A Survey on Context-Aware and Context- Adaptable System for Ubiquitous Computing

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Abstract: *The vast area of Human-Computer Interaction has a subdivision domain of ubiquitous computing (ubicomp). A Ubiquitous Computing is an enriched paradigm of embedding computational capability into our everyday lives, providing services and information anywhere with any device and anytime fashion. Ubiquitous computing, that enhanced the context-aware and context-adaptable system to upgrade the smart environment. Injecting context-awareness and context-adaptability into systems has facilitated, increased the level of intelligence and satisfaction. This paper presents the comparative study of various researchers in the domain of ubiquitous computing in different aspects of, a proposed design, methodology, data analysis, and its implementations of context-aware and context-adaptable technologies.*

Keywords: ***Human Computer Interaction, Ubiquitous Computing, Context-Aware, Context-Adaptable***

1. INTRODUCTION

Nowadays the implementation of technologies and the usage of electronic devices (like different types of gadgets, devices, and appliances) are huge and it's an integral part of our day-to-day activities. These computing technologies are mainly based on the field of Human-Computer Interaction (HCI). Human-computer interaction is a multidisciplinary domain that focusing on the designing mechanism, to achieve the needs of interaction between the humans (the users) and computers. Despite this, this is not only considered the comfort of the user, but it also focuses on assisting user tasks, proving access to information in the best way, and concentrate on a more powerful form of interaction. After considering its perspective of HCI, has taken to a new dimension especially in Ubiquitous computing.

Ubiquitous computing is upgrading technology in the world of telecommunication. The terminology ubiquitous (UbiComp) refers to the ubiquity of information technology and computing power, of everyday objects. Ubiquitous computing will provide a comfortable and convenient smart space information environment to a user. The rapid development of ubiquitous computing has accelerated the needs of context-aware and context-adaptable system that leverages information about surrounding situation.

The Context-aware systems are aware of their environment, situation, or context. In the last few years, we observe many applications that gather user context through sensors to

do the right things at right time. Most profound among these applications are Cyber Guide, Ubi Cicero, and Google Ad Sense. The Context-adaptable behavior is based on information sensed from the physical and computational environment. It also increased the ability to communicate and build a relationship with users.

In this paper, we discuss the concept of interrelated connections of a Smart environment that are, HCI, ubiquitous computing, context-aware, and context-adaptable system, that especially in the phase of, user interaction devices, dandelion framework, and session handling mechanism. The rest of the paper is arranged as follows: Section 2 gives a brief background of the technologies used in this research and reviews the relevant literature. Section 3 discusses the technologies. Finally, the conclusion and future work are given in section 4 for future directions.

2. LITREATURE SURVEY

Et.al., Heba Abdelnasser [1], conferred WiGest ubiquitous WiFi-based gesture recognition system to detect human hand motions around a user device. Authors addressed the various issues of signal denoising, gesture primitive extraction, reducing the false positive rate of gesture detection, and adapting to changing signal polarity caused by environmental interference. The author implements a proof-of-concept prototype using off-the-shelf devices and evaluates the system in two environments that are, a single AP and three overhead APs. From the resulting outcome, the WiGest detects an accuracy of 87.5% using one AP, when using three APs it increase by 96%. The author was a case study of the multimedia application, which achieves 96% accuracy. This conclusion is robust to the presence of other interfering humans. The author suggests increasing the ability of ubiquitous hands-free gesture-based interaction and system accuracy among others in the future.

The author [2] focused on the concept of design visualization tools for enhanced their ubiquitous analytical scope. The author proposed the VISTRATES platform provides a document-based framework, holistic, sustainable data analysis, literate computing platform, assembling, and sharing visualization components. The author carried out the proposed model offers a collaborative pipeline that supports the full range of visualization and analysis activities. The author has demonstrated the utility of Vistrates in a scenario involving data-driven travel planning, as well as in three examples involving server-side computation, wrapping existing web components, and cross-device visualization in ubiquitous analytics. The author suggests to a buddy researcher to extend the work to realize the grand vision of a universal visualization platform.

Authors, [3] aim to conquer the problem of efficient typing or text-input on mobile devices such as smartphones and wearable. The author proposed a novel acoustic-based ubiquitous availability of text-input system Ubi Writer app-cloud architecture. The author adopts and incorporates a technique of feature-preserved fast letter Alignment, k-Nearest Neighbor letter classification, and language structure-driven word recognition. The Author concluded from the model outcomes that UbiWriter can achieve an accuracy of 93.75% on average under various practical Environments. The authors' proposed approach can recognize freestyle handwriting with high ubiquity, more accurate, and robust text-input compared to previous approaches. For the upcoming researcher, the author wants to develop more accurate, filter high noise and universal text-input systems to recognize non-word or different languages.

In work [4], the Author's objective is to promote and enhance the concepts of physical user interface with the capabilities of interacting in an intelligent

production environment. The author proposed a model-based conceptual framework design method that incorporates a comprehensive context model and modeling tool, for mobile interaction devices and then after further proposed an ontology-based context model, for underlying techniques, was demonstrated with quantitative design recommendations for user interfaces of mobile phones and washing machines. The author conducts a validation and evaluation of the functional modeling tool, based on an industrial use case, in cooperation with design experts. The author suggests to the future researcher adaptive hardware concepts will be a well-established interaction concept and dissolving the limitations between the design process and the designed artifact.

In [5] author specifically focused on the area of user interface description languages in HCI. The author has proposed the description language of HCIDL in a model-driven approach. The author's work is motivated by the difficulty of existing interaction platforms that are SMUIML and M4L languages. Author proposition had to intend for modeling multi-target, multimodal, plastic interaction interfaces using a user interface description languages. The author's proposed work has the criteria of the MDE approach defining an effective model-based development with the MVC model. Author project development of its UI builder tool based on their HCIDL user interface description language will be considered. The author's main purpose is to promote, as much as possible, natural communication with the end-user.

In [6], the author presents an integrated model-driven development method of UI adaptation rules and context-of-use. The author has proposed an Adapt UI modeling language coupled with adaptation rules and integrated into an overall UI framework. This allows runtime UI adaptation realized by an automatic reaction to dynamically changing context-of-use parameters like user profile, platform, and usage environment. The author's approach was demonstrated by a case study, showing the development of self-adaptive UIs for a university library application, utilized the Angular 2 JavaScript framework. In the future, the researcher has to enhance the proposed UI self-adaptation loop. In this context, it is conceivable to apply learning algorithms based on the user's assessment of executed adaptation operations to further improve UI adaptations.

Author [7] focus the method for integrating adaptive UIs in enterprise applications based on CEDAR architecture. The author's case study method is to establish and apply technical metrics to measure the properties of the open-source enterprise application OFBiz as a test-case. The author's method uses interpreted runtime models to empower enterprise applications with adaptive UI capabilities. The author established the OFBiz open-source enterprise application to evaluate the scenarios. For an upcoming buddy researcher's author suggest automatically detect the temporal operators for the task models of a user interface (e.g., HTML) into a model-driven representation.

Authors [8] focus the study on an in-depth analysis of the strengths and weaknesses of a tangible user interface and graphical user interfaces of the same system, these modeling, and simulation tools called "Flow Blocks". The author carried out the interview method with users to reveal the stimulation and enjoyment of using both user interfaces. Author studies from the outcomes of the method the tangible user interface have the properties of physical interaction, rich feedback, and a high level of realism, which are failing in graphical user interface properties. The author suggests to the upcoming researchers in future they compare the other user interfaces also.

In [9], the main goal of the author was to propose an SPL approach for the development of context-adaptable UIs. The Authors proposed a UI-DSPL approach, which is based on a Model-Based User interface and also enabling developers to implement the context-adaptability. The authors work intended to handle UI adaptation within DSPLs, providing a unified representation of UI variability, context-aware, post-deployment reconfigurable, or runtime adaptable. The authors validate the model by implemented a design phase for the development of initial UIs and a runtime phase for the adaptation of UI to the context change prototypes. In the future, the author wants to extend this DSPLs model in many different domains.

In [10] the author presents a novel context-aware and fine-grained access control model based on the ABAC paradigm for smart devices. The author addresses the issues of the existing model of TDeX smart devices. The author implements a middleware framework M4HSD and extends these models. The author exploiting the ABAC model, the proposed solution allows controlling every feature independently and paves the ground to the automated generation of the GUIs required to interact with the devices. In the future author suggest to the upcoming researcher to extend the solution of middleware and achieve the decentralized management of access through the global and distributed contexts.

The author [11] focuses on the concept of user's touch-based mobile performance used by a behavioral biometric system. The author has studied the experimental model, to collect raw touch data to extract features of classified users. The author has proposed two feature models, a stroke level model for extract low-level features and a session-level model for extract high-level features. The author proposed a classification framework, to learn the touch behavior of a user and also authenticate the user's behavior. An artificial neural network classifier was used to classify and identify the users. The author's outcomes of the study are that the session-level features are higher promises than the gesture level features. The author suggests to the buddy researchers in the future, use the variety of hardware and software for enriching the domain of research.

In [12] this work, the author focuses on the concept of integrating biometrics along with session management for user authentication. The author proposed the NCASHMA protocol designed a secure protocol is used for a user to authenticate itself, and also biometric authentication through enough session time. The author carried out this proposed work in the banking site with security authentication and extended session timeout. The author used fingerprint or thumb impressions as a medium of security under the biometric model. The authors concluded that the proposed protocol is best in providing continuous transparent user identity services over the internet.

Authors [13] focused on the concept of augmenting wireless body sensors for healthcare applications. Authors present a Dandelion novel framework for developing wireless body sensor applications on smart phones. The authors provide an implementation of Dandelion on the Maemo Linux smart phone platform and the Rice Orbit body sensor platform. The author evaluates Dandelion by implementing real-world applications, and shows that Dandelion effectively eliminates the programming gap and significantly reduces the development efforts.

In [14] this work, the author focuses on the concept of a unified code offloading system for wearable computing to leverage computation resources nearby through D2D and cloud was offloading. The author proposed a Dandelion framework based on Java annotation, a lightweight offloading service, and a runtime task scheduler to make offloading decisions. The author proposed model increases the computational

power and reduces the energy consumption of wearable devices. In future work, the author wants the buddy researcher will study the feasibility to migrate the system to other platforms.

The author [15] focused on the concept of abstraction technology for user interaction devices in the context of Ambient Intelligence and Ubiquitous Computing. The authors developed a dandelion framework with multi-agent technologies to build a physical UI's based on the GIP. The authors carried out the framework techniques of a model-driven approach with distributed device abstraction to develop physical UIs. The author's model outcomes are to reduce the coupling between the systems and end devices to implement the physical UIs. From this study, the author suggests the upcoming researcher uses the system and device independently.

The author [16] addresses the problem of developing user interfaces for ubiquitous computing and ambient intelligence systems. The author proposed a UI abstraction framework for UC and AmI systems that effectively improves the portability of those systems between different environments and for different users. The author proposed a Dandelion framework of UC user interfaces adaptable to different usage scenarios. Dandelion instead of relying on an ad-hoc mixture of technologies can lead the huge reductions in the development efforts required to build UC user interfaces.

In [17] this paper, the author presents a short review of the learning management system adaptivity trends and development challenges in the field of learning services for education 4.0. The author performs a comparative perspective between technology and heutagogical aspect in evaluating their approaches. Author implementation of AUI in LMS for education 4.0 needs to achieve new ways based on its environmental approaches such as mobile learning, social learning, and gamification learning. In the future, the upcoming researchers want to rectify the challenges and drawbacks.

Table 1. Consolidate Report of the Survey

AUTHOR	AIM	METHODOLOGY	RESULTS	FINDINGS
Abdelnasser, H., Harras, K. A., & Youssef, M. (2018).	WiGest ubiquitous WiFi-based gesture recognition system to detect hand motions around user device.	proof-of-concept prototype, a single AP and three overhead APs.	WiGest detects an accuracy of 87.5% using one AP, three APs it increase by 96%.	Increasing the ability of ubiquitous hands-free gesture-based interaction and system accuracy among others in the future.
Et.al Badam, S. K., (2018).	**Design visualization tools for enhanced their ubiquitous analytical scope.**	**VISTRATES document-based framework,**	**Server-side computation, wrapping existing web components and cross-device visualization in ubiquitous**	**Extend the work to realize the grand vision of a universal visualization platform.**

			analytics.	
Yin, H., Zhou, A., Liu, L., Wang, N., & Ma, H. (2019).	To conquer the problem of efficient typing or text-input on mobile devices and wearable.	Acoustic-based ubiquitous system Ubi Writer app-cloud architecture.	UbiWriter can achieve an accuracy of 93.75% on average under various practical Environments.	Develop more accurate, filter high noise and universal text-input systems to recognize non-word or different languages.
Kirisci, P. T., & Thoben, K. D. (2018).	To promote and enhance of physical user interface with the capabilities of interacting in an intelligent production environment.	Model-based conceptual framework and ontology-based context model	The author conducts a validation and evaluation of the functional modeling tool, based on an industrial use case, in cooperation with design experts.	Adaptive hardware concepts will be a well-established interaction concept and dissolving the limitations between the design process and the designed artifact.
Gaouar, L., Benamar, A., Le Goaer, O., & Biennier, F. (2018)	Focused on the area of user interface description languages in HCI.	HCIDL in a model-driven approach.	To intend for modeling multi-target, multimodal, plastic interaction interfaces using a UIDL.	In future author wants to extend the natural communication with the end-user.
Yigitbas, E., Stahl, H., Sauer, S., & Engels, G. (2017)	An integrated model-driven development method of UI adaptation rules and context-of-use.	An Adapt UI modeling language coupled with adaptation rules and integrated into an overall UI framework.	Showing the development of self-adaptive UIs for a university library application, utilized the Angular 2 JavaScript framework.	Enhance the proposed UI self-adaptation loop to apply learning algorithms to further improve UI adaptations.
Akiki, P. A., Bandara, A. K.,	the method for integrating adaptive	Based on CEDAR architecture.	uses interpreted runtime models to	Author suggest automatically detect the

& Yu, Y. (2014)	UIs in enterprise applications		empower enterprise applications with adaptive UI capabilities.	temporal operators for the task models of a UI into a model-driven representation.
Zuckerman, O., & Gal-Oz, A. (2013).	In-depth analysis of the strengths and weaknesses of a tangible UI and GUI	"Flow Blocks".	The tangible UI properties of physical interaction, rich feedback, and high level of realism, that are failing in GUI .	The author suggests to the upcoming researchers in future they compare the other user interfaces also.
Sboui, T., Ayed, M. B., & Alimi, A. M. (2017)	To propose an SPL approach for the development of context-adaptable UIs.	UI-DSPL approach	Implemented a design phase for the development of initial UIs and a runtime phase for the adaptation of UI to the context change prototypes	In the future, the author wants to extend this DSPLs model in many different domains.
Baresi, L., & Sadeghi, M. (2018, July).	Novel context-aware and fine-grained access control model for smart devices.	ABAC model	Controlling every feature independently and automated generation of the GUIs required to interact with the devices.	To extend middleware and achieve decentralized management of access through the global and distributed contexts.
Ramadan, A., Hemeda, H., & Sarhan, A. (2017)	User's touch-based mobile performance used by a biometric system.	Stroke level model and session-level model classification framework	session-level features are higher promises than the gesture level features.	Use the variety of hardware and software for enriching the domain of research.

M. Somasundara Rao #1 , Dr. K. Venkata Rao #2 , Dr. M.H.M. Krishna Prasad	Integrating biometrics along with session management for user authentication.	NCASHMA protocol	Providing continuous transparent user identity services over internet only.	The proposed protocol is best in providing continuous transparent user identity services over the internet.
Lin, F. X., Rahmati, A., & Zhong, L. (2010)	Augmenting wireless body sensor for healthcare application	Dandelion novel framework	Effectively eliminates programming gap and reduces the development efforts	To improve the framework model in various related domains
Golkarifard, M., Yang, J., Huang, Z., Movaghar, A., & Hui, P. (2018).	A unified offloading system for wearable computing to leverage computation resources nearby through D2D and cloud offloading.	Dandelion framework based on Java annotation	Increase the computational power and reduces the energy consumption of wearable devices.	In the future work, author wants to the buddy researcher will study the feasibility to migrate the system to other platforms.
Varela, G. (2013, June).	Abstraction technology for UI devices in the context of AmI and Ubicomp	Dandelion framework with multi-agent technologies	To reduce the coupling between the systems and end devices for implement the PUIs.	To use the system and device independently.
Varela, G., Paz-Lopez, A., Becerra, J. A., & Duro, R. (2016).	Developing user interfaces for ubicomp and AmI's.	Dandelion framework	Lead the huge reductions development of efforts required to build UC user interface.	In future author wants to extend the framework to increase the utility

3. DISCUSSION

WiGest [1] has several techniques but it uses only a few of them and fails to handle other techniques. However WiGest has controlled the devices by interacting, signal receiving is the effect as it blocks the entire WiFi chip. Author [3] has some of the challenges, that in ubiwriter the power of noise overwhelms the power of writing sound, the filtration of noise is a big challenge and in word-level recognition, a random combination of independent characters, is an open problem. In [2] Vistrates used the principles of malleability, shareability, and distributability even though, it fails to support some of the limitations like scalability, usability, and flexibility. In [4], descriptive and qualitative nature, not sufficient for detailed technical design and fail to consider all product variations and features. Model-Based User Interface Development Tools are mainly focused only on software user interfaces and the Physical platform is predefined. In [5] HCIDL supports multimodal, multi positioning by the view model and it also used MDE model-based development, however, it fails to used other models. In [6], the quality assurance techniques in the model-driven UI adaptation approach are not cover, and also it fails to promote other technical algorithms to improve UI adaptation. In [7], operators are specified manually only, for using the task model design tool in our IDE Cedar Studio not automatically process one. Author [10], the solution does not impose any hardcoded solution, but everything is retrieved and generated at runtime. Author [11] used only specified hardware and software it fails to use a different variety of screen size, resolution, pixel densities, and different operating systems.

4. CONCLUSION

This computing technology is a restoration of traditional educational methods from day-to-day. Ubiquitous computing has high prospects for human life along with certain challenges across computer science, system design, system engineering, system modeling, and in Human-Computer Interactions (HCI) design. As we make a comprehensive study in this paper, the main concept of context-aware and context-adaptability in ubiquitous computing specifically user interfaces. During this process of observation that research into context-aware computing is still at its early stage and there exist several central research challenges in context-aware computing. We also intend to analyze the session handling concept in the context-aware and context adaptability model for the user interface that exists today and our future work.

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