

Integrating Location-Based Services into a Personal Health Hub Mobile Application

Author: Ponthip Limlahapun¹; Pranee Rushatamukayanunt²

Affiliation: Geography Department, Faculty of Social Sciences, Kasetsart University, Bangkok, Thailand¹; Faculty of Medicine, Mahidol University, Bangkok, Thailand²

E-mail: thip.limlahapun@gmail.com¹; pnrusha@gmail.com²

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ABSTRACT

In this era, the synergy between advancements in medical and communication technologies has revolutionized health awareness and information accessibility. While official channels like healthcare facilities and online medical resources facilitate informed decision-making, there exists a risk associated with self-diagnosis based on incomplete or inaccurate information. Therefore, it remains imperative for individuals to seek professional medical guidance to ensure accurate diagnosis and treatment. However, accessing comprehensive health records, including past treatments and medical histories, can pose challenges for both patients and healthcare providers. This research endeavors to address this issue by developing an application that empowers individuals to access and manage their complete health information efficiently. The envisioned application will enable users to import and review various health-related data, such as medical procedures, medications, allergies, and lifestyle habits. Furthermore, it will integrate data from government healthcare insurance systems and provide location-based information about hospitals within the national healthcare network, including details and directions. In summary, this research initiative aims to design a user-friendly application that enhances healthcare efficiency by providing individuals with seamless access to their comprehensive health data, thereby facilitating informed decision-making and improving overall health outcomes.

Keywords: health information, location-based information, health hub, mobile application.

1. INTRODUCTION

The United Nations has identified good health and well-being as one of the pivotal Sustainable Development Goals (SDGs) among its 17 objectives. This recognition underscores the fundamental importance of good health and well-being in human existence, exerting a profound impact on societal sustainability and national progress. Goal 3 specifically focuses on ensuring healthy lives and promoting well-being for all individuals, regardless of age [1]. Central to this goal is the imperative to ensure robust health and foster well-being across the entire lifespan of individuals. This comprehensive objective encompasses the provision of universally accessible healthcare services, guaranteeing that every individual has equitable access to medical care whenever necessary. A robust healthcare system should encompass preventive, curative, rehabilitative, and palliative care, alongside addressing mental health concerns. Sustainable development in healthcare necessitates effective management of hospitals and healthcare facilities, readiness for disease outbreaks, and the creation of supportive tools for diverse medical conditions [2]. In the contemporary world, medical technology plays a pivotal role in healthcare, spanning from diagnosis and treatment to healthcare system management. This resonates with Goal 9, focusing on industry, innovation, and sustainable infrastructure. The ongoing advancement of medical technology has led to groundbreaking innovations in disease treatment and the broader healthcare landscape. These advancements not only drive progress within the medical sector but also align with Goal 17, advocating for international collaboration and cooperative efforts among

nations to tackle global health challenges [2]. With the proliferation of tools and technologies, health-related information is now widely available across various media platforms. However, it's crucial for individuals to exercise discernment and critically evaluate the accuracy and reliability of such information. Seeking care at reputable healthcare facilities remains paramount to ensure the provision of expert treatment, thereby minimizing the severity of illnesses. Patients and their families often conduct research to select healthcare services, considering factors such as direct communication with healthcare providers for basic information, inquiries about treatment options and rights, and accessing relevant information to guide their healthcare journey. The prevalence of online searches has made it common for individuals to seek information about diseases or medical conditions from reputable online sources, including health organization websites, hospital platforms, disease control and prevention centers, as well as consultations with medical professionals or specialists in relevant fields. Gathering information before seeking hospital treatment is a proactive step that aids in preparation and ensures access to necessary information. This proactive approach fosters confidence in receiving appropriate and effective healthcare. However, it remains crucial to provide essential information when accessing medical and public health services, as this enables healthcare providers to gain a comprehensive understanding of one's medical history. Basic health information encompasses personal details, emergency contacts, medical history, chronic conditions, allergies, medications, exercise regimens, and dietary habits. Often, these details are not systematically documented and may be maintained in paper format. Retrieving them when necessary can pose challenges, particularly during emergencies when immediate access to hospitals is crucial. Over time, patients and their families may inadvertently overlook certain details, resulting in incomplete information. Consequently, this research endeavors to develop a healthcare data management application.

2. LITERATURE REVIEW

This research project aims to create an application for recording personal information. The relevant content and research have been reviewed as follows.

2.1 Health Related Applications

Health-related applications are currently being developed to meet various needs and enhance the convenience of tracking and managing individual health data. These apps can be used to record personal activities such as walking, running, cycling, or assessing physical fitness, such as calculating Body Mass Index (BMI), or utilizing devices and technologies that connect to the body, such as checking blood pressure through a smartwatch, for example.

2.1.1 Health for You App (H4U)

The Health for You (H4U) app is developed by the Office of Information Technology, Department of Mental Health [3]. It is compatible with both Android and iOS operating systems and can be downloaded and used on smartphones. Additionally, there is a user manual available to assist users in inputting various data such as weight and height for calculating Body Mass Index (BMI), recording blood pressure levels, monitoring blood sugar levels, and tracking vaccine records. Users can utilize the app to maintain personal health information.

2.1.2 Daily activity and exercise tracking app

The daily activity app allows users to record their daily routines such as sleep-wake times, meal times, and water intake [4]. The activity and exercise tracking app enables users to record various physical activities, including running, walking, jogging goals [5], sleep patterns (sleep cycle/sleep tracker) [6], water consumption (water reminder-daily tracker) [7], and calorie intake (calorie diary, zero, simple fasting tracker, MyFitnessPal for calorie calculation, and exercise) [8]. Additionally, users can sync their data with devices like Apple iPhones to monitor heart rate and other health metrics. This information helps users track their progress and reinforces the importance of regular physical activity.

2.1.3 App related to health impacts on the environment

There are numerous apps focusing on environmental well-being have been developed with the intention of raising environmental awareness and motivating users to adopt sustainable behaviors. These applications are

designed to mitigate environmental pollution and promote community sustainability. They typically offer a range of environmental information, for example, weather conditions and air Quality (primarily furnish users with up-to-the-minute details on local weather conditions, covering aspects like temperature, humidity, and PM 2.5 particulate levels [9]). Energy usage tracking which users have the ability to monitor their energy consumption by tracking diverse activities, such as car usage, walking, or cycling [10].

Nevertheless, it appears that there is a shortage of applications designed for individuals to document their personal medical histories as a memory aid before seeking medical attention. Patients are frequently obligated to furnish precise and comprehensive details, as doctors may rely on the patient's medical history to formulate diagnoses.

2.2 The Components of app Development

In order to develop an application that operates efficiently and aligns with its intended goals, it is essential to analyze its constituent elements and make suitable selections [11][12]. The summarized components are outlined as follows.

2.2.1 User Interface (UI)

The user interface (UI) is the component through which users interact, enabling actions like importing and viewing data, without the need to worry about data processing or the underlying database. Essentially, the user interface acts as the bridge for data exchange between users and computers. Designing it to be engaging and user-friendly is paramount, and there are several vital factors to consider. For example, simplicity and clarity ensure that content, text size, colors, and images are clear and easily understandable, minimizing any potential confusion for users. Layout and components organize elements in a structured and orderly manner, ensuring that information is appropriately presented. User-friendliness involves providing guidance and notifications when needed. Device flexibility means designing the interface to be responsive to various devices, such as mobile phones or tablets, by adapting to different screen sizes.

2.2.2 User Interface (UI) Design

When designing the User Interface (UI), it's important to prioritize simplicity and elegance while avoiding unnecessary complexity [13]. The key components include the home screen, which is the initial screen that users encounter when they

open the application. This screen can display various application elements, such as images, search forms, and menus. Creating menus that allow users to access different parts of the system conveniently. This menu can be implemented using buttons or a navigation bar. Forms play a important role in collecting user data, including tasks like registration, searching, and providing personal information. Lists are used to display categorized data, such as medication lists, diseases, or other information that users can easily search through.

2.2.3 Security and Privacy

Indeed, security and privacy are fundamental considerations in the development of all kinds of applications. System developers should give utmost importance to these aspects to build trust among users and prevent the exposure of sensitive data. Risk assessment involves analyzing and evaluating potential risks, including attacks and data breaches. User awareness of security concepts may involve obtaining consent before usage. Tools and techniques can be employed to help prevent attacks and errors. Using secure coding practices, such as data validation, is essential. Protecting data access at the user level and implementing two-factor authentication can enhance security. Utilizing appropriate encryption technologies, such as HTTPS, to encrypt communication between servers and clients is also crucial [14].

In the development of the app for this research, user-friendly UI design has been a key consideration. The app accommodates various data input formats, including typing and selection from predefined options, with a focus on minimizing input errors. Additionally, user security is prioritized, with a login system that requires a username and password. Furthermore, users are prompted to provide important information before accessing their saved data.

2.3 Geospatial Data and Geographic Location-Based

The application developed by taking spatial data and geolocation for processing is a versatile application of spatial data in various contexts. This includes navigation using the Global Positioning System (GPS) and location-based services. For real-time data retrieval, technologies like GPS, Wi-Fi, Bluetooth, or other device sensors can be employed. Data processing in this context can encompass various tasks such as calculating distances between two points, displaying maps, or presenting data based on the user's current location.

In terms of data presentation, it can be tailored to maps, tables, or specific project requirements. Another crucial consideration is managing offline data, which should be taken into account when internet connectivity is not available.

2.3.1 Global Positioning System (GPS)

The GPS is a satellite-based system used for determining locations by receiving signals from GPS satellites. The GPS system was developed by the Department of Defense of the United States since the year 1973, primarily for military purposes. The development aimed to create a system capable of providing accurate location information under all weather conditions, 24 hours a day, and globally accessible [15]. Nowadays, GPS is widely used. Signals from satellites are transmitted and received through devices or mobile phones equipped with GPS receivers, allowing individuals to determine their own locations and track various events. GPS is applied in a wide range of applications, including car navigation, pedestrian navigation, maritime navigation, location-based searching, land surveying, weather data collection, natural disaster analysis, and more.

2.3.2 Location-based services (LBS)

The LBS uses geographic data and geographic location reference data to provide information services. They can be used for navigation, utilizing spatial data to assist users in finding routes, locations, and travel recommendations [16]. LBS can also be employed for location-based searching, displaying information, or various services based on the user's current location. For example, finding nearby restaurants, location-based notifications, and applications that can send messages or alerts when users are in designated areas. This includes promotions when users approach specific stores. Additionally, location-based services are utilized in gaming, such as Pokémon GO, which uses GPS for player and in-game item locations, or services related to geographic areas [17].

This research involves collecting data on the locations and details of hospitals in Thailand. Users can access information about the locations of hospitals and utilize a system that allows them to pinpoint their own location for convenient access. Additionally, the application provides the capability to search for routes and directions through the mobile app.

2.4 Mobile App Development Technology

The technology for mobile app development depends on the platform used, which can be Android or iOS. There are various methods available, such as writing code using programming languages (as mentioned earlier), including Java, Kotlin, or Dart for Android applications. For iOS applications, one might use Swift or Objective-C [18]. However, the choice depends on the developer's expertise, familiarity, and proficiency. Nowadays, there are development tools available that make app development more accessible, such as Android Studio for Android and Xcode for iOS.

Currently, there are various online tools available for app development, and users may have the option to experiment with them without incurring any costs. However, charges may apply if they wish to use these tools in a real-world scenario or according to a company's specified plan. Users should thoroughly research the tool's functionality and associated expenses before getting started. Some popular tools such as Appy Pie which is an online app builder tool that supports both Android and iOS platforms, and it doesn't require specialized coding knowledge [19]. Users can try it out for free, but there are charges associated with real-world usage based on the plan chosen by the user. AppInstitute is a platform for creating online stores where users can customize the design themselves, and it also supports eCommerce functionality [20]. Thinkable is a cross-platform app development platform that supports both Android and iOS [21]. The platform is designed to work by using a block-based interface, allowing users to drag and drop commands. MIT App Inventor is a tool suitable for app development [22], using a block-based approach similar to Thinkable. It can be used at no cost.

This research utilized the MIT App Inventor tool, which is used for creating mobile applications that run on both iPhone and Android operating systems. It operates online and is a mobile application development platform developed by the Massachusetts Institute of Technology (MIT). It is user-friendly and suitable for individuals with no prior programming knowledge. Users can get started by creating an account through their Google account. The platform utilizes a block-based interface, allowing users to drag and drop commands. It offers various functions, including the ability to upload and create screens and implement mapping features.

3. MATERIALS AND METHODS

The research materials and data were obtained through a observation data collection methods, unstructured interviews, and a review of various written sources, including published books, articles from academic journals, government reports, and online web content. This information was subsequently utilized to construct and develop an application. Summarized as follows.

3.1 Materials and Data

3.1.1 General Information

Personal information that needs to be provided before receiving initial diagnosis or at the registration desk, such as name, last name, address, and phone number, as well as emergency contact information.

3.1.2 Medical History

Information regarding one's medical history, including pre-existing conditions and drug allergies, is essential to provide before receiving medical treatment. This information is crucial for an initial assessment, and it allows the healthcare provider to select the most appropriate treatment approach for each individual patient.

3.1.3 Insurance and Healthcare Rights

Thai citizens holding national identification cards are entitled to healthcare coverage provided by the government [23]. There are three main healthcare coverage systems in operation as follows.

- Civil servant medical welfare, the system provides healthcare coverage for government employees.
- Social security coverage, the system offers healthcare benefits to individuals covered by social security programs.
- The Universal coverage scheme (30 Baht for all diseases).

The government provides varying levels of financial support, and there are also insurance options offered by various companies, each with its own terms and agreements between the company and policyholders.

3.1.4 Hospital Information

Hospital information is available from various affiliations, including the Ministry of Public

Health, the National Police Office, and universities. The hospital name information was sourced from the National Health Security Office (NHSO) [24]. The data is organized into thirteen regions, denoted as region 1 through region 13. These regions correspond to geographical areas, including Chiang Mai, Phitsanulok, Nakhon Sawan, Saraburi, Ratchaburi, Rayong, Khon Kaen, Udon Thani, Nakhon Ratchasima, Ubon Ratchathani, Surat Thani, Songkhla, and Bangkok, respectively. Following the acquisition of the hospital data, a data cleansing procedure was undertaken. This process involved arranging and extracting information that pertained exclusively to hospitals, excluding data related to public health service centers. In total, the dataset encompasses 1,276 hospitals.

3.2 Methods

3.2.1 Data Input

Data import can be facilitated using tools to select from a list for convenience, reducing errors from typing. Structuring, arranging components, creating menus, formatting windows, and transferring data to different sections are essential steps. The diagram depicts the initial step in accessing the system, which involves entering login credentials, specifically a username and password (Fig. 1).

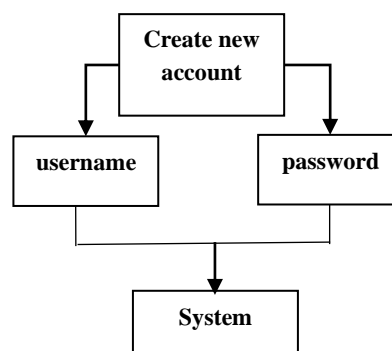


Fig. 1: Initial page diagram

The diagram illustrates the process of entering information by typing, including details like names and contact information. Additionally, users can select information from predefined lists, such as a list of hospitals. As an alternative, users have the option to make selections from predefined choices, and for any selections not included in the predefined options, they can manually input the information by typing. For instance, users can manually input their healthcare insurance coverage

if it's not listed among the predefined choices. Once the data is imported, the system will save them and users can proceed to the next page (Fig. 2).

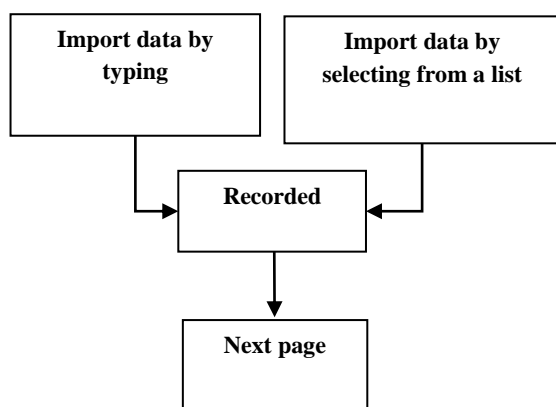


Fig. 2: Entering data and maintaining records

3.2.2 Screen Sequences

Screen sequences for importing data are general user, information medical conditions, medications taken, surgical history, other treatment information (blood tests, X-rays), health insurance coverage, occupation and activities, and travel routes. Each screen maintains its own record in a dedicated table without crossing over, a global variable has been established to store the data, specifically the name and last name. This global variable is used to reference the same person's information consistently. To facilitate the transfer of this variable to the next screen, TinyDB is employed, utilizing the mobile phone's memory for seamless data transfer to the subsequent screen [22]. This ensures that the information remains consistent and accessible as the user moves between screens.

3.2.3 MIT App Inventor

In MIT App Inventor, there are various tools available for users to select using drag and drop, allowing them to create blocks of code. Some essential components are similar to building a website, such as text boxes, buttons, images, and more. Users will select their preferred design tools to create the UI for their app. Once the UI is designed, they will need to write code blocks to make the app function according to their desired functionality (Fig. 3).

4. RESULT AND DISCUSSION

The research outcomes concentrated on determining which data to gather and provided insights into user interface design. The specifics are elaborated as follows.

4.1 Data Aspects

Information should be documented. While it may not be obligatory for patients who can respond to inquiries during their medical appointments, it is advisable to record this information, particularly in cases where patients arrive unaccompanied or are unable to provide answers due to their medical condition. The key information gathered through observation and received from hospital forms.



Fig. 3: Code block

- Patient identification (name, medical records or hospital number (HN),
- Contact information (address, phone number, emergency contact person and their details),
- Medical history (past illnesses and surgeries), allergies, current medications, chronic medical conditions,
- Insurance details (insurance provider),
- Diagnostic tests (laboratory test, X-ray, blood test).

Collecting and organizing this information is indeed crucial for providing comprehensive patient

care, maintaining accurate medical records, and ensuring efficient hospital operations.

4.2 App's User Interface Design

Designing is considered for comprehensibility, simplicity, and the use of tools for selecting from lists for convenience, reducing errors from typing, structuring, organizing components, menu formatting, window layouts, and transmitting data to various sections. Details shown as follows.

4.2.1 Login/Sign Up Screen

Prior to gaining access to the application, users are required to sign up by creating their unique username and password, both of which will be securely stored in the database. Afterward, they can log in to access the application. Fig. 4 shows the initial screen provides options for either signing up or logging in.

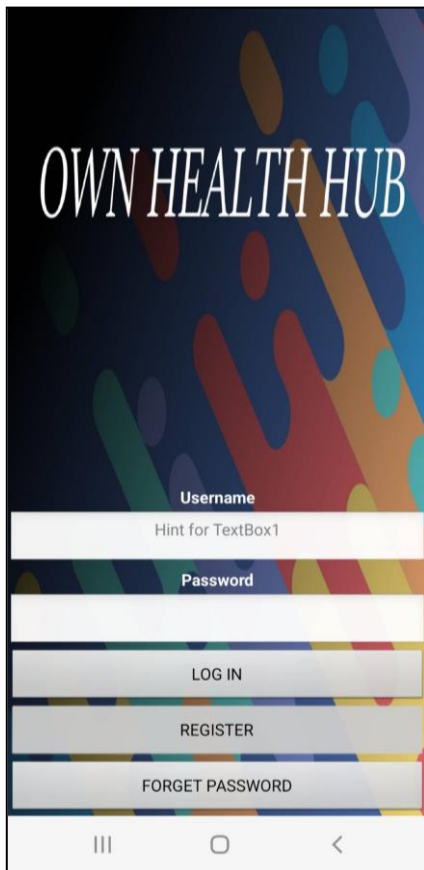


Fig. 4: Initial screen

The user can access data after logging in and has the option to either import new data, update existing data, or view previously saved data (Fig. 5). Once the user has logged in, several options for accessing and managing data within the application either input new data, view previously saved data or update existing data, route direction, and access

the list of hospitals under NHSO.



Fig. 5: Launch Screen

4.2.2 General Information

Information that will be requested before receiving medical services each time. Users may choose to save it for convenience if they prefer not to provide it verbally during the inquiry (Fig. 6).

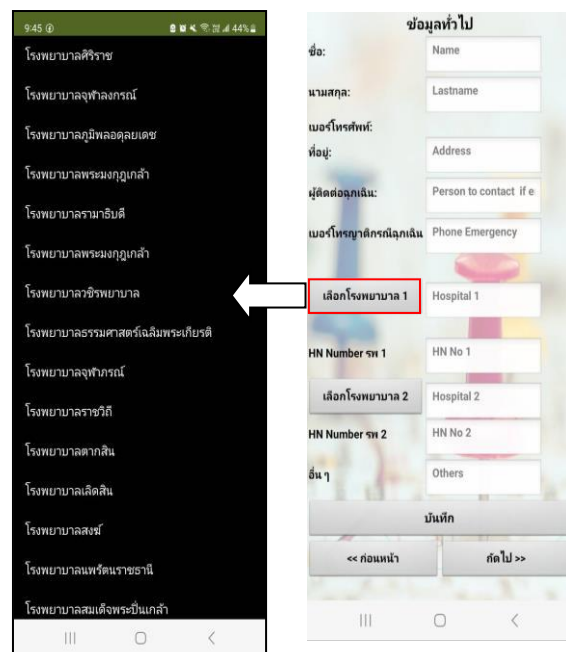


Fig. 6: General information input

Certain information requires manual input via typing, while some information users may have the option to click and select from the list. Importantly, users need to provide their patient identification number or hospital number to access their data. This is in place to enhance privacy protection, and by implementing this feature, the system ensures that only authorized individuals with the proper credentials can view and interact with the records.

4.2.3 Disease, Medication and Treatment Information

Due to the variety of illness, grouped and categorized them into major diseases that pose a high risk and are life-threatening. Lists have been created for users to choose from, for example, illness on nervous system and brain, heart diseases, kidney, respiratory system, liver, or others includes, high blood pressure, diabetes, systemic lupus erythematosus (SLE), immunodeficiency (HIV). Users may also manually enter the information if not listed (Fig. 7). Lists of medications taken regularly can be noted and kept in the system (Fig. 8). Other treatment information, such as surgery, X-rays, and blood tests (Fig. 9).

4.2.4 Healthcare, and Insurance Information

Users are empowered to select healthcare coverage options, such as the government healthcare plan. This plan offers benefits to Thai citizens who possess a Thai national ID. These benefits encompass access to crucial medical services, financial aid for medical costs, and the availability of healthcare facilities and professionals. Additionally, users can explore supplementary private health insurance coverage. To verify their healthcare entitlements, users can also utilize the services provided by the NHSO (Fig. 10).

4.2.5 Occupations, and Activities Information

Additional information encompasses one's occupation, activities, recurrent health data, and habitual behaviors. Certain occupations can potentially expose individuals to health risks, such as exposure to hazardous materials or physically demanding tasks. Recurrent illnesses and family medical histories may significantly influence healthcare requirements and preventive measures. Moreover, habitual behaviors such as smoking, alcohol consumption, dietary choices, exercise routines, and stress management can have a profound impact on one's overall health and

susceptibility to illnesses. It is necessary to maintain records to promote better-informed healthcare decisions (Fig. 11).

4.2.6 Hospital and Direction

Collecting data on hospitals within the National Health Security System, categorized by regions across Thailand, including Chiang Mai, Phitsanulok, Nakhon Sawan, Saraburi, Ratchaburi, Rayong, Khon Kaen, Udon Thani, Nakhon Ratchasima, Ubon Ratchathani, Surat Thani, Songkhla, and Bangkok. After obtaining the hospital data, it requires data cleaning. The primary focus is on extracting hospital-related information while excluding public health service centers. There are a total of 1,276 hospitals available in this dataset. Users can use this data to find travel directions and routes (Fig. 12).



Fig. 7: Illness information input



Fig. 8: Medication taken regularly

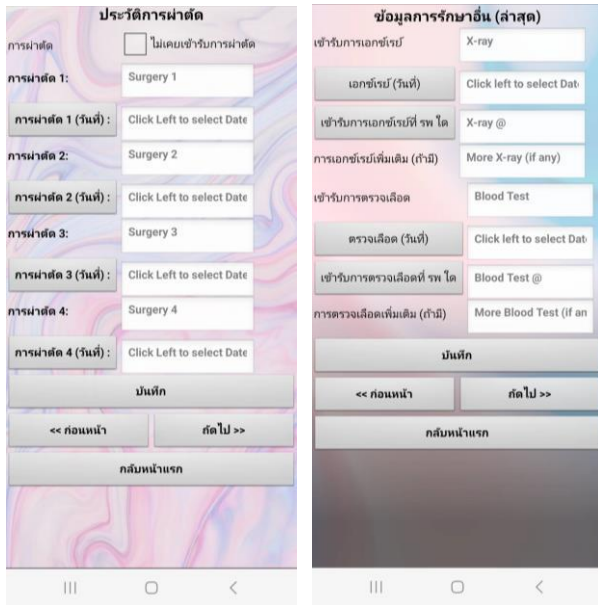


Fig. 9: Other treatments (surgery, X-ray)



Fig. 10: Insurance Information

Following the completion of all essential functions, the Android Application Package (APK) file was generated for our Android application [25]. This facilitates users in conveniently downloading and installing the app on their mobile phones. Importantly, this method streamlines the installation process and guarantees smooth updates. With each new update, users can effortlessly download the latest APK file, thereby preserving the integrity of their data.



Fig. 11: Occupation and activities information

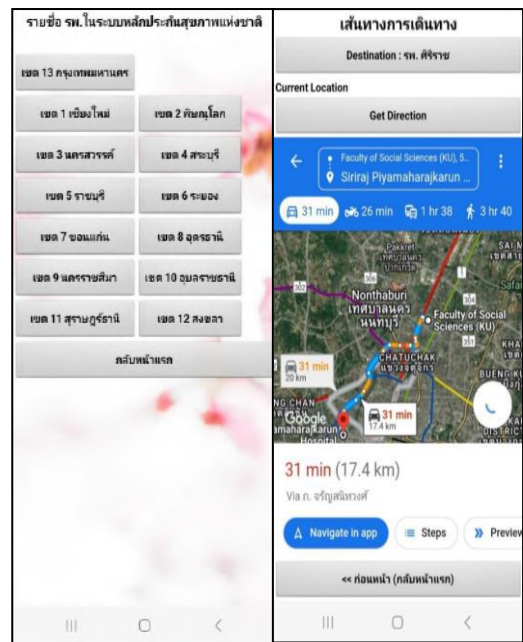


Fig. 12: Hospital and Direction

5. CONCLUSION

Developing a mobile application for gathering personal information can greatly streamline the process of providing necessary details before receiving treatment, ensuring completeness and accuracy. In today's technological landscape, developers may not require direct programming expertise to create such an app. However, possessing basic knowledge, understanding requirements, and outlining the workflow are essential for building a functional application. Research findings from the application's

development indicate that, apart from supporting data recording, viewing, and locating, users can also edit and update their information. Moreover, users can check their eligibility for the National Health Security Office (NHSO) insurance scheme, access a directory of hospitals within the national healthcare system, and obtain directions to hospitals across Thailand. Nevertheless, utilizing online tools may present limitations in various aspects, including network connectivity over Wi-Fi and cellular networks for user login and system access. Ensuring the stability and speed of these connections is crucial. Additionally, when importing initial data, it's imperative to do so completely and accurately to ensure the correctness and comprehensiveness of retrieved information.

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