



A Survey on Context Awareness Security in Healthcare

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Abstract: Context-aware computing is a very rich and an interesting area of research when it comes to healthcare applications. In the forthcoming years, health care systems will be incorporating many new computing technologies. This survey intends to obtain an objective view of how context awareness works in healthcare, and have a glance at the advantages and shortcomings in it. Context awareness in computer science means the idea of sensing and reacting to the user's environment. Mobiles (smart phones) are taken into consideration, based on where the user is located, when during the day, etc., his privacy and security is tracked 24/7, and this situational information helps to increase the information security decisions. When it comes to healthcare, every minute data has to be analysed thoroughly as it is related to a person's healthcare. Understanding and handling such huge amount of data is a tedious task and there should be a top-notch security for such huge data's. In such cases context awareness, would help to improve the security of current healthcare system. This paper concludes a better understanding of the important aspects of context and context-aware applications in health care. This paper also explains that an understanding of a number of disciplines is needed to conduct this research in healthcare system.

Keywords: Context; Context awareness; Context aware systems; Health care systems; Ubiquitous systems

I. INTRODUCTION

Context-aware security systems use information of a person based on situation (such as identity, geo-location, time of the day or type of end of destination of a device) to improve information security decisions using context aware systems, the system must be aware of certain parameters like who the user is, what data the user is requesting, how/which type of network the user is connected to and where exactly the user is located. To be technically precise a system is a context aware system if it provides relevant information and/or services to the user, where the probability depends upon the task which the user is currently performing [15]. Over the next 10-15 years, national health systems will have to treat proportionally more number of people, with more illness by relatively using less tax dollars and workers, for which the systems are already under noteworthy strain [8]. To develop the coming setting of diminishing resources in a vigorous way and increasing demand for it, we are in huge need of new systems for care which are fundamentally endurable with high end security and privacy and this may require nothing less, but the reinvention of the health care system all over [8]. The major goal is to prevent unauthorized end users or insecure computing devices from being able to access the sensitive data. Context awareness is a concept that has been described for some time now, but technologies (e.g. wireless technologies, mobile tools, sensors, wearable instruments, intelligent artifacts, handheld computers) are now available to support the development of applications in the same field. Technologies like these could help healthcare professionals to manage their chores while increasing the quality and efficiency of patient care.

Healthcare is a vast field which will keep evolving as and when the new technologies are adopted. The technologies like context awareness system keeps the healthcare professionals away from the manual work and shifts part to digitalized methods. The reinvention of healthcare systems is a complex task and hence there must be inventions which will increase the quality of the future healthcare system. Medical systems

and infrastructures represent a vast growing risk factor with respect to the security and privacy of the medical data's they contain. Hospitals and similar healthcare organizations typically have 300% to 500% more medical equipment than IT equipment and two trends are contributing to the increasing significance of this security risk:

- Medical devices and systems are being designed and operated as special purpose computers, more features are being automated, increasing amounts of medical data are being collected, analysed and stored in these devices.
- There has been a rapid growth of integration and interconnection of disparate medical (and information) technology devices and systems where medical data is being increasingly exchanged[10].

Cooperation between healthcare professionals can be mediated through digitalized/computerized platforms like homecare coordination system, hospital GP intermediation platform etc. These tools will integrate new mobile tools and increases the new communication abilities between the health care professionals and the patients [1].

II. LITERATURE SURVEY

A. Context Aware Systems in Health Care

Hospitals need to manage costs of the entire system while delivering high-quality patient care. A hospital can improve the quality of patient care, increase hospital staff efficiency, and reduce capital and operational costs [2]. The context-aware healthcare solution enables hospitals to improve performance efficiency by integrating real time contextual information such as location and current status of medical equipment and staff into the actual workflow. It also enables access to environmental information to provide an optimal patient experience. The solution enables both real time tracking of assets and event-driven tracking, where in real time tracking moves throughout the campus and event-driven tracking exists and enter areas. The main aim of the healthcare systems must be to protect and ensure that the patient data is safe and sound. Also, the use of context is very important in

interactive systems, where the user's data is changing rapidly, both in handheld and ubiquitous computing. To understand the better usage of the context aware systems and what context is, we have surveyed the existing context aware system [11].

b. Background Study and Applications of Context Awareness

There has been a lot of efforts put and work done by researchers wherein they have discussed the basic concepts of context aware systems. Most of them do not favor the basic concept of context awareness and have proposed their own ideas of the same. For instance, Schilit et al. [5] has suggested three things that are to be considered when handling context aware systems. These are the location one is at, with whom one is roaming around and what are the kinds of resources one is utilizing. Furthermore, Chen et al. [6] has termed context as the combination of the various states and settings that describes how an application works, by also taking into consideration the user's perspective. Moreover, Dey et al. [7] has suggested that context can be considered as information that is used to determine the current state of an entity, where an entity may be a person, place, etc. These entities can be further used to improve the interactions that a user would later have with the application. There already are various applications in existence since the recent past that are context aware, and using which greater ones can be made.

According to many researches, context aware applications have primarily been made use of in laboratories and have provided designers with a laboratory setup to work in. One notable example of this is the Active Badge introduced in the early 90's [7]. It made use of badges that send out infrared signals and which would then be received by the various sensors distributed across buildings. This could be used to track the user's location and thereby automatically redirect the user's call. Another example is the ParcTab which also provides functionalities similar to the Active Badge but at the same time does so by making use of much simpler badges [6]. This was later on also implemented in the form of a Personal Digital Assistant (PDA) to bring about further improved context aware applications. At present there are also mobile based context aware applications which have a great potential in providing users with new functionalities in the near future. These applications come with a plethora of services such as displaying relevant information to the user, performing certain tasks or services for the user automatically, etc. [1].

As mentioned earlier, tourist information system is another example which makes heavy use of context aware software [12]. A popular example for this would be a cyber guide which is heavily used by foreign country visitors nowadays. These applications provide the users with suggestions of places that would be of interest to them by analyzing the places visited by them previously, their direction of movement, etc. [4]. Another example, popular in the city of Lancaster, is the GUIDE system which basically acts as a tour guiding system for the city's visitors [4]. Yet another example is the Mobile Location-Aware Handheld Event which is essentially another tour guiding system which provides information to its users using GPS location acquisition. But in addition to this, it also has the added functionality of an event

planner [3]. Access Sights is another notable example of context aware applications which is a tour guiding system specifically designed for people who are with special requirements like the blind or weak sighted people [6].

Context aware system also plays a major role when it comes to health care systems wherein automatically differentiating a patient from the rest of the surroundings, recording the various events associated to a particular patient, keeping track of the various services provided in a particular location along with the required documentation are some of the important functionalities need to be met by the system. There is also the added responsibility on the system to keep the information about the patient and the health care professional safe and secure. Security is also needed for all the equipment being made use of by health care systems. Therefore, health care systems cannot be seen as a system which is independent of the rest of the technical systems, but is in fact a socio-technical system which depends on the combined outcomes of the interactions between the user and the technology.

III. PROBLEM STATEMENT

When it comes to healthcare, even minute data needs to be collected to thoroughly analyze a person's health condition. This detailed data can sum up to gigabytes or even terabytes of data for just a single person. Handling such large volume of data is a very tedious task. Transferring and processing such kind of data tends to overlook quite a few security loopholes. This puts user's privacy and health at risk and could be very dangerous if it were to fall into the wrong hands. Manipulating such kind of data could even lead to a person's death. Therefore, such data needs to be protected with top notch security. To do this, one suggestion would be to have a standardized organization collecting, organizing and analyzing such data. No external user should be allowed access to such data. To protect the sensitivity of data we require new methodologies that deny unauthorized or leakage of information.

IV. REQUIREMENTS AND DESIGN SPECIFICATIONS

A. Prototypes Used in Hospital

- A context aware hospital bed with a built-in display system which can be used by patient for entertainment sake and by healthcare professionals for accessing medical data of the patient. Context aware system makes it secure and due to which the bed "knows" who is accessing it, and what and who is near that particular system.
- A context aware pill container which is accurately aware of the patient and reveals itself when it is close to the patient by lighting the proper container with the name of the patient which helps the healthcare professionals to know that the right person is getting the right medication.
- A context aware Electronic Patient Record which keeps track of the complete patient data which reduces the manual work done by the clinicians.
- Intelligent hospital software, is a prototype that allows localization of a team member and the ability to initiate an audio-video conference from the nearest point of the destination. This is implemented in emergency and accident departments.

- Context aware mobile communication this empowers mobile devices to recognize the context in which hospital workers perform their tasks.
- Mobile ward (smart ward system, a prototype designed to support morning procedures in a hospital ward, and is able to display lists of the patients and their information's which are required. The device gives information and functionality according to the location of the nurse and the time of the day.
- The above-mentioned prototypes are used in hospitals on a daily basis which will help the health care system to work efficiently and to protect the security of the patient's data. But there are certain challenges faced in developing such systems which should also be considered while developing a huge system like these.

B. Challenges Faced in Developing Context Aware Systems

- There are no recommendations found about the functional requirements of the context.
- The distance between the context representation and the actual prototypes of the system.
- The difficulties and risks in developing such efficient computerized systems for a mediation of human level of perceptions.

These are certain constraints which is a loop hole in building an efficient healthcare system using context awareness. But there are certain factors which are to be considered as a main stream while developing a context aware health care system, discussed in the next sections.

C. Security in context aware system

Context aware systems face certain specific security and trust challenges.

- Confidentiality – This focuses mainly on protecting computer system assets such as Computer system assets include hardware, software, media storage and data from unauthorized entities/operators; For example, user can choose to disclose his age only to specific authorized entities and not to all.
- Integrity – This focuses on ensuring that computer system assets can be modified only by authorized entities; For example, temperature measured by thermometer must be reliable, accurate and not modified by any entity.
- Availability – This concentrates on ensuring that computer assets must be easily available to the authorized entities. A GPS receiver must ensure to provide user's current or the required location anywhere and anytime, but it should also take care of the user's security.

1) *Confidentiality in Context Aware System:* When it comes to a system like context aware healthcare which deals mainly with patient's data it is highly important to have confidentiality and handle it in such a way that there is no leakage of any personal or medical data of a patient. Following are certain important things which are to be considered. An architecture called Confab in order to provide privacy in computing systems. This framework has been specially designed for protecting a user's location information in systems. It is based on an analysis of privacy needs for end-users and application developers. The main idea is that personal information is captured, stored and processed as much as possible on the user's device when it is needed.

2) *Integrity in Context Aware System:* Integrity in context aware system - Integrity mainly targets on guaranteeing that the provided context information has not been corrupted by a

third party end user. Hash functions or public key digital signatures can provide context integrity and also for top notch security, Un-keyed and keyed hash functions. In the first case, un-keyed hash functions, such as MD5 or SHA-1, provides a very low level of data integrity with respect to the use of context in application adaptation Public key digital signature and this approach might not always be suitable for context-aware systems, especially in distributed systems including low-cost sensors.

V. PITFALLS AND FUTURE ENHANCEMENTS

The two major problems in context aware system security is ensuring accuracy of location information and identities and establishing secret/private communications [13]. The acceptance of such systems at levels like individual, social, economic level will strongly influence its future use. The system must remain intelligent even for the future enhancements and there is a possibility that when people invent new technologies through new tools, the purpose of the tool could be deviated at times and there will be no efficient usage of it if it does not satisfy the basic criteria of why the technology was developed.

VI. CONCLUSION

From the current study the paper not only comes to an understanding the detailed concept of context and context system themselves but also a constructive awareness regarding the privacy and security issues or the loop holes in the healthcare systems. This paper also provides an overview of the new area of context awareness in health care [14]. The issues and challenges in this area and the different prototypes used in healthcare to make sure that the data is maintained safe and sound. It also talks about different challenges faced in developing these systems, where all the security and privacy of a user (patient) can be kept or handled in a secured manner. However, in order to overcome these privacy concerns mentioned by the end users of context aware systems, there are certain essential security requirements raised by previous researchers on this field which are required to be efficient and effective [9]. This also talks about the different applications of the context aware healthcare systems, pitfalls in context aware systems which gives us a deeper understanding of correcting the loopholes for further enhancements in the medical field.

VII. REFERENCES

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