Journal of Engineering and Computer Sciences
Qassim University, Vol. 10, No. 1, pp. 39-52 (January 2017/Rabi' II 1438H)

Survey on Modelling Context-aware Systems

Mafawez Alharbi[1] and Abdulgader Almutairi[2]

[1]*Computer Science Department, College of science, Majmaah University*

[2]*Computer Science department, College of Art &Science, Qassim University (Saudi Arabia)*

M.alharbi@mu.edu.sa[1] *Azmtierie@qu.edu.sa[2]*

(Received 24/8/2016; Accepted for Publication 8/2/2017)

ABSTRACT. Context-aware system (CAS) presents completely novel opportunities for users and application developers through gathering context data and adapting systems behavior based on current situation. Particularly in relation to various types of mobile devices, high value mechanisms are utilized to increase usability of it.

The usage of CAS has been increased nowadays. The main objective of the CAS is to provide intelligence that has ability to detect context on behalf of the user. Modelling context-aware system is still developing and till date only a small number of researches tried to present modelling of CAS. This review focuses on the context aware system and conceptual design framework with respect to their principles and merits. This explains the two types of modelling CAS; the first one, when the context is certain and the second, when the context is uncertain. Each type has its own techniques. It is believed that this survey will make it easy for the software engineers to select the appropriate technique for the system.

***Keywords*:** Context-awareness; context model; pervasive computing

1. INTRODUCTION

The objective of context-aware system is that, it can provide intelligence and can be used to detect context on the user's behalf thus reduces the need for human attention [1]. Mark Weiser is considered the father of ubiquitous computing [2]. He proposed ubiquitous computing (pervasive systems) in 1991 when he was the chief technologist of Xerox Palo Alto Research Centre (PARC) in the US. Weiser wrote the earliest papers on this subject area; only later were his research and projects given increased attention.

Context-aware systems are one type of pervasive systems and computer scientists view these as a mature technology. A definition for the context is given by Dey [3] as, "Context is any information that can be used to characterize the situation of an entity where an entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and application themselves".

Many definitions of context-aware system are presented [4-6]. Some of these concentrate on various aspects of a context-aware system. According to Dey and Abowed in the context aware system, Context is mainly used by the system in order to obtain relevant information and service depends on user task [7].

Context aware system collects contextual information from different sources without explicit user interaction and executes the operation accordingly.

Context-aware systems have the ability to easily integrate with any service domain such as healthcare, commerce, learning, transport [8, 9].In order to develop context-aware systems, it is very important that the context models should be well designed. Earlier, the modelling of context was concentrated on one application, generic context model and application class, which make them of high interest and many application take advantage from them. While various models consider e.g. in a meeting, as the user current position whereas others consider i.e. location, as physical environment.

With reference to previous studies discussed regarding context aware model be aim to develop a recent approach for query language, uniform context model and reasoning algorithms that help in implementation of various application.

There are few research works on the topic of modelling context-aware system. However, these research works does not cover all the technique for modelling CAS [10-13].

When the software engineers design a system and reaches a point that they want to choose the tools for modeling their system, it takes more time to choose which model fit within their system. The time management is very important for the researcher. In addition, to the best of our knowledge, there is no research that has come up with complete information and gathers that in one paper. Each type has its own techniques. In the next section, we present the modeling CAS techniques; and we will discuss the techniques, the advantage and the limitations of it.

The objective of this review is to summarize context aware system and their conceptual design framework by two types of CAS modelling, the first, when the context is certain and the second, when the context is uncertain. Each type has its own techniques. In this paper, we present a survey of the most relevant current approaches to modelling context-aware system. The rest of the paper is organized as follows: Section 2 starts with related work and motivation. Section 3 gives a comprehensive modelling certain context. 'Modeling uncertain' context is presented in Section 4. And the paper has been summarized in Section 5.

2- RELATEDWORK AND MOTIVATION

2-1 Related work

There are very few research works that speaks about modelling context-aware system. First paper was presented [10], which reviewed common architecture principles of context-aware system. In addition, the paper presents a summary for the most relevant context modeling technique. However, the author did not give more details regarding the stability for each technique.

Other survey paper was presented in [11]. Similar to the previous paper, the author had shown the common technique for modeling context-aware system. In the modeling, approaches surveyed were evaluated concerning the requirements introduced. The main limitation of this study is that it did not include the uncertain modeling context.

Other paper presented in [12], show brief introduction of context-aware techniques. This paper helps to understand context-aware and appreciate the role of modelling context. The research classifies context-reasoning techniques broadly into six categories. The author presents the essential background by introducing the Internet of Thing (IoT) paradigm and context-aware fundamentals. However, the research presents a few modelling techniques, there are many other techniques which should have been presented.

In addition, a survey with title " A survey of context-aware mobile computing research " is presented in [13], the research has focused in depth to the type of context used and the model of context information. The paper point that context-aware research is an old but, it is rich area for research. The author argues that there are many type of context and all the current system uses their own way to model the context information. In addition, it shows that most researches of modelling context focus on location information. The limitation to the paper is that it fails to cover the rest of technique to model context aware system.

3- MODELLING CERTAIN CONTEXT

This section presents a summary of modeling certain context in CAS. Context-aware system can be modeled by the five modeling approaches as it is shown in table1.This section will describe context models approaches.

Table (1). Modelling approaches

Serial	Modeling name
1.	Key-Value model
2.	Mark-up Scheme model
3.	Graphical model
4.	Logic based model
5.	Ontology

3-1 Key-Value model

Key-value model is one of the easiest ways to model context, because it has simple structure. For example, Name: James, Location: work, Time: 10:00 Am. This model is based on data structure for modelling contextual information. [14] Used Key-Value Models in order to model context information. The value of the context information has been provided to the application as an environment variable. The key value models and key value pairs are used to describe different service framework and capabilities of service respectively. Furthermore the service discovery also then applied by utilizing by matching algorithms with key value pairs.

The advantage of using this model is that it is easy to manage. However, it lacks capabilities for structuring of efficient context retrieval algorithms and it is not appropriate for complicated structure [15].In additional, this technique is not suitable for hierarchical structure [43].

3-2 Mark-up scheme models

A hierarchical data structure is the common approaches in most mark-up scheme. This scheme includes mark-up tags with attributes and content. The content of the mark-up tags is recursively well defined by other mark-up tags. The good examples of this approach are the Comprehensive Structured Context Profiles (CSCP) and the Pervasive Profile Description Language (PPDL) [16].

Another approach to mark-up scheme is Pervasive Profile Description Language (PPDL). XML based language allows accounting for context information. Mark-up schemes have different other approaches for modeling context information [17].

3-3 Graphical model

Visual languages have the ability to play an important role in software engineering. The graphical model is easily understandable by human beings and the complex models are better realized. Thus, Object Oriented Model is able to model context-aware system. Generally UML are used by software engineer as object modeling techniques. This technique is capable to design context information model and mapping of the model which could be used in object oriented programming language.

The UML is a general purpose

modeling language with potential for use in many application domains

The UML is a general purpose

modeling language with potential for use in many application domains.

The UML is a general purpose

modeling language with potential for use in many application domains.

The UML is a universal-purpose modeling language with potential for use in many applications field [18].

UML provides diverse diagram classes to visualize separate aspects of the modeled software systems. A good example for modeling context-aware system by UML is Bauer's work [19], where UML has been used to model air traffic. The advantage of using UML is that it can be used to derive an Entity Relation Model(ER-model) which has the benefit of structuring instrument for a relational database. However, UML has limitations to model context information. For example, UML is not suitable to model context history, uncertainty and incomplete information.

Object-Role Modeling (ORM) is able to model the context. For example, ORM is used to model context-aware system by [20]. The advantage of using ORM is to allow express different constraints that are leveraged.

Context Modeling Language (CML) is based on Object-Role Modeling (ORM). CML is able to provide a graphical notation designed to support software engineering. In particular, it allows analysis and formalizes the requirement of context-aware system [21]. However, CML contains a flat information model where context type is represented as atomic facts.

The power in graphical model is on the structure level. It has the ability to describe the structure of context information and derive a code. The main function of graphical model is to define human structure purposes. However, the formality in graphical model is relativity very low.

3-4 Logic based models

In this model, the context is defined depending on three issues, which are facts, rules and expression. Context information can be added, deleted and updated as facts logic based system. The first logic based approach of context model is presented as Formalizing Context by [22]. A context was presented as mathematical entities and its properties where formalization recipe were given. The main important point in this model was that referring the truth in one context to the truth in another context. The primary relation in this model is (c, p), where p is true in the context c.

The advantages of all logic-based models are that they have a high degree of formality. On the other hand, the logic-based model is not able to infer from imprecise and incomplete context [23].

3-5 Ontology

The word Ontology is used in philosophy for long time, which refers to the subject of existence. Ontology is a way to describe knowledge systematically. It has a high degree and formal expressive. Ontology is popularly used to represent context in context-aware system. It is possible to apply ontology-reasoning techniques. Context Broker Architecture is a good example of modelling context-aware system using ontology model, where ontology concept is provided to characterize entities such as person, place and devices [24]. Ontology consists in the supporting of reasoning task.

There are advantages for modeling context-aware system via ontology. One reason is that it allows computational entities to have a common set of concepts about context while interaction with one another. In additional, ontology has logic reasoning mechanisms, which are used to deduce high-level context from low-level raw data [25].

Many ontology approaches are used for information system but CoBrA system (Context Broker Architecture) is excellent model among all [26], which characterizes entities by offering a set of ontological concepts.

On the other hand, ontology has some limitations regarding to the dynamic inferring context. Defining all the rules is required in ontology whereas user of context-aware system is not able to satisfy these requirements because there is a lack of comprehensive knowledge about their domains [21].

3-6 The Calculus of Context-aware Ambient (CCA)

This study has added the Calculus Context-aware Ambient (CCA in short) as another way to model context information.

An important issue in pervasive computing is that any component has to be mobile and context-aware. Mobility and context awareness are unique characteristics to build pervasive computing and context aware system amplifies all aspect of environment for the use of information as per the interface [27, 28].

There is a limitation for modeling context-aware systems. In particular, there is a lack of linguistic support and mechanism that model context-awareness in mobile application. The Calculus of Context-aware Ambient (CCA) is proposed to solve that issues which introduces a new constructs to allow ambient and processes to be aware of the environment in which they are being executed [26]. CCA is able to provide the mobile capabilities that allows context to move autonomously from one location to another. CCA has some mechanisms that support context-awareness as it has the ability to sense context. Formal models are those with sound basis in mathematics. Table 2 presents Syntax of CCA processes and capabilities.

Table (2). Syntax of CCA processes and capabilities

P, Q, R ::=	**Process**	α ::=	**Locations**
0	inactivity	$\uparrow$	any parent
$P \mid Q$	parallel composition	$n\uparrow$	parent n
$(\nu n)\ P$	name restriction	$\downarrow$	any child
$n[P]$	ambient	$n\downarrow$	child n
$!P$	replication	::	any sibling
$\kappa?M.P$	context-guarded action	n ::	sibling n
$x \triangleright (\tilde{y}).P$	process abstraction	ϵ	locally

M ::=	**Capabilities**
`del` n	delete n
`in` n	move in n
`out`	move out
$\alpha\ x\langle\tilde{y}\rangle$	process call
$\alpha\ (\tilde{y})$	input
$\alpha\ \langle\tilde{y}\rangle$	output

3-7-Temporal logic

Temporal logic are being used widely by academician and industries to verify behavior characteristics of various hardware and software.

Interval Temporal Logic (ITL) is the first order logic with added time dependent operators like “sometimes”, “always”, “next”. For ITL there is an interpreting mechanism and its program realization called Tempura.ITL is one of the formal methods in the development of real-time systems that have their benefits. However, turning them into a sound engineering practice has proved to be extremely difficult. ITL is a flexible notation for both propositional and first-order reasoning about periods of time [27].

4. MODELLING UNCERTAIN CONTEXT

To model a context-aware system when the context is ‘uncertain’, an AI technique must be used. The AI technique must have a property that fuses the sensed

information in order to resolve any conflict and thus increase the level of confidence in the results [44]. There are various widely deployed AI techniques, including fuzzy logic, neural networks, Probabilistic Logic, Bayesian networks and Fuzzy Situation Inference (FSI), and these are introduced below:

4-1-Neural networks

Neural networks are able to fuse the outputs of multiple sensors. A neural network has the ability to learn associations between input and output; the input and output are important factors for an observer [29-31]. The learning capability of a neural network is very high but its internal state is of no interest to the observer so it can be described as a black box for the user. Neural networks are good for applications that demand control, estimation and system identification. However, the limitation of neural networks is their lack of design techniques. Neural network technique cannot be used as foolproof technique in dynamic sensor configuration environment because it needs unique input node and well trained sensor-set configuration In addition, training a neural network is normally a slow process

4-2 Fuzzy logic

Fuzzy logic is defined by Michaed as: “A set of mathematical principles for knowledge representation, based on degrees of membership rather than on crisp membership of classical binary logic”. Fuzzy logic has been applied to various applications such as robotics and medicine. It is used to represent vague concepts and it is used for reasoning. Each component described in fuzzy logic has a membership degree of either 1 or 0. A serious weakness with this is that because fuzzy logic uses approximations rather than fixed and exact data, it is not a good candidate for managing systems that require extreme precision [32].

4-3 Probabilistic Logic

The aim of the probabilistic logic is to facilitate logical assertions that are associated with a probability [39, 34]. This technique makes it possible to make a statement, such as “the probability of B is less than ½” and “the probability of A is at least twice the probability of B”, where B and A are random variables. Furthermore, using probabilistic logic allows us to write rules to reason about an event’s probability of occurring relative to other events. These rules can be used for resolving conflicts between context information obtained from different sources. A serious weakness with this tool, however, is that it does not offer adequate expressive rules to capture the uncertainties and dependencies between variables, or to model the temporal aspects of the domain [35].

There are many examples for this approach, but one excellent example that is used is that Applications in Gaia uses the probabilities of various contexts to influence their decisions and behaviors. Gaia constructs on the concept of an active space, coordinating heterogeneous devices in a physical space, naturally a single room. Like operating systems, it delivers program implementation, I/O operations, file-system access, communications, error detection, and resource allocation. The

applications get context predicates and their associated probabilities from Context Providers and Context Synthesizers [36].

It can be utilized for development and execution of portable application for active spaces [37].

The Gaia architecture is shown in figure 1 below.

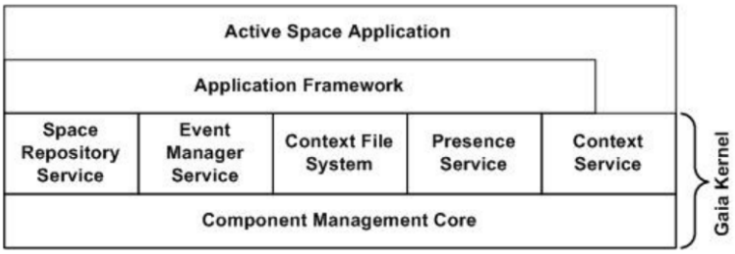

Fig. (1). Gaia architecture

4-4 Bayesian Networks

A Bayesian network (BN) is a graphical model resulting from a marriage between probability theory and graph theory. It provides a natural tool for dealing with uncertainty, knowledge representation and inference [39]. A Bayesian network is defined as having each variable in a Bayesian network represented by a node in a graph and direct dependency of variable are presented by direct edges [40].

The directed edges between two variables in a BN represent a causal relationship. The conditional probabilities table (CPT) specifies the relationship between two variables. BNs are precise and efficient in representing and storing conditional probabilities [42].

4-5. Fuzzy Situation Inference (FSI)

Fuzzy Situation Inference is the combination between Context Spaces (CS) model and fuzzy logic principles, which make it as formal and general modelling technique and context reasoning for ubiquitous computing environment. The context spaces model offers type of sensor data which Particularly developed for pervasive computing environments in order to deal with incorrectness of sensory initiation information e.g. error of reading and reliability and context characteristics. The FSI technique integrates into the CS model in order to support pervasive computing environments and context-aware system by the use of fuzzy logic to model and reason about unclear and unsure condition. A set of fuzzy sets can represent a situation in FSI and expressed as a FSI rule. However, the situation in CS can also be defined utilizing several rules that have reliant on or intersecting

conditions to deliver representation of the situation in flexibility way. The rule in FSI involves various conditions and between these conditions AND or OR operator and the testing of the input values will be done by each condition using membership function that links to a fuzzy term. The resulting of the rule represents the output which proposes the confidence degree in the occurrence of a situation [43]. The degree of confidence level is for hypertension yields is 0.885 it means output of rule assessment is same as standard.

5- CONCLUSIONS

In this paper, we presented different techniques for modelling context-aware system. This review focuses on most used technique to model context-aware system. The most appropriate definition from my point of view is that, Context aware system is one that is capable of utilizing the context to give appropriate services as per need of the requester which is based on user context. Therefore, modelling CAS is divided into two types; certain, and uncertain. Each type has its different techniques and their advantages and disadvantages.

We believe that this review criterion by summarizing research of various contexts aware models can support new researchers for advancement of appropriate to build compatible context aware system for future.

The results clearly show the importance of context aware system and the goal for this survey is to build a foundation that helps us to understand different technique for modelling context-aware. Our future work will be focusing on modelling uncertain context and studying these techniques in more details.

REFERENCES

[1].Loke, S.W., Singh, J. and Le, H., 2008. Context aware pervasive persuasive systems for managing water and energy usage and co2 emissions: multi levelled policies, goals, and an expert systems shell approach. In Workshop on Security and Privacy Issues in Mobile Phone Use (p. 3).

[2].M.Weiser.Available: http://pubweb.parc.xerox.com/weiser/ weiser.html[6/ 17/ 2011].

[3].Dey, A.K., 2001. Understanding and using context. Personal and ubiquitous computing, 5(1), pp.4-7.

[4].Schilit, B., Adams, N. and Want, R., 1994, December. Context-aware computing applications. In Mobile Computing Systems and Applications, 1994. WMCSA 1994. First Workshop on (pp. 85-90). IEEE.

[5].Zimmermann, A., Lorenz, A. and Oppermann, R., 2007, August. An operational definition of context. In International and Interdisciplinary Conference on Modeling and Using Context (pp. 558-571). Springer Berlin Heidelberg.

[6].Pascoe, J., 1998, October. Adding generic contextual capabilities to wearable computers. In Wearable Computers, 1998. Digest of Papers. Second International Symposium on (pp. 92-99). IEEE.

[7].Abowd, G.D., Dey, A.K., Brown, P.J., Davies, N., Smith, M. and Steggles, P., 1999, September. Towards a better understanding of context and context-awareness. In International Symposium on Handheld and Ubiquitous Computing (pp. 304-307). Springer Berlin Heidelberg.

[8].Hristova, A., 2008. Conceptualization and Design of a Context-aware Platform for User-centric Applications.

[9].Zhang, D., Yu, Z. and Chin, C.Y., 2005. Context-aware infrastructure for personalized healthcare. Studies in health technology and informatics, 117, pp.154-163.

[10]. Baldauf, M., Dustdar, S. and Rosenberg, F., 2007. A survey on context-aware systems. International Journal of Ad Hoc and Ubiquitous Computing, 2(4), pp.263-277.

[11]. De Roure, D. and Indulska, J., 2004. Proceedings of the First International Workshop on Advanced Context Modelling, Reasoning and Management.

[12]. Perera, C., Zaslavsky, A., Christen, P. and Georgakopoulos, D., 2014. Context aware computing for the internet of things: A survey. IEEE Communications Surveys & Tutorials, 16(1), pp.414-454.

[13]. Chen, G. and Kotz, D., 2000. A survey of context-aware mobile computing research (Vol. 1, No. 2.1, pp. 2-1). Technical Report TR2000-381, Dept. of Computer Science, Dartmouth College.

[14]. Schilit, B., Adams, N. and Want, R., 1994, December. Context-aware computing applications. In Mobile Computing Systems and Applications, 1994. WMCSA 1994. First Workshop on (pp. 85-90). IEEE.

[15]. Schilit, W.N., 1995. A system architecture for context-aware mobile computing (Doctoral dissertation, Columbia University).

[16]. Held, A., Buchholz, S. and Schill, A., 2002. Modeling of context information for pervasive computing applications. Proceedings of SCI, pp.167-180.

[17]. Chtcherbina, E. and Franz, M., 2003, January. Peer-to-peer coordination framework (p2pc): Enabler of mobile ad-hoc networking for medicine, business, and entertainment. In Proceedings of International Conference on Advances in Infrastructure for Electronic Business, Education, Science, Medicine, and Mobile Technologies on the Internet, L'Aquila, Italy (pp. 883-891).

[18]. Hsu, I., 2012. Extending UML to model Web 2.0-based context-aware applications. Software: Practice and Experience, 42(10), pp.1211-1227.

[19]. Bauer, J., Kutsche, R.D. and Ehrmanntraut, R., 2003. Identification and modeling of contexts for different information scenarios in air traffic. TechnischeUniversität Berlin, Diplomarbeit.

[20]. Henricksen, K., Indulska, J. and Rakotonirainy, A., 2003. Generating context management infrastructure from high-level context models. In In 4th International Conference on Mobile Data Management (MDM)-Industrial Track.

[21]. Halpin, T. and Morgan, T., 2010. Information modeling and relational databases. Morgan Kaufmann.

[22]. McCarthy, J., 1993. Notes on formalizing context.

[23]. Zhang, D., Guo, M., Zhou, J., Kang, D. and Cao, J., 2010. Context reasoning using extended evidence theory in pervasive computing environments. Future Generation Computer Systems, 26(2), pp.207-216.

[24]. Chen, H., Finin, T. and Joshi, A., 2005. Using OWL in a pervasive computing broker. MARYLAND UNIV BALTIMORE DEPT OF COMPUTER SCIENCE AND ELECTRICAL ENGINEERING.

[25]. Wang, X.H., Zhang, D.Q., Gu, T. and Pung, H.K., 2004, March. Ontology based context modeling and reasoning using OWL. In Pervasive Computing and Communications Workshops, 2004. Proceedings of the Second IEEE Annual Conference on (pp. 18-22). Ieee.

[26]. Solanki, M., Cau, A. and Zedan, H., 2004, May. Introducing compositionality in web service descriptions. In Distributed Computing Systems, 2004. FTDCS 2004. Proceedings. 10th IEEE International Workshop on Future Trends of (pp. 14-20). IEEE.

[27]. Siewe, F., Zedan, H. and Cau, A., 2011. The calculus of context-aware ambients. Journal of Computer and System Sciences, 77(4), pp.597-620.

[28]. Zedan, H., Cau, A., Chen, Z. and Yang, H., 1999. Atom: An object-based formal method for real-time systems. Annals of Software Engineering, 7(1-4), pp.235-256.

[29]. Siewe, F., Al-alshuhai, A., Almutairi, S. and Almutairi, A., 2016. Analysing Use Case Diagrams in a Calculus of Context-aware Ambients.

[30]. Hopgood, A.A., 2011. Intelligent systems for engineers and scientists. CRC press.

[31]. Wu, H., Siegel, M., Stiefelhagen, R. and Yang, J., 2002. Sensor fusion using Dempster-Shafer theory [for context-aware HCI]. In Instrumentation and Measurement Technology Conference, 2002. IMTC/2002. Proceedings of the 19th IEEE (Vol. 1, pp. 7-12). IEEE.

[32]. Schmidhuber, J., 2015. Deep learning in neural networks: An overview. Neural Networks, 61, pp.85-117.

[33]. Cintula, P., Fermüller, C. and Noguera, C., 2015. Handbook of Mathematical Fuzzy Logic-Volume 3.

[34]. Tapia, F.J., Lopez, C.A., Galán, M. and Rubio, E., 2008. 'Bayesian Model for Optimization Adaptive e-Learning Process. Journal of Emerging Technologies in Learning, 3(2), pp.38-52.

[35]. Al-Sultan, S.J., 2013. Context Aware Drivers' Behaviour Detection System for VANET.

[36]. Bettini, C., Brdiczka, O., Henricksen, K., Indulska, J., Nicklas, D., Ranganathan, A. and Riboni, D., 2010. A survey of context modelling and reasoning techniques. Pervasive and Mobile Computing, 6(2), pp.161-180.

[37]. Coletti, G. and Scozzafava, R., 2012. Probabilistic logic in a coherent setting (Vol. 15). Springer Science & Business Media.

[38]. Al-Sammarraie, M., 2011. Policy-based approach for context-aware systems.

[39]. Román, M., Hess, C., Cerqueira, R., Ranganathan, A., Campbell, R.H. and Nahrstedt, K., 2002. A middleware infrastructure for active spaces. IEEE pervasive computing, 1(4), pp.74-83.

[40]. Lan, P., Ji, Q. and Looney, C.G., A Probabilistic Framework for Modelling and Real-Time Monitoring Human Fatigue.

[41]. Ramachandran, S. and Mooney, R.J., 1998. Theory refinement of bayesian networks with hidden variables (Doctoral dissertation, University of Texas at Austin).

[42]. Al-Sultan, S., Al-Bayatti, A.H. and Zedan, H., 2013. Context-aware driver behavior detection system in intelligent transportation systems. IEEE transactions on vehicular technology, 62(9), pp.4264-4275.

[43]. Hulst, J., 2006. Modeling physiological processes with dynamic Bayesian networks. Faculty of Electrical Engineering, Mathematics, and Computer Science, University of Pittsburgh.

[44]. Haghighi, P.D., Krishnaswamy, S., Zaslavsky, A. and Gaber, M.M., 2008, October. Reasoning about context in uncertain pervasive computing environments. In European Conference on Smart Sensing and Context (pp. 112-125). Springer Berlin Heidelberg.

دراسة مسحية لنماذج أنظمة الإستشعار بالبيئة المحيطة

مفوز الحربي وعبدالقادر المطيري

قسم علوم الحاسب–كلية العلوم– جامعة المجمعة

قسم علوم الحاسب–كلية العلوم والآداب–جامعة القصيم

M.alharbi@mu.edu.sa, Azmtierie@qu.edu.sa[2]

(قدم للنشر في ٢٠١٦/٨/٢٤؛ وقبل للنشر في ٢٠١٧/٢/٨)

ملخص البحث.نظام الاستشعار بالبيئة المحيطة هو نظام يتيح فرصاً جديدة للمستخدمين ومطوري التطبيقات من خلال استشعار وجمع البيانات من البيئة المحيطة بالمستخدم ومن ثم جعل سلوك النظام يتكيف على الوضع الجديد, وخصوصاً مع استخدام أنواع مختلفة من الأجهزة المحمولة التي لها قابلية عالية للاستخدام.

وقد ازداد استخدام هذه الأنظمة في الوقت الحاضر وذلك لقدرتها على استشعار البيانات المحيطة بالمستخدم نيابة عنه. مازالت نمذجة أنظمة الاستشعار طور النمو حتى وقتنا الحاضر والقليل من الباحثين يحاولون تطوير هذه النماذج لتكون أكثر شمولية من الأنظمة التقليدية.

هذا المسح البحثي يركز على تصميم الإطار العام لأنظمة الاستشعار بيما يتوافق مع مبادئ هذه الأنظمة من خلال طرح نوعان من أنواع نمذجة أنظمة الاستشعار وكيفية بناء كل نموذج: النوع الأول عندما تكون البيانات معرفة ومؤكده والنوع الثاني عندما تكون البيانات غير معرفه وغير مؤكده وكل نوع من هذه الأنواع له طريقته الخاصة في التعامل مع البيانات المستسقاة من البيئة المحيطة. هذه الدراسة الاستقصائية سوف تساعد مهندسي البرمجيات على اختيار النوع المناسب لأنظمتهم.