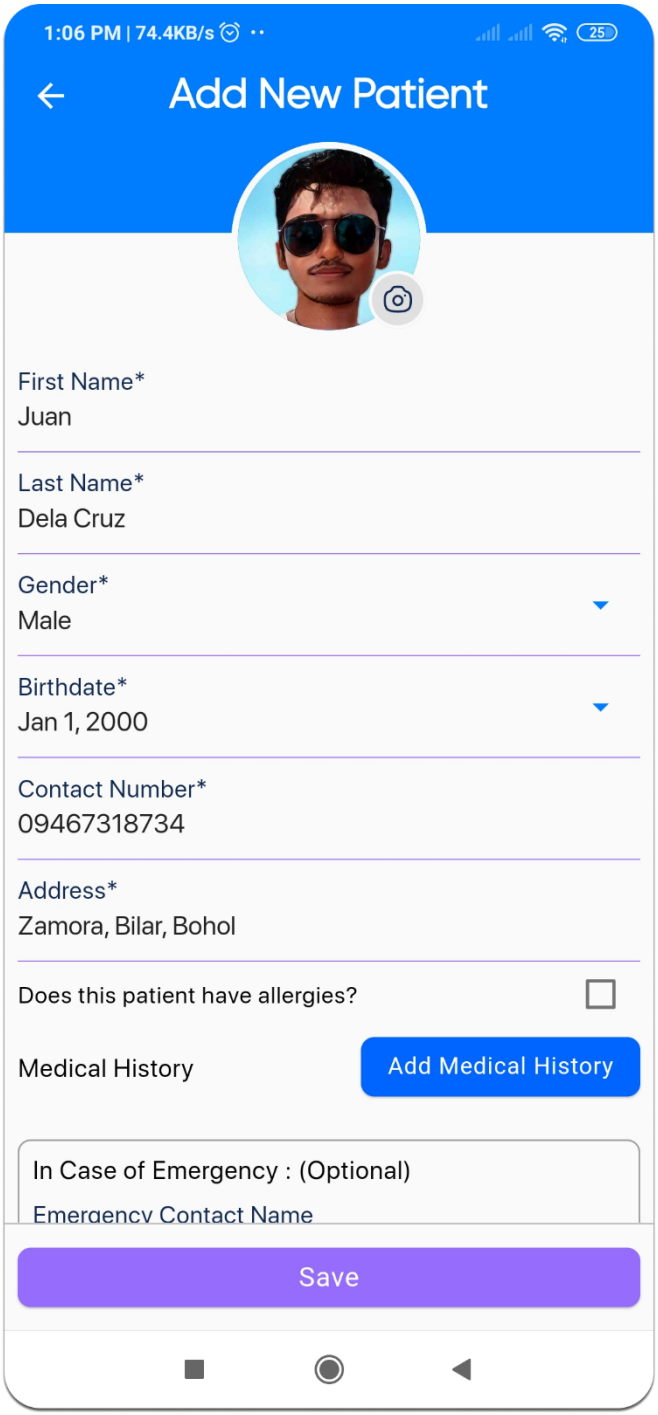
Preview 10. Add Procedure Page

Preview 11 below shows the Add Schedule View of the app.



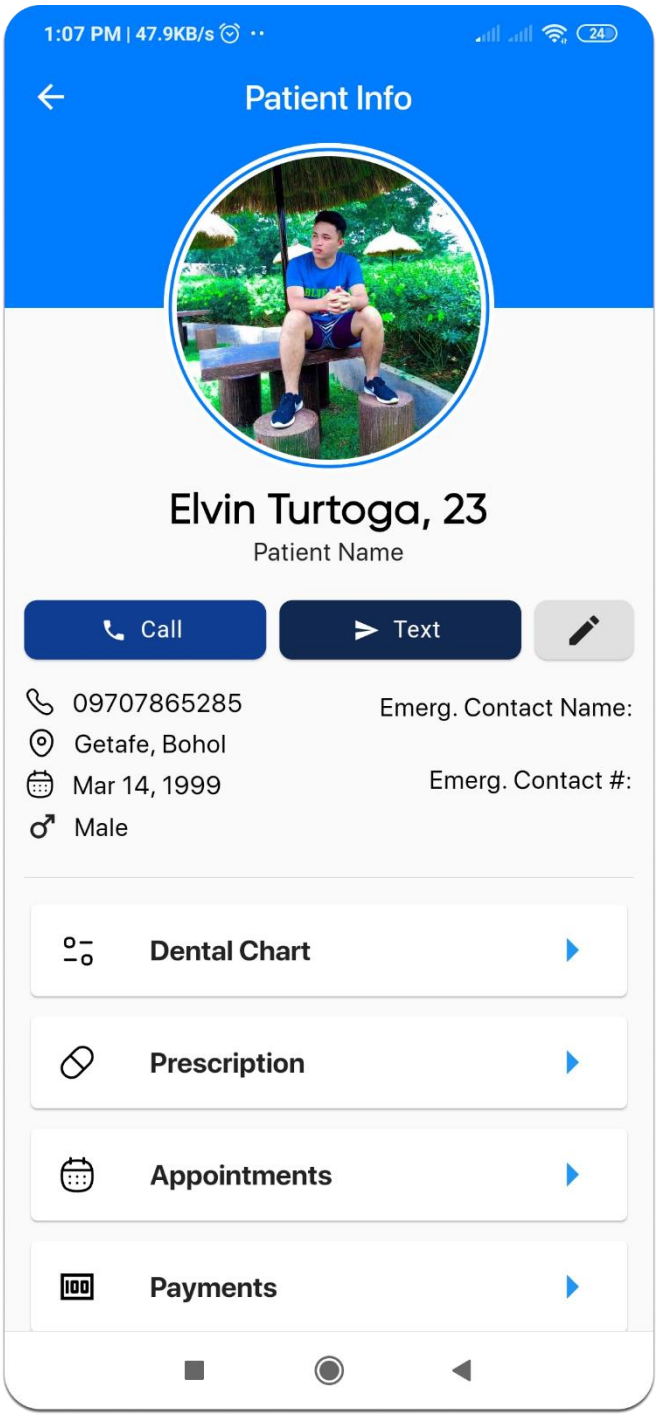
Preview 11. Add Schedule Page

Preview 12 below shows the Add Patient View of the app.



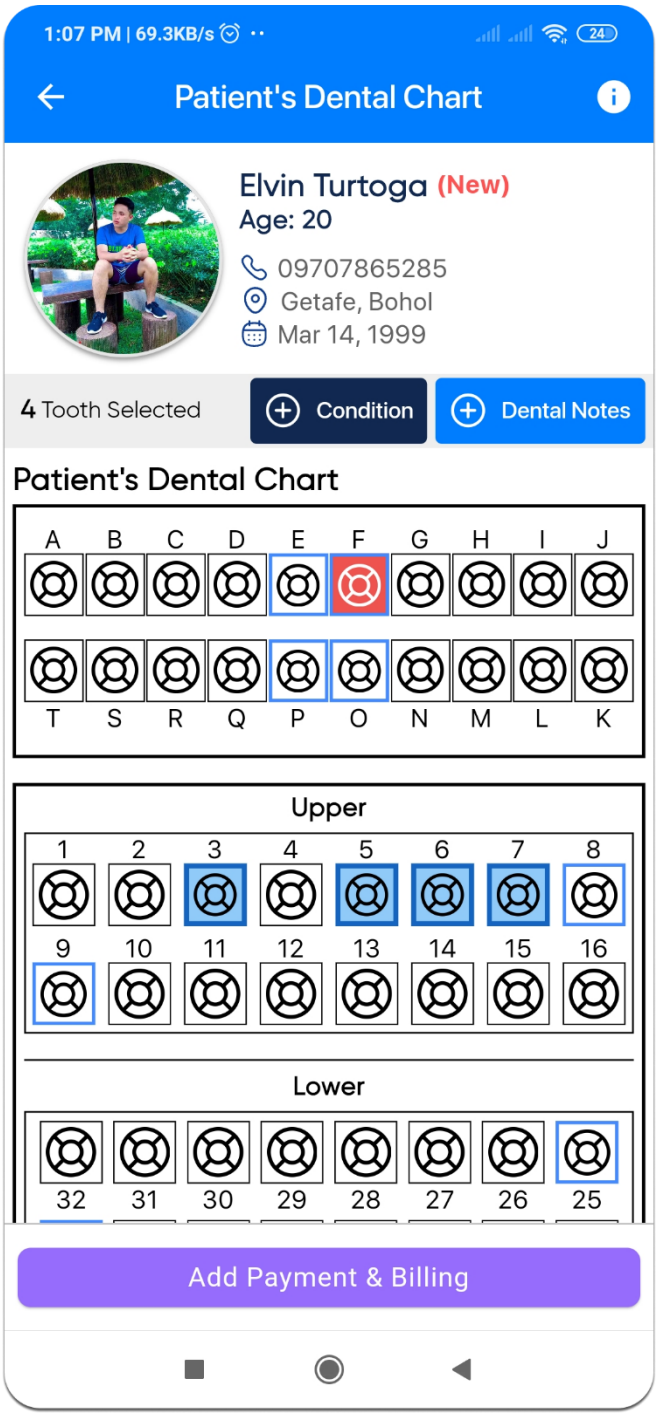
Preview 12. Add Patient Page

Preview 13 below shows the Patient Info View of the app.



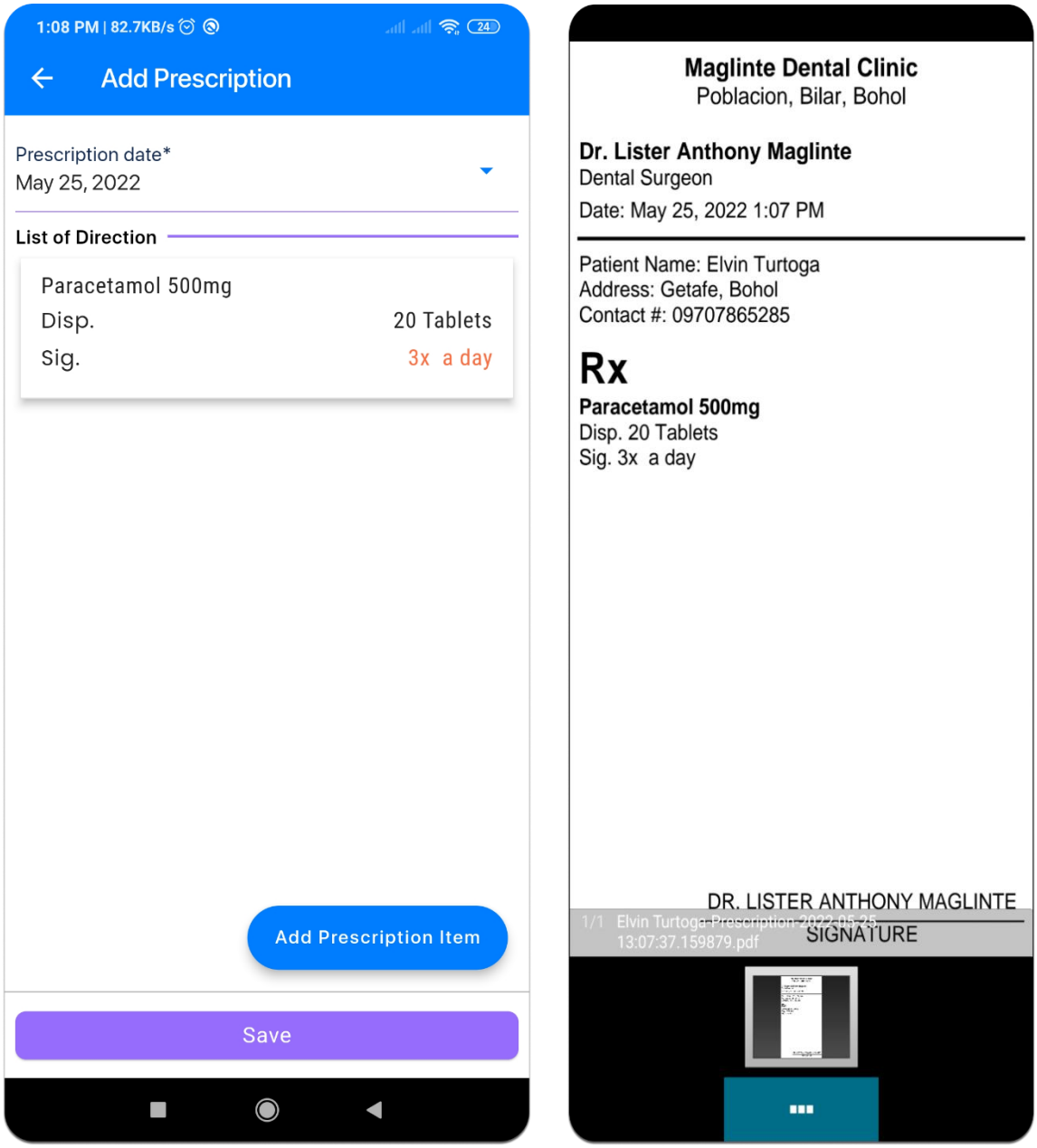
Preview 13. Patient Info Page

Preview 14 below shows the Patients Dental Chart View of the app.



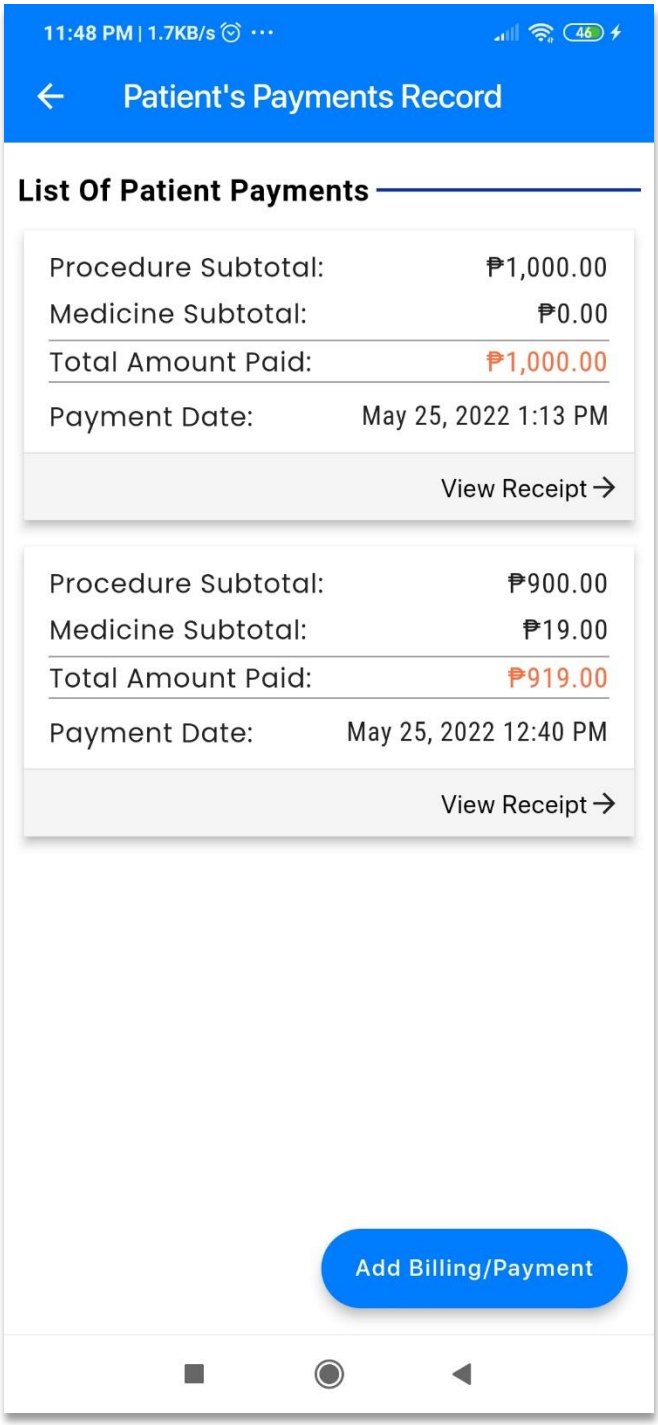
Preview 14. Patients Dental Chart Page

Preview 15 below shows the Add Prescription View of the app.



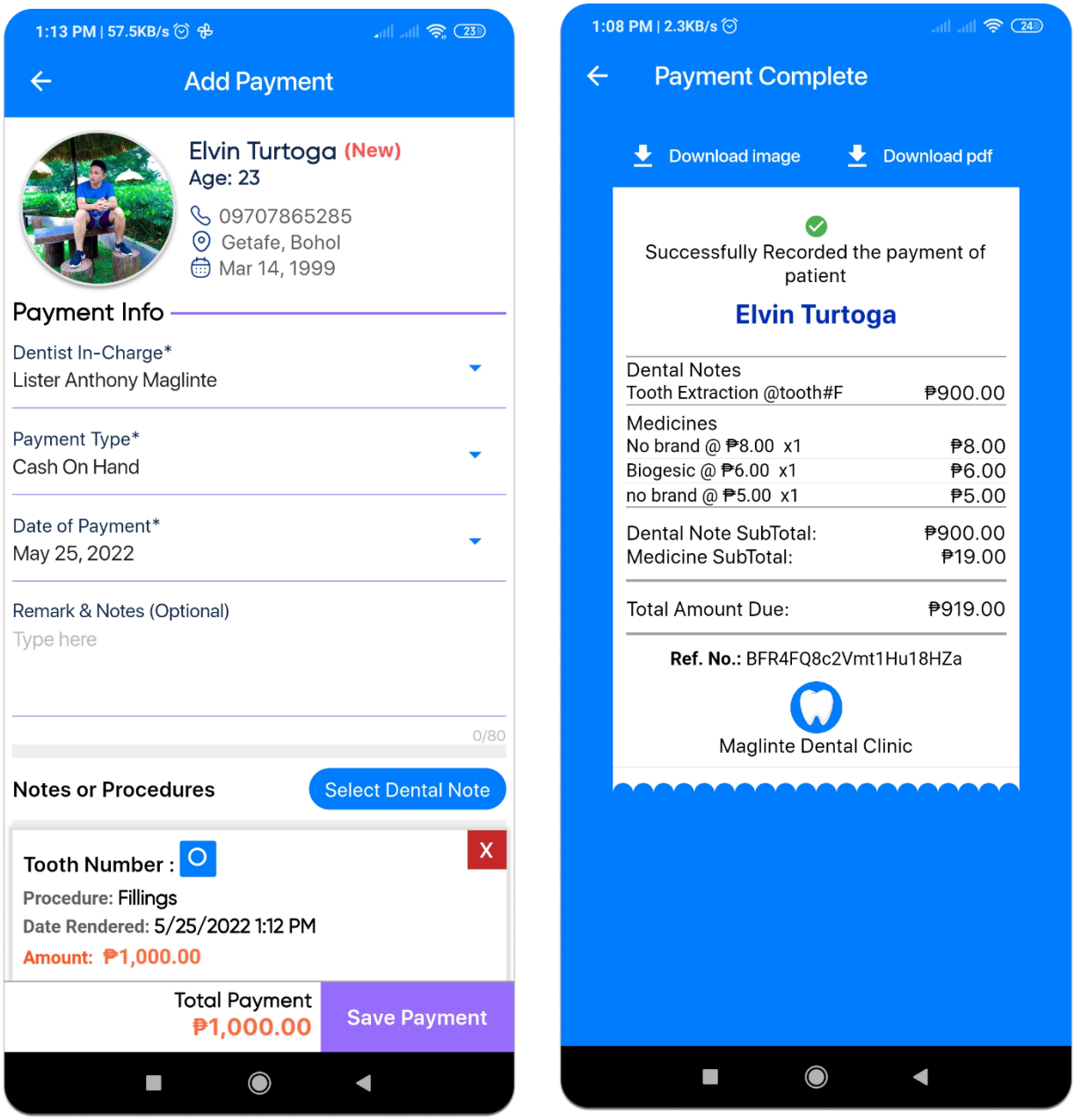
Preview 15. Add Prescription Page

Preview 16 below shows the Patients Payment Records View of the app.



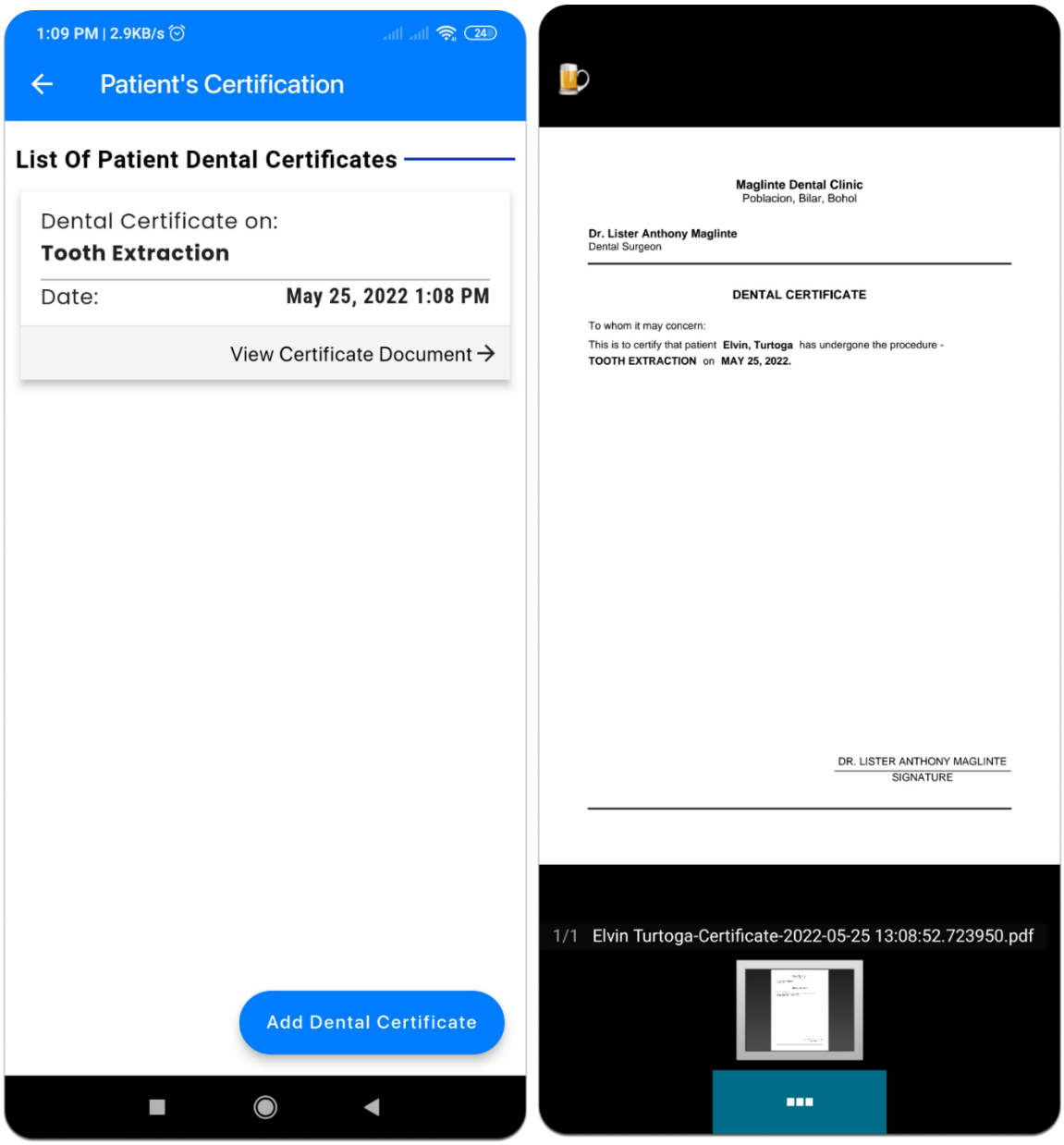
Preview 16. Patients Payment Records Page

Preview 17 below shows the Payment & Receipt View of the app.



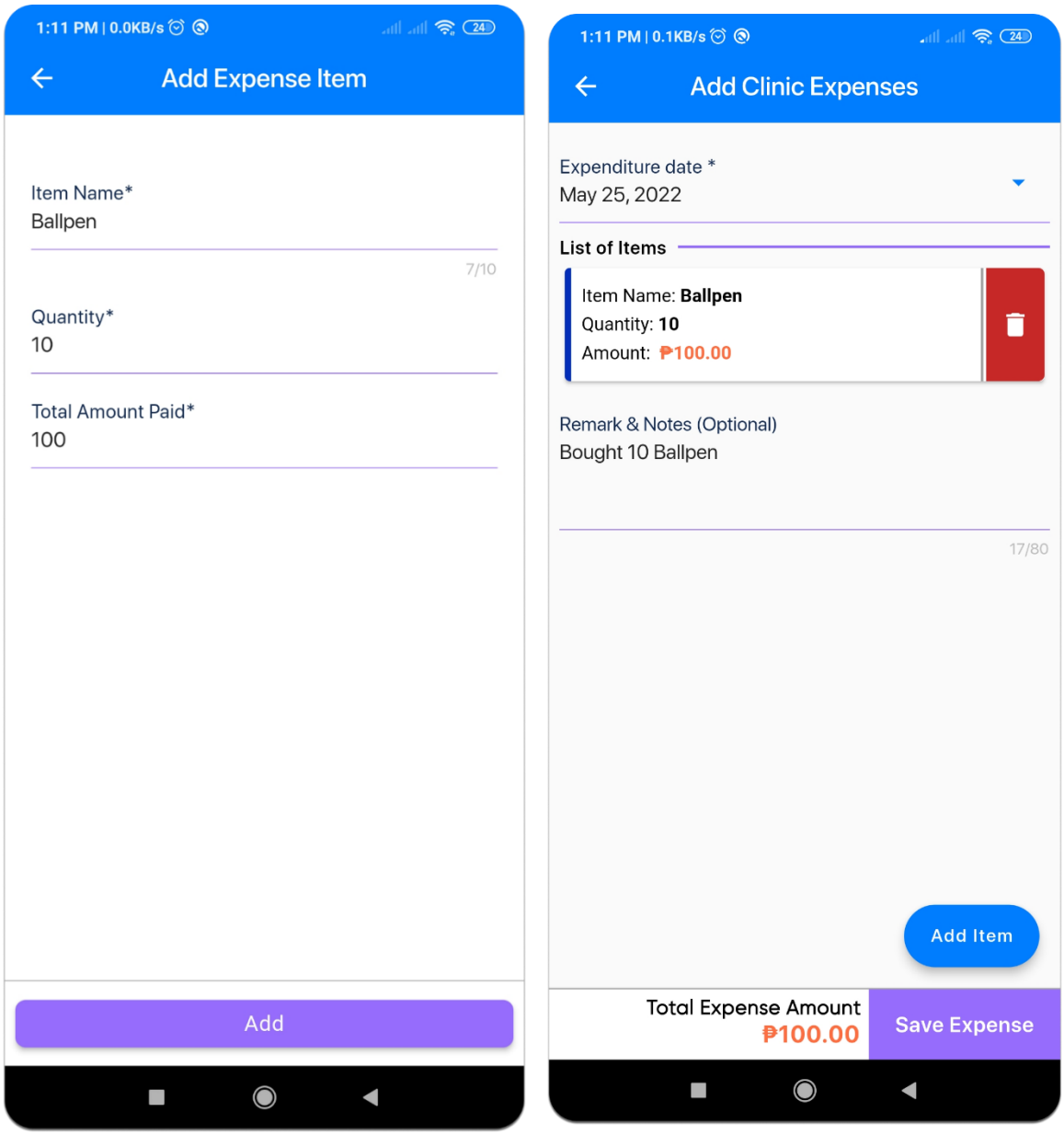
Preview 17. Payment & Receipt Page

Preview 18 below shows the Dental Certificate View of the app.



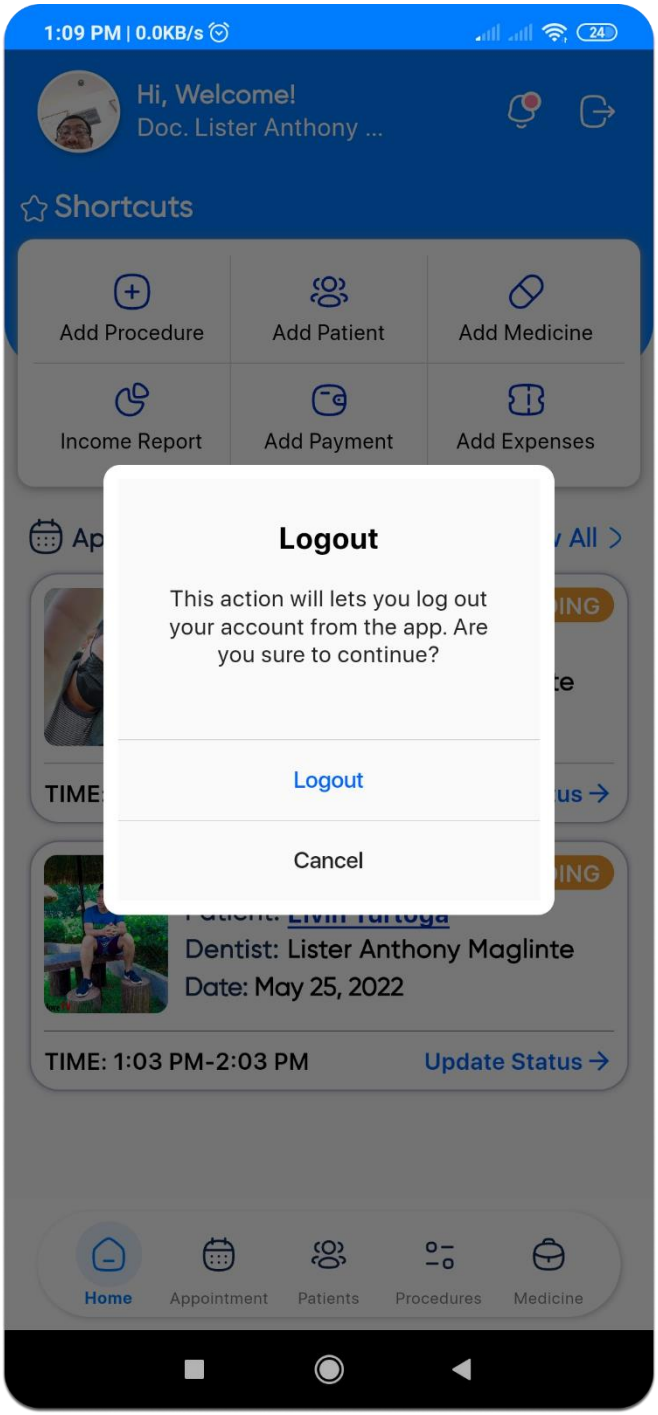
Preview 18. Patients Dental Certificate Page

Preview 19 below shows the Add Expense Item View of the app.



Preview 19. Add Expense Item Page

Preview 20 shows the Log-out Prompt



Preview 20. Log-Out Prompt Dialog

Hosting Implementation

A web hosting service is a type of Internet hosting service that allows individuals and organizations to make their website accessible via the World Wide Web. Web hosts were companies that provide space on a server owned or leased for use by clients, as well as providing Internet connectivity, typically in a data center. While the implementation was a realization of a technical specification or algorithm as a program, software component, or other computer system through computer programming and deployment. In the hosting implementation of the proposed system, the researcher created a firebase account. It is a technology that offers a free database server which has been used by the researchers to store the data gathered.

Economic Performance Evaluation

The Mobile Electronic Dental Record System's economic success was assessed in terms of initial investment. The initial investment was the amount required by the client prior to the start of the system's operation and deployment.

Table 30

Initial Investment and Annual Operating Cost

Item	Qty	Unit	Unit Price	Total
A. Initial Investment				
1. Hardware				
Android Mobile Phone	2	Pieces	₱ 6,000.00	(Existing)
Wifi Modem	1	Pieces	₱ 5,000.00	(Existing)
Printer	1	Pieces	₱ 7,500.00	₱ 7,500.00
Printer Ink	4	Pieces	₱ 350.00	₱ 1,400.00
			Sub-total	**₱ 8,900.00**
2. Software				
Software Licensing			₱ 8,000.00	₱ 8,000.00
Software Installation			₱ 1,000.00	₱ 1,000.00
			Sub-total	**₱ 9,000.00**
			Total Initial Investment Cost	**₱ 17,900.00**
B. Annual Operating Cost				
1. Office Supplies				
Bond paper	1	Reams	₱ 400.00	₱ 400.00
Ball Pen	3	Pieces	₱ 8.00	₱ 16.00
Stapler	1	Pieces	₱ 90.00	₱ 90.00
2. UTILITIES				
Electricity	12	Months	₱ 230.00	₱ 2,000.00
WIFI Internet Plan	12	Months	₱ 1,299.00	₱ 15,558.00
3. GENERAL SERVICES				
System Maintenance	4	Quarters	₱ 1,500.00	₱ 6,000.00
			Total Annual Operating Cost	**₱ 24,064.00**

Testing and Evaluation

Testing and assessment were carried out to verify the system's functionality, notably in terms of providing desired output, processing time/period, volume of data handled, and proper reaction to user inputs. This was also the process of evaluating the system's overall performance. In this study, system usability were evaluated to determine its technical performance as perceived by the target.

System Usability

The questionnaire prepared by Lewis (1995) was used in the system usability test to measure the level of system acceptability as perceived by the target users. Based from the result of the survey, the respondents provided a general rating of with an interpretation of "agree". The outcome generally implies that the system was suitable for recording patient data. The technology had specifically met the respondents' expectations in terms of functions and capabilities.

Table 31

System Usability Assessment Result

Criteria for system usability	Weighted Mean	Rating
1. Overall, I am satisfied with how easy it is to use this system.	7.0	Strongly Agree
2. It was simple to use this system.	7.0	Strongly Agree
3. I can effectively complete my work using this system.	6.0	Agree
4. I am able to complete my work quickly using this system.	5.3	Tend to Agree
5. I am able to effectively complete my work using this system.	5.3	Strongly Agree
6. I feel comfortable using this system.	6.6	Strongly Agree
7. It was easy to learn to use this system.	7.0	Agree
8. I believe I became productive quickly using this system.	5.3	Agree
9. The system gives error messages that clearly tell me how to fix problems.	6.3	Agree
10. Whenever I make a mistake using the system, I recover easily and quickly.	7.0	Agree
11. The information (such as online help, on-screen messages, and other documentation) provided with this system is clear.	5.3	Strongly Agree
12. It is easy to find the information I needed.	6.0	Strongly Agree
13. The information provided for the system is easy to understand.	6.6	Agree
14. The information is effective in helping me complete tasks and scenarios.	5.3	Agree
15. The organization of this system screens is clear.	5.3	Strongly Agree
16. The interface of this system is pleasant,	6.6	Strongly Agree
17. I like using the interface of this system.	7.0	Strongly Agree
18. This system has all the functions and capabilities I expect it to have.	5.7	Strongly Agree
19. Overall, I am satisfied with this system.	6.3	Agree
AVERAGE WEIGHTED	6.1	Agree

Chapter 3

SUMMARY OF FINDINGS, CONCLUSION, AND RECOMMENDATION

Summary of Findings

Based from the results of the survey, conducted at Maglinte Dental Clinic, the researchers found out that the clinic still uses a manual system for recording and monitoring patient information. The large amount of patients' information, appointments, and records that were accumulated every day have become a problem with retrieving, organizing, and analyzing patients' information. With the problems identified in the Maglinte Dental Clinic, the researchers intended to develop the "DIMS: A Mobile Based Dental Information Management System of Maglinte Dental Clinic Bilar, Bohol". It is a mobile system that would handle appointments, medical and patients' record and information, payments for services and medicines, patient dental chart, and notifications.

Based on the identified needs of the clinic, the "DIMS: A Mobile Based Dental Information Management System of Maglinte Dental Clinic Bilar, Bohol" was developed with the modules acquisition, data management and reports. The developed system was pilot tested and evaluated in terms of system usability. Based from the results of the survey, the respondents gave a general rating of with an interpretation of "agree". The result generally indicated that the system was usable in the recording of patient's information. Specifically, the expectations of the respondents as to functions and capabilities had been achieved by the system.

Moreover, the system has clear organization of information, the content was very comprehensive, with good user interface and ease of use.

Conclusion

Based on the findings of the study, the developers have concluded that the clinic lacked of system in the management of patient's information and inefficiently practiced the manual method of record keeping and retrieval. The “DIMS: A Mobile Based Dental Information Management System of Maglinte Dental Clinic Bilar, Bohol” had improved the record management efficiency and fits the requirements and expectations of the client. Further, adoption of the system requires minimal investment and incurs low operational cost, hence affordable and economical.

Recommendations

Based from the observations during implementation and on the aforementioned conclusions, the developers have recommended the following for efficient record management, smooth system adoption and operation and for future development:

1. The clinic must adopt the new system to improve the record management.
2. To familiarize and orient the target users with the functionality and function of the new system, a training and orientation seminar must be performed by the researchers to the clinic owner and staff.
3. System maintenance must be done by the researchers on a regular basis to ensure the protection of records and the system’s dependability.

REFERENCES

Republic Act No. 10173 - *Data Privacy Act of 2012*. An act protecting individual personal information in information and communications systems in the government and the private sector, creating for this purpose a national privacy commission, and for other purposes. *https://www.privacy.gov.ph/data-privacy-act/*

Codd, E. F. (1985). Relational database: A practical foundation for productivity. Communications of the ACM, 25(2), 109-117. Retrieved: January 27, 2020 https://pdfs.semanticsscholar.org/dbc.pdf

Bolanio, (2018). Patients medical and dental record system of BISU Bilar Clinic. Bohol Island State University Bilar Campus

Bontog, (2011). Patient record management and billing system. The patient's record management and billing system in Cong. Simeon Toribio Memorial Hospital of Carmen, Bohol

Amofa (2016). Patient Management System. The patient management system in El Camino Hospital of Mountain View, California

APPENDICES

APPENDIX A

System Usability Questionnaire

Instructions:

- Please rate the usability questionnaire
- Try to respond to all of the items
- For the items that are not applicable, use N/A
- Make sure these fields are filled in

Rating Scale:

7- Strongly Agree

6- Agree

5- Tend to Agree

4- Neither Agree or Disagree

3- Tend to Disagree

2- Disagree

1- Strongly Disagree

QUESTION	7	6	5	4	3	2	1
1. Overall, I am satisfied with how easy the application is.							
2. It was simple to use this application.							
3. I can effectively complete my work using this application.							
4. I am able to complete my work quickly using this application.							
5. I can efficiently complete my work using this application.							
6. I feel comfortable using this application.							
7. It was easy to learn to use this application.							
8. I believe I became productive using this application.							
9. The application gives error messages that tell me how to fix the problem.							
10. Whenever I make a mistake using the application, I recover easily and quickly.							
11. The information (such as online help, on-screen messages and other documentation) provided with this application is clear.							
12. It is easy to find the information I need.							
13. The information provided for the application is easy to understand.							
14. The information is effective in helping me complete the task and scenarios.							
15. The organization of information of the application screens is clear.							
16. The interface of this application is pleasant.							
17. I like using the interface of this application.							
18. The system has all the functions and capabilities I expect it to have.							
19. Overall, I am satisfied with this application.							

Based on Lewis J. R. (1995) IBM Computer Usability Satisfaction Questionnaires: Psychometric Evaluation & Instructions for Use.

INTERVIEW GUIDE QUESTIONS

Researchers guide for conducting the interview of the respondents:

Guide Questions for Interview:

Clinic Staff/Secretary:

1. What are the data that are need to be collected?
2. What are the procedures in collecting data?
3. How these procedures are being done?
4. How do recording of patient's information being done?
5. Where are these information recorded?
6. How these records are being kept and retrieve?
7. How thus the problem encountered by the clinic staff/secretary in collecting data?

Owner/Doctor

1. What are the problems encountered by the Owner/Doctor in keeping and retrieving the records of the patients of Maglinte Dental Clinic?
2. How long do you keep those gathered record?
3. How is the registration of patient done?
4. How are the records of patient kept?
5. What are the processes in Maglinte Dental Clinic?

APPENDIX B

LETTER OF INTENT

Republic of the Philippines
Bohol Island State University
Bilar Campus
Zamora, Bilar, Bohol

April 07, 2022

DR. LISTER ANTHONY MAGLINTE
Owner Maglinte Dental Clinic
Bilar, Bohol

Ma'am/Sir:

Good day!

We, the Fourth Year Students of Bachelor of Science in Computer Science of Bohol Island State University Bilar Campus will conduct a System Development project (Thesis) a requisite for graduation for the degree of Bachelor of Science in Computer Science.

In this regard, we would like to ask your good office to allow us to conduct system study base on the Mobile Electronic Dental Record System for Maglinte Dental Clinic.

To be able to develop the mobile application system for your business, we would like to request permission to perform interviews, observations, and surveys as needed in the data collection process. We assure you that we shall honor secrecy and privacy to all data and information we shall be handling during our data collection.

This is necessary for the development of the study's application system.

We are excited to collaborate with your organization.

Thank you and more power!

EDOLIANTES, ROLANDO JR.
FLORES, PETER JOHN
ALBINO, MA. FLOR
QUISTO, CHERYL
Researchers

Noted:

RENANTE S. DIGAMON
Subject Instructor

Recommended by:

SHEILA G. TABUNO
Chairperson, DCoS

DARREL CARDAÑA
Thesis Adviser

Endorsed by:

ARLEN B. GUDMALIN, PhD
Dean, CTAS

Approved by:

DR. LISTER ANTHONY MAGLINTE
Owner of Maglinte Dental Clinic

Letter of Questionnaire Distribution

Republic of the Philippines
Bohol Island State University
Bilar Campus
Zamora, Bilar, Bohol

April 07, 2022

DR. LISTER ANTHONY MAGLINTE
Owner Maglinte Dental Clinic
Bilar, Bohol

Dear Sir,

Good Day!

We, the Fourth Year Student of Bachelor of Science in Computer Science of Bohol Island State University Bilar Campus will conduct a System Development project (Thesis) a requisite for graduation for the degree of Bachelor of Science in Computer Science.

In this regard, we would like to ask your good office to allow us to conduct system study based on the Mobile Electronic Dental Record System for Maglinte Dental Clinic.

To be able to develop the mobile application system for your business, we would like to request permission to perform interviews, observations, and surveys as needed in the data collection process. We assure you that we shall honor secrecy and privacy to all data and information we shall be handling during our data collection.

This is necessary for the development of the study's application system.

We anticipate your favorable response..

Thank you and more power!

EDOLIANTES, ROLANDO JR.

FLORES, PETER JOHN

ALBINO, MA. FLOR

QUISTO, CHERYL
Researchers

Noted:

RENANTE S. DIGAMON
Subject Instructor

DARREL A. CARDAÑA
Thesis Adviser

Recommended By:

SHEILA G. TABUNO
Chairperson, DcoS

Endorsed by:

ARLEN B. GUDMALIN. PhD
Dean, CTAS

Approved By:

DR. LISTER ANTHONY MAGLINTE
Owner Maglinte Dental Clinic

Letter of Implementation

Republic of the Philippines
Bohol Island State University
Bilar Campus
Zamora, Bilar, Bohol

May 20, 2022

DR. LISTER ANTHONY MAGLINTE
Owner Maglinte Dental Clinic
Bilar, Bohol

Dear Sir,

Greetings!

It is my pleasure to inform you that the mobile application “DIMS: A Mobile Based Dental Information Management System of Maglinte Dental Clinic, Bilar, Bohol” conducted by us is now in its final phase. With this, we would like to conduct benchmarking activities as part of the implementation.

This will be conducted on May 24, 2022, in your office at any time of your convenience. This activity will allow you to assess our developed application and give feedback, as well.

By this time, we would like to express our gratitude for allowing us to conduct our thesis study. We are hoping for future collaboration with you, our dear client.

May God Bless you always.

Truly yours,

EDOLIANTES, ROLANDO JR.

FLORES, PETER JOHN

ALBINO, MA. FLOR

QUISTO, CHERYL
Researchers

Noted:

RENANTE S. DIGAMON
Subject Instructor

DARREL A. CARDAÑA
Thesis Adviser

Recommended By:

Endorsed by:

SHEILA G. TABUNO
Chairperson, DcoS

ARLEN B. GUDMALIN. PhD
Dean, CTAS

Approved By:

DR. LISTER ANTHONY MAGLINTE
Owner Maglinte Dental Clinic

Republic of the Philippines
BOHOL ISLAND STATE UNIVERSITY - BILAR
Zamora, Bilar, Bohol, Philippines

RESEARCH AND EXTENSION DEVELOPMENT OFFICE (RDE)

CERTIFICATE OF RECOGNITION

is awarded to

Rolando B. Edoliantes Jr. Peter John B. Flores, Ma. Flor Albino, Cheryl Quisto and Darrel A. Cardana

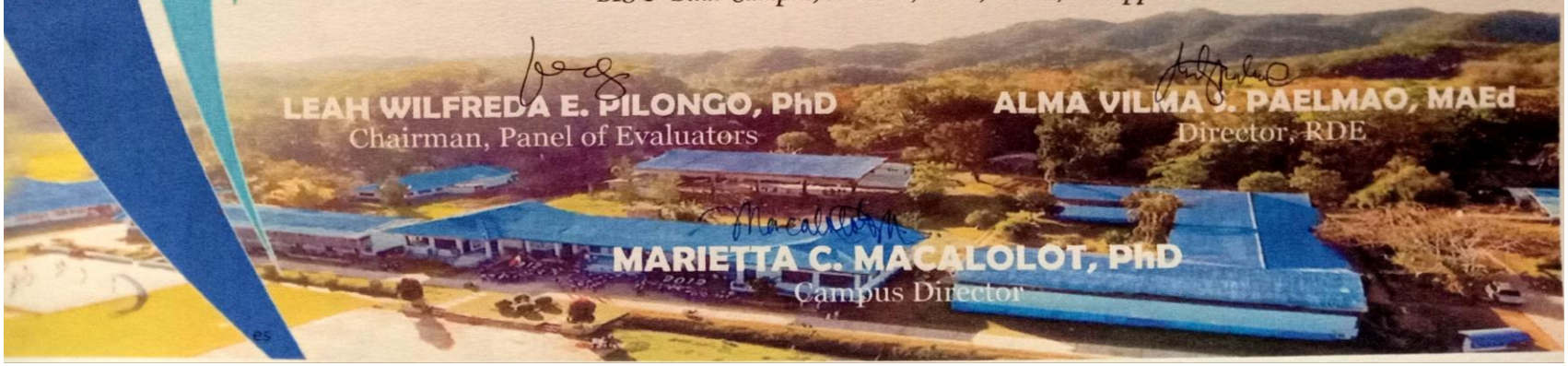
for having presented a paper entitled ""DIMS: A Mobile Based Dental Information Management System of Maglinte Dental Clinic Bilar, Bohol" under the Computer Science Strand during the Student Research Congress 2022 held last July 20-21, 2022 at Farmers Training Center, BISU-Bilar Campus, Zamora, Bilar, Bohol

Given this 21st day of July 2022 at Farmers Training Center, BISU-Bilar Campus, Zamora, Bilar, Bohol, Philippines.

LEAH WILFREDA E. PILONGO, PhD
Chairman, Panel of Evaluators

ALMA VILMA J. PAELMAO, MAEd
Director, RDE

MARIETTA C. MACALOLOT, PhD
Campus Director



APPENDIX C

User Manual

A. Accessing the application

Owner/Doctor's Account

Step:

1. Click the Application in Mobile Phone
2. Input email and password
3. Click "Login" button to access the modules of the system.

B. Adding Patient

Step:

1. On the main menu, select "Patients".
2. Click "Add" button.
3. Input detailed information.
4. Click "save" button for confirmation

C. Adding Appointment

Step:

1. On the main menu, select "Appointment".
2. Click "Add Appointment".
3. Select patient.
4. Input detailed information.
5. Click "Save" for confirmation.

D. Adding Procedure

Step:

1. On the main menu, select “Procedures”.
2. Click “Add Procedure”.
3. Input detailed information.
4. Click “Save” for confirmation.

E. Adding Medicine

Step:

1. In the main menu, select “Medicine”.
2. Click “Add Medicine”.
3. Input detailed information.
4. Click “Save” for confirmation.

F. Adding Dental Note

Step:

1. In the main menu, select “Patients”.
2. Select patient.
3. Click “Dental Chart”.
4. Select tooth.
5. Click “Dental Notes”.
6. Input detailed information.
7. Click “Save”.

G. Adding Payment

Step:

1. In the main menu, select “Patients”.
2. Select Patient.
3. Select “Payments”.
4. Click “Add Billing/Payment”.
5. Input detailed information.
6. Click “Save Payment” for confirmation.

H. Adding Expenses

Step:

1. In the main menu, select “Add Expenses” from shortcut.
2. Input detailed information.
3. Click “Add Item”.
4. Input detailed information.
5. Click “Add” for confirmation.
6. Click “Save Expenses”.

I. Adding Prescription

Step:

1. In the main menu, select “Patients”.
2. Select patient.
3. Click “Prescription”.
4. Click “Add Prescription”.
5. Set prescription date.
6. Click “Add Prescription Item”.
7. Input detailed information.

8. Click “Done”.
9. Click “Save”.

J. Adding Dental Certificate

Step:

1. In the main menu, select “Patients”.
2. Select patient.
3. Select “Dental Certificate”.
4. Click “Add Dental Certificate”.
5. Input detailed information.
6. Click “Save & Generate PDF”.

Developer's Biodata

Name : Rolando Edoliantes Jr.
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Birth Date : April 2, 1999
Home Address : Guinobatan, Trinidad, Bohol
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EDUCATIONAL BACKGROUND

Elementary : Guinobatan Elementary School
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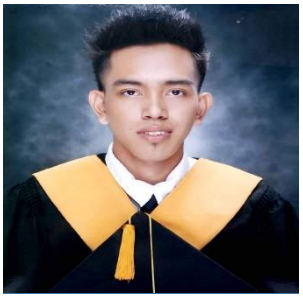
Developer's Biodata



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