Emotional Design in Wearable Technology

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ABSTRACT
As technology gets closer to our body, and even becomes part of us, there are new problems of both our emotions and our senses in successful design. It’s essential to design technology that works with human senses and cognition demands in both physical and psychological[1]. This paper focuses on the emotional aspect in the design of wearable technology.

Author Keywords
Emotional comfort, physical comfort, privacy, microchips, wearable technology, health care, monitoring.

INTRODUCTION
Contemporary, wearable technology has gone deep into people’s life. After Apple released the Apple Watch, those health-tracking technology companies hope it can rise another climax of wearable technology. The continuous advance of wearable sensor-based systems will potentially transform the future of healthcare by enabling proactive personal health management and ubiquitous monitoring of a patient’s health condition[2]. However, during the development of wearable technology, there is some emotional and ethical problems we must pay attention to. It is important to make users feel comfortable in both physical and emotional aspect and also make them feel safe under the monitoring system.

MICROCHIPS UNDER STAFF’S SKIN
Staff in a Swedish office complex called Epicenter were implanted microchips in their hands, which allow them to use the photocopier, open security doors and even pay for their lunch. It is hoped that eventually around 700 employees from the Epicenter hi tech office block in Stockholm may eventually have the chips implanted into the back of their hands. The chips use radio-frequency identification (RFID) and are about the same size as a grain of rice (Figure 1). They store personal security information which can be transmitted over short distances to special receivers. Mr Slater said the procedure to implant the microchip was painful, but over quickly[3]. Whether it becomes culturally acceptable to insert technology beneath our skin is also matter[4].

RFID
Radio-frequency identification (RFID) is the wireless use of electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects. The tags contain electronically stored information. Some tags are powered by electromagnetic induction from magnetic fields produced near the reader. Some types collect energy from the interrogating radio waves and act as a passive transponder. Other types have a local power source such as a battery and may operate at hundreds of meters from the reader. Unlike a barcode, the tag does not necessarily need to be within line of sight of the reader, and may be embedded in the tracked object. Radio frequency identification (RFID) is one method for Automatic Identification and Data Capture (AIDC). RFID tags are used in many industries. An RFID tag attached to an automobile during production can be used to track its progress through the assembly line. Pharmaceuticals can be tracked through warehouses. Livestock and pets may have tags injected, allowing positive identification of the animal[5].

PRIVACY CONCERNS OF RFID
Since RFID tags can be attached to cash, clothing, possessions, or even implanted within people, the possibility of reading personally-linked information without consent has raised serious privacy concerns.

Privacy advocates argue that mobile RFID readers can lead to increased identity theft, high-tech stalking, and commercial data collection, perhaps with the intent of hijacking the seemingly good intentions of RFID-tagged goods and cash[6].
Implantable RFID chips designed for animal tagging are now being used in humans. An early experiment with RFID implants was conducted by British professor of cybernetics Kevin Warwick, who implanted a chip in his arm in 1998. In 2004 Conrad Chase offered implanted chips in his night clubs in Barcelona and Rotterdam to identify their VIP customers, who in turn use it to pay for drinks.

The Food and Drug Administration in the United States has approved the use of RFID chips in humans. Some business establishments give customers the option of using an RFID-based tab to pay for service, such as the Baja Beach nightclub in Barcelona. This has provoked concerns into privacy of individuals as they can potentially be tracked wherever they go by an identifier unique to them. There are concerns this could lead to abuse by an authoritarian government, to removal of freedoms, and to the emergence of the ultimate panopticon, a society where all citizens behave in a socially accepted manner because others might be watching.

On July 22, 2006, Reuters reported that two hackers, Newitz and Westhues, at a conference in New York City showed that they could clone the RFID signal from a human implanted RFID chip, showing that the chip is not hack-proof as was previously claimed[7]. Privacy advocates have protested against implantable RFID chips, warning of potential abuse. There is much controversy regarding human applications of this technology, and many conspiracy theories abound in relation to human applications, especially one of which is referred to as "The Mark of the Beast" in some religious circles.

The two main privacy concerns regarding RFID are:

- Since the owner of an item will not necessarily be aware of the presence of an RFID tag and the tag can be read at a distance without the knowledge of the individual(Figure 2), it becomes possible to gather sensitive data about an individual without consent.
- If a tagged item is paid for by credit card or in conjunction with use of a loyalty card, then it would be possible to indirectly deduce the identity of the purchaser by reading the globally unique ID of that item (contained in the RFID tag). This is only true if the person doing the watching also had access to the loyalty card data and the credit card data, and the person with the equipment knows where you are going to be[5].

As we can see, it's possible that people can hack your RFID chip and then get or change your personal information. So it's dangerous to have your RFID chip known by others. Sometimes people choose to use other security method combining with RFID to prevent being hacked by others[8].

EPICENTER

Epicenter is Stockholm’s first House of Innovation at the heart of the city and Sweden’s digital landscape. There are many the world’s fastest growing digital companies and creative corporate initiatives in Epicenter. It creates an arena to attract dynamic innovators and entrepreneurs within the digital space. It is a magnet for fast growing digital companies and cutting-edge creative corporate initiatives. Epicenter offers a plethora of opportunities, from co-working space for collaborative projects and startups to share the latest in innovation to an innovation exchange for global leaders who want to explore digital opportunities. Epicenter will offer you: innovation labs, corporate innovation exchange, tailor-made activity programs, opportunity scouting, match-making, corporate venture development and a destination to facilitate entrepreneurial projects.[5]

COMPANY TYPE

We can see that most of the companies in Epicenter are digital companies. Epicenter provides three types of membership: Lounge for companies and individuals primarily seeking to utilize Epicenter for meetings, networking and attending events, not as office location; Office for members that also use Epicenter as office space, occasionally or frequently, and the membership offers a variety of different office solutions from co-working desks to studios; Partner for members that use Epicenter as their primary office location and have private offices at Epicenter. So most of the digital companies here are start-up or small companies. They are pursuing new kinds of technologies. Innovation and creation are in their hearts (Figure 3).

Since the Epicenter is located in Urban Escape Stockholm, where is a new vibrant city space of five buildings, four streets and two squares in Stockholm city centre, the companies there are full of innovation. Urban Escape Stockholm is a world-leading concept where innovation, knowledge and creativity are setting the scene. A space in
the middle of the city where you can focus, perform and deliver[9]. The feature of these area can attract people and companies, which have similar goals to come here and pursuing their dream.

**SIME**

Sime is a company in Epicenter. Most of the staff in this company have been implanted RFID chip.

Sime is Northern Europe’s largest conference about the Internet and digital opportunities with flagship events this year in Stockholm and Miami. Sime is about how digital opportunities can convert into new business, a better world and a lot of fun. Sime arranges open events and closed, by-invitation-only events. All events target professionals and leaders interested in digital business opportunities and in staying ahead in an increasingly fast moving environment where technology creates threats and opportunities for every industry and every company[10].

**PEOPLE IN EPICENTER**

People in Epicenter are young, innovative, willing to try new things and are crazy about technology. They work in a space full of innovative atmosphere. New kinds of technologies, designs and ideas are coming out from people’s heads and mouses everyday. They are talking about these new things and really have the interest in exploring new possibilities. When people in a place like this, they may get influenced by others and the atmosphere here (Figure 5).

**USERS’ FEEDBACK**

Felicio de Costa, whose company is one of the tenants, arrives at the front door and holds his hand against it to gain entry. Inside he does the same thing to get into the office space he rents, and he can also wave his hand to operate the photocopier.

Hannes Sjoblad, whose electronic business card is on his own chip and can be accessed with a swipe of a smartphone, has the title chief disruption officer at the development. He explained whether people really wanted to get this intimate with technology. “We already interact with technology all the time,” he said. “Today it's a bit messy - we need pin codes and passwords. Wouldn't it be easy to just touch with your hand? That's really intuitive.”

Rory Cellan-Jones, the BBC journalist who tried the RFID chip in his hand, found that it was not all that intuitive - He had to twist my hand into an unnatural position to make the photocopier work. And while some of the people around the building were looking forward to being chipped, others were distinctly dubious. “Absolutely not,” said one young man when Rory asked him if he'd sign up. An older woman was more positive about the potential of the technology but saw little point in being chipped just to get through a door[4].

**REPLACEMENT**

Since it’s only a RFID chip, why don’t we stick in on or inside our cellphones. Nowadays people can’t live without cellphones (Figure 4). They’ve almost become part of our body. The first thing when we wake up everyday is to check messages in our cellphones. So why not just put this chip in our phones?

There are many kinds of fitness wristbands on markets now. They are convenient and easy to use. It’s also possible to put the RFID chip into a wristband. People can just wear it everyday and put it near the door to open the door.

More importantly, although the RFID chips implanted in people’s body is harmless and can be used for decades, there must be new kinds of chips and wearable technologies come out. Even the facilities of the office and building is updating all the time. There must be one day the RFID chips in people’s hands can’t meet all the functions and must be replaced and updated. At that time, we must take the RFID chips out and implant new chips. If equipments are updating all the time, should we replace the chips each time or they can be updated inside our hands?

**WHY PEOPLE ACCEPT IT?**

As we can see, there are three main problem in this RFID chip. First, it really hurts people when the RFID chips are implanted into their hands (Figure 6). There was a moment of pain - not much worse than any injection but it still is painful. Second, it’s not that intuitive to interact with facilities because sometimes you must change the angles of your wrist to make the machine connect to your chip. Third, it’s true that people can hack your chip and get your personal information. They can also change the chip to control you and surveillance you. Also, the replacement of the chips may hurt and not easy. Thus there’re so many problems in this little chip and you can’t use it for anything.
else outside the Epicenter. But there are still about 700 people choosing to implant the chip voluntary. On one hand, most of the people work in Epicenter is from digital companies. They get touch with new kinds of designs and technologies every day. They understand the function theory of this chip and they know it won’t do anything bad to their health. They can accept it easily in mental. What’s more, they are willing to try new things and feel it cool when you can use your body to interact with the things surrounding everyday. After seeing others use the micro chips to open doors and print things, they may feel it interesting and want to have a try.

On the other hand, Although it’s a little painful to implant the chip, it won’t hurt after implanting the chip. The size of the chip is about the size of a grain of rice. People may not feel it in their hands. With the chips in their hands, they don’t need to take any other cards or keys. It’s very convenient for them to open doors and use printers with their hands.

USERS’ EMOTIONAL NEED

When Rory Cellan-Jones interviews the staff in Epicenter, some of the people around the building were looking forward to being chipped, others were distinctly dubious. “Absolutely not,” said one young man when Rory asked him if he’d sign up. An older woman was more positive about the potential of the technology but saw little point in being chipped just to get through a door. Since the function of the chip is simply a key to doors or machines. It just gives users some convenient and some fresh feelings at the beginning. As time goes by, people may feel it not interesting anymore. Instead, they may begin to concern the privacy issue of the chip. They may feel under surveillance. What’s more, if users want to change another job, their new company may feel threatened by this chip. User may need to take out the chip at that time.

Thus, when the Swedish Biohacking Group designs this kind of chip, they shouldn’t only focus on it’s function. Users’ emotional need may have more influence. They must guarantee users’ privacy safety. This chip won’t bother users when they don’t need the chip anymore. Maybe the chip will degrade by itself and won’t do harm to user’s body[11].

THE COMFORT ASSESSMENT OF WEARABLE TECHNOLOGY

From the response of BBC’s journalist we can see that it’s painful to implant a microchip. After that he feels the microchip is useless when he goes home. What’s the effect to user’s body? Will they feel uncomfortable to the wearable technology in or on the body? There are some comfort descriptors: emotions, concerns about appearance and relaxation; physical feel of the device on the body; physical effect, damage to the body; feeling physically different, upset; the device physically affects movement; worry about the device, safety, and reliability[12]. What’s more, when you wear some kind of wearable devices like google glass, people around you may feel under surveillance. So it’s also important to make other people feel comfortable when you are using some kind of wearable devices.

PRIVACY AND INTIMACY

Emotion has been an issue that is sometimes hidden from public view and is strongly related to privacy and intimacy. According to Klosek (2000), personal privacy has become an important issue because of the wide availability and use of electronic networks that create the ease of personally data circulation[13].

Wearable technology will be by far the most personal way of extracting data from users, and you would expect that most people would not be happy in giving away such data. By ensuring their data will not be sold and implementing basic business ethics this isn’t something moral businesses will need to worry too much about. As wearable technology becomes more widespread and common place, ‘wearable marketing’ will undoubtedly become the most reliable way to reach users. Business will hold more data than ever before about their customers, how they react, what they want and when to contact them.

Wearables are going to be the biggest game changer to the marketing world since the creation of the Internet. Businesses who take advantage of wearable technology today will be the leaders on their industry tomorrow[14].

CONCLUSION

It’s possible that wearable technology combines with our body directly. Maybe one day people are implanted microchips when they are born. At that time, wearable technologies are a part of our body. So it’s important to make people accept them in their emotion, especially reducing their concern in privacy issues. Just like the movie “Ender's Game”, everyone has a chip in their head and the government use it to know people’s thoughts. Under this pressure, users may feel uncomfortable. We should give users the flexibility to deal with their wearable things and give them the confidence of safety.
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