Effectiveness of Smart Medical Diary to ManageMedical Affairs of Sri Lankan People

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ABSTRACT

In this research paper we are proposing an application that can be used to manage people's medical affairs in an organized manner. This article included what research methods we used and what results we gathered from those methods. It also includes the existing problems we identified when managing medical affairs. This paper also includes what tools and technologies and software development methods we used to develop the proposed system. Our proposed system allows patients to manage their medical appointments and medications in a highly organized manner. In this system we introduce a new functionality where users can share their personal medical records with other parties (doctors) through an access token. This access token method is very secure, and the creator of the token has full authority. In summary, this research paper contains how we gathered our requirements and how we identified existing problems that users faced when managing their medical records, what are the existing applciations in the same domain and what are the advantages and limitaions of those applications, how we developed the proposed system, what are the tools and technologies we used to develop and maintain the developmenet process of the proposed system, and how the system will make people's lives easier.

Keywords— Medical Dairy, Medical Records, Share Medical Records

I. INTRODUCTION

Good health directly affects people's happiness and well-being. There are many habits and activities that we can do to achieve a good and healthy life. For example, we can take a healthy diet, proper exercise, adequate sleep and many more. By doing such activities, we can prevent diseases to some extent. But it is not guaranteed that we will never be affected by a disease. Especially as people age, there is a greater chance of suffering from non-communicable diseases such as high blood pressure, low blood pressure, cancer, and diabetes. According to the Institute for Health Policy, people's use of prescription drugs is skyrocketing [1]. Due to the advancement in today's medical field, there are always medicines available for all kinds of diseases. Even though there is medicine for every disease, it does not cure people from diseases. To recover from diseases, we need to follow some medical advice and manage our medical treatment in an organized manner. Due to people's busy lifestyle and many other reasons, nowadays people do not have enough time to think about their health and well-being. Due to this, nowadays people are always suffering from various types of diseases

Due to the advancement of information technology, we started looking for proper solution to those problems with the help of information technology. So as a first step we conducted research and a survey to capture what common problems people face when managing their medical care. From the conducted research we mainly identified four main problems faced by people when managing their health care.

- Lack of health care management
- Busy with the huge workload
- No one to remind about medical treatments
- Forgetfulness due to age
- Patients didn't have a proper way to share their medical record with the doctor prior to the appointment.
- Doctors have not proper way to study and examine about his/her patient's medical history prior to the appointment.

These are the main issues we identified from our research. Because we have clearly identified the existing problems of the people, we have developed a system (website) called "Mediary" that people can use to manage their medical affairs.

As we look at the sections of this research paper, the introductory section includes a detailed introduction of the overall scope of the proposed system and what motivates us to develop the proposed system. The next section is the literature review section. In that section, we provide brief information about some existing systems for medical management, and we point out the similarities and differences by comparing those existing systems with our proposed system. Next section is methodology

section. In that section we discuss about what are the tools and technologies we used to implement the proposed system and how all these tools and technologies communicate and work together in our system. In that section we also mentioned the software development lifecycle methods and other best practices we follow when we are developing the proposed system. The next section is Proposed system. In that section we include different types of design and architecture diagrams related to the proposed system and then we included what are the services that available for the users through the system to manage their medical affairs. In that section, we also mentioned how the internal parts of the system communicate and work together as one system. The next section is discussion. In that section we briefly explain about the importance of medical management and how the proposed system will help users to organize their medical affairs in an easy and better way. The next section is problems identified. In that section we briefly describe the problems that we discovered through the initial research process. It also includes the responses of the people to the survey that we conducted at the initial phase. The final section is the conclusion. In that section we considered the whole system as one and we discussed what are the strengths, weaknesses, advantages, and limitations of the system.

II. LITERATURE REVIEW

The main intention of proposing the website "Mediary" is to assist people in managing their medical affairs in an organized manner. So, we are not the first and only people concerned about this matter. There are several systems already in place to manage and support people's medical affairs.

Before designing our proposed system, we researched what systems were available for medical record management. From that research we discovered several existing systems, and in this section, we will address some of the advantages and limitations of those existing systems by comparing them with each other and with our proposed system.

The first system we identified is called "My Medical Record". This application is developed by university hospital Southampton.[2] This is a personal health record system, and through that system patients of the hospital can get support from doctors to co-manage their healthcare. And they can send /get information to/from hospital. Therefore, the need for hospital visits for these patients is reduced. But as a limitation of this system, it can be mentioned that it is not for the entire population but only for the patients of that hospital. This means you must be a patient at Southampton University Hospital to use the app. [2]

The next application we identified is called "Patient Access" [3]. It is basically an application that patients can book doctors appointments and order repeat prescriptions through the internet. The app facilitates the process of channeling the doctor and purchasing medicines and it reminds users about the appointments they have made through the system. But as a limitation of this application, we can mention that it only provides the ability to manage medical appointments made only through the system. That means the user cannot add other appointments to the system to manage.[3]

The next application we identified is called "MyChart" [4]. From this application users can contact their doctors and access all kinds of medical records (lab test) through the system. They can also manage their appointments and they can even have virtual appointments with doctors. Like all the other mentioned applications earlier, this application has the same limitations when managing channeling details that are not related to the system.[4]

Those are the main platforms that we identified from the research we conducted. There are many more applications that have developed with the aim of managing users' medical affairs. But when looking at all applications we addressed that most of the existing applications only manage the appointments and medicines that have some relationship with the system itself. There is no room for managing the appointment and other medical affairs that the user did or plans to do without assistance of the application. Another thing we addressed was most of those applications are for commercial purposes and users must pay some money for the services.

By considering the advantages and limitations that we found from the existing systems, we got a clear understanding about what services we need to provide from our proposed system. So, from the proposed system we provide functionalities to manage any kind of doctor channeling and other medical affairs. In our system, we do not provide any online medical channeling and medicine ordering as there are plenty of apps that provide such services. So, we addressed some needs that no other system had, and we tailored our system to meet those needs.

I. METHODOLGY

A. Tools and Technology

This section explains how the anticipated result, which satiated the client's needs, was built, or designed using technology.

MEARN stack is the proposed development Technology.

- Front End Development with React.js.
- Back End web application Framework with Express.js,
- Backend Language with Node.js.
- Database Management with MongoDB
- Version Controlling System with Git

A group of technologies known as the MERN stack make it possible to construct applications more quickly. It is a framework for web development. The fundamental

goal of the MERN stack is to create apps that solely use JavaScript. This is since all four of the technologies that comprise the technology stack are JS-based. Its functional components are MongoDB, Express JS, ReactJS, and NodeJS.

As in figure 1, the top tier of React.js is a free

and open- source front-end JavaScript library. It's used for building interactive user interfaces and web applications quickly and efficiently with significantly less code. It is a declarative JavaScript framework for developing dynamic client-side HTML applications.
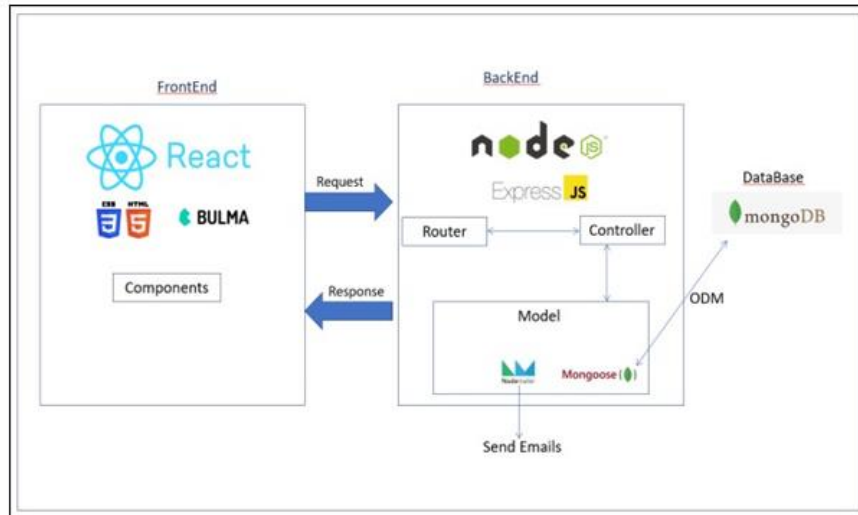
Figure 1: MERN Architecture

Express is a web application framework that provides broad features for building web and mobile applications. A single page, multipage, or hybrid web application can be built with it. It's a layer built on the top of the NodeJS that helps manage servers and routes.

A database is required if the application stores data. MongoDB is a source-available cross-platform document- oriented database program. Classified as a NoSQL database program, MongoDB uses JSON-like documents with optional schemas. Developers can store organized or unstructured data with ease with MongoDB because it is a document database.

We used Azure boards for our project. Azure boards is a service for managing the work for software projects. Using boards, team members may plan, track, and collaborate. To track every part of the project, the boards team can use Azureto build work items, backlogs,

dashboards, and reports.

To check the project's code quality, we used SonarQube. SonarQube is a code quality measurement tool. It works well for statically analyzing code to find bugs, bad code, or security flaws. It gathers and examines source code and generates reports on the project's code quality.

We used selenium tool for testing our project. Selenium used open-source Web User Interface automation testing suite. Selenium supports automation across multiple platforms, programming languages, and browsers.

IV. PROPOSED SYSTEM

A. *System Overview*
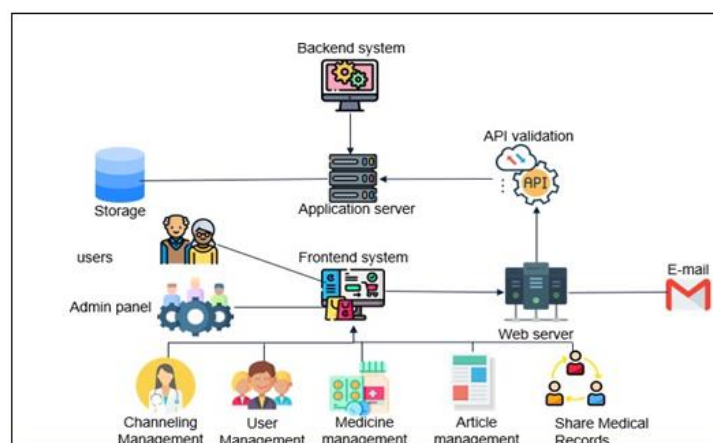
Figure 2: System Architecture Diagram

The main functions of the proposed system are Channeling management, medicine management, user management, article management and share medical records.

There are three types of users who use this system. which are admins, users(patients) and doctors. Admins and Patients need to sign into the system to get the services while doctors can check the shared reports using a link and a code without registering to the system.

1) USER MANAGEMENT

Users can register for the system using email, name, password, age, gender, telephone number, NIC. To login to the system users must enter their valid email and password. Both email and password must be correct, otherwise they will not allow to enter the system. They can manage their profile by uploading images and updating personal information. Users can update their accounts and update their passwords. Admins can manage users. They can search users by entering name, email, NIC. They can remove users from the system. Admins can get a report of user details as a pdf.

2) CHANNELING MANAGEMENT

Channeling management system is where the system provides users to manage all kinds of channeling in private space. There are two types of channelings

     1. Past Channelings
     2. Future Channelings

Users can create channeling and store details like time, place, doctor, date, feedback, prescription slip and add lab reports for each channeling. So, whenever they login to the system they can check for channelings. Also, when a user logs in to the system, they will get a notification for the next channel. Users can also update and delete their personal channels. When a user wants to get a specific channel, they can search for it by using date and keyword. Users can get a report about a specific channel.

3) MEDICINE MANAGEMENT

The medicine management system is used to manage medicine details of users. Users can create medicine by entering details like dosage, frequency, time, reason, start date, end date, drug name, image of the drug, description. So, the users can check for times and dates to take medicine. Users can update and delete their personal medical details. When a user wants to get a specific medicine detail, they can search for it by using date and medicine name. Users can get a report about a specific medicine.

4) ARTICLE MANAGEMENT

Article management system is introduced to share medical knowledge among the members. So, they can read articles in free time and get to know about medical information. users can create meaningful articles and share them among the members. Other users can read them and interact by liking the articles. Users can update and delete their own articles and admins can delete inappropriate articles. Users can search for a specific article by name and can download the article as a pdf.

5) SHARE MEDICAL RECORDS MANAGEMENT

Users can share medical records with doctors. They need to select a category which they need to share with doctor, expire date of the token and provide the email of the doctor. then the doctor will receive a token and a URL for the site. then the doctors can check the details using the system. Token can be deleted anytime. The user wants, so the data is only shown when needed. Creator of the token has the full control of the tokens he/she created and can view list of all token he/she created. When a token is expired it can't be use to view the medical records anymore.
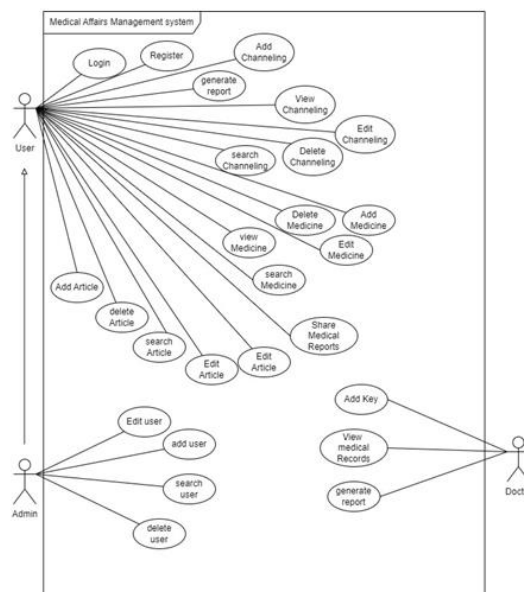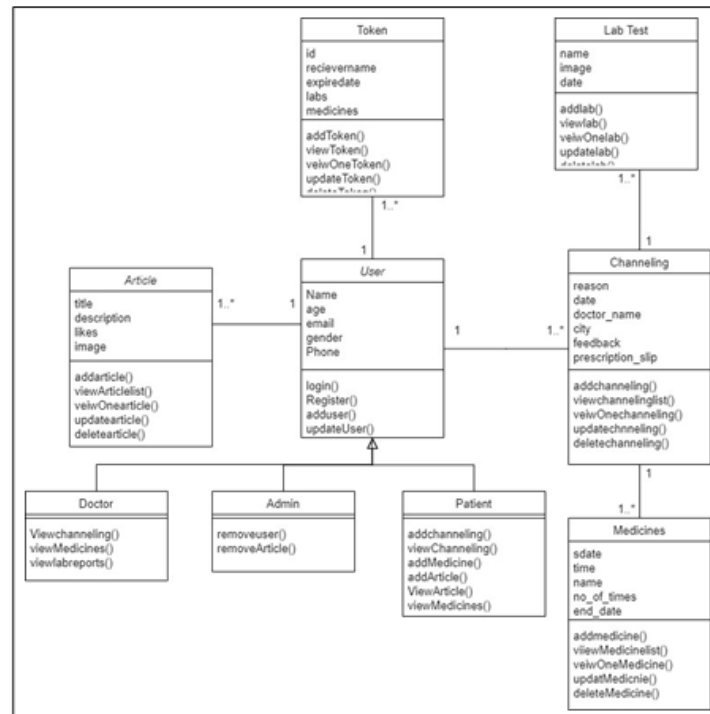
B. Use Case Diagram

Figure 3: Use Case Diagram

This is the high-level use case diagram of the proposed system. It provides the overview about what are the functionalities that each user group can perform. In our scenario in our proposed system we have three user types. This diagram show what are things that they can perform in the system.

C. Class Diagram

Figure 4: Class Diagram

This is High level class diagram of the proposed system. Mainly this provides the structure of the proposed system. From this class diagram it shows what are the classes and interface included in the system and how they communicate each other. (what are the collaboration and relationshipsbetween those classes).

V.   DISCUSSION

The improvement of medicine and technology has made significant advancements in areas like medicine. Any patient's common issue is lack of management of prescriptions, old medical records and forgetting to take medicines effectively. Nowadays people are not following healthy habits due to their busy life or age. Thereby, medical record apps must be utilized as a result to solve this issue. Reminders for taking your medications are an effective method to maintain a regular routine and keep on track. Making sure that you or a loved one is taking their prescriptions as directed might help you avoid unnecessary risk and life-threatening sickness. The global issue of non-adherence to long-term drugs is being addressed by the increasing number of smartphone health applications that are accessible in app stores. However, to date, it is proven that available medication apps are effective.

A reminder or view mechanism is used in the application known as Health Reminder. By setting up interactions between patients and doctors, this app primarily focuses on assisting patients. This software assists in view informing users to take their dosage at the proper time, so that patients are reminded to take their medicines.

Most patient's common issue is misplacing their old medicine prescriptions and forgetting to take the right medication in the right dosage at the right time. Mediary app must be utilized as a result to solve this issue. This is a view about medication, which will prevent patients, from double dosage. Patients lose adherence when they forget to take their meds. According to the findings of a study, 49.6% of patients reported forgetfulness as one of the main unintentional causes of non-adherence. Patients' views of the need for their medication or their concerns and beliefs about its harmful effects can also lead to non-adherence.

Due to old age, most elderly patients forget to take their medication. Printed instructions, such as medicine cards, medication charts, or any written material in a plastic sheet or laminated sheet are hard to maintain, particularly for senior patients. Some drugs can be purchased in an extended-release form, allowing for less frequent delivery. Some people forget to take their meds because they don't include them in their daily routine. It has been calculated that up to 75% of individuals with all diseases do not properly take their medications. Simply by failing to take your medication as directed by a doctor or pharmacist, you run the risk

of hospitalization, serious illness, or even death.

This app will improve the adherence of the patient for the medical treatments and can keep a recorded history of medicine. also, this application has a new feature called an article, which users can add articles on their own and share their different perspectives about medications and health with others, or view articles that others have added. Likewise, app will improve the patient's engagement in medical treatments. Minimize the risk of misdiagnosis. This app provides patients with improved prescription alerts. This will enhance the medical environment with IoT implementations. This gives patients a lot more control over their treatments without worrying about missing any treatments. They can easily maintain and view their old medical history. Primarily, this app helps the patient to take medicine on time as prescribed. It monitors and records all the medical history of the user, and also aids in monitoring any recent medication the user has taken.

Nothing is more rewarding than observing clients' joy when a healthcare app has been created as we focused on the end-user when creating the app. Get a user-friendly health reminder app that lowers the risk of being admitted to the hospitals. Get a basic yet extremely useful health reminder app as well. Our health reminder app development services let you set automatic reminders and receive individualized medical treatments and ultimately lead you towards an organized healthy life. Also helps the patient to take medicine on time as prescribed. It monitors and records all the user's medical history, and aids in monitoring any recent medication the user has taken. We focus on the end-user when creating the app. Nothing is more rewarding than observing clients' satisfaction when a healthcare app has been created. Get a user-friendly health reminder app that lowers the risk of being admitted to the hospital. Get a basic yet extremely useful health reminder app as well. Our health reminder app development services let you set automatic reminders and receive individualized medical treatment.

VI.   PROBLEMS IDENTIFIED

For one to fully experience life, good health is essential. The body stays healthy, and the mind is sharp and alert when a person maintains a healthy lifestyle. A healthy lifestyle would increase longevity and help the body and mind to repair. The foundation [5] of human happiness is having excellent health. But nowadays, with the busy life of people, their health and attention towards it is decreasing. There are various reasons for this. Based on all these factors, there are many cases where people miss their medication and doctor appointments.[5]

So, before starting the designing of the proposed system we conducted a survey to correctly identify what are the actual problems and gather some other related information when developing a medical management application. So, these are the key information and problems we identified though our survey.

One question that we included in the survey is "How frequently do you visit the doctor?". According to the responses, the majority of people visit their doctors seldom. 14% of people go to the doctor once every month. 3% of people visit their doctor once every week. 5.5% of patients go to the doctor twice a month.

Another important question we included in the survey is "How often do you take medicine?". According to the responses we got, the 70.3% of people take their medicines rarely.16.2% of people take their medicines daily. Around 8% of people take their medicines weekly.5.4% of people take their medicines monthly.

Those are the key questions we included in the survey to identify the important information related to the system.

We included following questions in the survey to identify the existing problems that users faced when managing their medical affairs and what are the reasons for those problems.

One question we included under this section is, "Have you ever missed a doctor's appointment?". According to the user's responses, the majority of people answered "Yes" (51.4%), while 48.6% answered "No". So, from that we identified that majority of the people have experienced a situation where they forget to join a doctor appointment.

Then we asked why they missed an appointment (what are the reasons). To make the answering process more ease we gave them multiple answers to choose.
1. Lack of management
2. Busy with huge workload
3. No one to remind
4. Forgetfulness due to old age.

According to the user's responses, most people are "busy with a huge workload" (60.9%), the second most are "lack of management" (47.8%), the next most are "no one to remind" (17.4%), the least "Forgetfulness due to old age" (4.3%) was also answered.

Next, we asked "Have you ever missed taking your medication?". According to the user responses, most of the people answered "yes" (73%) while 27% answered "no". Then we asked about why they forgot to take medicines on time by providing the same options so select as in previous question. From the responses we can identify many people forget due to heavy workload. (58.1%) and about 7% of people have the problem of forgetting with old age. Also, about 49% of people have no one to remind them to take medicine. About 52% of people miss their medicine due to lack of management.

The next question we included with the intension of find the awareness of the people about healthy habits. The question we asked is "Are you aware about the healthy habits?". According to user responses, most of the users (91.9%) are aware of healthy habits and the

rest are not aware about healthy habits. It is very pleasing to see that most of the users aware about the healthy habits. But one of the goals of our proposed system is to make aware all people of healthy habits.

The final question we asked from the users is whether they like to use an online application that enables users to share their medical records with others and manage their doctor appointments and medicines in an organized manner. According to the user responses we got about 95% of the users like to have such kind of application.

So, by deeply examining the information that we gathered from the survey, we finally come up with set of key problems that users (patients) face when the are managing their medical affairs. We briefly explain those problems in the below section.

A. LACK OF MANAGEMENT AND BUSY WITH HUGE WORKLOAD

People are so busy with their everyday obligations today that they tend to neglect their physical and mental health. People are forced to deal with a variety of health issues as a result. Even their doctor appointments are neglected due to the volume of work. The main reason for this is not only the business but also the lack of proper management.

So as a solution to this issue we introduced functionality for users to store their medical records and appointment details. Users can add their medicines details to the system. The user can check their pharmaceutical information at any moment without having to memorize it. Our system notifies the user via e-mail at the scheduled time reminding thechanneling.

B. FORGETFULNESS DUE TO OLD AGE

When people get old, forgetfulness is a common problem. Which cause problems such as,

1. Losing track of date or time of year.
2. Misplacing things often and being unable to findthem.

If there is a person who has these problems, it is common for them to forget about their medicines and doctor appointments. If they do not have anyone to remind them, it can be a serious problem for their health.

C. NO PROPER WAY TO CONNECT WITH DOCTOR PRIOR TO THEAPPOINTMENT

When we often go to get medicine from the doctor, the doctor may have a clear understanding of our current disease and condition. But doctors may not have a clear idea about patients' past medical conditions and diseases. It is very important for doctors to have a clear idea of their patient's medical history because in some cases it can be very dangerous to prescribe medicines without proper investigation of the patient's medical history. This is because some drugs may be good for certain diseases, but they may be dangerous for other diseases. According to BBC News [10] they stated that there are 237 million drug offenses per year in England. 28% of those errors caused moderate or potential harm to patients, and 700 of those errors resulted in death.

There are also 22,300 possible deaths due to drug offenses [10].

So as a solution to this issue we introduced a functionality for users to share their medical records with anyone with the help of an access token. The creator of the access token has full control of the access token and can remove the token at any time. So, the proposed system allows the users to share their medical records with the doctors and then the doctors can get a clear understanding of the patients before the appointment.

D. NO ONE TO REMIND

Forgetfulness is the major reason that causes non-adherence of medication. Mostly senior patients suffer with forgetfulness due to their old age and weak health. As a result, they might forget their channeling dates, which might cause serious issues. Some patients who have serious medical issues must visit doctors on the given exact dates and do checkups. This medical app will be a great help, since this app will teach you about your appointments with doctor, which makes channeling easier. It will make sure that you won't miss any medical treatment. Some people might forget when to take their medicines and in which quantity, which causes misdiagnosis. Our app will prevent you from misdiagnosis and help you to take medicine on time and prescribed. Most of the people forget their treatments because it is not a part of their daily routine but not it will take just one notification to keep you healthy.

Some patients' views of the need for their medication might be different from others, and some people might have beliefs and unwanted fears about medical treatments which will cause non-adherence. For them, who doubts their treatments and medications, we have a separated section called articles where users can read articles and other patients' perspectives of different medications and treatments which make a positive impact about treatments and reduce misunderstandings. Likewise, users who like to share their experience, can share everything, and let other users know.

There are many instances where non-adherences can be seen within patients. And this app works as a solution for every instance which makes your life easier and effective when it comes to your health habits.

VII.   CONCLUSION

In this research paper, we proposed a new system to manage people's medical affairs in an organized manner. Before starting the development of the proposed system. We conducted research about existing systems for managing medical records and then we categorized the advantages and limitations of those systems. From that we figured out what are the services we need to include in our system. Then we conducted a survey to find the common problems people have when

organizing medical affairs. From the collected information we figured out some key challenges people faced during organizing medical affairs. Then we planned the proposed system with the aim of overcoming those challenges. This research paper also includes the tools and technologies we used to develop the proposed system and included some diagrams that show the overview of the system and relationships between different components of the system. It also includes a detailed explanation about the functionalities of the proposed system. We planned to upgrade this system with advanced notification and remainder functionalities to make it as a real time application.

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