A REVIEW ON SOFTWARE ENGINEERING APPROACHES IN HEALTH CARE SECTOR AND CHALLENGES IN MEDICAL MOBILE APPLICATIONS

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ABSTRACT

The healthcare sector usually ensures the availability of cost-effective medicines. Patients self-manage their conditions assisting physicians to take an appropriate decision-making process. The healthcare system attempt physicians to be freed up for other activities. Today Medical Mobile Applications(MMA) captures and stores clinical images in health records enabling clinicians to monitor the progress of the disease. This paper discusses various surveys related to software engineering practices in the health sector and reviews related to MMAs.

Keywords: Software Engineering, Health Information Systems, Medical Mobile Applications.

I. INTRODUCTION

Medical Mobile Applications (MMA) promotes a healthy lifestyle. They are software applications that run on mobile devices. The major objective is to monitor health behavior and perform decision-making. MMA support patients to improve healthcare outcomes and help them in self-managing health conditions. These are used both by patients and healthcare practitioners (Davies & Mueller (2020)). As they are cost-effective including healthcare services, surveillance, education, etc. Here information and communication play a major role in technology facilitating healthcare (Magrabi et al. (2019)).

Internet is used as a common tool for communication, usually, medical information is searched in it. MMA's potentially educate people on their chronic diseases and help them to manage them. The authors Ayyaswami et al. (2019) took the medical conditions of Artial fibrillation and worked on the challenge of patients understandability. They assessed the readability and quality of MMA by supporting Artial fibrillation to improve patient's self-care. The apps were selected based on smartphone distribution metrics. A total of hundred apps were identified related to Artial fibrillation. However the majority of the app lack validation of regulatory agencies for ensuring its quality.

Financial pressures and commitment to health increase (Paschou & Sakkopoulos (2019)). The Healthcare crisis has created technological innovations where people streamline and manage their health (Davies & Mueller (2020)). Digital health technologies solve these constraints and improve the services provided by healthcare practitioners. The usage of mobile technology is increasing across the world and globally there are three billion smartphone users. Moreover, around 90% of the population are connected to the Internet. This widespread smartphone and the internet have created health apps that are scalable and cost-effective (Davies & Mueller...
It has also been estimated that the healthcare workforce will get affected by above 80% by the MMA’s. MMA’s improve clinical outcomes.

Jimenez et al. (2020) dealt with the Cyber-Physical Systems and Digital Twins which are utilized in the healthcare sector to enhance patient care services and capabilities. The author critically analyzed the challenges of the above-mentioned system based on their performance and security. In cyberspace, the devices, data, and people are interconnected. Medical cyber-physical systems are related to medical devices. The cyberspace interconnection is done using different frameworks and network protocols. However, challenges exist in terms of security, privacy, and performance. The major targets in a healthcare system include patient, data, device, or healthcare institution. And the challenges involved in the system are heterogeneity, usability, and safety solutions. Thus the author analyzed the challenge perspective of the system that supports the capability of the healthcare services. Though digital twin is not yet implemented in the healthcare sector many researchers undergo in this field. Healthcare operations in a country is a major part that can lead to life/death decision and the system should ensure the security of patient data.

II. SOFTWARE ENGINEERING PRACTICES IN HEALTHCARE

Pikkarainen et al. (2018) provided new knowledge on health data used to shape healthcare service delivery. The author focused on the impact of digital data affecting healthcare practices. The research question analyses the smart city case study in Finland. The researcher investigated the phenomenal concepts and their relationships on multiple data sources. the analysis of social practice thereby includes the key elements such as i) process, ii) agent, iii) things iv) discourse. The cases considered for investigation include diabetes and obstructive pulmonary disease. The collected data was transformed from end-user using a cloud service. The challenges faced are the receiving of several health requests and solving them with available resources. However, the issue was addressed from the perspective of the network and not on the customer.

Kadhum & Hasan (2017) conducted a study to determine the key factors associated with cloud computing services in an Iraqi healthcare system. The study investigated the real-life context of the hospitals in Baghdad. This is because these hospitals had high-end infrastructure facilities and practitioners were familiar with its usage. The interview study consists of fourteen questions discussing the subject. The results showed that current technology posed a negative perception concerning the timely maintenance of health records. And the health information system does not ensure privacy concerns and deals only with basic authentication. The majority of interviewees stated dissatisfaction with the usage of the health information system. Further lack of technology training is also another factor the less use of the health information system. Thus the study described the key factors such as cost, effectiveness, hardware/software modularity, network, and training. However, the result presented was only a preliminary study.

Akdur et al. (2018) conducted an online survey to investigate to what degree the embedded software projects are used. The survey included the opinion of software engineers from 27 countries. The survey revealed on i) various modeling approaches utilized in the embedded software industry, ii) the adapted usage of modeling is usually informal, iii) unified modeling language is the preferred stakeholder model, iv) the top priority functions cost, less development time, reusability and quality.

Amershi et al. (2019) the authors focused on the software engineering aspects based on machine learning. The objective of the study was to enable the software organization to build artificial intelligence-based applications. The survey addressed the software engineering practices of Microsoft teams. The aspects include i) data management, discovery, and versioning for a complex machine learning approach, ii) customization and reuse of software skills among the software team, iii) handling of traditional software components. The results were addressed based on the considered aspects. Initially for data training and tuning the engineer needs to collect, clean, and process the data. when data from large diagnostic feeds are collected, the machine learning engineer has to wait, update, deploy, and propagate before the arrival of the next data. small changes cause significant impacts affecting the performance of the application.

Next, customized machine learning models begin from function, libraries, algorithms, and modules. The source code obtained from a library has to be changed by the engineer to develop a new source code. Hence a software engineer must acquire machine learning skill and has to expertise themselves in the field. These are the practices followed by the Microsoft team.

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Garousi et al. (2016) focused on an exploratory study to analyze the cross factor in software engineering practices. The objective was to identify patterns and pinpoints in the demographic context. The motive was to benefit both the software engineering professionals and researchers to understand trends in the software engineering industry. The survey was conducted in terms of software used for mission-critical, business applications, and web-based software. Cross factor analysis involves factors such as a change in magnitude, size, severity, and people. The type of research approach utilized was Goal, Question, Metric. The findings reveal that most of the small companies prefer the agile model compared to the traditional waterfall model. However, software engineer face challenges in the design phase where it needs a complete understanding of the requirements. Further, the author stated that there is a need to compare the newest trends in software engineering tools and practices.

Natsiavas et al. (2018) presented the KONFIDO's user requirements engineering phase to provide useful insights for the technical design and developing a secured and interoperable IT solution. The framework focused on four pillars i) gap analysis study – the study used to identify the qualitative or quantitative difference between the current and target subject. The gap analysis was done using the desk research where the material regarding the subject was analyzed. ii) Defining user scenario – this focuses on the health data exchange policy. iii) Elicitation of user requirements, iv) Validation of stakeholders feedback. The study focused on the comprehensive requirement set facilitating the software engineering framework.

Pantelic et al. (2018) improved the Simulink software from the perspective of the SE to develop an automated tool. The four types of tools considered include i) Signature tool, ii) Reach/Coreach Tool, iii) Data Store Rescope tool and iv) Auto layout tool. Initially, the first tool extracts the subsystem interface to understand the implicit data flow. The second tool improves modularity compared to traditional languages. The third tool deals with the control and data dependency. Finally, the fourth tool presents the graphical layout to improve the readability. Thus most of the software development deals with automation it is necessary to upgrade the tools in traditional software.

Parkhi (2019) focused on the lean approach in the healthcare sector. Lean identifies and eliminates healthcare waste within the organization. The scope of the lean range from narrow to large waste elimination. The authors surveyed the various software engineering models and derived evidence that the agile model is best suited for smart healthcare. Yaeger et al. (2019) defined the various health-related software applications in the context of improving the regulatory approval process. However, the authors claimed that a healthcare practitioner must understand the various levels of risk in a software application used for medical service.

### III. MOBILE MEDICAL APPLICATIONS AND CHALLENGES

Today healthcare is on one's hand. There are a near about two hundred MMA launched per day. MMA is developed for a specific health disorder and it is easy to manage one's medication stated by Tabi et al. (2019). Thus MMA is designed to meet a specific audience following an agile development process. However to design a mobile application for asthma and allergy requires a team of experienced software developers, a complex and expensive adventure. MMA development involves a combination of arts and science. From the survey, it has been accessed that the public is interested to use MMA for education, telemedicine, and to alert themselves when their disease is not in control. Caregivers prefer a patient-centered medical home. Thus the result presented indicates that asthma- the based app was reliable, easy to use, etc. however its integration was not easy and had an overall score of five out of ten.

Moshi et al. (2020) focused on the MMA assessment for the regulatory purpose. MMA is used for diagnostic and therapeutic purposes and is now recommended by clinicians globally. To ensure the quality assessment on this technology and perform reimbursement in the decision-making process. There exist various risks in MMA especially in medical services. The evaluation of MMA is done rarely. Thus the author developed evaluation criteria for MMA assessment. The results were synthesized by the conduct of interviews among the various stakeholders. Most of the stakeholders reported on the trustworthiness of the MMA. Also, they noted that the professional use of the technology shall lead to malpractice if the app cannot deal with insurance schemes. However, the authors pointed out that there is a need for further research in the assessment of MMA and its adoption in health technology globally.
Apidi et al. (2017) evaluated the common features of MMA and the benefits related to the drug information was also included in the study. The major focus was on drug dosage recommendation, its adverse reaction, and interactions. The initial survey was conducted among pharmacists in Malaysia related to the drug information. Then the commercial MMA from online app stores were reviewed[21][22][23]. The MMA Blue Book was the only app that had the checking features without any interaction. Comparing the feature assessment Lexicomp, Micromedex, Drugs.com had the highest score.

Treatment of mental health conditions is long-existing in society. Though few MMA's are available they do not lay on the regulatory constraints. McNiel & Binder (2018) reviewed the regulatory guidelines available for psychiatric MMA. The survey results in evidence of the bad outcome of mental health apps. Hence the authors pointed out that growing MMA development has to focus on the development of MMA related to psychiatric care.

Shi et al. (2016) proposed a Social Medical Application to bridge the gap between general health and mobile health. This narrows down the patient-doctor relationship. The experiments were evaluated using the Peter Morville approach and validated the proposed model. Most of the MMA is used to obtain information, guidance, and communication purpose. However, the proposed model simplifies medical service and business logic. But the design proposed was only at the primary level and does not deal with complex medical institutions as they have policy-level issues. Further, the design is limited for its expansion where there exists a lack of resources and technical complexities. Patients take medication based on the healthcare provider's recommendation. And it is influenced by multiple factors such as need, effectiveness, safety, etc. the strategy to prevent adherence depends on behavioral methods.

Hao & Xu (2018) evaluated the MMA’s effect on those utilized for monitoring blood glucose control. Type 2 diabetes is seen in young patients and monitoring of this reduces diabetic complications. For this, the patient has to be systematically reviewed for a long-term. MMA with such functionality can support patients to self manage their disease. The developed app had versions for patients and doctors. The version of the patient could promote health information, record data, dosage, and communication. Whereas the doctor version checks and records the glucose levels, etc. though the app was feasible to youngsters there existed compliance issues in blood glucose control, performance efficiency, etc.

Kao & Liebovitz (2017) focused on the consumer-facing application, their current state, and barriers. The MMA's are categorized into two types based on their top utilizations. These are wellness and disease management. Whereas others belong to the category of self-diagnosis, dosage reminder, etc. in the current state the consumers take an active role in the personal health. However, it is pointed out that developers should focus on security concerns.

Li (2020) investigated the behavior and usage of MMA from the perspective of Chinese users. The research attempted to analyze the various mHealth applications and how Chinese users seek medical care. The result reveals the anxiety and trust among the users regarding the personal privacy and usefulness of the application. The authors assessed patient engagement and utilization for the Rheumatic Arthritis (RA) MMA. The research revealed that users do not have a major experience in MMA in concern to RA. Hence it is necessary to develop the MMA for the same and must be rigorously tested. However, the authors point that MMA incorporation in healthcare is highly essential can be taken into consideration.

IV. CONCLUSION

In this paper, a detailed literature survey has been done that reviewed various software engineering approaches related to the healthcare sector and various challenges in medical mobile applications. Though there exist several apps in the healthcare sector there still exist challenges related to the quality, privacy, security, and regulation issues.

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