Implementation Success of an Indoor Navigation with Location-Based Augmented Reality

Mashael Khayyat, Saadiah Yahya, Muna Alsharabi, Atheir Aljahdali, Arwa Alshehri

Abstract*: Confirming the adoption and use of information technology is central to human-computer interaction. User experience (UX) and Usage Continuance (UC) which latently signifying implementation success are vocal upon this mechanism. The advent of smart phones and mobile technologies such as Geographical Positioning System (GPS) has seen great proliferation in positioning outdoor location. However, GPS is incapable to work in an indoor environment (Hub, 2008) properly. Hence, for navigating indoor location one need to combine the existing mobile technologies and most of their components with location-based augmented reality. In this paper, implementation success of Indoor Navigation with Location-Based Augmented Reality named 'GuideMe" is studied. The factors considered to evaluate implementation success are adopted from information systems and mobile computer interface literature. The objectives of this paper are to determine users' experience (satisfaction) and usage continuance of GuideMe. Prior to that, GuideMe has been successfully designed and developed using IOS with tools (Unity engine, Placenote SDK and XCode to set up IOS packages), User feedbacks are gathered via questionnaire forms taken from 35 respondents who volunteer to experiment GuideMe. The volunteers are free to choose and navigate offices at buildings of University of Jeddah (UJ), with the help of GuideMe. The findings of the study conclude that: GuideMe has facilitated users to navigate and seek indoor location independently, conveniently and efficiently since they did not disturb or asked others for directions. Hence, this has improved users' experience which indicates users' satisfaction. The high value of mean for "behavioral intention to use" has shown users intend to continue using GuideMe. This is further verified and confirmed by "expectation confirmation" analysis. These findings have the potential to deploy GuideMe to large complexes, such as airports, shopping malls, schools, hospitals and libraries in a cost-effective manner.

Keywords: Indoor Navigation, Mobile Technologies, Augmented Reality, User experience, Usage Continuance, IOS.

I. INTRODUCTION

Assistive Technology resources can be used to provide people with several mean to enhance their quality of life [1].

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It is always difficult to locate for a place in a large and complex campus such as universities, hospitals, supermarkets and shopping centers [2]. Positioning systems for outdoor environments have proven effective and available commercially [3], [4], [5]. But, Indoor navigation, is still lacking [6], [7], [2], [5], [8]. The navigation is more challenging when the person is new or not familiar to a building to locate a place in the building without the need to ask anyone surround. Therefore, an indoor navigation system is necessary to assist a person navigating inside a building particularly when the person is exploring the building for the first time. It is easier to navigate indoors when one can see the surroundings while moving through space naturally as contextual information conforms to the view. Therefore, Augmented Reality (AR) technologies can ideally be used for indoor navigation to provide environmental information and navigation routes [9], [10], [11], [12], [13]. In parallel, HCI and usability considered as core aspects of the system development process to satisfy users' needs and necessities and to enhance system facilities. HCI is important because it assists users, analysts and designers to identify the system needs from many aspects such as color, fonts text style, layout and graphics. While usability will confirm if the system is efficient, effective, safe, utility, easy to learn, easy to remember, easy to use and to evaluate, practical visible and provide job satisfaction to the users.

II. BACKGROUND OF THE STUDY

The use of mobile devices especially smart-phones and mobile technologies have significantly increased. Correspondingly, various applications have been developed to meet the requirements of mobile users which include navigation. Integrating these applications with maps, and different localization technologies such as Augmented Reality (AR), will enhance the robustness of the navigation systems towards indoor wayfinding. AR blends the computer-generated sensory inputs and information into user physical view of the world in real-time via the camera live feed that is being displayed to the user [14]. Simply, AR is a technology that immerses virtual objects into the real world or mixes real world and the virtual world in such a way that both real and virtual objects appear to the user to be in the same space. Indoor Navigation with Location-Based Augmented Reality is an innovative visualization technology. It provides users with a real-time navigation experience that will enhance human-computer interaction within real world environment. AR can be leveraged to overlay an interactive virtual 3D map of the indoor

environment together with its navigation path to guide users to their intended destinations and hence, improve user experience in navigation applications. The implementation success of AR navigation system such as GuideMe is normally dependent on a better user experience [15] and user behavioral intention to use. The best predictors for user experience that signifies user satisfaction are: perceived usefulness, perceived ease of use, usability and behavioral intention to use. The implementation success is validated and confirmed by expectation confirmation factor.Nowadays, practitioners extensively apply quick and reliable scales of user acceptance as part of their user experience analyses to obtain well-founded measures of user satisfaction within time and budget constraints. However, in the HCI literature the relationship between the outcomes of standardized satisfaction parameters and the amount of product usage has been only marginally explored. This study aimed to provide stakeholders of UJ (students, employees and visitors) with an experience to walk around the campus in AR using GuideMe. Specifically, the objectives of this paper are to determine users' experience (satisfaction) and usage continuance of GuideMe. Prior to that, GuideMe has been successfully designed and developed using IOS with tools (Unity engine, Placenote SDK and XCode to set up IOS packages), which is in accordance to two main functional requirements (FR) for a system dedicated for indoor navigation. First FR allows indoor navigation for users by mean of Mobile Augmented Reality techniques. While second FR allows for the visualization of virtual direction arrows in the smartphone display, matching to AR fiducial markers and arrival point position. The placing of fiducial markers must consider mobile device specification. This paper will skip detailing the design and development but rather concentrate on experimenting GuideMe performance. GuideMe is being experimented on 35 volunteers in an academic building of UJ with various labs, classrooms and offices. Data are gathered based on volunteers' feedbacks forms which composed of specific questions indicating items of the factors to be evaluated as specified in Table 1. The parameters and items used are aligned with the study done in e-Education Systems Implementation Success Model by [15]. Finally, the data are analyzed to verify the success of GuideMe implementation.

Table- I: GuideMe Implementation Success and Usage Continuance (Implementation Success) Variable & Items

Variable	Item	5-point Lickert Scale Range (midpoint is always neutral)
Perceived Usefulness	Rate the extent to which you agree with the following statements: Q1: Using GuideMe has improved my speed in locating a place in a building Q2: Using GuideMe has boost my confidence in searching for a new destination. Q3: Using GuideMe has enable me to be more independence in navigating for a new destination	Strongly disagree – Strongly agree
Perceived Ease of Use	Rate the extent to which you agree with the following statements: Q4: GuideMe is easy to use with AR and visualization Q5: GuideMe is easy due to well-designed User Interface	Strongly disagree – Strongly agree
Usability	Rate the extent to which you agree with the following statements: Q6: GuideMe is effective in locating a destination in Indoor Q7: GuideMe is safe to use Q8: I am satisfied with using GuideMe to locate a place	Strongly disagree – Strongly agree
Behavioral Intention to Use	*Rate the extent to which you agree with the following statements:* *Q9: I intend to continue using GuideMe* *Q10: Most of the time GuideMe is reliable and stable* *Q11: GuideMe is preferred in IOS platform*	Strongly disagree – Strongly agree

Expectation confirmation	Rate the extent to which you agree with the following statements: Q12: My experience using GuideMe was better than what I expected Q13: The service level provided by GuideMe was better than I expected Q14: Overall, I am satisfied with GuideMe	Strongly disagree – Strongly agree

III. THE MECHANISM AND RELATED TERMINOLOGIES

As specified earlier, this study rather focusses on the performance evaluation of GuideMe and therefore, skips detailing it design and development. The study considers that GuideMe has successfully been designed and developed and available for deployment. Briefly, GuideMe was developed in three phases.

The steps/ phases as follows:

1. The first phase is importing the indoor map,
2. next is the phase of consuming the custom data in Unity
3. and the final phase is seeing it localized in world scale AR.

In this section, the relevance of considering factors (variables) specified in Table 1 to measure user satisfaction that lead to usage continuance is explained. This study had examined GuideMe implementation success as sustained information technology usage over time. Sustained technology usage is an understudied research area in the information systems literature. Although the phenomena of technology acceptance or usage behavior towards technology have been widely examined, less emphasis had been placed on sustained technology usage. The importance of sustained usage is underscored when many corporate failures or abandoned information systems projects have been blamed on users' resistance or refusal to use systems that were implemented [16].

[17] in his proposed model of Enjoyment Quality named Hierarchical Semantic Differential Model (HSDM), has listed "Ease of Use" as one of the five factors to evaluate user experience that denotes user satisfaction. Hence, this study is also adopting "Perceived Ease of Use" as another factor to measure user satisfaction. Mobile platforms have sought attention from HCI community. While there are several studies investigating scopes related to mobile user interface, unfortunately, a standard of mobile user interface design patterns has not been established. For, example, the research on menu composition was quite limited. Moreover, since 2007, the topics that included usability assessment of 2D and 3D menus, which primary concern factors are user preference ,menu efficiency, and satisfaction. This positively affects users' satisfaction and preference towards the system. Other user factors that may have potential effects, such as user with disabilities, elderly users and children were not studied. Evidently, the lack of knowledge of what type of display should be used in what context and for which group of users. Lumpapun & Nuttanont (2017) [18], emphasized that, there is a huge knowledge gap for mobile interface design.

Research has shown that early perceptions and acceptance decisions by users would likely to encourage repeat usage behavior which will elicit more and more benefits, thus triggering a chain reaction which would finally lead to technology infusion and its ultimate success. Training also create positive first-time perceptions which are critical, not only to early acceptance decisions, but to continued usage as well. It has been found that subsequence user perceptions and motivation had no significant effect on short-term use.

Perceived usefulness is the user's evaluation of the system characteristics, which helps to explain the success or failure of a new technology adoption from the user's perspective. In this study, perceived usefulness refers to specific gains of benefits related to personal productivity, efficiency and effectiveness in performing individual and organizational task as afforded by the technology. Further, 'perceived usefulness' represents individual level perceptions of utility. Literature shown that information systems impacts are positively correlated with heavy systems usage or sustained usage at both pre-adoption and post adoption stages of implementation. The significant paths between 'perceived usefulness' benefit and IS continuance has added further support. It also provided support for Orlikowski (1999) theory [29].

Sustained usage is also more essential than first time use after users' initial adoption decision [30]. This is because users may change their intention of using the GuideMe system in the future after initially accepting it. In effect, non-sustained use indicates that the information system in question is a failure for failing users' expectations. Oliver (1980) suggested that users' intention to continue using a system is determined by their pleasant experience after using the technology [30]. As attitude is a complex mental state involving feelings, beliefs, values and dispositions to act in certain ways, the expectation confirmation construct refers to an attitude formed by an evaluation or cognitive process, made up of a combination of the experience of interacting with a technology and the resulting satisfaction or dissatisfaction associated with usage of the technology or the consumption of the product (information) of the technology [31].

Implementation success of an information systems is said to be achieved when the systems has been routinely used, cease to become a novelty and lost its newness. At this stage of deep usage, users would have also reached a level of acceptance and understanding that using the information system is a matter of fact and a necessity in order to accomplish tasks. This specific awareness, or 'continuance of the information systems', which have been grasp by stakeholders is an objective notion whereby each stakeholder understands that they need to use the systems. This awareness is objective enough to make it an appropriate proxy for implementation success.

The construct is suggested as an appropriate measure for implementation success based on several factors. First, studies on information systems use show that while initial acceptance of an information system is a factor contributing to its success in a firm, the long-term viability of the system is more important for survival. According to innovation diffusion research, individuals gather and synthesize information about the innovation; this information processing results in the formation of perceptions about the innovation and the decision to adopt or reject the innovation is made [32], [33], [34]. However, initial use of the innovation, may not always be enough to fully derive the benefits desired from the system. Users still need to institutionalize the innovation as part of regular work behaviors; this type of usage has been variously referred to as confirmation [33], routinization [32], [35] and continued-sustained implementation [34]. Innovation diffusion research thus specifically recognizes that institutionalization of a behavior is different from, and perhaps more important than first time adoption. Users may be persuaded to use a new system early in the implementation process but the benefits from system usage may never be derived in the absence of continued, sustained usage. Ineffective, inappropriate and infrequent long-term use of available systems can significantly contribute to corporate failures, particularly for firms offering serviceswhich suggests that continued use rather than first time use is a better reflection of systems success [16].

Through the experimentation of GuideMe, this study managed to provide further clarification to users' evaluation for the post-adoption stage. Pre-adoption decision is only based on a mental evaluation, while post-adoption decision is a mental as well as an experienced-based evaluation. Therefore, 'expectations-confirmation' construct in the study is included as a suitable variable that represents the cognitive process that users' go through to evaluate the systems' efficacy or success. This variable also distinguishes the difference between users' decisions at the initial stage and the post-adoption stage. The 'expectations-confirmation' variable as defined in this study is the result of a cognition and experiential process.

IV. EXPERIMENT SETTING

GuideMe system was thoroughly tested after its development to analyze several elements of user experience and to investigate hence confirm usage continuance of the applications of indoor navigation. Among the different methods used in current mobile usability research [19] , a field study entailing the involvement and participation of volunteers was opted. Such approach allows to conduct the evaluation in a realistic environment by adopting main factors used in information system implementation success [15], and EQ of HSDM [17] as depicted by Table 1. The factors are frequently reported as affecting the mobile experience [20], [21], [22] , not only on users' characteristics (mobile user factor), but also on the context of use (mobile environment factor). The feedback forms contained questions which are relevant on measuring users experience on the factors of: perceived usefulness, perceived ease of use, and usability. Users feedbacks analysis on Usage Continuance that signifies implementation success was based on the *behavioral intention to use* questions. This can be verified by analyzing the *expectation confirmation*. Overall, the analysis followed a quantitative research.

In order to gauge the level of acceptance and usage continuance, user feedback forms are gathered from 35 users who volunteer to experiment GuideMe. Each volunteer was given a questionnaire which they have to fill-in after the visit. They were asked to freely use the GuideMe system to explore the academic buildings of UJ. Before the visit, volunteers need to submit their demographic information such as, their: age, status (staff, student, or visitor) and technical know-how (1 for poor skill towards 5 for highest skill). In order to conduct the evaluation under realistic conditions, volunteers were not forced to perform specific visits, but rather to use the application according to their curiosity and interests. Prior to the using, general information of GuideMe was briefly given, without explaining in detail all its functionalities and let participants familiarize themselves with the use of the Indoor Location-Based AR smartphone through a sequence of introductory screens.

Particularly the respondents of this study were selected randomly using a convenience sampling technique. The composition of the volunteers is: 15 staffs, 15 students and 5 visitors of UJ. Demographic information of the volunteers is: age and skill of technical know-how. On average, visitors age is 31.42 years and 5 months, staff age is 38.08 years, and students age is 21.08 years respectively. The technical know-how of the three group of volunteers: visitors, staff and students are quite high which is 4.6, 4.3 and 4.4 respectively.

V. RESULTS AND DISCUSSION

Figure 1 depicts mean values of perceived useful of the staffs, students and visitors respectively based on three different items namely: speed in locating a place, independent in navigation and increase user confident in searching. Overall, the mean values for these items are high for all groups of users especially students. This shows that overall, all users accept and hence satisfy with GuideMe.

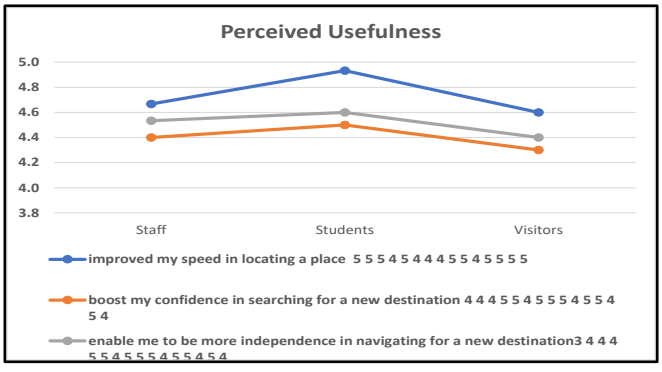

Fig. 1.Level of Acceptance with Perceived Usefulness

On the same notes, Figure 2 illustrates mean value of perceived ease of use of the staffs, students and visitors respectively based on two items namely: easy to use with AR and visualization and easy to use with well-designed user interface. Its evidence that, the mean values for these two

items are high for all groups of users especially students. Visitors group shown high perception of ease of use with well-designed UI. These findings overall signify that, all users accept and hence satisfy with GuideMe.

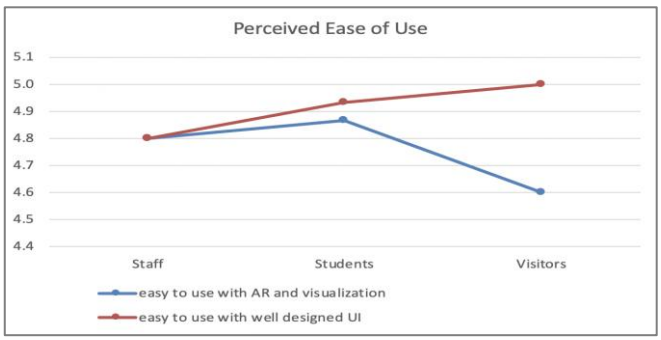

Fig. 2.Level of Acceptance with Perceived Ease of Use

In In parallel, Figure 3 illuminates the mean value of usability of the staffs, students and visitors respectively based on three items namely: effective in locating indoor destination, safe to use and satisfied with using GuideMe to locate a place. It confirmed that, the mean values for these three items are high for all groups of users especially students. These findings overall signify that, all users accept and hence satisfy with GuideMe

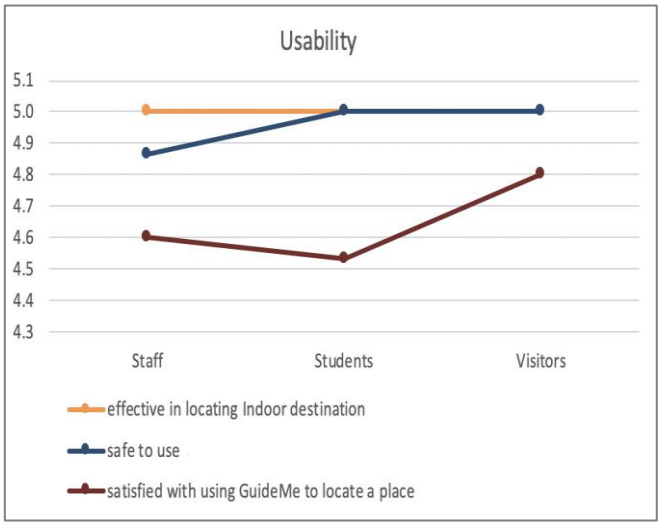

Fig. 3.Level of Acceptance with Usability

Figure 4 shows that the mean values of behavioral intention to use GuideMe by the staffs, students and visitors respectively based on three items namely: intend to continue using GuideMe, GuideMe is stable and reliable and GuideMe in IOS platform is preferred. It shows that, the mean values for three items particularly: intend to continue using GuideMe, GuideMe is stable and reliable, and GuideMe in IOS platform is preferred are high for all groups of users especially students. These findings generally denote that, all users satisfy with and plan to continuously using GuideMe.

Figure 5 depicts expectation confirmation and is triangulating results gained from behavioral intention to use factor (Figure 4). Overall, all items mean are high for all groups (students, staffs and visitors). These findings verified and confirmed results of behavioral intention to use. Hence, it is evidenced that GuideMe have been evaluated and verified accepted to be used continuously by users.

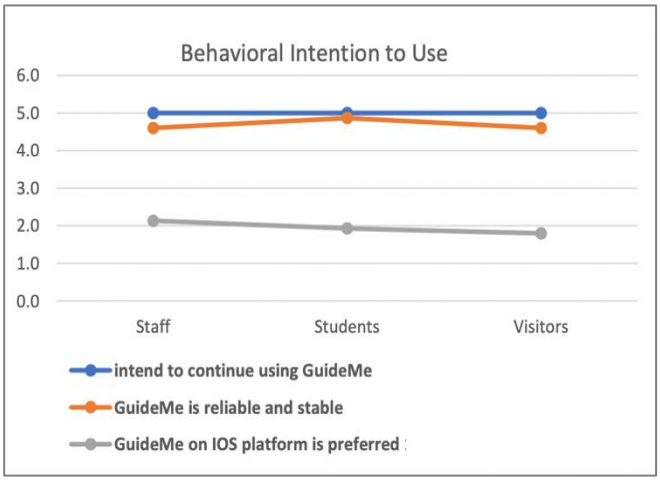

Fig. 4.Level of Implementation Success with Behavioral Intention to Use

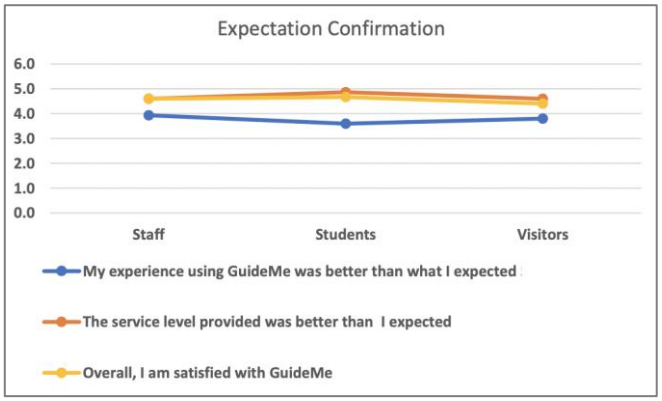

Fig. 5. Verification of Implementation Success with Expectation Confirmation

Findings illustrated in Figure 1 to Figure 5 above can be summarized as the following:

a. This study had successfully extended Bhattacherjee's (2001) [16] expectation confirmation model of IS continuance to include individual-level constructs encompassing a technology innovation which is inclusion of AR and visualization technology in indoor navigation systems implementation.
b. This study synthesized theories and perspectives from various research streams technology acceptance, expectations confirmation, IT evaluation, IT implementation, technology diffusion) had served well in predicting users' intentions of usage continuance and in explaining how users reach to their decisions. The findings discovered that, both variables, 'perceived usefulness' and 'perceived ease of use' are significant predictors for GuideMe implementation success. Between these two, however 'perceived ease of use' is the stronger predictor based on its higher overall values of mean
c. This study found empirical support for the assumptions that 'perceived usefulness', 'perceived ease of use', 'usability', and 'Behavioral Intention to Use' can appropriately predict GuideMe implementation success.
d. This study had reiterated the findings of previous study in relation to systems implementation success model [15].

e. This study had shown support for 'expectations confirmation' as an attitude construct resulting from knowledge and experience and is associated with goal-seeking behavior, thus providing support for similar views in previous studies as a significant predictor for routinization of information systems use. [23], [24], [25], [26], [27], [28], [37].

VI. CONCLUSION

In this paper GuideMe has been successfully designed and developed using IOS with tools (Unity engine, Placenote SDK and XCode to set up IOS package. GuideMe was tested for implementation success which covers user satisfaction or acceptance and usage continuance for AR Location-Based Indoor Navigation system which is capable of supporting UJ stakeholders with wayfinding. GuideMe relies on a vision-based approach to detect users' indoor position and orientation. The combination of indoor navigation, path communication, turned out to be a reliable and effective way to enhance users experience which denote user acceptance or satisfaction of GuideMe. This is proven by the analysis findings with higher mean values for all related parameters specifically: perceived usefulness, perceive ease of use and usability. Refer to Figure 1 – 3. Likewise, the findings shown by Figure 4 reveal that users intend to use GuideMe continuously in future (usage continuance). It is triangulated or further convinced by the higher mean values of expectation confirmation analysis depicted by Figure 5.

The two main contributions of this study are the GuideMe systems benefits evaluation and implementation success through users' acceptance to continue using the system. Results of the data analysis indicated that the proposed GuideMe benefits dimensions and user acceptance have empirical support. The study had successfully applied behavioral and diffusion of innovation theories to a GuideMe system implementation area.

The experience would be considerably enhanced with the use of Bluetooth beacons. This can be done by tracking a user's position and orientation constantly, this would provide automatic synchronization context at regular intervals. It would also allow a seamless transition between indoor and outdoor navigation, covering a wide variety of use cases. Further improvements can be done to GuideMe by using a standard voice interface of the smartphone, just by vocalizing commands and names of specific locations.

REFERENCES

1. Santarosa LMC, Conforto D, Basso LDO. Eduquito: ferramentas de autoria e de colaboração acessíveis na perspectiva da web 2.0. Revista Brasileira de Educação Especial. 18(3): 449-68, 2012.
2. Tsetsos V, Anagnostopoulos C, Kikiras P, Hasiotis T, Hadjiefthymiades S. A human-centered semantic navigation system for indoor environments. ICPS '05: Proceedings of the 2005 International Conference on Pervasive Services; 2005 Jul 11-14; Santorini, Greece. Greece: IEEE; 2005. p. 146-55, 2005.
3. Chakraborty B, Hashimoto T. A framework for user aware route selection in pedestrian navigation system. ISAC: Proceedings of the 2nd International Symposium on Aware Computing; 2010 Nov 1-4; Tainan, Taiwan. Tainan: IEEE; p. 150-3, 2010. http://dx.doi.org/10.1109/isac.2010.5670466.
4. Hansen R, Thomsen B. Using weighted graphs for computationally efficient WLAN location determination. MobiQuitous 2007: Proceedings of the Fourth Annual International Conference on Mobile and Ubiquitous Systems: Networking & Services; 2007 Aug 6-10; Philadephia, PA, USA. Philadelphia: IEEE; p. 1-5, 2007.
5. Tsetsos V, Anagnostopoulos C, Kikiras P, Hadjiefthymiades S. Semantically enriched navigation for indoor environments. International Journal of Web and Grid Services; 2(4):453-78, 2006. http://dx.doi.org/10.1504/IJWGS.2006.011714.
6. Kouroupetroglou G. Disability informatics and web accessibility for motor limitations. In: Kouroupetroglou G, editor. Advances in medical technologies and clinical. Hershey: IGI Global; 2013.
7. Ran L, Helal S, Moore S. Drishti: an integrated indoor/outdoor blind navigation system and service. PerCom 2004: Proceedings of the Second IEEE International Conference on Pervasive Computing and Communications; 2004 Mar 14-17; Orlando, USA. Orlando: IEEE; p. 23, 2004.
8. Yohan C, Talipov E, Hojung C. Autonomous management of everyday places for a personalized location provider. IEEE Transactions on Systems, Man and Cybernetics. Part C, Applications and Reviews. 2012; 42(4):518-31. http://dx.doi.org/10.1109/TSMCC.2011.2131129
9. Delail BA, Weruaga L, Zemerly MJ. CAViAR: context aware visual indoor augmented reality for a university Campus. WI-IAT: Proceedings of the 2012 IEEE/WIC/ACM International Conferences on Web Intelligence and Intelligent Agent Technology; 2012 Dec 4-7; Macau, China. Macau: IEEE; p. 286-90, 2012. http://dx.doi.org/10.1109/wi-iat.2012.99.
10. Hervas R, Bravo J, Fontecha J. An assistive navigation system based on augmented reality and context awareness for people with mild cognitive impairments. IEEE Journal Biomedical and Health Informatics.; 18(1):368-74, 2014. http://dx.doi.org/10.1109/JBHI.2013.2266480.PMid:24403436.
11. J. Kotsakos D, Sakkos P, Kalogeraki V, Gunopulos D. Using smart mobile devices for monitoring in assistive environments. Proceedings of the 6th International Conference on Pervasive Technologies Related to Assistive Environments; 2013 May 29-31; Rhodes, Greece. USA: ACM; 2013. p. 1-4, 2013.
12. Matuszka T, Gombos G, Kiss A. A new approach for indoor navigation using semantic webtechnologies and augmented reality. In: Shumaker R, editor. Virtual augmented and mixed reality. Lecture notes in computer science: designing and developing augmented and virtual environments. Heidelberg: Springer; v. 8021, p. 202-10, 2013. http://dx.doi.org/10.1007/978-3-642-39405-8_24.
13. Rehman U, Cao S. Augmented reality-based indoor navigation using Google Glass as a wearable head-mounted display. SMC 2015: Proceedings of the 2015 IEEE International Conference on Systems, Man, and Cybernetics; 2015 Oct 9-12; Hong Kong, China. Hong Kong: IEEE; p. 1452-7, 2015. http://dx.doi.org/10.1109/smc.2015.257
14. Schmalstieg, D., Langlotz, T., & Billinghurst, M. Augmented Reality 2.0, pp.13-37. Springer Vienna, 2011.
15. Saadiah, Y., Nor Zaila, W. and Noor Habibah, A., 'e-Education systems implementation success model', International Journal of Education and Development using Information and Communication Technology, Vol. 5, Issue 2, 123-133, 2009.
16. Bhattacherjee. Understanding information systems continuance: An expectation-confirmation model. *MIS Quarterly* , *25* (3), 351-370, 2001.
17. Wenjun, H. The Three-Dimensional User Interface. China: Beijing University of Posts and Telecommunications China, 2008.
18. Lumpapun P & Nuttanont H. Usability Studies on Mobile User Interface Design Patterns: A Systematic Literature Review. Advances in Human-Computer Interaction; Volume 2017, Article ID 6787504, 22 pages, 2017. https://doi.org/10.1155/2017/6787504
19. Fatih, N.; Desharnais, J.-M.; Abran, A. The State of the Art of Mobile Application Usability Evaluation. In Proceedings of the 25th IEEE Canadian Conference on Electrical and Computer Engineering (IEEE CD: 978-1-4673-6/12), Montreal, QB, Canada, 29 April–2 May 2012.
20. Kenteris, M.; Gavalas, D.; Economou, D. Electronic mobile guides: A Survey. Pers. Ubiquitous Comput. 15, 97–111, 2011.
21. Baharuddin, R.; Singh, D.; Razali, R. Usability dimensions for mobile applications—A review. Res. J. Appl. Sci. Eng. Technol. 5, 2225–2231, 2013.
22. Gansemer, S.; Großmann, U.; Suttorp, O.; Dobbelmann, H. Evaluating a Location Sensitive Multimedia Museum Guide: Results from a Field Trial. In Proceedings of the Digital Cultural Heritage—Essential for Tourism, 2nd EVA 2008 Vienna Conference, Vienna, Austria, 25–28 August 2008.
23. Warshaw, P., & Davis, F.. Disentangling behavioral intentionand behavioral expectation. Journal of Experimental Psychology, 21 (3), 213-228, 1985.

24. Sheppard, B., Hartwick, J., & Warshaw, P. . The theory of reasoned action: A meta-analysis of past research with recommendations for modifications and future research. Journal of Consumer Research ,15, 325-343, 1988.
25. Venkatesh, V., Morris, M., & Ackerman, P. A longitudinal field investigationof gender differences in individual technology adoption decision-making processes. Organizational Behavior and Human Decision Processes , 83, 33-60, 2000.
26. Cooper, R., & Zmud, R.. Information technology implementation research: A technological diffusion approach. *Management Science , 36* (2), 1990.
27. Kwon, T., & Zmud, R. Unifying the fragmented models of information systems implementation. In R. B. Hirschheim (Ed.), Critical Issues in Information Systems Research. p. 88-97, 1987.
28. Zmud, R., & Apple, L. Measuring technology incorporation/infusion. *Journal of Product Innovation Management , 9* (2), 148-155, 1992.
29. Orlikowski, W. Managing use not technology: A view from the trenches. In D. Marchand, T. Davenport, & T. Dickson (Eds.), Financial Times Mastering Series: Mastering Information Management. New York: Prentice-Hall, 1999.
30. Oliver, R. A cognitive model of the antecedents and consequences of satisfaction decisions. Journal of Marketing Research , November (17), 460-469, 1980.
31. Muthukrishnan, A., & Kardes, F. Persistent preferences for product attributes: The effects of initial choice, context, and uninformative experience. Journal of Consumer Research , 28, 89-104, 2001.
32. Hage, J., & Aiken, M. Social Change in Complex Organizations. New York, USA: Random House, 1970.
33. Rogers, E. The diffusion of innovations (3rd ed.). New York: Free Press, 1995.
34. Zaltman, G., Duncan, R., & Holbeck, J. Innovations and Organizations. New York: Wiley & Sons, 1973.
35. Saga, V., & Zmud, R. The nature and determinants of IT acceptance, routinization and infusion. Proceedings of the IFIP TC8 Working Conference on Diffusion, Transfer and Implementation of Information Technology, pp. 67-86, 1994.
36. Lyytinen, K., & Hirschheim, R. Information systems failure: A survey and classification of the empirical literature. Oxford Surveys in Information Technology , 4, 257-309, 1987.
37. Taylor, S., & Todd, P. Assessing IT usage: The role of prior experience. MIS Quarterly, 19 (4), 561-570, 1995.

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