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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 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 ongoing research paper, we propose the initial design steps of a personalized health assistant application. 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 necessary for today's society. Nearly every country worldwide has begun defining and establishing the foundation of digital transformation in many industries. The healthcare system is among these fields since the health systems have started facing a shortage of healthcare professionals and a continuous workload increase of physicians, especially during the pandemic [1]. In addition, an increase in the amount of medical information may be accessed using the Internet by anybody. All of the aforementioned factors result in the development of a wide range of mobile health applications. Healthcare-focused mobile applications serve as digital conduits of health-related knowledge and research, facilitating both healthcare practitioners and patients in augmenting health treatments and public health. By transforming mobile platforms into regulated medical devices, these applications embody an evolution of technology in healthcare. Superseding traditional technologies, mobile apps have established new avenues for communication with autistic individuals and are increasingly being used as

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digital medical identification tools, integrated within smartphone lock screens [2]. Such applications leverage sensor-collected data to assess an array of health-related parameters, including physical activity, body part imaging, and overall health status [3]. Moreover, mobile sensors can capture crucial health parameters, enabling the identification of daily activities and lifestyle patterns [4].

Governments opened the door for the legalization of the public's use of those apps that can be purchased [5]. 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. Moreover, based on GlobalData's recent report Thematic Research: Mobile Health Apps forecasts that the regulated medical apps market will reach $12.1 billion by 2030[6,7]. These applications can be downloaded through the apple store as well as the google play store [8,9]. 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 [10]. 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. However, 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 [11]. Additionally, Margaret R. Emerson et al.'s study has shown that dissemination of health information through mobile devices (mHealth) increases the amount of information that is available. However, it also leads to challenges in terms of ensuring that the materials are appropriate for and understandable by all community members, regardless of their health literacy levels [12]. A certain need to be considered is the social structure of the community while designing mhealth applications. Otherwise, using 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, they provide or target 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.

Figure 1. The general classification of mHealth applications

2. Related Work

There are a significant number of mobile health applications available across the globe [9]. 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 [13,14]. These are some of the primary purposes of mobile health applications.

Given 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 for various documents and encyclopaedia containing detailed medical information [15,16] memory tests related to anatomy [17,18], calculation of drug dosages and reference values [19,20,21], social networking applications that facilitate communication with other healthcare professionals [22,23,24], tracking and follow-up patient care [25,26].

Patient and non-patient society members use mobile health applications, such as monitoring personal care and life changes [27,28], record and store medical information and health history, as well as drug and appointment management [29,30,31,32], together with general health education, first aid, and rehabilitation practices [33,34].

Lastly, although the existing applications differ in terms of their subjects and functions, our PHAS is more comprehensive than the others. For example, 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.

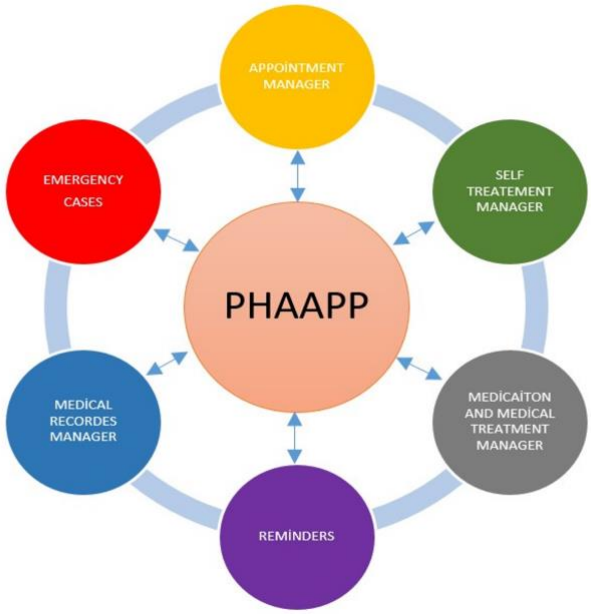

Figure 2. PHAS services

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, such as developing a general list of typical symptoms associated with respiratory system issues and presenting 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 [35,36,37].

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.

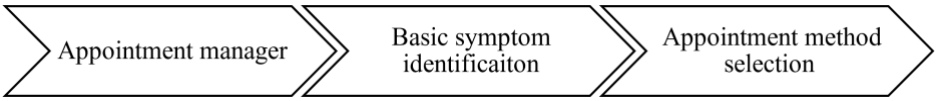

Figure 3. Appointment manager in PHAS

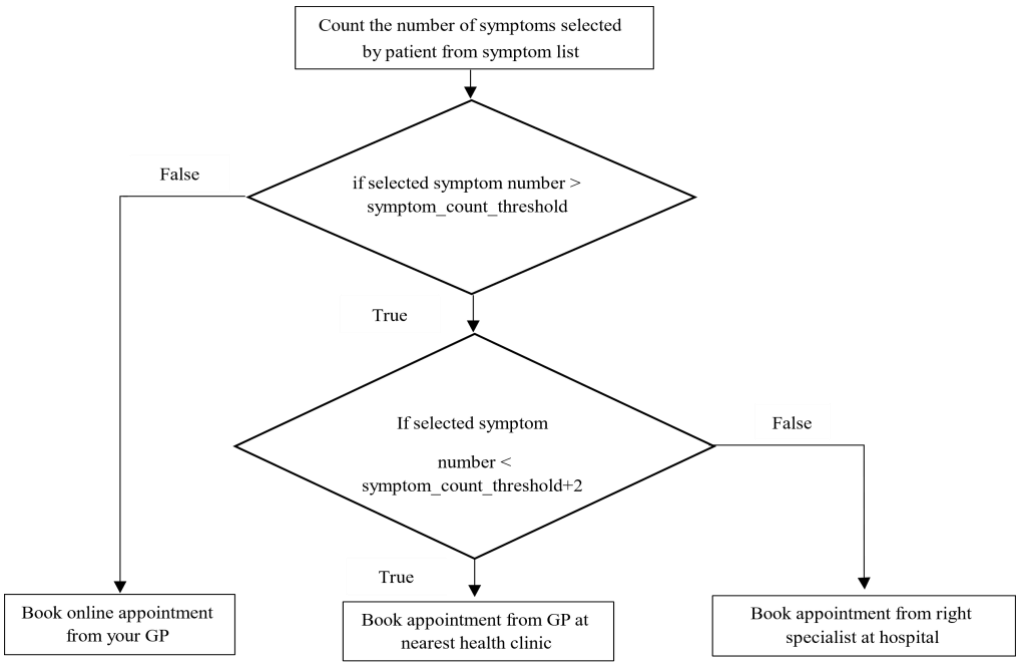

Figure 4. Flowchart for an appointment booking system

3.2. Self-treatment Manager

Many nations encounter challenges in providing access to quality healthcare systems for diverse age groups [38]. The health systems of the world must be resilient. For example, 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 due to 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 [39,40]. 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 [41,42].

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 Figures 5 and 6, respectively.

Finally, in this paper, we will not dive into the implementation details of these sections, which are left as further work.

Figure 5. PHAS self-treatment manager sections

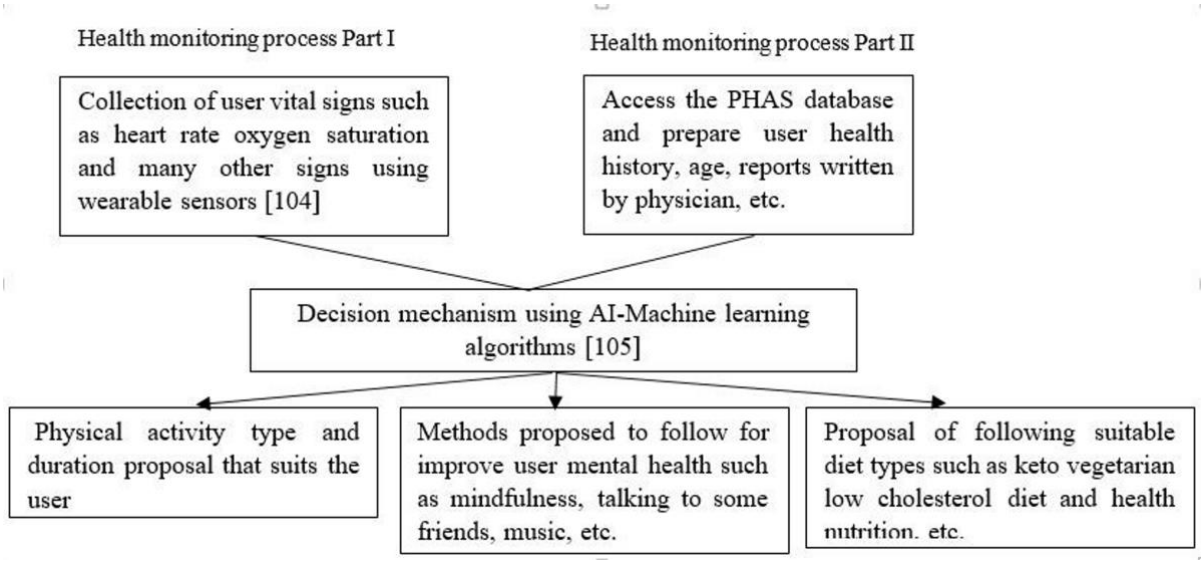

Figure 6. PHAS self-treatment manager working mechanism

3.3. Medical Record and Remainder Manager

Even the implementation of these two sections is not new and is available in many healthcare systems [43]. 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 analyse 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 show both remainder and medical records manager services, respectively.

Figure 7. PHAS remainder manager sections

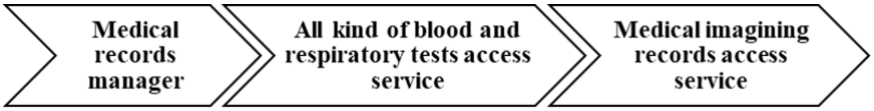

Figure 8. PHAS medical records manager sections

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 [44,45]. 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, it allows 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 [43].

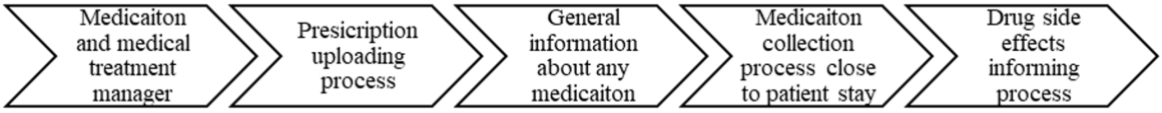

Figure 9. PHAS medication and medical treatment manager

4. Experimental And Implementation Methodologies

We can divide the phas implementation phase to two major parts. The first one using software platforms to design a mobile application that execute on both android and iOS operating systems. For this purpose, using react, flatter will allow creating cross-platform mobile applications with a single codebase [46,47]. The second part is the usage of backend services, many technologies such as Node.js, Ruby on Rails, and Django are used [48,49]. In our research we decide to use Node.js to create a backend server application because of its wide range availability of frameworks and libraries [50]. For data storage and processing, many database technologies are utilized. According to the latest survey research conducted by Stack Overflow in 2022 [51], PostgreSQL and MySQL are the most popular relational databases, whereas MongoDB is the most popular non-relational database. Thus, we use MongoDB due to its capability in managing large amounts of data and has built-in support for horizontal scaling, making it ideally suited for use in modern, high-traffic mobile applications [52]. Also, it is essential to utilize version control systems to monitor changes to the source code and to allow cooperation among other developers. GraphQL will be used as a flexible and efficient data retrieval from a server [53]. Git platform will used as a version control system because it facilitates user collaboration and stores a complete history of commits [54]. Moreover, for providing personalized health recommendations and treatment plans for users, we need to use different data sets collection tools and platforms for training our machine learning models such as ukbiobank, Kaggle, U.S. Department of Health & Human Services (HHS), Centers for Disease Control and Prevention (CDC), National Institutes of Health (NIH). [55,56,57,58,59]. Lastly TensorFlow [60] 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 obtained data sets from the aforementioned platforms. The summary of technologies that planned to be used in our paper are described with their advantages in Table 1 and Table 2 respectively.

Table 1. Planned technology

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

Table 2. Planned technology and their advantages

Technology Name	Description	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
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 robust 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
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 Further Research

Undoubtedly, the healthcare system will encounter many issues in the future. Countries should strengthen their healthcare systems and alleviate the strain on them. Then, they can offer quality health care to all community levels. 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. Most 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 analysing user data, and many others during its design process. We confidently can say after PHAS implementation completion in the near future, and 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 to keep them as far away from hospitalization and physician assistance as possible.

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