A Performance Evaluation Model for Mobile Applications

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***Abstract*— The advancement of use of quality product has been considered as an imperative part of software development. With the expanded interest of Mobile applications clients, the quality of the Mobile applications turns into a noteworthy concern. The number of studies has been done for the assessment of the performance of different types of Mobile applications. There is a need for a model that can be used in a generic way. The proposed model is a generic model for performance evaluation of Mobile applications that can be of any type or from any domain. The research, examines the key performance criteria's that are essential for a Mobile application success and evaluate performance using a model applying the SWARA approach.**

Keywords*— *Mobile Application, Multi-criteria decision making approach (MCDM), Performance Evaluation, Step-wise weight assessment ratio analysis (SWARA), Software Maintainability

I. INTRODUCTION

These days, Mobile application improvement for cell phones has advanced immensely because of pervasiveness and notoriety among end clients. This fast intrigue has drawn Mobile application engineers' consideration throughout the last few years [1, 2]. As of now, a large number of Mobile applications are downloaded and utilized over the globe. There are various Mobile applications stores (e.g. Google Play Store, the Apple Application Store, the Windows Phone Store, and so on.) which offer free and paid both kinds of Mobile applications to clients [3] [22]. The increase in advanced mobile phones causes' Mobile applications number to grow significantly.

Nowadays, Mobile applications are utilized in different fields for distinctive kinds of services. An application can be utilized inside or remotely relying on its functionality. For instance mobile browsing, mobile payment modes, instant messaging, using internet, location based services and so forth [4] [12]. For this sort of services and functionalities it must have a defined platform to run and the user requirements. This decides the general quality of the Mobile application [24] [25]. With this high client requests, quality of Mobile applications is turning into a noteworthy issue. Engineers need to develop a good quality software application to satisfy client requirements [5] [7].

Quality is imperative from both the points of view development and deployment of an application to clients. The word quality has different implications [6] [23]. The meaning relies upon how somebody sees it and might be seen diversely by various individuals. In general sense, the quality estimates how well the product is structured, how well it is working without issues and adjusting to the defined structure. As indicated by IEEE, quality of a software is "the degree to which a system, component or process meets specified requirements". Developing good quality software product needs a well focused process. The quality of a Mobile application is essentially imperative. It is normally investigated by client's survey and evaluations and furthermore relies upon market policies [8]. Sufficient number of versatile Mobile applications is accessible, contending high in application store. It is easy to locate an option of an application giving great quality from rating viewpoint.

The quality of any application can be controlled by estimating the performance regarding the different performance criteria. The performance of an application can be estimated by utilizing different criteria's for example, application speed, application latency, and network errors and so on. A portion of the execution influencing perspectives can be resolved and tried before the launch of the application and can expand the application use, quality and viability of an application. In the existing literature various tools and framework has been proposed to evaluate the performance of an application but for a specific domain or application. In the present research work, a model is proposed to evaluate performance which can be used for any type of mobile application. It's a generic model for evaluating performance of a Mobile application.

II. RELATED WORK

A literature survey is done to analyze the different performance evaluation methods taken up earlier by various researchers. Numerous versatile application testing tools and techniques are accessible to test in various systems, for example, Trace view android application framework is utilized to check the general program and thread execution time to assess the performance from log trace [9]. Appthwack is another framework that measures resource utilization to evaluate the performance of an application [10].

UI automator is a testing structure used to test Mobile application dependent on the application UI usefulness which estimates performance of application functionality [11]. Based on the response time a testing framework named as "Test My App" was proposed to evaluate the performance of online Mobile applications [21]. A performance monitoring tool [13] was developed that

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measures the critical aspects and the operational aspects a Mobile application such as network traffic, CPU usage etc and the results were verified with five different application.

There are various heuristic strategies for estimation of different components. Diverse researchers have quite recently outfitted gainful results with these heuristic procedures yet at the same time there is a possibility of enhancement as the models proposed are not generic. There is a need for a generic model for evaluating performance of any type of Mobile application. In this paper a multi-criteria decision making approach (MCDM) named Step-wise weight assessment ratio analysis (SWARA) approach is utilized to decide the weight values of chosen performance criteria. Based on the literature review five criteria has been identified that plays a vital role while evaluating performance of any Mobile application.

III. PROPOSED MODEL

The proposed model uses a multi-criteria decision making approach (MCDM) for assessing the performance of any type of Mobile application. Different methods are there for the assessment of weights, for example, AHP, ANP, and FARE and so forth among these methodologies one of the productive methodology is Step-wise weight assessment ratio analysis (SWARA). It's another methodology presented in 2010 [14]. It is not quite the same as different strategies that ascertain weights in a way as it enables expert's to cooperate for giving a decision on a specific issue as per the present circumstances.

The methodology is appropriate for the issues that are solved by expert opinions. As the work talks about performance evaluation, the developers are the one who are the experts in developing a Mobile application and can evaluate the application much better as compare to others. The experts ought to be from the related domain, known to the specific issue beforehand [15] [16] [17]. The well ordered method to apply SWARA approach is depicted in Figure 1 as [15] [16] [18]:

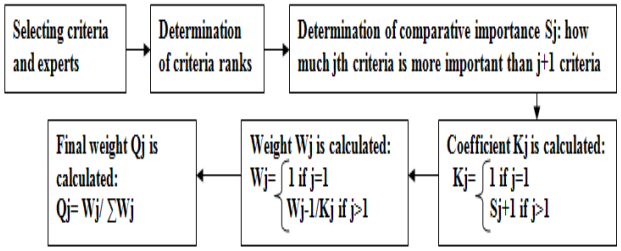

Figure 1: SWARA Approach

Due the advantages of SWARA approach, it was recently connected in different domains, for example, selection of flood related criteria [19], selection of architects [18] and selection of product producing criteria [20] and many more.

The proposed model incorporates five key performance criteria of Mobile application according to the experts in the same domain and the SWARA approach is applied to calculate the weight values of each criteria. As described in Figure 1, in the SWARA approach firstly criteria and the experts are chosen then the ranks are provided by the experts individually. After that the average ranks are calculated and the criteria's' are arranged accordingly. The five key performance criteria taken for this are:

1. Mobile application speed (MAS): this refers to the speed at which the application runs i.e. how fast the application runs.
2. Mobile application latency (MAL): this refers to the interval of time between the application API proxies gets called till their first response.
3. Mobile application crash rates (MAC): this refers to the rate at which the mobile application gets crashed after installation.
4. Mobile application load per period (MALP): this refers to the total time the mobile application takes starting from its first step till it gets into the use.
5. Mobile application network errors (MANE): this refers to the HTTP errors when trying to connect to a network.

In the next step, comparative importance of each criteria with its below criteria is determined again by the experts only denoted by Sj. Then Kj, Wj and at last Qj is calculated to determine the final weight values. The final results are shown in the below given Figure 2:

Key Performance Criteria	Sj	Kj	Wj	Qj
C1: MAS		1	1	0.253
C2: MAL	0.044	1.044	0.958	0.244
C3: MALP	0.115	1.115	0.859	0.219
C4: MAC	0.452	1.452	0.592	0.151
C5: MANE	0.135	1.135	0.521	0.133
				∑Qj = 1

Figure 2: Weight values of Key performance criteria's

The result shows that the key performance criteria Mobile application speed plays a vital role for the evaluation of performance of any Mobile application. Similarly, according to the weight values Mobile application latency has the second largest weight values then the Mobile application load per period, Mobile application crash rate and at last its Mobile application network error. Each and every criterion is having some weight value, so one cannot neglect their importance. Each one of them must be considered while evaluating performance of a Mobile application. The model proposed allows evaluating the performance providing the values of above defined five key performance criteria's.

IV. CONCLUSION

Quality of Mobile application is being an essential concern nowadays. It has been seen that developers are just not concern about the quality rather they are concerned about the quick launch of the application. With the ample number of Mobile applications available

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on the play store, it's important to evaluate the quality parameters and find out the Mobile application having good quality. Quality consists of various different parameters. One of the essential parameter is performance of any type of Mobile application. The present research work focuses on the evaluation of the performance of a Mobile application. For this, a performance evaluation model is proposed that allows determining the performance values of a Mobile application. In total five criteria's are taken and weight values for each criteria is determined using a MCDM technique SWARA. The results shows the weight values for the selected criteria which further can be used to evaluating performance of a Mobile application. Further, number of criteria can be increased so as to evaluate more accurate performance of a Mobile application or in accordance with the application for which the model is used.

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