InTelect: Interactive Telemedicine Communication Technologies Mobile App

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Abstract. In over 90 million of the population in the Philippines, for every 10 people, 8 of them reported never having a medical check-up in their lives. Reasons for this are the ongoing economic issues of the country such as poverty, poor infrastructure, and heavy traffic. This paper focuses on developing a system for both medical doctors and patients whose ability and affordability to access healthcare in terms of medical consultations are very limited to almost none. The developed system, a mobile application, provided an environment for the remote communication of doctors and patients utilizing the mobile communication tools for the Information and Communications Technology (ICT) through the concept of telemedicine and the use of Global Positioning System (GPS). Through this research, medical consultations between doctors and patients are made more accessible since both users are able to communicate over long distances, making it possible to look for a doctor especially in the rural areas. The mobile communication tools and the GPS are used to allow patients to search for a specific kind of doctor and consult with them. Patients can also utilize the GPS alone to locate and get directions of the nearest healthcare facilities from their locations. On the other hand, doctors are able to accommodate patients remotely giving them the benefit for comfort and an additional source of income.

1. Introduction

Today, the height of electronic and computer technology can be said to be at its peak, information is obtained so fast and results are conveyed and transported instantly. Communication has become so easy and distance does not matter anymore as compared to years back. Mobility and accessibility are two of the foundations over which information and communications technology (ICT) is built. The emergence of mobile technology is so flexible and versatile that it extends major improvements even to the healthcare industry. It has potentially facilitated and simplified the manner clinical research is conducted and the delivery of disease therapies. Prompt delivery of service and care and effectiveness are vital components that serve as demarcation to patient experience. These are the drivers that healthcare companies are pushing to deliver a much higher level of patient care [1].

The standard way people resort to when they are feeling sick is to consult a family member or a relative or go to a medical doctor for checkup. However, given the situation in the Philippines, consideration should be given to economy-related matters and environmental issues like constant heavy traffic congestion. Most of the time, people deal with one of the country’s biggest issues which is heavy traffic. With this condition, people often give up the idea of consulting a doctor or going to a medical facility, more so if they do not feel anything alarming.

The Philippines is just one of the many low and middle income countries (LMIC) where telemedicine networks to aid medical doctors in an environment of inadequate means and supplies. Communication
between them has been informal and relatively limited in scope [2] [3]. Though there had been previous researches on teleconsultations, e-mail and SMS were the only means of communication supported by doctors as reference to patients’ health conditions. The result of such programs has revealed the capability that telemedicine has on enhancing the delivery of the services that the healthcare sector renders and its positive impact to the patients’ wellbeing [4]. Nevertheless, despite the definitive strength of the scheme in dealing with the concerns and issues of the healthcare sector, the extent of its realization is quite poor [5].

The researchers proposed and created a process in line with the goals of the National Telehealth Center (NTHC) of the Philippines which is to engage people to identify problems in the health care system and develop telehealth applications from the people’s very own problem-solving contributions. Having stated the problem previously, people’s most go-to solution is to browse their mobile devices and search the internet for information regarding their health concerns. However, resorting to such risky self-assumptions only based from personal research concerning the health of a person is not ideally recommended nor is it proven safe. Because majority of the country’s population now have the access to mobile technologies, the researchers have created a mobile application which contains the tools for ICTs and GPS functionalities that enables both users, medical doctors and patients, to interact in medical consultations remotely. With the GPS, users are able to track the location of each other before and during the consultation. For the patients, they are able to go to a healthcare facility as they are guided through the GPS in real-time.

1.1. Objective of the Study
The researchers’ aim was to improve the conventional way of patients of seeing a medical doctor for health consultations and even doctors accommodating patients allowing speedy delivery of treatment and medication, reduce costs both for patients and providers, and provide additional source of income for doctors. Through remote medical consultations, patients can save both time and expenses finding and travelling to a healthcare facility and looking for a specific doctor according to their medical needs. The system provider can also make use of the application as an entirely new business which can be made into an online healthcare facility assisting patients remotely through employing licensed doctors eligible to participate in the system. To make the system possible, the ICTs and the GPS were integrated to allow the consultation between the doctors and patients remotely.

1.2. Conceptual Framework
Figure 1 shows the conceptual framework which the researchers used in identifying the accessibility features contributing to the efficient implementation of the system. The conceptual framework classifies the traditional and digital processes involved in the development of the system.
1.3. Scope of the Study
The created mobile application is accessible upon download and installation from the Google Play Store. Each of the pages in the application is responsive, meaning it will run in any mobile device as long as it has the Android operating system. The mobile application is created using HTML5, Bootstrap, and jQuery as its front-end and using Apache Cordova for Visual Studio as its back-end. For monitoring and management purposes, a web application is also created as the server for the entire system. The web application is accessible through its domain name and using the Google Chrome browser. The web application is created using HTML and Bootstrap as its front-end and using PHP as its back-end.

![Doctor’s Management Module](image1)

![Patient Menu](image2)

![Consultation Module](image3)

The web application of the system is for monitoring and user management of the mobile application. The user for the web application is a system administrator. It comprises a user management module which oversees both the doctor and patient users who use the mobile application. Figure 2 shows this feature. In order for a doctor to have an account, the system administrator is the one who is in charge of creating the doctor’s account. The NTHC coordinator, Dr. Geohari L. Hamoy, devised with the researchers that this is a necessary requirement to avoid identity theft on the doctors’ end.

For the mobile application on the doctors’ end, the primary purpose is to assess and accept requests for consultations from the patients. It comprises of a menu module, consultation module, and report module. Figures 3 and 4 show these features. First, the components of the menu module are: Profile, History, Notification, Reports, Help and FAQs, and Settings. This module and its components are for the doctors’ information and tracking and evaluation of their performance on the patient consultations they have accommodated and the income they have acquired from it. Second, the components of the consultation module are: Chat, Voice Call, and Video Call Options for the consultation session, Queueing, ePrescription, and eReceipt. This module and its components are for the doctors’ consultation session with their patients. They can choose and switch from the provided tools for communication and prescribe their patients. Lastly, the components of the report module is the functionality to generate reports. Here, the doctor is able to assess and evaluate his patient accommodations as well as his income gained on a daily, weekly, and monthly basis.

For the mobile application on the patients’ end, the primary purpose is to look for healthcare facilities and doctors utilizing the GPS and getting their directions or consulting with their selected doctors. It comprises of a menu module, consultation module, and feedback module. First, the components of the menu module are: Search Doctor, History, Profile, Notification, and Help and FAQs. This module and...
its components are for the patients’ tracking of their previous in-app medical records. Second, the components of the consultation module are: GPS, Chief Complaint, Payment and eReceipt, Chat, Voice Call, and Video Call Communication Options for the consultation session, Queuing, and ePrescription. This module and its components are for the patients’ consultation with their selected doctors. Before proceeding with the consultation session, the patients are required to enter their chief complaint to which the doctors will be able to preview as the patients’ concerns. Patients can also interact better through sending images, via capturing a photo or sending an existing image from their devices, as well as attaching file/s and sending them to their doctors. After the consultation is done, the patients receive their ePrescriptions and eReceipts of the consultation that has just ended. Lastly, the components of the feedback module is the functionality for the patient giving feedback to their doctors, right after their consultations have ended.

2. Review of Related Literature

Virtual consultation system plays a significant role in the transformation of the healthcare industry at large as it may reduce the cost of service delivery, give easier and quicker access to both users, bring cost-effective post treatment consultations, conserve time to both users, reduce the costs of travel, and improve the quality and efficiency of medical care.

Health literacy is the degree to which an individual has the capacity to obtain, communicate, process, and understand basic health information and services to make appropriate health decisions. In the Philippines, the low-income group or the lowest class of the society have low level of understanding when it comes to health matters [6].

The doctors are anxious in the increasing mortality rate among the citizenry caused by chronic non-contagious illnesses and lifestyle-related diseases. It’s sad to say that patients go to the doctor when their sicknesses are already severe and therefore making the treatment more difficult and costly.

A similar study in the Health Institute of the US found virtual consultation processes are 92% accurate. It concluded that virtual consultations can potentially shorten treatment decision time and enhance clinical outcomes [7].

Over this platform, various conditions can be addressed including cancer, complex orthopedic cases, spine disorders, transplants, congenital heart disorders, joint replacement cases, complex pediatric disorders, certain neurological disorders, genetic diseases, and liver disorders [8].

This changes for the patients to represent advantages for the doctor. More patients mean more revenue, and more revenue allows for more investment in the hospital or practice. Beyond increasing revenue, medical experts are looking to the virtual consultation for their marketing efforts [9].

There are no laws for the security, specifically, between doctors and patients online, only the Data Privacy Act, which is a law that seeks to protect all kinds of information covering both natural and judicial people, serves as a foundation for information in the healthcare industry in the Philippines.

3. Methodology

The researchers utilized the Research and Development methodology for this project. This allowed the researchers to solely refer on the objectives that are applicable for the project as it is very much technology-based. There are three phases in this methodology: basic research, applied research, and the research and development phases. The basic research phase comprises the researchers’ studies through continuous meetings with experts on the subject matter such as medical doctors from some healthcare facilities and researchers from the NTHC. Lastly, the researchers conducted user acceptance testing (UAT) and item analysis to gather the primary results needed to formulate the conclusion for the entirety of the research and development stages.

3.1. Accessibility Features

The primary focus of the system lies in its accessibility features through the mobile application which is created varying the doctors’ and the patients’ end. It is made available in-app that patients are able to locate healthcare facilities and available doctors even without having the ability to consult with a doctor
due to reasons of absence of the communication tools on their devices, incapability to register credit card details or pay online, etc. The three main modules addressing accessibility are the menu module, consultation module, and assessment and report module.

3.2. Menu Module
In the menu module within the profile page, the patients and doctors must input their complete details. For both users, they have to fill in their personal information. For the doctors, they have to fill in the work information, as well.

The menu module on the patients’ end also comprises of the search doctor page wherein patients can specifically find a doctor. The patient can filter their search in terms of the doctor’s name, gender, specialization, and/or location. For both patients and doctors, their menu modules comprise of the history page wherein both users can track and view back their previous consultation records such as ePrescriptions and eReceipts. Figure 5 shows this feature.

![Search Doctor](image)

Figure 5. Search doctor page for the patient users

3.3. Consultation Module
In the consultation module, the GPS map is shown and, by default, already shows the healthcare facilities and available doctors for the patients. Selecting a healthcare facility shows its details and an option to which the patient can click to get its directions. Selecting an available doctor shows the doctor’s details and consultation fee. It also has an option to view the doctor’s profile or proceed to consultation. For the doctors’ end, the pending consultations are shown. The doctors may choose to reject or accept the patients’ request for consultation, or preview the patients’ chief complaint, first. The queueing functionality of the system handles the queues of the accepted requests. Figure 6 shows this feature.

3.4. Assessment and Report Generation Module
The assessment and report generation module is only available on the doctors’ end. The doctor can determine his consultation fee within his profile. All transactions made will be stored in his registered bank account. In this module is the report generation page wherein the doctors can assess and view their performance and total income through their patient accommodations from their selected time, for example, ‘Weekly’. Upon viewing, the will automatically display the doctor’s income breakdown.
3.5. Monitoring and User Management Module
The monitoring and user management module comprises pages for the system administrator to oversee the performance of the system, in terms of system reports and user ratings and feedback, and also manage all kinds of users in the system, specifically their accounts and legitimacy to proceed in using the application. In this module, the system administrator can add, edit, activate or deactivate, and notify all kinds of users through messaging. User data such as passwords, bank account registrations, in-app medical records, and sessions are kept encrypted to the administrator and is therefore confidential only to every user of the system.

3.5.1. User Access and Login. This component comprises the pages where the system administrator can manage the users of the system according to their roles. The system administrator is also responsible for the registration of the accounts of doctors as it is the only way how doctors are able to use the system.

3.5.2. User Notification. This component comprises the functionality for sending the users a message in terms of system-related messages such as announcements, updates, system maintenance, etc.

3.6. Testing
The researchers conducted UAT, in a form of questionnaires, with 5 medical doctors and 10 patients who registered themselves in the system, located healthcare facilities and doctors, and consulted with doctors, for the patients, and gave prescriptions, for the doctors. Out of 5, the aspects of the system as rated by the doctors are: learnability (4.10), satisfaction (4.47), interface (4.61), and efficiency (4.92). Out of 5, the aspects of the system as rated by the patients are: learnability (4.08), satisfaction (4.32), interface (4.70), and efficiency (4.85).

4. Conclusion
Patients here in the Philippines, especially those residing in the rural areas, find it difficult, time-consuming, and expensive to afford and access their right to quality patient care. Because of this, they resort to their very own ways of finding a solution on how to relieve themselves of their conditions. The project developed raised the possible implementation of a system that utilizes the tools in technology through ICTs. The concept of telemedicine was integrated for the ease of access to healthcare via remote doctor-patient communications addressing the economic issues of the country hindering the people on their right to better health services. The features for accessibility paved the way for the system to be a
channel for doctor-patient relationships over distances and for the additional knowledge and research to serve as a feasible project for future advancements.

5. Recommendations
The researchers recommend to add options for the mode of payment of the patients, it can be connected to health insurances and/or Health Maintenance Organizations (HMOs) for cases of patients who use such affiliations for their medical needs. Another recommendation is to include educational materials in-app. Aside from the topic of the research, the future researchers may also integrate the system, whilst possibly already developed, to another system that may be bigger or for the purpose of creating a newer system.

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