Wearable Technology with Future Fabrics

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웨어러블 테크놀로지와 미래 소재

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Abstract

The wearable technology takes the concept of clothing over its limits -integrating software, communication devices, and sensors into the garments to enable them to "think" for the wearer. A dress is no longer just a dress, but a dress as well as a wearable computer interface. This wearable computer network transports the data, power and control signals within the wearer's personal space. The purpose of this thesis is to explore the wearable technology from a commercial perspective. On this theme I made a survey and interviewed 20 men and 20 women in London to find out if many people are familiar with the concept of the wearable technology.

The main results of this study include:

Firstly, according to the survey, people are not familiar with the concept of the wearable technology, and further people thought negatively about the wearable computer rather than positively they worried about high prices, inappropriate technology and side effects.

Secondly, people are especially interested in items related to health and security, so in this area there are huge potential opportunities for the wearable technology.

Finally, wearable technology needs to be a simplified set of interactive devices, which are in a user friendly format for marketability because convenience was one of the biggest concern for consumers. Therefore, development of the wearable computer should be promoted not only through computer engineering but also through the connection with human life.

Key words: Wearable computer, Intelligent clothes, Sensory signal, Smart fabric; 웨어러블 컴퓨터, 인
공지능, 감각 신호, 스마트 소재

I. Introduction

Fashion, as an essential component of everyday life, is not only the way to express personal taste but also the reflection of the times, regional specificity and culture. Throughout history, fashion has reflected interactions with social changes, and the social nature of fashion will be much more diffused in the future. In addition, the computer revolution, as it applies to industrial design, affects the design methodology and practice.

Nowadays, everything is in the process of change towards an information-oriented society, and fashion design is no exception. Fashion allows technologies

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to engage with the human body in a comfortable aesthetic manner.

In being compatible with this change, design can make products of the digital revolution come to users. Thus, this new concept of fashion makes its move as the "Hybrid Concept" such as "Wearable Technologies" in terms of mixing function and beauty of design, introducing vital engineering or matching high-tech materials.

A person's computer can be worn, much as eyeglasses or clothing, and interact with the user based on the context of the situation. Furthermore, current 'Nano' technology will bring us revolutionary changes in the textile industry and it will be possible to make high-tech textiles, which react with their surroundings automatically in the near future.

However, there are several obstacles that prevent the wearable computer from being commercially in use including high production costs, the perception that this is an expensive and impractical gimmick and possible side effects on the human body.

The core objective of this thesis is to explore the wearable technology from a commercial perspective. The assumption is that the wearable computer can be commercially in use in the near future despite several drawbacks. The questions for investigation are as follows:

1. What is the wearable computer?
2. How has the wearable computer been developed?
3. Which kinds of wearable computer are available?
4. Are people familiar with the concept of the wearable computer?
5. Which items available from wearable computers are people interested in the most?
6. What other things have to be done for the wearable computer to be commercially in use?

II. The wearable computer

First of all, wearable technologies are computers that are worn on the body. They have been applied to areas such as behavioral modeling, health monitoring systems, information technologies and media devel-
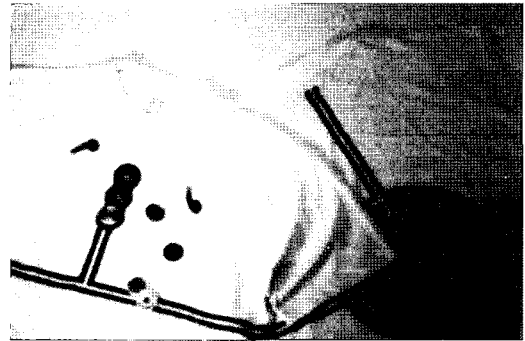

Fig. 1. Philips corporate design 'vision of the future' project.

opment.

In addition, the wearable computer is integrating fashion and technology and could pave the way for fashion to interact with the environment. The wearable computer takes the concept of clothing over its limits - integrating software, communication devices, and sensors into the garments to make them "think" for the wearer.

According to the MIT Media Lab which is one of leaders in the technology of wearable computing, their definition is that: To date, personal computers have not lived up to their name. Most machines sit on the desk and interact with their owners for only a small fraction of the day. Smaller and faster notebook computers have made mobility less of an issue, but the same staid user paradigm persists. Wearable computing hopes to shatter this myth of how a computer should be used. A person's computer should be worn, much as eyeglasses or clothing are worn, and interact with the user based on the context of the situation.

A dress is no longer just a dress, but also a wearable computer interface. This wearable computer network transports the data, power and control signals within the wearer's personal space. Thus, it is possible to configure the network system to match the wearer's choice of interaction, rather than requiring the wearer to adapt their behavior to accommodate the system.

Although most products are intelligence - related at the moment, including intelligent garments to enhance the protective quality of combat gear, there is much room for further development and greater

Fig. 2. Top; Wearable, liquid crystal monitor by SONY Global position system, Right; Casio Wrist watch, Left; Video jewelley, design by Krohn.

commercial availability in the near future. This is a repeat from further up.

III. The development of the wearable computer within its functional effects

"The gap between fashion and technology is being

bridged by research laboratories dedicated to exploring intelligent fashion's immediate and future possibilities"(Quinn, 2002).

Since the 1960s, wearable technology has been developed from glasses, pocket watches and cellular phones to wearable computers for the blind and the deaf(Fig. 2).

The most prominent research laboratory is MITís media lab, which was the first to explore computerized clothing(Fig. 3, 4).

In addition, there are several prominent laboratories such as International Fashion Machines directed by Margaret Orth and Joanna Berzowska, Charmed Technology spearheaded by Alex Lightman, and Starlab who collaborated with the fashion designer Walter Van Beirendonck before closing in 2001(Evans, 2004). They are transforming new and existing technologies into beautiful, innovative and practical garments, using a combination of skills and fashion expertise.

In particular, MIT's media lab began researching ways of embedding technology into garments. MIT scientists did several experiments to make sure that computer systems could be made wearable and still operate efficiently when worn on the body, and they proved that they could.

1. Electric Embroidery

As intelligent wear was not compatible with clean-

Fig. 3. Greg Priest-Doman, Herbert.

Fig. 4. Mike Litanen, TUT wearable 1.

Fig. 5. 'Firefly dress' and necklace.

ing machines or the normal environments of clothes, International Fashion Machines(IFM) adapted special weaving and embroidery techniques including conductive thread through which an electronic signal can pass.

This is called 'electronic needlework', 'e-broidery' (Fig. 5).

For example, chip of the wearer's choice of music could be 'clicked' on to a solar-powered chip shirt (Fig. 1).

2. Sensory Signals

Star lab developed intellectual wear to create hormone release in order to detect the mood of the wearer, so it could be programmed to sense and record the emotions and the state of mind of the wearer. It could give garments a heart, a soul and a reason to live(Fig. 6, 7). Also, Jenny Tillotson, the director of Sensory Design Lab in London introduced smell technology to intelligent fashion. This is
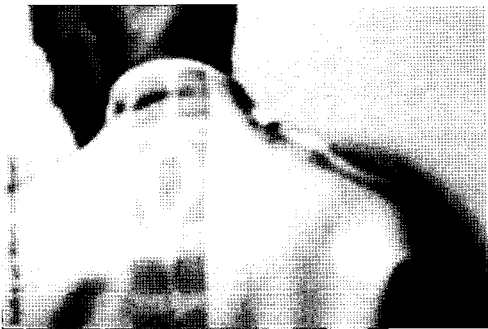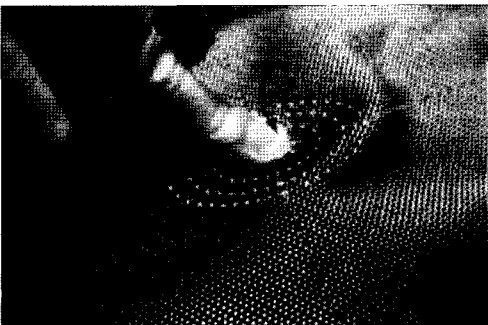
called 'Psychoscents' which border between pharmacology and perfumes(Quinn, 2002).

'Psychoscents' trigger to emit scents based on the temperature, heart rate and excitement of the wearer. In other words, any mood change of the wearer is detected, it releases the aroma and perfumes to keep you in the mood that you prefer.

3. Techno Medicine

Health consciousness is one of the big targets for the evolving techno fashion industry, and there is great potential to use intelligent wear in health care. A 'health care' tier contains sensors that monitor bodily functions, administer medications and deliver medical data to a doctor who could diagnose the patient without even a visit to a surgery. Garments that medicate the wearer are commercially in use.

Fig. 6. Biometric sensor.

Fig. 8. Social telepresenc.

Fig. 7. Elec Tex.

Fig. 9. Still from 'safe' and Jacket prototype.

Fig. 10. Nato military standards and folded.

Fig. 11. People blind dates.

Fig 12. Ear-Lid helmet.

For instance, the remote hardware of the Social Tele-presence consists of a small camera and a binaural microphone. Telepresence is the experience of being fully present at a live location which is remote from one's physical location(Fig. 8). The function of the mask and the jacket watch that monitor blood-sugar levels by analyzing the chemistry of perspiration are available(Fig. 9). Also its protect the wearer while warning others about the dangerous level of pollution in the environment.

In addition, cancer specialists have developed a wearable cancer diagnosis system which transmits data to an analysis computer.

4. Military Intelligence

The US Military has established a project to carry out research on intelligent clothing for soldiers, to monitor the physical condition of soldiers during bat-tle, and enhance the communicative properties of their uniforms. In particular, the uniforms of soldiers can change colour to match their surroundings, sense the impact of a bullet, and detect poisonous gases (Fig. 10).

The 'body LAN vest' is one of the most sophisti-cated wearable devices and is made of durable high tech synthetics. With this, a wounded soldier can be

monitored through his Global Positioning System's (GPS) tracking device(Braddock & Marie, 2001).

5. Virtual Networking

Technology is integrating with commercial work wear and uniforms. Charmed has begun a project which has made business cards redundant. Those wearing the 'Charmed badge', which is an electronic device to transmit and receive information simulta-neously through filters programmed to match the wearer's criteria, can communicate as they come within range of each other. The system's experts Xybernaut are developing face-recognition technol-ogy enabling airport security to investigate suspi-cious travellers using the Mobile Assistant 5, which is a wearable computer being phased into security personnel uniforms (Martegani & Riccardo, 2000).

Also, the wearable computer has developed for the handicapped persons who had been lost theiris eye-sight or hearing(Fig. 11, 12).

IV. Research methodology

As the description of techno textiles and wearable computers, its brought about expansion of function-ality of clothing. These functionality, unlikely that of

the existing clothing, allows to overcome human limitation and provides even the function of machine which was outside.

In addition to this, technology applied to fashion helps us to adapt to multiple and ever-changing lifestyles, and comfort, freedom, versatility and functionality are key(Braddock, 2005).

At this time, we need to investigate the concept of functionality of wearable technology requested by commercial way. From this, a survey is necessary to find out the customerís opinions and priorities for the development of wearable computer and it can provide instructive information for the future wearable technology market.

1. Primary research

The first piece of research was a survey from the end of June to early July 2005 of customer opinion. I surveyed 40 people, 20 men and 20 women in London to know if many people are familiar with the concept of the wearable computer.

In this survey, 40 people- who were living in London at that time - were approached with a questionnaire which all of them answered and a few of them more specifically.

Questions were as follows,

1) Have you ever heard of the wearable computer? If so, where did you hear about it?

2) What was the first thing, which came to your mind when you heard about the wearable computer?

3) If you are interested in the wearable computer, which kinds of wearable computer are available to wear?

4) If the wearable computer that youíre interested in is available, would you like to buy one?

5) If you decided to purchase one, which type are you most interested in?

6) Do you think that the wearable computer will be commercially in use like mobile phones in the near future?

7) Which item do you think will be commercially in use for the first time and why?

2. Secondary research

A wide variety of secondary sources of data have also been examined and used in the compilation of this essay including internet and related books, reports, newspaper, press articles, magazines and so on.

V. The results of the customer's opinion survey

In this survey, there were 3 groups of questions, which were:

firstly, regarding the respondentsí acknowledgment of the wearable computer with 2 questions,

secondly, regarding customerís preferences for the wearable computer with 2 questions,

thirdly, regarding the respondentís preferences about possible future developments in the wearable computer with 3 questions.

1. From the first group of questions

Only 2 men out of 40 answered that they had heard about the wearable computer from a TV program several years ago.

Since people haven't heard about the wearable computer, I gave them a brief explanation of the idea of the wearable computer to help their recognition for answering the next questions(Fig. 13).
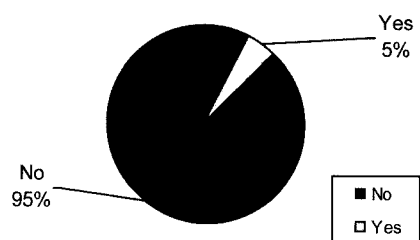

Fig. 13. Respondent's recognition.

28 of 40 people recognized the wearable computer in negative ways rather than positively. Some of them said that the wearable computer will not be convenient, useful, practical, inexpensive and possible to be in commercial use. In addition, some were worried about invasion of privacy and the controlling

of private information.

However, 12 out of 40 people answered positively rather than in negatively. Some of them were surprised about the technological advance with flamboyant phrases such as fantastic, wonderful and marvelous.

2. From the second group of questions

I gave an example of 5 items of wearable computer to know which items people are interested in the most.

1) Listening to music wearing a musical jacket

2) Monitoring body functions such as blood pressure or blood-sugar level, administering medication and delivering medical data to a doctor

3) Adjusting automatically to weather and detecting the mood of the wearer. If it's hot, your wear adjusts your temperature, it makes you cool and vice versa. Also, it releases the aroma and perfumes to keep you in the mood that you prefer.

4) Protecting yourself from biological and chemical attack to escape or wait for emergency help to arrive in case of terrorist attack.

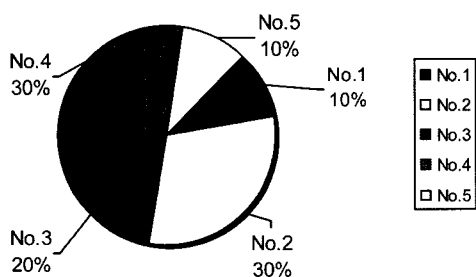5) Transmitting and receiving information simultaneously

Fig. 14. Respondent's preference.

As you see in the graph, 12 out of 40 respondents answered that they were interested in the most in number 2. Also, the same number of respondents said that the most interesting one for them was number 4. Through this, we can easily see that people are more concerned about their health and security problems.

Moreover, 8 out of 40 respondents answered that they were interested in number 3 the most because people in U.K. always are keen on the weather forecast due to its volatility(Fig. 14).

When it comes to the decision to purchase, people were reluctant to buy one. Only 8 out of 40 respondents answered that they are going to buy one, but the rest of them are not. The biggest reason given was the price. Some of them answered that they would consider buying one if the price was reasonable in comparison with normal wear. Furthermore, 4 respondents said that they could not find any benefit in the wearable computer as much as they would like to purchase one mentioning it as an impractical gimmick.

3. From the third group of questions

As expected, 16 out of respondents answered that the price is the most important factor that they would consider. Secondly, 12 out of respondents said that they would care about convenience. Only 2 out of 40 answered that design would be important(Fig. 15).

1) Price

2) Design

3) Technological Advance

    (whether this is the most advanced one or not)
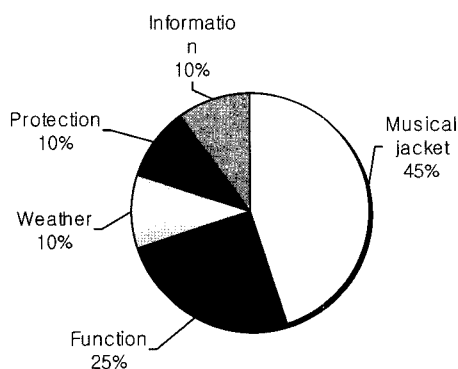
4) Convenience

5) Function

Fig. 15. Respondent's prospect.

22 out of 40 respondents said that the wearable computer would be commercially in use in the near

future. However, the rest of them were skeptical about this. Most respondents who said yes answered that it would take more than 10 years to be commercially in use due to the establishment of a mass production system for the necessary price reduction.

The musical jacket was dominant. Almost a half of the respondents answered the musical jacket since a portable listening device is already available. 25% of respondents answered monitoring body functions reflecting increasing health concerns.

From this, it can be concluded that people put more importance on functions with price rather than design. Also, people perceive the wearable computer as functional and supportive wear rather than normal wear(Table 1).

Table 1. Respondent's important concept

Price	Design	Technol-ogy	Conven-ience	Function	Total
16	2	6	12	4	40

VI. Finding and discussion

The purpose of this thesis is to explore the wearable technology from a commercial perspective through a customers' opinion survey and interviews. I assumed that the wearable computer can be commercially in use in the near future, and asked 40 respondents, 20 men and 20 women in London.

In analysis, the survey and interviews illustrate some important points which are that people are not familiar with the concept of the wearable computer, and more people recognized the wearable computer in negative ways rather than positively criticising inconvenience, high prices, inappropriate technology and side effects. Also, respondents are more interested in items related to their health and security problems. But people are reluctant when it comes to their decision to purchase one due to the high price, which was the most important factor. Even though almost half the respondents answered that the wearable computer will be commercially in use in the near future, they said that it would take more than 10 years.

On the other hand, technologists want people to consider the wearable computer as a part of their everyday wardrobe. However, it still has several obstacles that the technologists have to overcome to make this come true, for instance, health concerns and its high cost ñ the problems mentioned above.

It needs lots of research to reassure the public that they are absolutely safe. As it is revealed that people are more interested in items related to health and security, there are huge potential opportunities for the wearable computer, especially in these areas. Therefore, a synergy is necessary among those in the fields of fashion, health care, defense and computer science for marketability. Moreover, there needs to be a simplified set of interactive devices, which are in a user friendly format for marketability as convenience was the second biggest concern for consumers.

How has the intelligent Wear been applied to the fashion field? Some collections used the sort of new textile technology that many intelligent wear designers might be interested in.

However, it will take time for the fashion field to be applied to the wearable computer as people perceive the wearable computer as functional and supportive wear rather than normal wear.

Initially it may be a specialized minority who buy the wearable computer, for health or military reasons. However, as costs come down in the next decade, it could be perceived as attractive and practical wear by more and more young people and the mainstream retailers start to stock such items.

VII. Conclusion

The production of fashion now exists within a diverse range of contextual settings, and as such encompasses a broad range of communicational scope (Melissa, 2005).

The wearable computer integrates software, communication devices, and sensors into garments to make them think for the wearer. It also transports the data and control signals automatically within the wearer's personal space. Research laboratories have an important role to bridge the gap between fashion and technology, and the most well-known one is MIT's media lab. MIT's media lab explored computerized clothing for the first time, and it still puts lots of

effort into embedding technology into garments efficiently.

The wearable computer can improve our lifestyle. 'Intelligent clothes', equipped with sensors developed by IBM, are able to signal the effect on our behavior caused by alterations in the environment. However, there is a possibility that private information is revealed without the consent of the wearer as every piece of information can be transmitted. There are potential health risks in the case of techno medicine as the wearer can be exposed to radiation and it would cause side effects from inappropriate technology.

In addition, the potential of techno fashions may have profound implications for our experiences of body and mind, our communication abilities, health care and lifestyle. Fashion also allows technologies to engage with the human body in a comfortable and aesthetic form. Therefore, each new generation of technology will have multiple opportunities to market itself as the ephemeral trends of fashion bring to the consumer each new look. Moreover the wearable computer will also function in an industrial context even though it is not popular and commercial right now.

In conclusion, one of the most important points of this kind in all these projects and studies is that, in its renewed desire for innovative forms of creativity and drive, with which to progress its development, fash-

ion's interplay with the human body has provided new challenges and opportunities. Consequently, development of the wearable computer should be promoted not only through computer engineering but also through the connection with human life. Moreover, fashion designers should understand the functionality of clothing from people-oriented opinions and reflect these into the designs to present more progressive fashion designs.

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요 약

첨단소재와 테크놀로지를 수용·접목하기 위한 연구는 컴퓨터 공학 분야와 패션에서 나날이 중요한 이슈로 부각되고 있다. 특히 웨어러블 컴퓨터는 통합 소프트웨어 개념, 커뮤니케이션 장치들과 착용자를 위해 "감지" 할 수 있는 옷으로 전환되는 센서가 갖고 있는 한계를 극복할 수 있는 새로운 아이디어들을 잠재하고 있어 앞으로 이 분야에서 많은 개발 가능성을 보이고 있다. 웨어러블 컴퓨터의 기능은 이제 더 이상 하나의 옷이기 보다 옷과 입을 수 있는 컴퓨터의 상호 작용이 되기도 한다. 이 착용할 수 있는 컴퓨터 통신망은 자료를 전달하고 파워와 제어신호를 착용자 개개인의 공간 안에서 조절 가능하게 되었다. 그럼에도 현실적으로 웨어러블 컴퓨터가 상업적으로 정착하기에는 여러 가지 어려운 문제점들을 갖고 있다. 이러한 시점에서 본 논문은 일반인들이 갖고 있는 웨어러블 컴퓨터에 대한 인지도와 관심도를 조사 및 분석하고 앞으로의 상업적 전망을 연구하는데 목적을 두고, 패션의 주요 도시 중 하나인 런던에 거주하는 20-30대의 젊은 층을 대상으로 설문조사를 실시하였다. 설문조사를 통해 얻은 결론을 요약하면 다음과 같다.

첫째, 소비자들은 웨어러블 테크놀로지에 친근하지 않은 것으로 나타났다. 개인 정보가 유출될지도 모른다는 우려와 기계조작에 대한 거부감, 비싼 비용 등으로 부정적인 견해가 더욱 큰 것으로 나타났다.

둘째, 소비자들이 더욱 흥미를 갖는 웨어러블 컴퓨터 아이템들은 건강문제와 개인의 안전에 관한 것이며 이는 앞으로 이 분야의 잠재성과 시장성에 중요한 요인으로 작용하고 있음을 알 수 있었다.

마지막으로, 웨어러블 테크놀로지의 상업적 시장성을 위해서는 상호작용 장치의 단순화, 편리한 작동법 등도 소비자들에게 중요한 관건이 되고 있음을 알 수 있었다.

따라서 앞으로의 웨어러블 테크놀로지는 단순한 기술 개발에 앞서 소비자의 확실한 안전을 바탕으로 한 상품의 제공을 위해서 다양한 연구조사가 보다 더 적극적으로 선행되어야 할 것으로 여겨진다.