AN ATTENTION TOWARDS SOFTWARE ENGINEERING PRACTICES ON MEDICAL MOBILE APPLICATIONS

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Abstract
Innovations in software technologies are widely adopted in improving health and healthcare delivery. Software engineering functions that meet the device definitions are deployed as mobile applications. Medical Mobile Applications (MMA) manages healthy living when needed. Industry experts have estimated the use of MMA of around 3, 25,000 on smartphones in the year 2017. Present world scenario the development of MMA reduces the safety risk of healthcare professionals. At the same time, when focussed on the patient side the MMA has to perform the intended functionalities showing its effectiveness on patient's health monitoring and treatment satisfaction. In this paper, the proposed module analyzes and determines how software engineering tasks influence and affect the MMA development process.
Keywords: Health monitoring, digital data, medical mobile applications, medical treatment.

Introduction

During the year 2019, the rise of the Covid pandemic has increased the usage of MMA which not only involves applications for medical treatments, stress overcome, psychiatric counseling, etc. The Government has put its part on and updated the MMA policy guidance based on the software device functions. MMA is the software engineered programs run on mobile devices. Common MMA to manage health are calorie monitoring, weight monitoring, etc. Similarly, today MMA provides diagnosis guidance and treatment advice. For instance, Radiation Emergency Medical Management (REMM) app is utilized to diagnose and treat radiation injuries. MMA is available for complicated health issues such as cancer, cardiac arrest, diabetic status monitoring, etc. The software-defined functionalities:

- Support users to self manage their health conditions.
- Enable medical practitioners to provide timely advice on self-treatment measures.
- Automate the health-care provider's various tasks.

Public health issues such as obesity, overweight, etc. Are common problems among adults in countries like the U.S. intensive exercise, energy intake, etc. Have failed due to the pandemic. Development of smartphones and various other software engineered applications offer a promising solution in delivering interventions. Thus MMA with the internet-based user approach provides high utility with favorable costs.

Most of the smartphone customer uses mobile phones for knowing health-related information especially, on diet target, weight management, etc. Thus software engineered activities have influenced in maintaining healthy lifestyle habits (Azar et al. (2013)). However, major researchers in this field focus on traditional theoretical strategies to know how app developers focus on user interface and user engagement. Traditional theories are insufficient while dealing with the influence of software engineered methodologies on MMA development and the challenges the app developer faces. Thus it is necessary to study the theoretical constructs on modern health behavior about MMA in this global pandemic scenario (Azar et al. (2013)).

People nowadays have integrated smart devices into their daily routine. Phone with internet connection called smartphones. Smart devices integrated with software programs are the applications disseminated for the medical purpose. The software engineered smartphones with medical apps support communication between patients and healthcare practitioners. The medical industry has recently incorporated technical changes to support healthcare practitioners concerning diagnosis, treatment, sharing of health records, laboratory test results, etc (Yaman et al. (2016)). Thus MMA supports both clinical practice and public health. MMA's can be executed on the mobile platform that runs on a server. Penetration of mobile applications grows world-wide and it has decreased healthcare costs with high efficiency. MMA based education and awareness have to be provided to promote preventive medicines and quality treatments. The attractive feature of these MMA is the real-time data surveillance enabling timely reporting of disease outbreaks during pandemic disasters, accidents, etc. Also, the misuse of the software engineering principles leads to erroneous diagnoses causing public risk (Yetisen et al. (2014)).

The rest of the section in this paper is organized as follows: Section 2 discusses the literature survey and section 3 discusses the methodology adopted for the study. Section 4 discusses the findings. Followed by that, the conclusion of the paper is given in Section 5.

LITERATURE SURVEY

The healthcare sector usually ensures the availability of cost-effective medicines. The authors **Bvuchete et al. (2020)** focused on the healthcare supply chain experience in South Africa where the community experiences challenges in the distribution of medicine at the right time and cost. **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. 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. New ways of healthcare delivery and services are emerging in software companies. The authors Carroll & Richardson (2016) proposed a Design Thinking Principle that supports the software developers to identify the healthcare requirements, enriching the traditional software requirement gathering mechanism. The authors Alhashmi et al. (2019) presented an AI-based model to assist the health sector of the Dubai Government. The service was to monitor the patients by adapting Artificial Intelligence and providing medical services.

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. 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.

Today healthcare is on one's hand. There are a near about two hundred MMA launched per day. 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.

METHODOLOGY

To study the MMA developer's software engineering practice different levels of the survey have been conducted as shown in Figure 1.
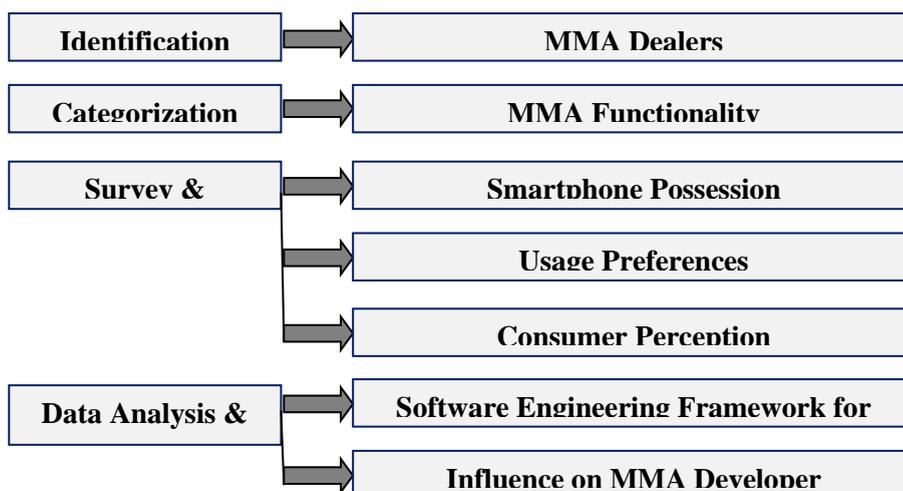
Figure 1: Framework - MMA Study Design

The major part of the study involves the MMA developers software engineering practice for which there is a need to perform survey analysis and understand the various research questions such as,

RQ1: Who are the major stakeholders dealing with the MMA right from development to usage?

RQ2: What are the various types of functionalities involved in the software engineering process of MMA?

RQ3: What percentage of the social community possesses smartphones and makes it their routine on MMA usage?

RQ4: What is the perception of the consumer in concern to the MMA?

The research questions were framed and disseminated among a wider range of communities who are directly and indirectly involved in the MMA development process.The initial survey analyses the contemporary phenomenon of the MMA development process. However, overall it represents the MMA aspects affecting the MMA developer activities. Most of the software engineering promises undergo thematic study as it provides an easy understanding of the theoretical context. The various stages of the software engineering life cycle process involved in the MMA development process are described in detail.

The survey was conducted with the major stakeholders who are called the MMA dealers. The questionnaire was designed and disseminated among the social community. To a larger consent, the questionnaire validated the theoretical findings. The questions were framed providing valuable concern over the software engineering practice and were systematically investigated.

Study Design

The stages involved in the study of each research question depicted in Figure 2.
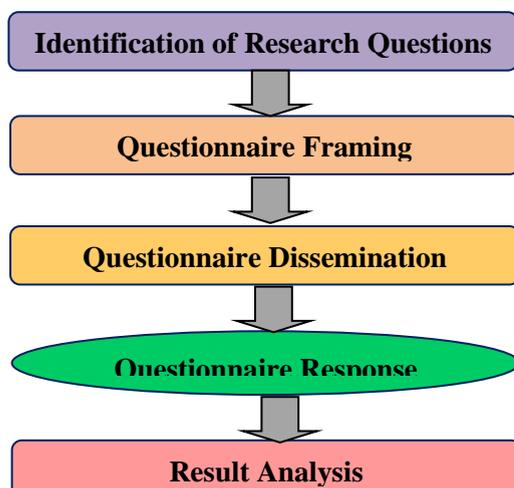
Figure 2: Various steps involved in the study [AlSubaihin et al. (2019)]

Research Questions

The primary objective of the study answers the below-mentioned research questions considering the influence of software engineering practice in the MMA development process. The effect on the evolution of MMA has inspired the first research question:

RQ1: Who are the major stakeholders dealing with the MMA right from development to usage?

The four major dealers of the MMA are the Researchers, MMA Developers, Consumers, and Healthcare Practitioners. Researchers work on the implications of MMA providing a rational plan for MMA development in the real-world scenario. Many research laboratories have specializations in MMA development and have commercialized them in Smartphone platform for applications such as public health monitoring, telemedicine, etc. Thus the researcher plays a vital role in the MMA development and assessment process (Yetisen et al. (2014)). Second is the MMA developer, they are the stock house of innovations with no imagination restriction. They craft ideas that are incorporated into the MMA development process. It is the developer's perspective that changes in innovation kill the barriers in bringing the MMA to the market with certification. Certified MMA hubs were established to provide services beyond traditional medical limitations. These communities lower the healthcare cost with fresh ideas and ensure consumer safety with the highest priority (Yetisen et al. (2014)).

The major concern on MMA was expressed on their safety risks. Healthcare practitioners lack involvement during the validation process. Thus it has been a practice that healthcare practitioners are one of the testing phase members evaluating the operation and security issues of MMA abiding by the healthcare standards.

RQ2: What are the various types of functionalities involved in the software engineering process of MMA?

Table 1: Various MMA Functionality

MMA Type	Functionality	Example	Identifications
T1	MMA to display, store, analyze, and transform health data	X-rays, bedside EEG monitor, MRI, etc	Screen resolution must be good
T2	MMA transforming mobile platform to a healthcare device	Smartwatches, Glucometers, Spirometers, etc	Should provide extremely accurate readings
T3	MMA Website/app to diagnose and recommend treatment based on the input provided	Dosage calculator, disease diagnosis, etc	Availability of the prescribed drug
T4	General healthcare MMA	Thermometer, Heart rate monitor, Fat calculators, etc	Satisfies general healthcare benefits

RQ3: What percentage of the social community possesses smartphones and makes it their routine on MMA usage?

The RQ3 analyzed the percentage of the community possessing smartphone and has made it routine. Varied type of participants was asked the questions for the study of RQ3. The verbal consent of the participants is depicted in the findings. The participants include a diverse type of smartphone dealers as categorized in RQ1. The survey included questions of various types to understand the usage of smartphone in terms of i)Phone calls, ii)Whatsapp, iii)MMA, iv) Internet Access, v) Games, and vi) others. The questions were framed in such a way to understand the motive for the possession of smartphones and the knowledge on the availability of varied applications in it. **RQ4: What is the perception of the consumer in concern to the MMA?**

This research question indicates the consumer's perception and experience on the usage of MMA. The participants considered were the cases who utilize MMA as a daily practice. The survey was conducted to answer the questions in the three range scale such as i) agree, ii) undecided, iii) disagree.

The research question mainly focussed on the personal consideration of the MMA. The answer focussed on the user experience when the MMA application was used (Yaman et al. (2016)). A few of the items included were ability to find the appropriate MMA, ease use of MMA application, MMA security, MMA affordability and acceptability, Handling technical issues and User satisfaction level.

4 FINDINGS AND DISCUSSIONS

This section describes the findings of the research study that make several contributions and evidence on how the developer's influenced by the MMA development process, the varied type of community who are involved in the MMA development, and the various software engineering practices that are directly connected to the MMA development process. The developer's ability not only ends up with the competitor whereas it involves the constitution of the market witnessing the qualified product compared to the traditional software.

RQ1: Who are the major stakeholders dealing with the MMA right from development to usage?

When questioned on who are the major stakeholders with the MMA development, it has been identified that researchers, MMA developers, consumers, and healthcare providers are the major stakeholders of the MMA. Although, MMA initially assisted the healthcare providers for data management followed by prescription and healthcare delivery. The major development emphasis focuses on the MMA developer. As it is the developer's fresh ideas leading to quality healthcare at a lower cost ensuring patient safety. However, the researcher has to establish a strong collaboration with the remaining stakeholders for future development. The role of MMA developer gets constantly evolved. Thus from the survey, it concludes that the primary stakeholders influenced by the MMA are the MMA developer as their continuous innovation shall shape the future healthcare industry without uncertainty.

RQ2: What are the various types of functionalities involved in the software engineering process of MMA?

Figure 3 depicts the various levels of MMA risk factors. From studies, it has been analyzed that MMA type of T1 has high risk when screen resolutions are low leading to negative clinical decisions. On type T2 if the product doesn't belong to the regulatory regime false readings affect clinical decisions. Type T3 has a medium risk as the availability of drugs directly depends on the geographic location. Finally, T4 has the lowest risk factor where it deals with temporary healthcare benefits to maintain a healthy lifestyle.
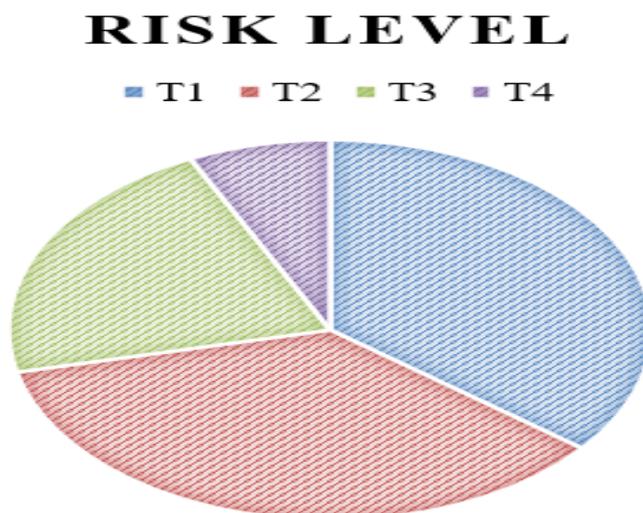

Figure 3: MMA- Risk levels

RQ3: What percentage of the social community possesses smartphones and makes it their routine on MMA usage?

The study identified that the major reason for the usage of the smartphone was for phone calls (97%) and Whatsapp applications (89.9%). The factor considering the MMA was also equally given importance for about 78%. The majority of the community utilized smartphones for internet access (98%). Whereas for gaming and another purpose the usage was too low. The participants of gaming were in the age range of 0-12 years. The utilization of smartphones is portrayed in Figure 4. Thus it is shown that the MMA participants used the application at least once in a day for their medical problems and this has been raised high due to the pandemic situation. Thus it is understood that MMA has provided

potential benefits to manage the COVID-19 situation. The government of India and State Governments have introduced MMA's to inform on future public health initiatives. Software engineering innovations are now improving the efficacy of the health system and raising public awareness on the usage of the technology.
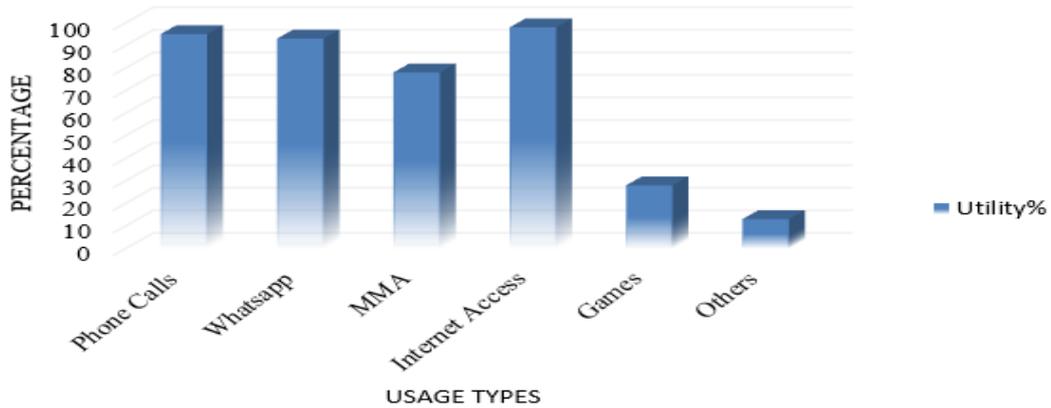

Figure 4: Smartphone utilization in the software engineering perspective

RQ4: What is the perception of the consumer in concern to the MMA?

The participants answer to the questions is visualized in Figure 5. The user's ability to find an appropriate MMA was acceptable as 43% agreed, 22% undecided and 35% disagreed. The ease of usage of MMA was acceptable as around 48% agreed. Whereas 25% undecided and 27% disagreed. The security of MMA was not acceptable as only 38% of the community agreed. Many privacy experts have raised concern on this as the majority of the community is reliant on the MMA (Bassi et al. (2020)). The question of affordability and acceptability was greatly agreed upon as most of the MMA are downloaded and upgraded for free of cost. The technical issues related to MMA were not acceptable as 35% only agreed. This is due to the consumer's lack of knowledge of the technical apps. Mostly consumers of age around 40 years and above. The role of MMA developers has greater concern here during the implementation stage as it must be ensured that users face zero technical issues. Preference for auto updation has to be given the primary concern. However, the final perspective on the satisfaction of MMA was acceptable as around 47% of the participants agreed.
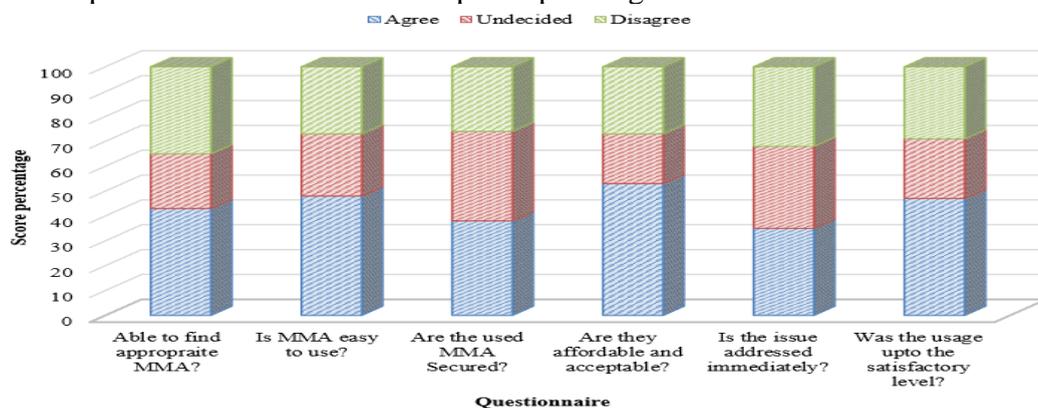

Figure 5: User's experience in MMA usage

The gap between the MMA developer and the user is bridged by the app stores. Some of the developers seem to be very much aware of this and this was reflected in the respondent's answer. Also, 47% of respondents suggested the user review mainly focused on the feature enhancement. However, research lack in identifying fraudulent reviews. The participants included in the survey were the different types of smartphone dealers. Most of them were middle-aged and married, having working experience of more than two years, and used Android-based smartphones. The community believed that the devices played a major role in their daily lives. Smartphones were used for MMA apart from regular phone calls, internet access, and Whatsapp. From the survey, it is understood that most of the participants were concerned about security, quality, support, and easy usage. Based on the authors Yaman et al. (2016)

around 85% of the healthcare practitioners have started practicing the usage of smartphones for various medical-related applications.

CONCLUSION

The study reveals that software engineering practices had a major role in people's daily lives. From RQ5 the software engineering framework and utilized for the MMA development process is understood. And the process of having a reduced V model in combination with agile practices fulfills the objective of the MMA development process. Further, the MMA developers focus on the new skill sets facilitating the user expectations in the competitive environment supporting a better brand for the app is also deduced. This paper investigated various software engineering aspects of MMA revealing the importance of the app developer, user's feedback, etc. The survey found that developers refer to similar apps while designing their own. The results reveal that for maintenance and evolution it is necessary to monitor the user reviews and ratings highlighting the app improvement.

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