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Context aware mobile computing: A survey

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Abstract
Context awareness is a property of mobile devices that is defined complementarily to location awareness. Whereas location may resolve how certain processes around a causal device operate, context may be applied more supplely with mobile users, especially with users of smart devices. As the number of sensors on smart devices continues to raise, these devices can automatically trail data from the user's surroundings, including geo location, time of day, movement, and other sensor data. Making intelligence of this data in an ethical manner that respects the privacy of smart devices users is just one of the many challenges faced by researchers.

Keywords: context awareness, mobile users, smart devices and sensor

1. Introduction

When we aim to create applications, devices, and systems that are *easy to use*, it is essential to understand the *context of use*. With context-aware computing, we now have the means of considering the situation of use not only in the design process, but in real time while the device is in use. In Human-Computer Interaction (HCI), we traditionally aim to understand the user and the context of use and create designs that support the major anticipated use cases and situations of use. In Context-Aware Computing on the other hand, making use of context causes a fundamental change: We can support more than one context of use that are equally optimal. At runtime – when the user interacts with the application — the system can decide what the current context of use is and provide a user interface specifically optimized for this context. With context-awareness, the job of designing the user interface typically becomes more complex as the number of situations and contexts which the system will be used in usually increases. In contrast to traditional systems, we do not design for a single -or a limited set - of contexts of use; instead, design for several contexts. The advantage of this approach is that we can provide optimized user interfaces for a range of contexts.

2. Overview

2.1 What is Context awareness?

Context awareness is the ability of a system or system component to gather information about its environment at any given time and adapt behaviors accordingly. Contextual or context-aware computing uses software and hardware to automatically collect and analyze data to guide responses.

Context includes any information that's relevant to a given entity, such as a person, a device or an application. As such, contextual information falls into a wide range of categories including time, location, device, identity, user, role, privilege level, activity, task, process and nearby devices/users.

Web browsers, cameras, microphones and Global Positioning Satellite (GPS) receivers and sensors are all potential sources of data for context-aware computing. A context-aware system may gather data through these and other sources and respond according to pre-established rules or through computational intelligence. Such a system may also base responses on assumptions about context. For user applications, context awareness can guide services and enable enhanced experiences including augmented reality, context-relevant information delivery and contextual marketing messages.

Although often defined as a property of mobile devices used to present relevant, actionable information to the end user, context awareness is also a technological driver for M2M (machine to machine) and Internet of Things (IoT), ubiquitous computing and event-driven computing environments.

2.2 Advantages of context awareness

It was simple earlier — as a business you put across what your customer needed. However, many businesses especially in the IT world began to understand that the needs of customers vary and constantly change — one needs to understand the context of the situation better in order to respond to the needs of the consumer.

When it comes to the contextual world, data is gathered, algorithms used and social graphs drawn by sensors to ensure that users get what they want. It is simple. When it comes to context aware computing, different variables are taken in by the device, including the user habits, the environmental information about them as well as other things to offer a personalized experience that is situation aware and understands the needs of the user.

Among the companies who have jumped on to the context

aware bandwagon are the likes of Intel. Intel has a rather simple principle — using context to make user experiences better. Sensors will monitor the user's behavior and offer a bespoke experience, curtailed to the user's needs and requirements. Therefore, you will have your computer or device responding differently to individual members of the household. Different types of niche are cropping up including Context Entertainment, which makes machines respond to the user to enable and create an environment that enriches daily life, through the use of contextually aware technology.

The use of context aware applications isn't just restricted to entertainment. In fact, the future holds a lot of promise and we will surely see context being used in some of the situations below:

- Operations will be easier as surgeons will be able to view relevant important data like blood count as well as have anatomical references like the blood vessel location.
- Context Aware Expertise Location and Management (ELM) systems will ensure that service techs can interact with subject matter experts when needed.
- Expect further changes on how you work with your smart phones. Google is continually working on enhancing the context awareness quotient and we will see many changes soon.
- You don't need to tell your TVs what you want to watch or what you want to do — they can predict what you intend to do, which saves you time.

3. Issues in Context Awareness

Challenges for context-awareness in ad-hoc networks do not differ from other areas using context information. It can be quite challenging to capture, represent, and process contextual data. This can be even more challenging in an ad-hoc environment if no infrastructure for doing this is available, or it is created "ad hoc", or it changes frequently when the network changes. In this case the devices themselves must be able support all necessary mechanisms or they need a standardized context-service in the ad-hoc network.

Another challenge, which has not been discussed in much detail in this paper, is the privacy of users, as well as confidentiality. How to make use of context information and still enable the user to be in control of what is disclosed and to whom?

4. Conclusion

The human computer interaction can be improved with context information. With help of such information computer systems and applications can be made more user friendly and flexible. Especially in the mobile environment where the environment and user needs change rapidly the use of context information will be important.

The usage of context information is still quite limited since it is very challenging and complex to capture, represent, and process contextual data. The most used types of context information are location, identity and time information. The context-aware application development is mainly concentrated around user interfaces, virtual and augmented reality, mobile, ubiquitous, handheld and wearable computing. The development is mainly research based. There are very few commercial products using context information yet, because of the challenges in this field. There are activities to make it easier to create context-aware applications with the help of application frameworks. The existing applications, which are mostly on a prototyping or testing phase, are in the area of office, guide, remembrance aid, or fieldwork tool applications. Context-awareness is a natural part of ad-hoc networks. Context information can be used both in establishing ad-hoc networks, in routing protocols, as well as, on application level. In the ad-hoc networking the challenges for context-awareness are quite similar to those in other areas. It can be quite challenging to capture, represent and process contextual data. This can be even more challenging in an ad-hoc environment if no infrastructure for doing so is available. Privacy issues are also important.

For the future of context-aware applications in ad-hoc networks and other areas, it will be important to try to create consistent modular ways to obtain and process context information. Standard APIs, data representation formats and infrastructure need to be developed in order to support this development. Work in this direction has already started, but still a lot of work remains. Most challenging is to create the intelligence to analyze the context information and deduce the meaning out of it, and to integrate it into applications.

It will be increasingly important for computer systems and applications to use context information. With an increasing diversity of computer systems integrated in our surroundings and increasing mobility of both users and hardware this will be one of the main challenges in the next years.

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