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Research paper

Engagement Elements for Mobile Augmented Reality Application

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Abstract

Mobile Augmented Reality is a form of Augmented Reality which allows users to interact with the augmented environment in a social context. However, the degree of engagement and non-distraction of Mobile Augmented Reality has been of major concern to scholars. This is because Mobile Augmented Reality should be a focused, movable and engaged augmented environment which can allow users to achieve the desired objectives. Thus, this paper explores Mobile Augmented Reality engagement elements that promote social acceptance among users. These elements will enable Mobile Augmented Reality designers to design apps that will be able to raise clients' engaging quality and enthusiasm for a satisfying way. The finding of this paper contends that there are 22 noteworthy components of commitment required for the structure of a drew in clients' Mobile Augmented Reality application. These 22 elements include Aesthetics, Novelty, Usability, Feedback, Motivation, Attention, Perceived Control, Curiosity, Enjoyment, Self-efficacy, Friendliness, Social skill, Endurability, Interest, Immersion, Challenge, Satisfaction, User, Autonomy, Improvement, Supportive, Trust and Interaction. This paper contends that for a productive and drew in Mobile Augmented Reality application, these 22 components are basic. It is vital for planners to consider these components in their structure so as to guarantee that their application clients are emphatically locked in. In like manner, these components guarantee that Mobile Augmented Reality application rises above past the utilization of writings and recordings shows.

Index Terms— Engagement element, mobile augmented reality, engaged user, engagement mobile app

1. Introduction

Augmented Reality (AR) includes the presentation of virtual articles into the genuine condition so as to acquire an enlarged domain. This expanded condition is the immediate superimposition of physical articles and PC duplicated objects. The learning of AR is affecting human-PC connection significantly with the present multiplication of Mobile Augmented Reality (MAR) applications and the arrangement of social help inside numerous areas going from medicinal services to the travel industry. The advantages of MAR applications incorporate portability, handle, wearability, condition mindfulness, multi-modular, adaptable use, visual alarms and updates which advance positive social communication. Regardless of the actualities that MAR applications have tremendous advantages to people both socially and modernly, there are as yet couple of specialized confinements of these applications, for example, open air and versatility use, profundity discernment, following and alignment, client experience, over-burden, and over-dependence [1]. Out of these confinements, numerous examinations have concentrated on the specialized issues of MAR while there is constrained investigation in the literature that explores MAR users' engagement. Hence, this paper explores MAR engagement elements that promote MAR social acceptance among users.

2. Review of literature

The applications of AR are enormous within the vast literature. For instance, AR has been used to provide solutions to the development of industrial prototypes. This is done to reduce the high cost of producing the real industrial prototypes and also preventing human from being exposed to the harmful situation during the prototypes testing stage. AR prototype saves companies considerable amounts of time and money as prototypes would be able to be changed quicker and created at a lower cost since they would no longer involve materials. Likewise, AR has been used in various domains like Archaeology, Gaming, and others. For instance, AR has been used to visualize archaeological landscapes and notation as presented in studies like [2], [3], [4] and [5]. It has also revolutionized the manner in which the architectural practices are implemented as discussed in [6] and [7]. Also, AR app is vital for product previews through the integration of print and video marketing in the commerce domain [8] and [9].
Nevertheless, it has been discovered that AR is majorly deployed for the purpose of learning. Learning based AR application covers various apps ranging from game, historical, cultural, museum guidance and sightseeing. In order to ensure that the apps are more interactive, entertaining and educative, MAR apps were developed. Although, the usefulness of MAR is huge however, the issue of users' experience is very imperative for the success of the MAR app [10]. User experience is defined as the engagement of the user

perception and reality with a given app which depends on their assessment of the app quality, service, and usage [11]. It refers to the user deep comprehension and feeling of the app which is rooted in if the app meets their need, value, abilities, and expectation. This is what informs the users' interaction with the app and from their conclusion about the app. User engagement experience demands that the user will be satisfied not only with the app design but also its efficiency. The issue of user engagement is very important for any app since it is also related to the user satisfaction.

According to [12], user satisfaction can be enhanced by the app novelty, users felt involvement and endurability. It is believed that a novel app will attract and satisfy the users because it triggers the users' curiosity for unfamiliar or new experiences with the app. This experience becomes mysterious and conundrum which will increase the learning passion of the users with the app. Users will become more involved if there is an increased the learning passion of the users' with the app. This activation results in the user enjoyment and satisfaction with the app. On the other hand, endurability describes the likelihood of the user to return back to the usage of the app. This determines the user's continuous usage of the app which revolves around the values the users derive from the app. This value is usually based on the users' perception of the app to be rewarding to meet their expectation and determine their future recommendations to other users.

The elements of engagement are widely used in person-centred practice research such as behavioural change intervention and user-centred studies. According to [13], the elements of engagement involve the decision by a user to undertake the tasks (as given by the mobile app) related to his/her interest and competence, practice it continuously by interacting immensely and deeply in order to continue the task with persistence and commitment because of the value attributed to the task. [14] explained engagement in terms of multimedia perspective as a system that enables users' curiosity, attention focus, and intrinsic interest. In addition, [15] pointed out that engagement is the attribute that depict the quality of user's value, experience and continuity with a mobile app. Similarly, many scholars have explained mobile app engagement in terms of users' attitude and behaviour [16], user stickiness [17], long-term retention [18], users' impact [19], and users' measure of comprehension on an app [20]. In summary, it can be concluded that the mobile app engagement is the number of users' counts to interact continuously with an app.

As established previously, engagement involves users' interest and competence. The elements of interest and competence are deeply rooted in the users' feeling and sense-making on the mobile app. According to [21], the elements of users' engagement with the mobile app are more than the user involvement interaction. Users' involvement depicts the interaction that is without feeling or compliance which will not result in engagement. The study by [22] shed light on the issue of mobile app engagement when discussing the three major dimensions of engagement namely; behavioural, emotional and cognitive. Behavioural engagement is when users show optimism, curiosity, passion and attention towards a mobile app which usually increase the motivation to learn. Emotional engagement is when users show affective tendencies such as the sense of belonging and fun with the mobile app. Cognitive engagement is when the users show critical thinking level by challenging themselves in the interaction with the mobile app. In order to fully comprehend the rationale for this issue, there is a need to explore the various elements of engagement in the mobile apps.

3. Methodology

This paper focuses on engagement elements that are needed for the design of a mobile app which will captivate the users' attention and involvement. In order to achieve the study objective, a systematic literature review has been employed based on [23]. The systematic literature review was used to identify the MAR elements which were accessed from the database such as IEEE, SpringerLink, World Scientific and ScienceDirect. The keywords used for this review includes AR, MAR, mobile app, engagement app and engagement. Based on these searches, a total of 116 related studies were selected and critically reviewed where 22 elements were selected based on the expert opinions which made up of academicians within the AR and MAR.

4. Findings and discussion

The discoveries of this examination pinpoint 22 noteworthy components of the MAR required for the plan of a connecting with MAR application. These 22 elements include Aesthetics, Novelty, Usability, Feedback, Motivation, Attention, Perceived Control, Curiosity, Enjoyment, Self-efficacy, Friendliness, Social skill, Endurability, Interest, Immersion, Challenge, Satisfaction, User, Autonomy, Improvement, Supportive, Trust and Interaction.

4.1. Aesthetics

This is the component of blending the idea of excellence, workmanship, and MAR [24]. This component infers that the hypothesis of excellence is brought into the MAR with the goal that portable clients can value the articulation and portrayal of the message that the MAR application is passing on. In a major study by [25], the element of aesthetics is identified as an evaluation and measurement factor for engagement.

4.2. Novelty

This element depicts the usage of MAR to teach and learn new behaviour and knowledge. The element ensures that the conveying message of the MAR is based on the principle of quality, originality and newness in order to achieve the target behaviour of the app. This element has been implemented in studies such as [26], [27] and [28] where it is argued that novelty enhances engagement. These studies pinpoint that when users know that the app is teaching new behavior, then their curiosity to explore the app will increase which will make them to be more engaged with the app.

4.3. Usability

This is the component of adaptability, convenience and learnability of MAR. As referenced by [29], usability of a framework is one of the estimating instruments for assessing MAR applications. Comparable component has been actualized in concentrates like [30], [31], [25], [24], [32] and [33] where it is kept up that ease of use advances clients commitment and fulfillment with the MAR application.

4.4. Feedback

This is the element of users' response and reaction to obtain modification in order to promote positive performance. [34] argue that when users perceive that their input and contribution to a system

is vital then their engagement with the system will increase. This further supports [30] position that positive feedback information enhances passionate reactions and promotes positive performance.

4.5. Motivation

Inspiration characterizes the capacity for clients to will and want to go with assignment [35]. An examination by [36] have demonstrated that clients generally get drew in with the applications that they saw to rouse or persuade them towards greatness.

4.6. Attention

This is the demonstration of picking up mindfulness and making message additionally fascinating and amusing to the client [37]. Numerous investigations, for example, [25], [37], [36] and [38] executed this component in their examinations. These investigations inferred that the applications which can pick up clients' consideration will effectively draw in clients.

4.7. Perceived Control

This state turns out to be progressively exceptional when clients conviction that they have more control and impact on the application condition or potentially realize the ideal results. This component has been utilized in concentrates, for example, [39] and [30] where it is noticed that clients' apparent control on the application advances their commitment.

4.8. Curiosity

Interest is the component that portrays the nature of the curious reasoning which will push clients to inward investigation and examination. This component advances casual learning while clients learn by examining and investigating. The component has been executed in concentrates, for example, [40], [39], [31], and [36] where it is found that applications that expansion client interest can effectively connect with the clients in the learning condition.
Enjoyment
The component of satisfaction suggests the sentiment of being profiting to the passing on message of the application. This component includes clients encountering fun, bliss, fulfillment, harmony and satisfaction dependent on their cooperation with the applications [41].

4.9. Social Skill

This is the ability to facilitate communication, relationship and interaction with others within the same social circle. Studies by [42] and [43] have highlighted that any app that facilitate social ability and skill enhances users' engagement. Social skill element implies that users are able to connect with others by forming bonding and circle.

4.10. Self-Efficacy

Self-viability characterizes the trust in clients' faith in their capacity to prevail in explicit circumstances or achieve an undertaking. In view of [44] and [38] thinks about, any applications that improve clients' self-viability will likewise connect with them.

4.11. Friendliness

The element of friendliness defines the ability for an app to have good nature, amiability, good humour and affability. This element is vital in engagement because it promotes pleasant companions and social interactions which has been implemented in studies such as [45], [46] and [33].

4.12. Endurability

This is the ability for the user to bear and tolerate instructions from the app in order to perform the target action or behaviour. This element defines the likelihood of the user to return back to the usage of the app and has been explored in studies such as [40], [12], [38], and [25].

4.13. Interest

The component of intrigue is the picking up of clients' mindfulness and worry so as to get them includes and partakes in predefined activity or conduct. Numerous examinations, for example, [12], [40] and [36] have contended that clients' commitment is succeeded when the clients are keen on the application's message.

4.14. Immersion

The element of immersion defines the state of deep mental involvement of users based on their interaction with an app. This element implies that the user is able to experience deep thinking as a result of the app interaction. This element is well explained in the studies of [12], [40] and [36] where element of immersion is associated with engagement.

4.15. Challenge

The element of challenge involves a provocation to action or summons to compete and contest. Thus, an engaged app should be able to dare and persuade its users to perform the target action and behaviour. This element has been implemented and explained in previous studies such as [12], [40] and [48] and has been identified as a determinant of engagement.

4.16. Satisfaction

This component suggests the production of satisfying minutes with an application at whatever point the clients satisfied their desires with the application. This component pinpoints that each client as a rule have predefined target or point in investigating an application. At whatever point this objective or point isn't met then they will separate with the application. Then again, in the event that the objective or point is met, they will turn out to be progressively drawn in with the application [12], [40], [48].

4.17. User Autonomy

This is the element that defines the users' ability to set desires and goals where the app support and ensure that the predefined desires and goals are met or implemented. Based on [49], an improved user' autonomous learning ability will enhance the quality of engagement of the apps [54].

4.18. Improvement

This element pinpoints that the app users [55] must see the perceived benefits in an app toward their defined behaviour or action. This implies that the app should be seen as a positive application which will enhance the users' target behaviour and actions [50] and [45].

4.19. Supportive

The application should be able to enhance the unachievable tasks performed previously by the users. The element of support depicts that the users can be encouraged and assisted in order to achieve the needed behaviour and action [51].

4.20. Trust

The element of trust defines the users' confidence in the workability of the app to achieve its defined objective and aim [52]. The element is vital because without trust, it will be impossible for users to follow the instruction of the app. This element has been implemented in studies such as [36] and [40] where it is established that a trustful app will be more engaging by the user [56].

4.21. Interaction

This component delineates the way and way that clients and application interfaces [53]. This is imperative in light of the fact that the stage and nature of the application correspondence will influence the client commitment with the application [40]. In this way, the capacity to interface between the clients and application is basic to commitment [33].

The 22 chose components are considered as the real MAR commitment components that are required for the structure of a productive MAR application and are outlined in Table 1.

Table 1: Summary of MAR engagement elements

No	Elements	Description	Reference
1	Aesthetics	This is the element of mixing the nature of beauty, art, and taste and with the creation and appreciation of MAR.	[25] , [24]
2	Novelty	The element of using MAR to teach new behavior and knowledge.	[28, [27], [26]
3	Usability	The element of flexibility, ease of use and learnability of MAR	[29], [25], [24], [30], [31], [32], [33]
4	Feedback	Positive information that will enhance passionate reactions which will promote positive performance	[34], [30]
5	Motivation	This is the ability to be willing and desire to accompany a task	[35], [36]
6	Attention	Act of gaining awareness and making something interesting.	[25], [37], [36], [38]
7	Perceived Control	Making users to feel in control of the event or situation	[39], [30]
8	Curiosity	Act of increasing users desire towards learning and knowledge	[40], [39], [31], [36]
9	Enjoyment	The user experiencing fun, joy, satisfaction, peace and fulfilment with the usage of the app	[41]
10	Social skill	Ability to facilitate interaction and communication with others.	[42], [43]
11	Self-efficacy	Confidence in one's belief in one's ability to succeed in specific situations or accomplish a task	[44], [38]
12	Friendliness	The application should be easy to use and confident to interact with	[46], [45], [33]
13	Endurability	The likelihood of the user to returns back to the usage of the app	[25], [40], [38], [12]
14	Interest	It should gain the involvement to act by the users	[12], [36], [47], [40]
15	Immersion	The app should be able to cause deep mental involvement to the users	[12], [36], [47], [40]
16	Challenge	The app should be able to provoke users to action	[12], [40], [48]
17	Satisfaction	It should create pleasing moments with the app	[12], [40], [48]
18	Learner Autonomy	An improved users' autonomous learning ability and thus improve the quality of app teaching	[49]
19	Improvement	Users must see that the app can improve their behavior or action	[50], [45]
20	Supportive	The app should be able to enhance the users to perform previously unachievable tasks	[51]
21	Trust	Users must have confident in the workability of the app	[36], [32]
22	Interaction	Ability to connects between users and app	[40], [33]

Based on the systematic literature review, 22 elements of MAR have been identified from the vast literatures. This implies that each of these 22 element trigger engagement in the MAR app.

5. Conclusion

This paper depicts the vital elements that are needed for the design of an engagement MAR app which will captivate the users' attention and involvement. These 22 elements include Aesthetics, Novelty, Usability, Feedback, Motivation, Attention, Perceived Control, Curiosity, Enjoyment, Self-efficacy, Friendliness, Social skill, Endurability, Interest, Immersion, Challenge, Satisfaction, User, Autonomy, Improvement, Supportive, Trust and Interaction. This paper contends that for a proficient and drew in MAR application, these 22 components are basic. It is vital for the MAR originators to consider these components in their structure of MAR application so as to guarantee that their application clients are emphatically locked in. In like manner, these components will guarantee that the MAR application rises above past the utilization of content and video shows. In spite of the fact that, this investigation has possessed the capacity to display 22 components of MAR application commitment, further examination is as yet expected to investigate in more subtleties the individual helpfulness and effect of these components. This will help MAR application architects and engineers to comprehend the suitable usage of these components in their plans.

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