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Benefits of Mobile Applications in the Healthcare Industry

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Abstract. **The scope of this paper is to evaluate the benefits of applications designed for mobile devices in the healthcare industry. This study includes research on adoption of applications running on end users devices within the healthcare and investigates the benefits for the patients and medical organisations after initiating the process of implementation. Besides the mentioned, the article contains a overview regaind most common use cases of mobile applications in healthcare, modern mobile frameworks used for development and a list of suggestions while developing such mobile application.**

Keywords: Mobile application, Healthcare, Patient Care, Patient Experience, Clinic Care, Digital Health, Doctor Supervising, Clinical Data Privacy

I. INTRODUCTION

Mobile applications play a significant role in modern society and are being adopted across all industries, health care industry is not considered as an exception. People tend to consume more and more internet traffic using a portable device like a smartphone or tablet, rather than a desktop or laptop [1], in order to navigate over the Internet and find the requested information. A mobile application, usually defined as a mobile app, is a software designed & developed to run on protable devices such smartphones, tablet or even a smart watch. In present a mobile device does not represent anymore handhelp computer with limited capabilities [2], it can be considered as an compact and mobile device that can solve complex problems using the hardware capabilities and installed mobile application on it. Healthcare is in the midst of a mobile oriented revolution, and it will only be a matter of time before mobile healthcare applications change how we deliver information, use services, measure the clinical requests, and pay for healthcare offered services.

In the past year COVID-19 has increased the speed of technology innovations across the National Health Service (NHS) [3] on a global level, because of the need to support the health care industry and population that uses it on a daily basis. When we analyse the mobile application as primary tool within the healthcare industry, we can classify it as a communication channel that can provide the required patient information to the organization that takes care of him and with the patient consent. The main actors of this channel are the hospitals/clinics, doctors and patients using the mobile applications to deliver the medial information on upper level.The entire health care industry has three main common difficulties:

- finding different type of patients
- gathering medial data from the patients
- communication with patients.

Mobile applications has the possibility to close the last two major difficulties or at least the gaps that blocks from getting them.

II. MOBILE APPS USE CASES IN HEALTHCARE

There are a lot of mobile applications available in the healthcare industry. They can be categorized into major areas:

A. Clinical and diagnostic

Clinical and diagnostic applications that allow clinical entities (for ex. doctors) to gather and analyse medical data about their patients or clients. They might include the following list of features like:

- Fetch electronic health records (EHR)
- View lab analisys results in a visual form (like chart, digital imaging etc.) or in standard form
- Printed medical references (like Johns Hopkins Antibiotic Guide (JHABx), Dynamed, UpToDate, 5-Minute Clinical Consult (5MCC), 5-Minute Infectious Diseases Consult (5MIDC), Sanford Guide to Antimicrobial Therapy (SG), ePocrates ID, Infectious Disease Notes (ID Notes), Pocket Medicine Infectious Diseases (PMID), and Iddx) [4]
- Other health records related to the patient.

These evidence-based apps serve as medical decision-making information providers for the doctors

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[5]. These type of application usually consists from at least two system roles: the doctor and the patient.

B. *Remote monitoring*

With the current improved mobile devices, not every health condition needs to be monitored within a clinical environment. Remote monitoring apps permit patients to stay at home while they under the virtual care of the providers. Now with internet accesibility, clinical devices designed for patients, using special designed mobile applications, can update their vitals like heart rate, oxygen level, blood glucose readings, blood pressure and other important healthcare information without the need to visit the clinical providers. This offers providers to manage and take care of patients remotly. Remote patient monitoring systems are designed to obtain a number of physiological data from patients. Most common data are Electrocardiogram (ECG), Electroencephalogram (EEG), heart beats and respiration rate, oxygen volume in blood or pulse oximetry, signals from the nervous system, blood pressure, body/skin temperature and blood glucose level. In addition to these, sometimes, weight of the patient, activity history of the patient and sleep data are collected. A number of researches have been done for wound management and sleep monitoring [6].

Heart related monitoring software are the most common type of monitoring systems met in the industry. They are usually integrate in wearable devices that support this hardware capability. The wearable devices might contain the possibility to gather information like ECG, heart rate, respiration rate and blood pressure [7].

C. *Healthy life style*

Modern mobile applications most of the time try to keep their user conversion high as much as possible, so they do deeper engagement with the users. This kind of application towards focus on healthy living tracking health metrics such as obesity, exercises, heart rate, sleep etc. Patients with chronic conditions such as diabetes may benefit from apps that offer diet plan, daily routine, lifestyle changes etc. Pregnant women can even use similar mobile applications about fetal development. Patients with diabetes or heart disease may benefit applications that offer a diet plan tailored to their specific circumstances. There is need for innovative ways to stimulate physical activity and a healthy lifestyle. One promising development is the use of smartphones during exercise. Use of mobile applications may be a powerful tool to encourage physical activity and health [8,9]. Mobile applications are accessible, have a large reach, and have multiple functionalities, such as interactive possibilities and feedback opportunities [10,11]. Although more than 17.000 health and fitness mobile applications have been developed, deployed on mobile stores and are available for the public use [10].

D. *Productivity*

With devices enhanced with more and more capabilities features, developers have started creating more lifestyle, health focused apps. It ranges from apps getting calories intake, heart beat, pulse, oxigen level, to eveng ECG features.

Latest mobile applications advances include IoT enabled functionality where physicians can view the trend and pattern of the patient remotly. Most of the productivity software will offer functions while maintaining Health Insurance Portability and Accountability Act (HIPAA) [12], that is used within United States and General Data Protection Regulation (GDPR) [13], that is used within Europe. Most users download a mobile application to meet a specific goal and feel that the desired application help them to achieve it. Two distinct groups emerged, those who used them to adopt a new behaivour. The majority of participants reported that acceptable apps were free, easy to use, provided visual/auditory cues, and had in-app gamification. Most participants strogly opposed linking their social media with apps and did not use those features [14].

III. BENEFITS OF MOBILE APPLICATIONS

The impact of mobile applications in healthcare industry differs from country to country, mostly it relies on the adoption rate of the population from

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specific country. A statistic of adoption rate per country regading mobile apps in healthcare we can observe in the following Figure 1.

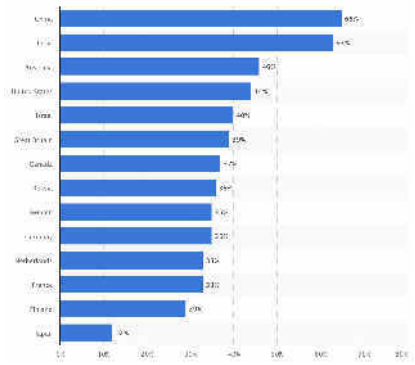

Figure 1. Adoption rate of mobile applications in healthcare per country [15]

Mobile applications offer mutual benefits for all parties in healthcare industry, its more like a bridge that connects two towns. The greatest measurable benefit from the mobile apps is the time spent. From the logistic point of view a patient in order to visit a doctor has to do the following steps:

- Book a window in the doctors calendar
- Travel by car or public transport until destination and return back
- Wait his/her line.

A modern mobile application allows the patient to avoid those expenses, time consumed and provide a contactless (clinics duting Covid-19 are considered as well a source for contamination) communication channel with the doctor. Patient in the end gets in touch with the doctor and in the same time the doctor gets the needed information for patients current treatment or simply updating his medial information.

Migrating from classical healthcare in clinic environment and allowing patient to treat remotely from home, under medical surveillance, can be considered as well a optimization of a doctors load that can allow to check out more patients.

The last, but not the least, the entire digital communication and trasnfered data are stored remotely, that allows more flexibility to all parties to access and manage it.

IV. Mobile Development Frameworks

Choosing a mobile development framework is an important point for designing an health care mobile application. It is influenced by many factors like development time, cost, maintenance and time to implement new features. Such frameworks can be classified in two basic categories, native mobile development and hybrid mobile development.

Common native mobile development frameworks are:

- Google Android Framework based on Java/Kotlin [16]
- Apple iOS Framework based on Objective-C/Swift [17].

The main aim of hybrid mobile development frameworks is to use a single code base and achieve same results for both platforms Android and iOS. The dominant hybrid frameworks at the moment are:

- React Native [18]
- Flutter [19]
- Xamarin [20]
- Ionic [21].

As shown in Table 1, each development platform has its advantages and disadvantages.

TABLE I. Table comparison between native and hybrid

Cirteria	*Native Development*	*Hybrid Development*
Final Cost	High	Medium - High
Required number of developers	One for each platform	At least one developer
Spent development time	Fast	Medium
Native mobile features	Complete adoption	Partially adoption
Performance	High	Medium
Maintanence	High	Medium
Product Complexity Support	High	Medium
Depency on third-parties	None	Depends
Access to hardware capabilities	Available	Depends on third-party integrations

Selecting the type of mobile development framework represents an important decision that has to be done at the beginning of any development. On later stages when the product passed several cycles of development, it can be modified or changed completely.

V. Recommandations

Developing a mobile application for any type of industry is not a cheap and easy task. In order to avoid many confusions on what a mobile application in health care needs to have, the product owner [22] or stakeholders [23] must decide and define the following points:

A. Product Stage

Defining at what stage the current product is represents an important step, before diving into deep development or planning stage. Here needs to be defined at what stage the product is, whenever its on proof-of-concept, most viable product or simple idea.

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B. *Feature list*

Defining feature list on short-term, mid-term and long term is important for making the development plan and primordial in choosing the mobile development framework. For example if in the roadmap its planned to establish communication with custom medical devices or exploit the mobile device hardware capabilities, then would be more reasonable to go for native mobile development.

C. *Time to market*

Time to market represents an important aspect for every product. This is important moment that depends what feature needs to be developed and kicked-off first.

D. *Security*

Patient medical information represents a sensitive data. In the digital health world this data must be stored and distributed according to HIPAA and GDPR. These rules apply as well for the mobile applications, from the moment they share same information. The mobile applications as well represent a target for the attackers [24].

VI. CONCLUSION

Every day we use at least one mobile app to make an action, for example a simple phone call. Mobile applications have become an inevitable part of our life style. With the growth of the performance of the mobile devices and integrations with the IoT segment, the mobile applications markets grow at an incredible speed. This article describes the main categories of the healthcare mobile apps, where each can contain multiple branches of subcategories that target specific use cases. Mobile applications are part of a global ecosystem that can facilitate many aspect of human life. We must consider the mobile apps as an option that could help solve a problem in the lifecare industry or at least offer additional benefits to the patients in order to improve their lifestyle and make their treatment seamless.

REFERENCES

[1] Mobile Vs Desktop Internet Usage, 2021 (https://www.broadbandsearch.net/blog/mobile-desktop-internet-usage-statistics , accessed on 15 May 2021)
[2] Mobile Device (https://en.wikipedia.org/wiki/Mobile_device , accessed 15 May 2021)
[3] Covid-19 pandemic has increased speed of tech deployments across the NHS (https://www.computerweekly.com/news/252492035/Covid-19-pandemic-has-increased-speed-of-tech-deployments-across-the-NHS, accessed 19 October 2020)
[4] Medical applications for pharmacists using mobile devices. Aungst TD Ann Pharmacother. 2013 Jul-Aug; 47(7-8):1088-95
[5] A systematic review of healthcare applications for smartphones.Mosa AS, Yoo I, Sheets LBMC Med Inform Decis Mak. 2012 Jul 10; 12():67
[6] Malasinghe, Lakmini & Ramzan, Naeem & Dahal, Keshav. (2019). Remote patient monitoring: a comprehensive study. Journal of Ambient Intelligence and Humanized Computing. 10. 10.1007/s12652-017-0598-x.
[7] Nguyen HH, Silva JNA (2016) Use of smartphone technology in cardiology. Trends Cardiovasc Med 26(4):376–386.
[8] Glynn LG, Hayes PS, Casey M, Glynn F, Alvarez-Iglesias A, Newell J, et al. Effectiveness of a smartphone application to promote physical activity in primary care: the SMART MOVE randomised controlled trial. Br J Gen Pract. 2014;64(624):e384–91.
[9] Stephens J, Allen J. Mobile phone interventions to increase physical activity and reduce weight: a systematic review. J Cardiovasc Nurs. 2013;28(4):320–9.
[10] Middelweerd A, Mollee JS, van der Wal C, Brug J, Te Velde SJ. Apps to promote physical activity among adults: a review and content analysis. Int J Behav Nutr Phys Act. 2014;11(1):97.
[11] West JH, Hall PC, Hanson CL, Barnes MD, Giraud-Carrier C, Barrett J. There's an app for that: content analysis of paid health and fitness apps. J Med Internet Res. 2012;14(3):e72.
[12] Health Insurance Portability and Accountability Act (https://www.cdc.gov/phlp/publications/topic/hipaa.html , accessed 18 February 2021)
[13] General Data Protection Regulation (https://gdpr-info.eu/, accessed 18 February 2021)
[14] Mary Gowin, Marshall Cheney, Shannon Gwin & Taylor Franklin Wann (2015) Health and Fitness App Use in College Students: A Qualitative Study, American Journal of Health Education, 46:4, 223-230, DOI: 10.1080/19325037.2015.1044140
[15] Percentage of health app users in selected countries as of 2020 (https://www.statista.com/forecasts/1181436/share-of-health-app-users-by-country, accessed 5 May 2021)
[16] Android Native Development Platform (https://developer.android.com/ , accessed on 20 Jan 2021)
[17] iOS Native Development Platform (https://developer.apple.com/ , accessed 29 May 2021)
[18] React Native Development Platform (https://reactnative.dev/ , accessed on 15 January 2021)
[19] Flutter Development Platform (https://flutter.dev/ , accessed on 15 January 2021)
[20] Xamarin Development Platform (https://dotnet.microsoft.com/apps/xamarin , accessed on 15 January 2021).
[21] Ionic Development Platform (https://ionicframework.com/ , accessed on 15 January 2021).
[22] Product Owner (https://www.scrum.org/resources/what-is-a-product-owner, accessed 29 June 2021)
[23] Stakeholder (https://en.wikipedia.org/wiki/Stakeholder_(corporate), accessed 29 June 2021).
[24] OWASP Mobile Security Testing Guide (https://owasp.org/www-project-mobile-security-testing-guide/ , accessed 29 June 2021)
[25] 10 Mobile Commerce Trends That Will Dominate 2021 (https://buildfire.com/category/ecommerce/, accessed 23 February 2021).