Digital Health Navigator: Preliminary Work on a Personal Health Assistant Software for All Health Literacy Level Users in Turkey

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Abstract. Today's digital health terminology is actually advanced medical technologies that include computer-assisted therapy, smartphone apps, and wearable technologies. These technologies offer significant potential for improving access to immediate medical care, efficiency, clinical effectiveness, and personalization of many health problem therapies. In this paper, we will elobareate on the preliminary design steps of a personalized health assistant application project (PHAS). The proposed application can be classified as a mobile health app and not a telemedicine application. The idea behind this application is to reduce the physicians' workload in hospitals while providing health care to the community with different health literacy levels by easily using the application when general assistance about any health issues or an overall health and wellness improvement is required.

Keywords: digital health, mHealth, eHealth literacy, digital transformation, mobile applications

1 Introduction

Tablets and mobile phones are ubiquitous and indispensable gadgets in today's society. Nearly every country in the world has begun defining and establishing the foundation of digital transformation in numerous industries. The healthcare system is inevitably among these fields, as the health systems start facing a shortage of healthcare professionals and a continuous workload increase of physicians, especially during the pandemic [1]. In addition, increase in the amount of medical information served via the Internet is expected to facilitate this transformation of digitization of the health system. All of the aforementioned factors result in the development of a wide range of mobile health applications also in

paving the way for the legalization of the public's use of those apps that can be purchased [2].

Statistics cited by IQVIA in an article published by Medical Device Network in 2021 indicate that more than 350,000 digital health applications are currently accessible on the global market. These applications can be downloaded through the apple store as well as the google play store [3,4]. Furthermore, Figure 1 depicts the general idea of Miguel et al research. Their research showed how they classified mobile health applications and categorized them based on application features and usage goals [5]. The use cases range from wellness and fitness services to complicated applications for diagnosis and support in aftercare settings. mhealth applications may also be used for educational purposes, as well as for tracking, monitoring, or managing the chronic conditions of patients by medical professionals.

Nevertheless, it is still exceedingly difficult for patients and healthcare professionals to identify and evaluate high-quality apps in the various app stores. There is currently no common quality standard for mhealth applications [6]. Additionally, Margaret R. Emerson et al study showed that dissemination of health information through mobile devices (mHealth) increases the amount of information that is available, but it also creates challenges in terms of ensuring that the materials are appropriate for and understandable by all community members, regardless of their health literacy levels [7]. A certain need to be taken into consideration is the social structure of the community while designing mhealth applications. Otherwise, the usage of little complex mhealth applications by low or basic health literacy level users may increase medical errors, illness, and compromised public health.

Lastly, we can conclude that all mhealth applications are not suitably designed for all community users of all ages and literacy levels. Additionally, are providing or targeting to solve a specific health problem. Consequently, one of the primary purposes of this study is to build a mhealth application that provides individualized support and early guidance for daily health needs.

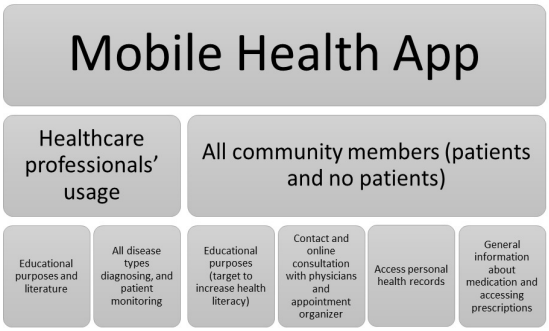

Fig. 1: The general classification of mHealth applications

2 Related Work

There are a significant number of mobile health applications available across the globe [4]. The scope of these applications extends from advice on leading a healthy lifestyle every day to professionals who give personal health care. There are a variety of approaches that can be learned through mobile health applications, including learning the disease-related process, improving patient care to facilitate treatment and diagnosis, electronic prescription, clinical support, and personal care, and e-learning to increase health literacy [8,9]. These are some of the primary purposes of mobile health applications.

Considering the area covered by the current applications, it can basically be divided into two main parts: Applications used by health professionals and individual care applications used by community members. Health professionals use mobile health applications about various documents and encyclopedia containing detailed medical information [10,11], memory tests related to anatomy [12,13], calculation of drug dosages and reference values [14,15,16], social networking applications that facilitate communication with other healthcare professionals [17,18,19], tracking and follow-up patient care [20,21].

Patient and non-patient society members use mobile health applications such as monitoring personal care and life changes [22,23], record and store medical information and health history, as well as drug and appointment management [24,25,26,27], together with general health education, first aid, and rehabilitation practices [28,29].

Lastly, although the existing applications differ in terms of their subjects and functions, our Personal Health Assistant Software (PHAS) is more comprehensive than the others. For instance, our application will be accessible to both health professionals as well as other members of the community. Thus, patient-specific treatment, control, medical follow-up, continuous patient monitoring, and performance evaluation will become easier. In addition, we believe that the proposed PHAS will definitely raise the health literacy of individuals and lessen the strain on healthcare centers since the application provides the user with the right direction to follow about his/her health during the life course.

3 PHAS Technical Structure

The proposed PHAS differentiates itself from its counterpart by trying to cover all areas related to personal health rather than concentrating on one health problem and its solution. Figure 2 shows PHAS's main services. Lastly in the following sections, we will examine the detailed structure of each service.

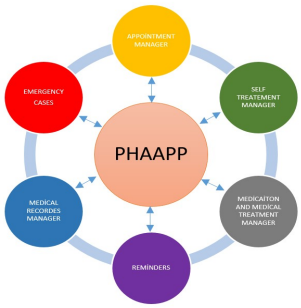

Fig. 2: PHAS services

3.1 PHAS Appointment Manager

We believe this phase will significantly alleviate the strain on the healthcare system. Due to varying degrees of health literacy in the community, many patients may schedule appointments with the incorrect hospital department. The physician will then refer the patient to the relevant department to diagnose and treat the health issue. This procedure can waste patient and physician time and prevent other patients from scheduling an appointment with the relevant department.

At this time, we propose implementing an appointment manager in our PHAS to resolve this issue. Figure 3 illustrates the appointment manager's phases. First, we intend to visit specialists from several health departments and compile a comprehensive list of symptoms associated with a certain health concern. For instance, developing a general list of typical symptoms associated with respiratory system issues, etc. Secondly, present the symptom list to the patient in an understandable and straightforward manner, allowing them to choose from the list. This can be accomplished by integrating a Chatbot into our appointment manager [30,31,32].

Based on the patient's choices from the symptom, our manager will suggest that the patient book an appointment with the right physician, if needed. The appointment booking system flowchart is shown in Figure 4. The parameter symptom_count_threshold specifies the minimum number of symptoms from the symptom list that must be selected by the patient to be directed to the correct appointment system. We intend to use static threshold values for symptom count and X value for the time being and leave the use of dynamic threshold values for future work.

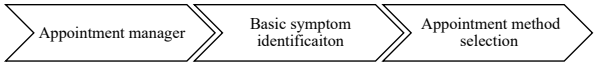

Fig. 3: Appointment Manager in PHAS

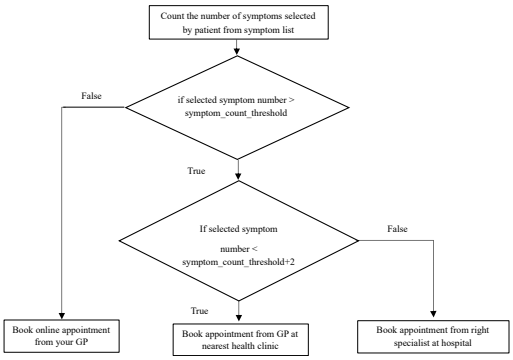

Fig. 4: Flowchart for an appointment booking system

3.2 Self-treatment Manager

Many nations are encountering difficulties in providing access to quality healthcare systems for diverse age groups [33]. The health systems of the world must be resilient, for instance, COVID-19 assessed their ability to withstand acute shocks, but they must also withstand long-term trials and threats. Articles published in the Lancet on global and planetary health illustrated the increasing burden of non-communicable diseases that will accompany aging populations as a result of climate change and a decline in nutritional quality. Furthermore, the most significant future challenges for a healthcare system will be issues with monitoring and addressing unmet mental health burdens in various age groups [34,35].

On the other side, governments start preparing and looking for a solution to decrease the impact of these difficulties on their health system by educating and encouraging the community to utilize mhealth applications and building general-purpose websites approved by the ministry of health. All of these applications strive to provide advice and a variety of information regarding learning how to maintain a healthy lifestyle over the course of one's life [36,37].

The proposed self-treatment manager in our PHAS will assist in instructing users of all ages to follow necessary daily actions that will protect them as long as possible from hospitalization and health-related interventions. The PHAS self-treatment manager sections and general working mechanism are shown in Figure 5 and Figure 6, respectively. Finally, in this paper, we will not dive into the implementation details of these sections which are left as future work.

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Fig. 5: PHAS Self-treatment manager sections

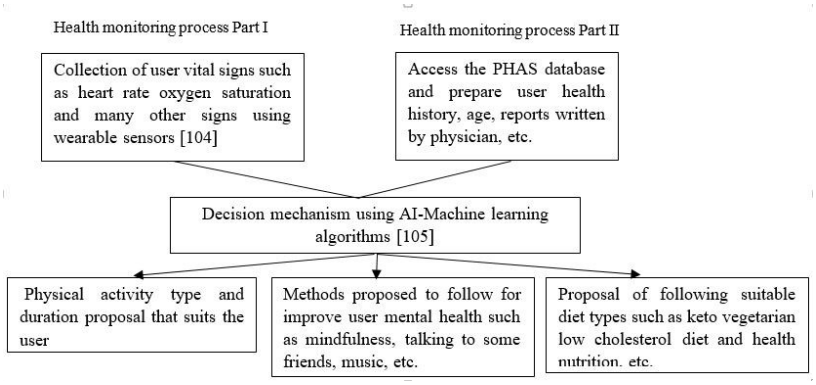

Fig. 6: PHAS Self-treatment manager working mechanism

3.3 Medical Record and Remainder Manager

Even the implementation of these two sections is not new and is available in many healthcare systems [38]. We believe integrating these managers into PHAS will simplify the access process and save the user time. We plan to save the user time by constructing a separate health database for each user that may later be used by machine learning algorithms from other PHAS sections to analyze the data and give basic feedback about the action type that shall be followed by the user to prevent any complicated health issues (early diagnosis system). Figure 7 and Figure 8, respectively, show both remainder and medical records manager services.

Fig. 7: PHAS Remainder manager sections

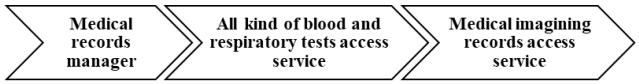

Fig. 8: PHAS Medical records manager sections

3.4 Medication and Medical Treatment Manager

As mentioned in the previous sections about raising population knowledge in all health-related fields, one of these areas is drugs and medications. In the market, there are few mhealth applications for only providing information about a specific group of drugs rather than all medication types [39,40]. One of the services provided by the PHAS medication manager is to provide general information about any medications (herbal medications included), such as an instruction list. To construct these lists, we plan to work with a team of pharmacists. Also, allow patients to report to their physicians in case they have or show any side effects while taking the prescribed medication. In addition, allowing the patient to acquire the prescription from the nearest pharmacy to his or her location. The detailed structure for medication and medical treatment is shown in Figure 9. Lastly, there is a need to mention that the prescription uploading service is not new and is already available in the Turkish health system [38].

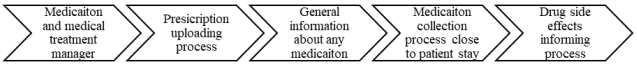

Fig. 9: PHAS Medication and medical treatment manager

4 Implementation Methodologies for PHAS

Some technologies are required to create a mobile application. For Android applications, there are programming languages such as Java or Kotlin, while for iOS applications, there are Swift or Objective-C. For both the Android and IOS platforms, software frameworks such as React Native, Xamarin, and Flutter are available which allows creating cross-platform mobile applications with a single codebase. As backend services, many technologies such as Node.js, Ruby on Rails, and Django are used. For data storage and processing, many database technologies are utilized. According to the latest survey research conducted by Stack Overflow in 2022 [41], PostgreSQL and MySQL are the most popular relational databases, whereas MongoDB is the most popular non-relational database. It is essential to utilize version control systems to monitor changes to the source code and to allow cooperation among other developers.

The technologies planned to be used in our paper are explained with their advantages are mentioned in Table 2 and Table 1 respectively. The planned usage of React Native allows the production of native applications for platforms such as Android, iOS, and others while utilizing a single codebase [42]. Node.js is planned to be used to create a backend server application because of its wide range availability of frameworks and libraries [43]. The MongoDB planned for usage can manage large amounts of data and has built-in support for horizontal scaling, making it ideally suited for use in modern, high-traffic mobile applications [44]. The planned usage of GraphQL is because it provides for flexible and efficient data retrieval from a server [45]. Git is planned for usage as a version control system because it facilitates user collaboration and stores a complete history

of commits [46]. Kaggle is a platform for data science and machine learning competitions. We will obtain data sets through Kaggle [47]. TensorFlow [48] is an end-to-end machine learning platform which is very popular and thus will be used to create machine learning models while utilizing the data sets obtained from Kaggle.

Table 1: Software tools and frameworks planned to be used in PHAS development cycles

Technologies	Free to use	Is Open Source
React Native	Yes	Yes
Node.js	Yes	Yes
MongoDB	Yes for community edition	Yes
GraphQL	Yes	Yes
Git	Yes	Yes
TensorFlow	Yes	Yes

Table 2: Planned technologies and their advantages

Technologies	What	Advantages
React Native	Enables the development of native apps using React for platforms including Android, iOS, and more.	– React Native is Community-driven – Maximum code reuse & cost saving – Strong performance for mobile environments – Modular and intuitive architecture similar to React

Table 2 – continued from previous page

Technologies	What	Advantages
Node.js	Node.js is an open-source, cross-platform JavaScript runtime environment.	– Helps in Building Cross-Platform Applications – High-performance for Real-time Applications – Easy Scalability for Modern Applications – Community Support to Simplify Development
MongoDB	MongoDB is a document database with the scalability, flexibility, and necessary querying and indexing.	– Full cloud-based developer data platform – Flexible document schemas – Cost-effective – Powerful querying and analytics
GraphQL	A runtime that responds to API queries with already-existing data is called GraphQL. Additionally, GraphQL offers flexibility, provides strong developer tools, and makes it simpler to adapt APIs over time.	– GraphQL provides a flexible structure – Best for complex systems and microservices – No over-fetching and under-fetching problems
Git	Git is a distributed version control system that is free and open source and is made to efficiently and quickly handle projects of all sizes.	– Git is free and open source. – Git is fast compared to others because each developer has access to a local repository with a complete history of commits. – Branching and merging operations are simple and cost-effective.

Table 2 – continued from previous page

Technologies	What	Advantages
TensorFlow	Machine learning models may be easily created with TensorFlow for desktop, mobile, online, and cloud platforms by both beginners and specialists.	– Easy model building – Robust ML production anywhere – Powerful experimentation for research

5 Conclusion and Future Works

Undoubtedly, the healthcare system will encounter numerous issues in the future. Countries must strengthen their healthcare systems and alleviate the strain on them. Then, offering quality health care to all levels of the community. By utilizing contemporary technology and smartphones. The design and use of the mobile application in health areas will significantly increase the health literacy level of the population, thereby educating and instructing users to maintain good health and preventing them from visiting hospitals, thus reducing the workload of all healthcare professionals. The vast majority of designed and proposed mobile health applications focus on a single health concern rather than assisting the user in all health-related areas. The proposed PHAS will host a wide range of technologies such as the adoption of wearable sensors, machine learning algorithms used for analyzing user data, and many other during its design process. We confidently can say after PHAS implementation completion in the near future our software will provide a solid foundation that addresses all types of users' health-related demands and which path they should follow to live a healthy lifestyle in order to keep them as far away from hospitalization and physician assistance as possible.

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