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WEARABLE DEVICES APPLICATIONS & ITS FUTURE

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Abstract: Wearable technology implies the use of items that are worn by individuals rather than digital accessories that are simply attached to an individual's body. Such technology enables a person to access digital machines located nearby. Presently, wearable technology is receiving significant attention worldwide and is regarded as mobile technology that could replace smart phones in the future. People have become aware of wearable technology; consequently, smart device developers have begun releasing various wearable devices. The applications for wearable devices are currently concentrated in the healthcare field. The benefits of a device on the body that can be freely attached and detached has spurred an interest in human health. The wearable device collects the movement information of the user to provide services. Furthermore, by integrating additional devices (i.e., cell phones, TVs, or tablets) with the smart device, it is possible to expand the range of services Given this trend, we have developed user motion-aware smart bands that use these recently-developed wearable device technologies. The goal of our proposed device is to recognize human motion with a wearable device similar to a wristwatch; we also propose different applications that can be installed on smart TVs or smart phones so that users can transfer their recorded motion data. We aim to build an effective user-motion recognizing system by integrating different devices with wearable devices.

Key Words: Wearable, Smart watch, Google glass, Applications, Future

I. INTRODUCTION

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. Wearable devices have the same computing abilities as mobile phones and tablet computers. In some cases, however, wearable devices are more competent for tasks such as calculation, navigation, remote picture than handheld devices due to their portability and characteristics to be detailed below.

A. The Development of Wearable Devices

We can have a clear understanding of the development for wearable devices from. Wearable devices have undergone many years of development since the initial ideas and prototypes appeared in the 1960s. During the 1960s to 1970s, wearable devices were in their embryonic period. People designed wearable devices for special purposes, interests or events. During the period, wearable devices remained in a small-scale field and people rarely understood their roles. In 1966, Edward Thorp, a professor in the Massachusetts Institute of Technology (MIT), invented a pair of shoes that could be used to cheat at roulette. This is the first wearable device in the world. In 1975, the Hamilton Watch Company launched a "calculator" watch which is the world's first wrist calculator. In 1977, the CC Collins designed a wearable device for the blind, which converts images captured from a head-mounted camera into tactile grids located on the blind's vests. During the 1980s to 1990s, wearable devices entered the primary stage of development. People began to pay attention to wearable devices. Although wearable technology had a great improvement, wearable devices were still not practical for consumers and not friendly for users. In 1981, Steve Mann designed a head-mounted camera that to some extent can be regarded as the pioneer of Google glasses. In the same year, Steve Mann designed a backpack style computer with text, image and multimedia functions, displaying through the helmet. In 1997, Massachusetts Institute of Technology, Carnegie Mellon University, and Georgia Institute of Technology jointly organized the first International Symposium on Intelligent Wearable Computer (ISWC). Since then, smart wearable computing and smart wearable devices have attracted wide attention in academia and industry. Since the 21st century, wearable devices have entered an advanced stage of development and aroused widespread concern. They become more complex and are designed according to the needs of users or the market. Many companies launched independently designed wearable devices and released corresponding software and hardware development platforms. In 2007, James Park and Eric Friedman founded the Fitbit Company that is dedicated to the development of wearable devices on pedometer and sleep quality detection etc. In 2013, Google launched Google glass and caused a sensation in the world. Meanwhile, Apple, Samsung, Sony and other companies have been developing their smart watches. In the next few years, predictably, wearable devices will enter a period of prosperity. The IMS data revealed that wearable devices shipments will reach 92.5 million units by 2016. According to Juniper's research, the number of wearable devices including smart watches and glasses will approach 130 million by 2018. Moreover, according to IDC's reports, we note that wearable devices had been under a rapid development; the number should be up to 19 million by the end of 2014; and the predicted shipments including smart watches and related devices will grow at an annual rate of 78% and reach 112 million by 2018. Therefore, we can believe that wearable devices will gradually enter people's lives and bring convenience to human, and wearable market will attract more participants.

B. Classification Standards for Wearable Devices

At present, there are two standards for classifying wearable devices. One standard is based on product forms, including head-mounted (such as glass and helmet), body-dressed (such as coat, underwear, and trousers), hand-worn (such as watch, bracelet, and gloves), and foot-worn (such as shoes and socks).

Figure 1 Various wearable products available in market

Another standard is based on product functions, including healthy living (such as sport wristband and smart bracelet), information consulting. Juniper defines a 'smart wearable device' as an app-enabled computing device (that is a device which accepts input and processes that input) which is worn on, or otherwise attached to the body, while being used. In most cases a wearable device is also a fashion accessory. Most wearable devices are always on and accessible at any time with a constant interaction between the user and the device. This definition covers a wide range of devices from watches to displays which can either work independently or in conjunction with an external platform, such as the smart phone or tablet.

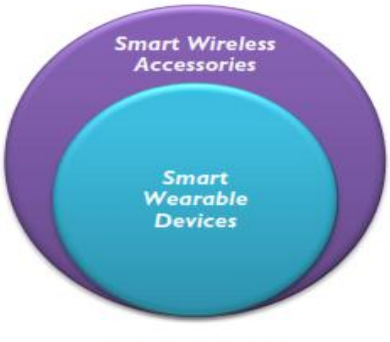

Figure 2: Smart Wireless Accessories and Smart Wearable Overlap

The wearable market is in fact a subset of the wireless accessories market and there have already been significant numbers of deployments, particularly in the health and fitness market. Our recent Report on Smart Wireless Accessories: CE, Fitness, Health, Payments & Enterprise 2013-2018 studies and forecasts the market exclusively.

Figure 3 Various Wearable Products

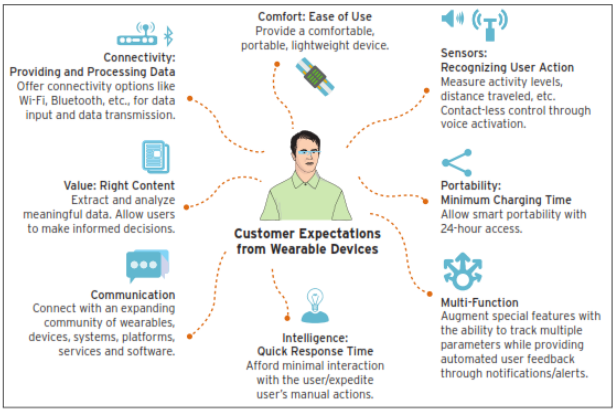

Figure 4 Wearable Devices Expectations

Figure 5 Spectrum of Wearable Devices

II. WEARABLE DEVICES DIFFERENT

A wearable device is more convenient for users to use and carry due to its miniaturization, lightweight and dressing. Their functions, forms and usages are different from tablet

computers and mobile phones. Following are the characteristics that a wearable device should have:

- It may be used while the wearer is in motion;
- It may be used while one or both hands are free or occupied with tasks;
- It exists within the corporeal envelope of the user, i.e., it should be not merely attached to the body but becomes an integral part of the person's clothing;
- It must allow the user to maintain control;
- 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) held in 1998, The three operational modes include constancy, augmentation and mediation. And the Six attributes include unmonopolizing of the user's attention, unrestrictive to the user, observable by the user, controllable by the user, attentive to the environment and communicative to others.

There are many ways for users to interact with wearable devices:

1) Contextual Awareness: Wearable devices continuously run and collect data, but in most cases, the user does not use them. Wearable devices should run independently, perceive the external environment, and transfer useful information to the user. Starner T et al. proposed in visual environment perception method for wearable devices, and pointed out that a wearable device can observe its user to provide serendipitous information, manage interruptions and tasks, and predict future needs without being directly commanded by the user.

2) Augmented Reality: That is a technology that enhances users' awareness to real world through the information such as sound, video, graphics or GPS data generated by the computer. The goal is to apply virtual information to the real world and to superimpose virtual object, scene or system message generated by computers to the real scene. Zhou et al. presented a design approach and a series of practical proposals of wearable user interfaces in real augmented environment.

3) Non-keyboard input: The most familiar way for people to input information into computers or mobile phones is through keyboard or mouse. However it is impossible to connect such input devices to wearable devices because of their miniaturization and lightweight. Users can interact with wearable devices through non-keyboard ways such as voice, handwriting, gestures, data glove etc. For the disabled, the interaction ways of traditional smart devices cannot bring normal experience. But they can wear a wearable device that receives messages from other sensors, which are transmitted to their sensory system after analysis. For example, for a person whose eardrum is broken, hearing devices are directly connected to his/her skull, which enables him/her to sense the voice that is not passing through ears. Therefore, compared to computers and mobile phones, wearable devices can provide many different ways of human computer interaction for users to strengthen their experience. But these ways cannot meet the demand of all users, developers should strengthen the study of human-computer interaction technologies:

1) Apply existing mature human-computer interaction ways to wearable devices, such as handwriting, voice and other non-keyboard input. These ways can be easily realized in wearable devices and better accepted by users.

2) Strengthen the research of currently-immature human computer interaction ways, such as contextual awareness, augmented reality, mediated reality, etc. These ways can enhance user experience and make users have greater interests in wearable devices.

3) Propose new human-computer interaction ways. Some ways may be suitable for particular groups or particular environment. However, this approach will increase the burden to developers, and moreover, it may take time to study and practice these new ways.

Software Engineering

With the massive popularity of wearable devices, software engineering for wearable devices is becoming more and more important. Although the research of software engineering for wearable devices is still rare, we can predict some aspects/issues that may be of value and worth studying:

1) Demand analysis: how to perfect the requirement documents should be a problem worth studying. From users' comments on the application, the discussion in the BBS or the analysis of related online articles, users' expectation for the functionalities of the wearable devices can be acquired and thus be used to improve the requirement documents.

2) Code recommendation: many functions are likely to be reused in different applications. Through analyzing source code of existing applications, we can recommend function codes to developers to achieve fast development.

3) Application transplantation: it is not necessary to design different applications for each operating system. We can create API mapping among different platforms, and develop an ideal compiler that can complete the application development for multiple platforms.

III. THE FUTURE OF WEARABLE

While the widespread adoption of consumer wearable devices promises improvements in health, safety, productivity and entertainment for both individuals and society at large, there remains much we do not yet understand about how they will fit into our economy our lives. The rapid pace of technological innovation today makes it difficult to predict what wearable will look like in even a few years, let alone to govern how they should collect, use and store information. In just a few years the wearable market has shifted from clip-on devices with basic accelerometers to flexible wristbands, chest straps and smart-watches with accelerometers, altimeters, gyroscopes, ambient light sensors and heartbeat sensors. Future technological advancements may bring devices and sensors even closer to consumers: in clothing, prosthetics, Dermal

patches, contact lenses, tattoos, implants, and even "swallowable" gadgets. A clip-on pedometer that can be easily removed or deactivated obviously carries different privacy and security risks than a futuristic biometric sensor embedded literally under the skin. Premature regulation at an early stage in wearable technological development may freeze or warp the technology before it achieves its potential, and may not be able to account for technologies still to come.
As wearable technologies gather more and novel types of information, new privacy and design sensitivities will also continue to arise. While many wearable devices collect information about users' health and fitness, for example, more than one type of quantified-self data exists, each with its own level of sensitivity and potential privacy or security impacts. A mobile app that measures only the number of steps a consumer takes in a day requires less privacy engineering than a wearable device that measures blood sugar levels. Any approach to managing privacy risk for such devices must be flexible enough to take these varied sensitivities into account.
Further, as new types of data are more widely collected, new sensitivities around their uses likely will continue to arise. Consumers are choosing to collect, analyze and share data about themselves in new ways and for new purposes every day. Consumers are already utilizing fitness
data from wearable for their medical rehabilitation programs, insurance discounts and employee benefits, as well as for personal use, each of which may raise different privacy and civil liberties concerns.
Given that some uses are inherently more sensitive than others, and that there may be many new uses still to come, flexibility will be critical going forward. While wearable devices and sensors continue to get cheaper and smaller, the number of uses we have for them continues to grow. Wearable already serve a wide variety of primary uses,
including individual fitness and health tracking, environmental monitoring, photography, life coaching, navigation, communication and entertainment, art, and assistive services. They also support a wide range of secondary purposes, including invaluable medical and social sciences research. And app developers also begin to advance into the wearable space, they bring even more innovation and personalization to these devices. The sheer variety of useful data produced by wearable devices – and the even more diverse array of interfaces through which consumers
interact with them – requires a common sense approach that ensures consumer protection as well as ensures that these tools and the data they provide will be practically available.

IV. WEARABLE DEVICES: GOOGLE GLASS & SMART WATCH

The terms "wearable technology", "wearable devices", and "wearables" all refer to electronic technologies or computers that are incorporated into items of clothing and accessories which can comfortably be worn on the body. Wearable devices may perform the same tasks as mobile phones or laptops. It is more sophisticated than the handheld technology. It provides sensor and scanning features not typically seen in mobile and laptop devices, such as biofeedback and tracking of physiological function. Wearable technology have some form of communications capability and allows the wearer to access information in real time. It possesses some features like the data-input capabilities, local storage, etc.
Examples of wearable devices include watches, glasses, contact lenses, etc.

Google glass
Google Glass is a type of wearable technology with an optical head-mounted display (OHMD).It was developed by Google. It displays information in a hands- free format. Wearers of the glass can communicate using the natural language voice command using the internet.

Working of google glass
Google Glass contains almost the same components as a computer like, CPU, sensors such as GPS, speakers, microphone and battery, added in mini projector and a prism which is used to redirect the light onto the retina of an eye. All components are neatly arranged in the frame of the glasses. Most of the processing of the glasses occur in the cloud storage that requires good mobile broadband signal to work efficiently.

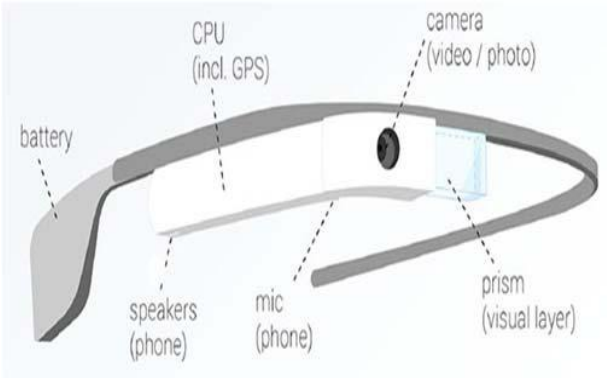

Figure 6: shows the components of google glass

Functions of the Google glass

- Video recording: It is possible to record videos using the google glass as it has a camera.
- Capturing of images: It is also possible to capture images using the glass as it has a camera embedded in it.
- Display of messages: The google glass can display/show messages.
- Navigation: It is easy to access GPS on the glasses.
- Finding information: It is easy to find information on the glass however, it may appear to be clumsy at times.
- Integration of Google now: It is possible to integrate the glass with google now feature.
- Translation: translation to various languages is possible with this gadget.

The Pros and Cons of Google Glass
The Pros

- **Hands Free:** The currently most popular applications for Google Glasses are continuous hands free tasks, such as video recording, maps/directions, and clock/date apps.
- **Convenience:** Another advantage of Google Glasses are the convenience apps, such as taking photos with just a push of a button, head or eye movement, or voice command without the need of taking out a cell phone or camera from a pocket or bag, turning it on, then starting camera application, and then aiming at the camera to take the photo.
- **Multitask:** Users can perform multiple tasks simultaneously using the glasses. For example, drivers do not need to take their eyes off the road if they need directions.
- **Open Platform:** It is easy for any developer to implement new applications on the open platform of Google Glasses

The Cons

- **Distraction:** If a person wearing the google glass is doing an important task and is suddenly flushed by audio or visual information that does not hold for that task, the wearer may get distracted.
- **Privacy:** Other people might not come to know if they are being recorded by Google Glass.
- **Stress:** Google Glasses can always be worn and may be in use therefore, inviting stress and anxiety.
- **Surfing:** Surfing using the glasses can be clumsy. Thus, it is not convenient and easy to use it as a replacement of computer cell phone, etc.
- **Price:** The current price for google glasses is somewhere between US$500 and US$1500. But, mostly they are made with commonly available parts or that are easy to manufacture. Therefore, the price of Google Glasses should not be very high.

The smart watch
A device that can be worn on a user's wrist and offering the same functionalities as that of a smartphone. Smartwatches can either be independent or can be paired or synced with a smartphone, but it can be paired using internet, Bluetooth, NFC, etc. It can be used for running mobile applications, making calls, messaging, accessing weather updates, using GPS coordinate, and much more. Companies like Google, Samsung, Apple, LG, Sony, Pebble, etc. have developed smart watches.

Working of a smart watch
A smartwatch needs to be synced with a smartphone so that it can work to its fullest. This syncing can be done using Bluetooth pairing, some devices allows pairing using NFC also. Once a smartwatch is connected to a smartphone, the user can choose what notifications to get on his/her wrist like messages, emails, calls, etc. Using applications the user can control what music is played on the device or to take a photo remotely. However, functionalities may vary from smartwatch to smartwatch. Shown below in figure 2 is an apple smartwatch with some of its functionality. However the working and design may vary from brand to brand.

Figure 7: Smart Watch

Features of the smart watch

- **Replying to texts by voice:** Using the smart watch, the user can reply to the messages using voice.
- **Vibrate with an incoming message**: the watch vibrates when a message arrives.
- **Can access Google Now in hands-free mode:** The user of the watch can access google now feature in a hands free mode.
- **Sleep tracking:** It is a feature where the application tracks the time of sleep and responds to the user based on it. It also wakes up the user automatically.
- **Variety of the hardware:** it offers a variety of hardware.
- **Control music:** the watch can be synced to the smartphone using Bluetooth, NFC, etc. which can help in controlling the music through the watch.
- **Weather and Traffic updates**: The weather and traffic updates can easily be checked using the smartwatch.

Disadvantages of the smart watch

- **Battery:** Good battery life is a must for any hardware device. The use of censors, CPU may consume a lot of batteries so, a smartwatch should have a good battery backup. Most of the smart watches 300 mAh which is very small as compared to the smartphone devices.
- **Size and weight:** Size of these watches is large as compared to normal wrist watches and it may be too heavy to carry on the wrist.
- **No phone calling:** Some of the smart watch does not allow answering the calls directly. The smartwach may have microphone and speaker and it is possible to use it as a hands-free device. But, some of the watches does not have the microphone

or speaker.

- **No Camera**: The smartwatch cannot replace a smartphone when it comes to the camera as some of the smartwatches do not have camera so they need to use their smartphones in order to use the camera.

V. CONCLUSION

There is much work still to be done to determine when and how these privacy principles should be applied to specific wearable devices or to protect certain types of consumer-generated data. Consumers, businesses, and policymakers must all have a voice in deciding how wearable can and should fit into our increasingly interconnected lives. Moving forward in the wearable space, we urge policymakers to adopt a forward-thinking, flexible application of the FIPPs. In this way we can recognize the often heightened sensitivity of consumer-generated personal data and craft appropriate protections for the growing variety of wearable devices, while also allowing for the use and sharing of this data for societally and individually beneficial purposes.

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