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A Case Study on Wearable Devices : Smart Watch

Anandhi Giri[1], S. K. Srivatsa[2]
[1]VELS University, Chennai, Tamil Nadu, India
[2]RETD, Senior Professor, Anna University, Chennai, Tamil Nadu, India

ABSTRACT

Recent hardware advances have led to the development of wearable computing devices ranging from exercise and sleep tracking bracelets [1] to augmented reality glasses [2]. While these new technologies enable a spectrum of new applications, they also introduce security and privacy questions that are unexplored. Wearable devices are a new form of mobile computer system that provides user-personalized services. Wearable devices bring new issues and challenges to computer science and technology. The introduction of smart phones created important new risks to users privacy due to their mobility, ubiquity, and wealth of sensors-wearable computing form factors are likely to magnify these threats. For instance, while smart phone malware can hijack the sensors to spy on the user, video-capable smart glasses or smart watches are worn continuously outside the clothing where they are even better positioned to record both the user's activities and others nearby. Beyond risks to the user's own privacy, wearables have the potential to be maliciously deployed by the users themselves to violate the security and privacy of others. These threats will be particularly acute in coming years: as wearables gradually become widespread and unremarkable, they will challenge social norms and breach expectations about the capabilities of technology. For instance, glasses and wristwatches are socially acceptable in situations where the use of smart phones and computers might not be and they can be used to capture data of privacy expectations. In this work, we explore these implications and analyze the impact of one of the first networked wearable devices smart watches-on an academic environment. We discuss the broader implications of this technology and pose questions for future research. This paper summarizes the development process, issues in design process and current situation of wearable devices.

Keywords : Wearable Devices, Network; Human-Computer Interaction; Security, Wearable Computing, Smart Watches

I. INTRODUCTION

It is clear that as technology evolves, computers are getting smaller, faster, more capable, cheaper, and more efficient. Such improvements are visible across the entire spectrum of computing starting from the smallest of microcontrollers to large supercomputers. Technology has now reached a point where we are able to pack a significant amount of computer power into small portable devices.

1.1 The Definition of Wearable Devices

A wearable device is a computer that is subsumed into the personal space of a user, controlled by the user, and has both operational and interactional constancy, i.e., is always on and always accessible [1]. Wearable devices have the same computing abilities as mobile phones and tablet computers. However, wearable devices are more competent for tasks such as calculation, navigation, remote picture due to portability.

1.2 Classification Standards for Wearable Devices

At present, there are two standards for classifying wearable devices [2]. One standard is based on product forms, including head-mounted (such as glass and helmet), body-dressed (such as coat, underwear, and another standard is based on product functions, including healthy living (such as sport wristband and smart bracelet), information consulting (such as smart glass and smart watch), and somato sensory control (such as somato sensory controller). Figure 1 lists a variety of wearable devices trousers), hand-worn (such as watch, bracelet, and gloves), and foot-worn (such as shoes and socks).

1.3 How are wearable devices different

A wearable device is more convenient for users to use and carry due to its efficiency, lightweight and dressing. Their functions, forms and usages are different from tablet computers and mobile phones. In the wearable symposium held in 1997 [3], Bass L. summarized five characteristics that a wearable device should have [4]:

1. It may be used while the wearer is in motion;
2. It may be used while one or both hands are free or occupied with tasks;
3. It exists within the corporeal envelope of the user, i.e., it should not be merely attached to the body but becomes an integral part of the person's clothing;
4. It must allow the user to maintain control;
5. It must exhibit constancy, in the sense that it should be constantly available.

Steve Mann also provided the definition of wearable devices and described them from three operational modes and six attributes at the International Conference on Wearable Computing (ICWC) [5] held in 1998, The three operational modes include constancy, augmentation and mediation. Six attributes include unmonopolizing of the user's attention, permissive to the user, visible by the user, controllable by the user, helpful to the environment and communicative to others. However, wearable devices show more features as they evolve, such as diversity and concealment [6]. Wearable devices not only change the human-computer relationship and the way people use computers. Moreover, they produce a significant influence on people's life and work.

Figure 1. A variety of wearable devices

II. PROBLEMS AND ISSUES IN DESIGN OF SMALL PORTABLE DEVICES

2.1 Size and convenience

One of the significant problems faced by mobile users has sarcastically been the lack of portability of their computing devices. If we can fit a substantial amount of compute power into a device that the user was already familiar to carrying, then there was a greater possibility that the device, and therefore, the compute power will be with the mobile user. There has to be a sufficient number of useful contexts to make the user want to purchase the device.

2.2 Energy supply

Another major problem that mobile users face is providing adequate energy to run their mobile devices. The most common method of powering these devices is to use batteries. Unless the benefits of the mobile device are high enough to warrant the difficulty of recharging batteries, the acceptance of the device is questionable. One of the main ways of

making it easier to replace or recharging the batteries is to ensure that the battery lasts for a long time by doing aggressive power management, making replacement or recharging less frequent. A completely different approach to powering computing devices is not to use batteries at all, and instead generate the required energy through other means such as solar energy, or generating energy from the physical movement of the user. Unfortunately, these means either do not provide sufficient energy capacity or appear to be inconvenient. As a result, batteries still are the preferred method for powering mobile computing devices. Increasing the physical size of the batteries is not an option for mobile computers since this make the devices larger. The shrinking size of the electronics allows for more scope in the device for the battery and can result in increase of battery life. One of the key challenges in this context is how to get to the point where the battery life is long enough that it is no longer a major factor in deciding whether or not to use the mobile device.

2.3 User interfaces

Designing a user interface is a hard problem. The limitations of space to incorporate input devices are stern. The input devices need to be large enough that the user can manipulate them at the same time be small enough that it makes sense to incorporate them into the space available. A common complaint about keyboards is that the keys are too small and too close together for many users. An added problem is that many portable devices may have to be used in situations where the user's time and attention are limited. Visual output is another problem with small devices. The available area for display tends to be small and many users may lack visual perception to read text presented in small fonts. On the contrary, people seem to be comfortable reading the time on a wrist watch when the time is shown in an analog fashion with hour and minute hands even when the watch is quite small.

2.4 Multiple devices

A constant debate in the area of portable devices is whether it is better for a device to do fewer things and do them well or to do as many functions as possible. Proponents of the less functionality per device viewpoint argue that these devices are hard enough to use that adding functionality simply complicates the issue. It is said that most people tend to use four or five of the dozens of features available on the current cell phones. It may be easier to design and offer services to users if their devices were integrated.

2.5 Adoption of watch form factor

There is an important difference between a watch and other mobile devices such as a pager or a cell phone. When the pager was introduced in a large scale, it was worn on the belt or carried in the pocket. So the typical pager user did not have to throw away existing devices on his waist in order to make scope for the pager. Since most people wear a watch already, it is a challenge to get them to discard their present watch and switch to new one. People often tend to have more of a sentimental association with their watches compared to other computing devices, and often consider watches to be more of statements of fashion than performing specific functions. As a result one can expect a certain degree of reluctance to give up one's favorite watch for another even if the new one is better. Many others did so after electronic watches became cheaper than and as elegant as mechanical ones.

III. APPLICATIONS

The common applications that a set of people requested on a smart watch are included in figure above. They can be grouped into a few categories.

1. Keeping Time: Basic watch functions. Some examples include
   a. Time, world time and stopwatch, perpetual calendar
   b. Alarms - Hourly, Daily, Event Triggered, Twice Daily, Thrice Daily (reminder for medicines)

c. Holiday Lists - based on country, religion, etc., downloaded from the Internet each calendar year

2. Managing Time : Personal Information Management (PIM) Functions. Some examples include

a. calendar schedule, to do, phone/addresses, micro-email
b. Multi-user calendars - holds calendar of manager, spouse, team members, children, etc.,

3. Point in Time Information: Static cache - Examples include

a. personal data vault with password protection - possibly credit card numbers, bank account numbers, passport
b. numbers, frequent flier numbers, etc.,
c. reference information - dictionary, tourist information
d. download data from web or PC or other watches

4. Just in Time information: Dynamic retrieval - pull, push and demand pull paradigms. Examples include

1. a calendar that is always up to date
2. customized information delivery - stock quotes, weather, traffic, ..
3. directions with maps to hotels, restaurants, theaters, etc., downloaded from the Internet
4. "Web Serf" - Universal Alert mechanism

i. your bid on Ebay has been outbid - what do your want to do?
ii. temp in NY < 32O F - what do you want to do?

5. Authenticator and controller

1. Wearer securely gains access to other devices, buildings, rooms.
2. Personalize, control and interact with other devices

6. Utilities and health monitoring. Examples include

a. Currency converter and language translator
b. Calorie counter, pulse monitor

7. Entertainment

1. Games
2. Horoscopes

A quick review of the above list indicates that some applications rely on just having the data in the watch. However, even for these applications, the data has to enter the watch from some adjunct device, such as a PC, because the input capabilities on the watch are rather limited. Other applications people want on the watch extend to the network and to information on servers on the Internet.

IV. CONCLUSION

Wearable devices will become the mainstream of the development of mobile smart devices and change modern way of life. They offer an exciting platform for new types of applications and have the potential to more tightly integrate computing within daily life. Currently, the development of wearable devices is still in its immature stage, and the major functions focus on running calculation, navigation, remote picture and other related services. These services can also be achieved on smart phones. They also pose new security and privacy concerns. Meanwhile, research on hardware materials and battery life has not achieved a breakthrough; limited screen space makes the product design very difficult; application software development is still in the initial stage. Due to these problems, it will take a long time for wearable devices to become the mainstream of market.

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