THE POTENTIAL OF HAPTIC INTERFACES FOR URBAN CYCLISTS IN CHINA

Zhu Yu Lin
Zhuyulin2008@gmail.com

B.A. Industrial Design, Tsing Hua University,
2002

Industrial Design
School of Architecture & Design
RMIT University, Melbourne, Australia
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Declaration:

I hereby declare that the following Masters by Research (project), except where due acknowledgement has been made, is my own work and has not been submitted previously, in whole or in part, to qualify for any other academic award. The content of the thesis is the result of work that has been carried out since the official data of the approved research program- October 2005. Any editorial work, paid or unpaid, carried out by a third party is acknowledged.

Zhu Yu Lin
Masters Candidate

Industrial Design
RMIT University, Melbourne Australia

27 July 2010.

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Abstract

This thesis is the culmination of a two year investigation into revolutionary mobile communication interface designs for cyclists in large cities in China. The research came about as a result of my interest in the growing trend of cyclists making phone calls while cycling in China.

There is current discussion in China about whether creating legislation would be a good option for controlling mobile phone use while cycling. My analysis of website articles indicates, however that fining cyclists for making mobile phone calls while cycling would be ineffective. An article from CCTV's website, for example suggests that simply implementing more fines and new legislations will have little effect on reducing the occurrence of cyclists using their mobile phones while riding. (CCTV, 2007) In a sense my research is concerned with this view. I hope to demonstrate through this research, therefore that the problem can be addressed through product design rather than through stricter laws and changes to legislation.

This current project looks at:

- Why and how this phenomenon of cyclists making phone calls arose in current modern China; what are the implications, hidden problems and potential opportunities for the existent system?

- How can these problems be addressed through design with a view towards creating a better interface for cyclists to interact with other people and the traffic system whilst cycling in urban cities?

- The final design scenarios are used to illustrate how cyclists being an integral to interact with the systems and stay in connect with others. How and why haptic interface can contribute for the cyclists' safety in a broader traffic situation in china.

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Introduction

Initiative for the Design

Many investigations and research reports reveal that, using mobile phones while driving impairs the driver's performance and increases the risk of accidents (Butcher 2009). The increased rate of mobile phone ownership and the large number of cyclists in China make the public safety problem more serious, requiring government action, to determine legislative needs (RoSPA, 2002). Although cars offer increased mobility and are changing the way that Chinese people live, there are still many who rely on bicycles as their priory form of transport, and cycling remains a key component of a sustainable transport system for China. Not surprisingly, China also has the world's largest number of cyclists and mobile phone users. there are more than 500 million mobile phone users in China alone, and it is predicted that this number will increase to over 700 million by the end of 2010 (Jane 2007). The number of cyclists, especially the electric bicycle user group, is growing rapidly. Many people make phone calls whilst cycling, yet most respondents to my questionnaire (see chapter 2.5.1, pp 36) admitted that using mobile phones while riding is dangerous. According to my research, the high prevalence of cyclists using their mobile phones whilst riding exposes a very serious public safety issue in Chinese cities. Attending to phones or making calls whilst cycling distracts cyclists, particularly at a time when their full attention ought to be focused on their own security. 'On-the-go' phone use significantly increases the risk of traffic accidents, as users must divert their attention from their surroundings and are a potential danger to themselves and to others.

Phone use by anyone on-the-go (drivers, cyclists and pedestrians) causes disruptions to traffic flow. People often have to stop to text or to make phone calls. Distracted by their mobile phones, people often miss the chance to cross the street or to make a turn. Distracted by a text message or a call, many consequently fail to obey traffic signals, and when they do observe changes to traffic signals, their reactions are significantly delayed. Mobile phones are also a distraction to pedestrians and may lead to a dangerous situation should a pedestrians' attention be diverted at an inopportune moment. New legislation is one option for addressing the potential danger of phone use whilst cycling. However, I believe that legislation is neither the only nor even the best answer, to address this issue. Anecdotal experience suggests that little heed is paid to traffic laws, and there is no clear indication that creating a law regulating mobile phone use whilst cycling (or driving) would be an effective measure. Development of a communication device that is less distracting to the mobile users would provide a significant advance to public health and safety. This project will show the potential for appropriate design to effectively address the needs of this segment of mobile phone users.

Introduction

Design Aim

To address the safety issues of cyclists using mobile communication devices several aspects of these devices will be defined, mainly to make sure that this research is conducted rigorously. The aim of this project is essentially to create a device that will assist cyclists who need to communicate in "on-the-go" scenarios. The device will also allow cyclists to communicate in a manner that encourages better road and traffic safety. Interface design will be the main focus of this research project. This aim can be achieved by concentrating on the following objectives:

- Compatibility with existing cell phones;
- Portability, so the device can be carried by cyclists whilst they are cycling;
- Simplicity of use to help reduce the risk of accidents whilst cycling;
- Safety, especially in power-supply design;
- Aesthetics;
- Ergonomics; and
- Environmental impacts.

Research Direction and Scope

The primary goal of this research is to explore whether the mobile phone's existing interface can be used easily and conveniently by cyclists whilst they are cycling. Three major study areas: the mobile phone, cyclists, and transportation systems. In terms of observations, images, and videos recorded, the target-user groups of this research project were selected based upon the findings of previous research into mobile phone usage. Target audiences of the scenario designs were carefully divided into two major groups of people: educated white collar workers and city delivery riders conducting service-based business in big cities.

This project aims to develop a mobile communication system designed for "on the go" use by cyclists. The device should be able to filter out unwanted information and provide a better communication interface, both satisfying the user's need for connectivity and enhancing cycling safety—all within one product.

This project envisages the creation of a user interface that utilizes a new method of interaction; thus, it visits the fields of wearable design, wireless technology, haptic interaction, and ubiquitous computing. Persona design, adopted from business marketing research methodology, helped to define the consumer group. It was used as a parallel design methodology to vividly fulfill the vision conveyed by scenario design at the end. Design methodologies are also applied to compare with the design processes commonly used in most design consultancies, in-house design departments, and studios. (See the diagram of design process on Page 4.) This provides a perspective of using persona and scenario design to help implement design cases in real life.

A fundamental premise of using a design concept to solve the safety problems is that the auditory and visual components of the mobile phone interface can be changed to provide a quieter yet more perceptual method of alerting cyclists to messages and calls through sensory signals via a wireless connection. Each design attempt represents a solution to problems exposed at each stage of the project. Design concepts were generated through the research

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of manufacturing techniques, materials, cyclists' emotional desires, mobile usability, and haptic interaction. Some functions which are already commonly in use in portable devices may be ported to the haptic device to create diversity and selling points in mature products, thereby making the exercise a profitable proposition for manufacturers. Scenarios (pictures and videos) have been used to evaluate and record each concept and to test the viability of each concept design. Some concepts were redesigned or abandoned to meet the core requirement–cycling safety. I-Band was finally chosen to be tailored to design scenarios that provide the best solution. GPS functions were also incorporated into design scenarios to assist users to negotiate heavy traffic and make traveling safer.

Research Methodology

The research methodologies in this project are aiming to find the data and information which can help to find the motivations behind the problem itself and to analyse them to find the best solution.

Observation, images, and video recordings of cyclists making phone calls while cycling was the methodology initially used to find references and evidence for the research problem.

Literature review was used to discover the results of earlier research into "on-the-go" usage of mobile devices, particularly mobile phones. The literature-review section also discusses the reason that mobile phone use creates a safety problem results were retrieved from existing research, particularly studies of customer feedback from online resources and articles listed in bibliographies of other researchers. After reviewing the existing literature, further research about the target users was able to be defined. Mapping was used to analyse the data collected on existing portable digital devices related to this design project. Mapping also assisted in understanding and exploring cultural, emotional, and social aspects of interaction via mobile phones. A fundamental working system diagram was generated to clarify the relationship between those reference data for this project. (See the diagram in the appendix.).

Questionnaire investigation was used to narrow the research range to target audiences. It determined the interfaces used by cyclists to stay in connection with others, contributed to the core problem solving, and led to the creation of user personas and scenarios.

User personas and user scenarios are two powerful communication and design tools. User personas were employed to explore how a product might fit into a user's lifestyle and address the user's needs. User scenarios were employed in the concept development process and focus on the research and design in order to create a mature and lasting product. A more detailed explanation of the scenarios can be found in the scenario chapter (Chapter 5 - User Study, Persona and Design Scenario).

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The Cross-over Chart Comparison of Design Process and Design Methodologies used in this Project

Research Methodology	Design process	Design methodology
	Project brief	Observation, pictures and video recording, literature review
		Mapping
	Analysis	Interactive systematic problem
	Design direction Haptic-interface design	Haptic interaction
	Idea, sketches, model, rendering	User-study, questionnaire
		User persona, User scenarios
	HF(human factor) check	Design scenarios

Diagram of Research Methodology (product design process/design methodology)

Overview of Chapters

This exposition is divided into five chapters which investigate aspects of cycling in China.

Chapter 1: Mobile Telecommunication use by Cyclists in China. This chapter describes background research into the hand-held device market in China and looks at the issues and risks associated with using mobile phones whilst cycling. It indicates the potential opportunity for design to be used as an effective solution. It considers mobile-communication culture, trends and product analysis which limit the development of new mobile communication products. It looks at the lack of mobile communication products that can be effectively used "on the go". It investigates the development and progress of mobile phone design. It analyses existing mobile phones from a number of perspectives, such as convergence and divergence and multimedia interaction trends.

Chapter 2: Cycling in Urban China Research and Observation. This chapter follows the process of collecting user study data. This includes investigations into the cycling conditions of large cities in China, the behaviour of cyclists, pedestrians, and drivers, and other information relevant to the conditions of cycling in China. This chapter also defines the research domain; it introduces the widespread trend of making phone calls while cycling in China and describes problems associated with cyclists in China.

Chapter 3: Interfaces for Users in Mobile Situations. This chapter unveils the direction of the design solution towards research into the application of haptic interfaces and haptic interactions, a growing global phenomenon. Studying the way

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we interact ‘person-to-person’ and ‘person-to-environment’, is widely regarded as a new stage and guide for the development of technology products. This chapter seeks to focus on human-to-human sensing ability. It explores wearable design, as an offshoot of haptic interfaces, and considers wireless technologies and electronic fabrics; relevant materials like smart fabric, electronic fabric and wireless sensor technology produced for handheld communication devices are also studied. (Ashby, M. & Johnson, K. 2002 Materials & Design) Finally, it suggests a manner of perceptual interfaces which could potentially lead to safer mobile phone use for cyclists.

Chapter 4: Design Investigation and Scenario Evaluation. This chapter investigates the optimal wearable positions on the human body for the products suggested by this design project that are most ergonomically suited to cyclists. It includes sketches, rendering, specific frame drawings, and evaluation criteria to explain why the haptic interface was chosen as a design solution. It also introduces the design concepts, and uses scenarios as a design evaluation tool finally, the research in this chapter investigates modes of communication that work at a peripheral awareness level.

Chapter 5: User Scenario. This chapter argues that using a haptic interface may provide significant opportunities for enhancing the user’s interaction experience with others while cycling, thereby helping to reduce traffic disruption and create an improved and safer cycling experience within urban China. It looks at how users currently operate their communication devices. The aim of this chapter is to investigate how people relate emotionally and physically to personal objects on a daily basis.

Chapter 1

Mobile Telecommunication use by Cyclists in China

In this first chapter I will introduce the background to mobile communication in China, and build an argument for my assertion that current mobile phone designs are unsuitable for cycling conditions. I will also discuss how, in a time when the industry is experiencing exceptional prosperity, mobile phone design is largely dependant on technological enablers, showing little other user or use-related design advances (Goggin, 2006). It is common to see people using mobile phones while walking, driving cars, or riding bicycles. Given the natural growth in the bicycle user population, it is only reasonable to infer that safety issues arise when cyclists make phone calls ”on-the-go”, which is only set to increase. In the following paragraphs, I will introduce some background information on mobile phone users, and the development of the mobile phone in China.

China is currently facing massive challenges, including environmental degradation, increasing energy needs, mass urbanization, and rural poverty (Ying, 2004). Any one of these challenges would be a formidable task for a country and its leaders, and China is riddled with problems of this magnitude. It is widely agreed that a better living environment in China is essential for society to advance, and to attract greater immigration over the next 15 to 20 years. This is required to correct an imbalance in the working demographic. The increasing number of private vehicles taking to China’s roads has exacerbated serious environmental problems and brought with it the phenomenon of gridlock in major cities, such that the government is now in the position of discouraging car use by urging citizens to use public transportation. Bus fares, for example, have been reduced, because, even though buses are the most polluting form of mass transport, their use is balanced by the efficiency in which they carry large numbers of people each day. Bicycles, especially electric bikes, are becoming more popular amongst ordinary people as a daily transportation tool to get to work. Given the rise in the popularity of bicycles (Richburg 2009) the phenomenon of cyclists making phone calls whilst cycling is only likely to increase. Thereby giving rise to the number of accidents that result as a consequence.

In China, mobile phone regulators and operators get mobile phones into more hands, more quickly than ever before (Dong & Li. 2004). The mobile phone has become a ubiquitous symbol of prosperity in many developing countries. In 2006 China Mobile was already ranked as the world’s second biggest operator, after Vodafone (Goggin, 2006). Today, you can hardly see anyone in a public place without a mobile phone. With multiple lines, cell phones, voice mail, e-mail, and fax machines all allow for a steady flow of information in and out of our lives. Being connected has become essential to our idea of domestic comfort (Busch, 2005). Talking loudly in mobile phones frequently attract unwanted attention in public places, such as on buses or in subways. An important point to note is that the content of the visual interface on a mobile phone is becoming extremely complicated to the point were it only suits people in a static situation, not in a mobile situation. The screens on handheld devices have become clearer and larger, but the physical size of mobile phones themselves has become smaller. The content is becoming ever more complicated, requiring a great deal more concentration from the user. This begs

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the question, how can a user operate a phone accurately and safely, when in motion?

China Mobile subscribers sent 607.1 billion messages in 2008, (Ankeny,2009) Short messages are so popular that a myriad of services have been created, based on systems that automatically answer customers messages sent through SMS. For example, in big cities like Shanghai, one can check the Yellow Pages and make restaurant reservations using SMS, (Medeiros, 2006). People riding the subway or on a bus in China's capitals are apt to switch to SMS mode, so as not to disturb others. SMS can thus be said to be a potential area for development, in order to better suit the requirement of public communication.

Most people in China rely on SMS to chat with their family and friends, as such cyclists, being part of this phenomenon; will be apt to receive more text messages than phone calls while cycling. Sending texts whilst cycling, however, demand greater time and attention than talking and is therefore potentially more dangerous. We can, through appropriate driver education and awareness programs, hope to change public behavior - though it may take years. Due to the scale and mobility of China's population, it is difficult to predict just how long it would take to change user behavior in relation to cyclists' phone habits. But elsewhere, such as during the TAC (The Transport Accident Commission) campaign in Victoria, Australia positive driving habits have taken effect. This was done by applying tougher drink driving laws, more driver education, passenger restrictions for P-plate drivers, and mandatory car safety technology.

The mobile phone, and sending SMS in particular, has changed the way people communicate. In order to shorten the time taken to text a person, and to save money, phrases or sentences have been compressed to only a couple of characters, using abbreviations and symbols (emoticons) to express meaning. For this purpose a new mixture of language has evolved, such as the practice of using the English suffix "ing" to convey something that is currently going on. This has been adopted into the Chinese language and is widely added after Chinese verbs, to describe these "on-going" situations. Young adults prefer to use abbreviations in their text for speed typing, both to reduce the ache that develops in their thumbs (Blackberry Thumb) and for fun.

Many Chinese young people use an abbreviated form of Chinglish, made up from Chinese words combined with English grammar, or some Chinese words translated from English, or English in Chinese style (Image 1.).

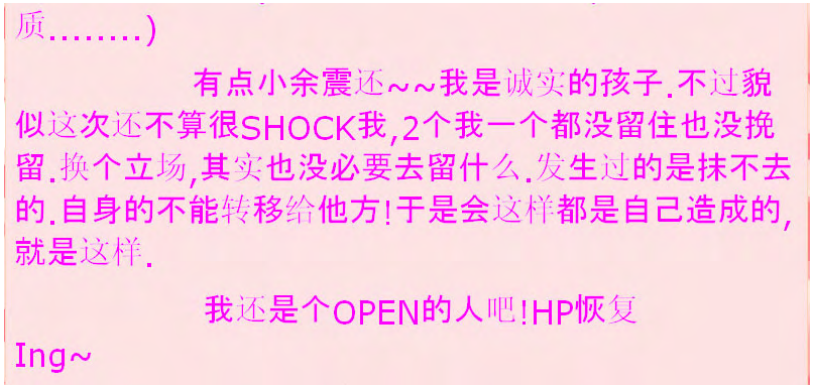

Image 1.

Cited from a young Chinese girl's personal blog dairy website, it shows how popular Chinglish is used among young adults

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Mobile phone usage and cycling are not immediately compatible. For a phone to work well in the context of cycling, its interface needs to be redesigned. Phone form and size needs to be adapted for being used on the move, and the way people receive messages and phone calls also needs to be reconsidered. Interaction with the phone should be minimal and require as little attention and concentration as possible. The service it provides should anticipate what people need while they are cycling, and do nothing more, as it should be dedicated to the specific context of use.

There are roughly 300 million adults in China aged between 18 and 30 (Elegant, 2007), who form the main user group for wireless technology and mobile devices. It is this group that I have selected for the primary persona in the scenarios of this project. The youth of China now tend to worship Western brands such as Apple, Nokia, Motorola (Rein, 2007). People are able to express themselves with the things they use and the things around them. Many young Chinese have a sense of brand loyalty, trusting the products of a particular brand to be of a better quality and suit their own style better than other brands as well. Brand consciousness is very much a part of their character.

They are a youthful group, always wanting to express their individuality through fashion and by the things they own. The more technologically savvy like using the latest communication tools, such as mobile phones, new internet chatting software and blogs. They are often attracted to the "next cool thing". Some strive to become technology virtuosos, while others just appreciate the symbolic value of technology as an investment in their individual personalities (Lobet-Maris, 2003). A consumer will identify powerfully with messages that reflect their own perception of self.

This closes them off to contrasting meanings that could be said to challenge or conflict with their fragile self (Chapman, 2005). Image 2 illustrates the scenarios of the connecting experiences of mobile communication device users. It shows a connection between gathering people who share the same beliefs in create their own territory for sharing their same values and social activities (Lobet-Maris, 2003).

Image 2.
Three main socio-semiotic features of the mobile brand language: fashion imaging, tribalism and body expression have been evoked in the above picture.

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In general, it is easy to find the connection between people's belongings and their personality. Even the material and design style of their clothes can emit the charm and feelings that the individual usually has. Young adults like to express themselves not only with their favorite brands but also the quality that the material and design convey (see Image 3 below) the emotional connection between the person and the brand, and the personality he wants to project through his style of dress are tied to in the materials and appearance of his personal items.

Image 3.
The emotional connection between the person and his belongings

The comparison of three big brands, mobile phone companies in China (see the diagram in Image 4) provide adequate information on user's feedback. This can be seen to prove the success of how Nokia used its strategy of" connecting people" to win customer's hearts and a market share in China.

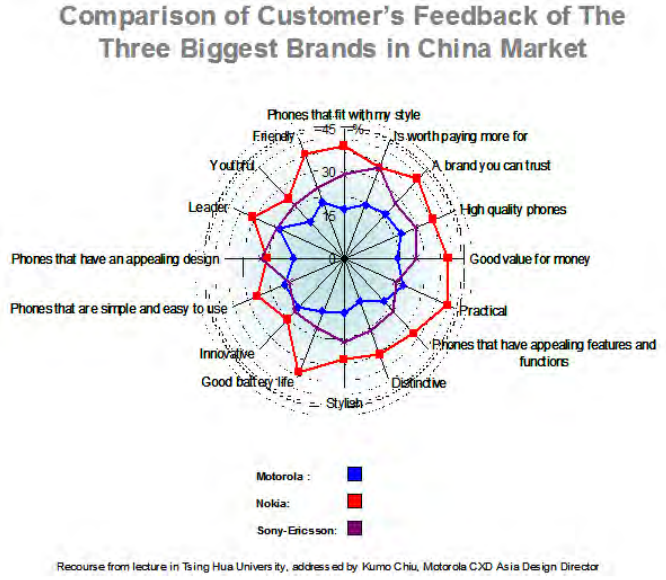

Image 4.
The comparison of three big brands, mobile phone companies in China

Nokia is strongly communications-focused, and has successfully used this strength to attain the No. 1 brand position in China across all age groups. A huge amount of investment has been put into China by the global leading mobile phone producer Nokia, since the middle of the 1980s. Nokia so far appears to be the best at understanding what the markets want. Some studies show that Nokia's success lies in the cooperation with other outlets and operators (Mimoun, 2009). It is believed that Nokia's success

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stems from its spirit of 'connecting people'. This is also the reason why Nokia excels at satisfying their customers, compared to the likes of Motorola and Sony Ericsson. A comparison of the three largest brands in China (Nokia, Sony Ericsson and Motorola) shows how users rank them according to preference. According to the diagram in Image 4, Nokia's mobile phone is considered superior in the aspects of practicality, user-friendliness, and battery life, appeal of features and functions, and value for money.

45% of users think Nokia mobile phones' designs suit their personal style, 30% of users think Sony-Ericsson mobile phones' designs are matched with their own style but only 15% of users feel the same about Motorola mobile phones.

Sony-Ericsson does better than Nokia in only one aspect: phones that have an appealing design. That is possibly because Sony is well known for the design appearance of their digital products. In 2006, since Motorola V3 came out, many people also changed their opinions on Motorola's mobile phones. In 2004, Motorola put a lot of effort in improving the user interface and the product identity of their mobile phones. They did research on the Chinese market and found that Chinese people favor symmetrical patterns and styles. Since then, Motorola has developed symmetrical and streamlined models such as the U6 and V3. The V3 went on to become the best selling mobile phone in China and the world.

According to the population of mobile phone users is increasing and the group of cyclists is expanding. It was demonstrated that people are more likely to use their mobile phones and sending or receiving messages to others in an on-the-go situation than in a static position. The user persona will be further elaborated in chapter 5. In the next section, we will look into the convergence trend of current mobile phone development, compare handheld devices and find and discuss the inadequacy of their interface design used in on-the-go scenarios.

1.1 Convergence — Developing Trends of Mobile Phones

This section introduces the developing trend of mobile phone use around the world. The essential reason for existence of the mobile phone, along with the changing behaviors of people, the culture of society, media and the theories of design to user's emotion will be brought to discussion (Image 5). To participate actively in using mobile technology some secondary sources relating to multimedia interaction trends, design forms, and color trends of mobile phones, have been included. The trend of mobile phones is moving towards smaller, more stylish, functional and highly competitive designs that will earn quick profits, it is more important to understand the emotional underpinnings of consumer decision-making as a driving force behind viewing and purchasing decisions (Jenkins, 2006).

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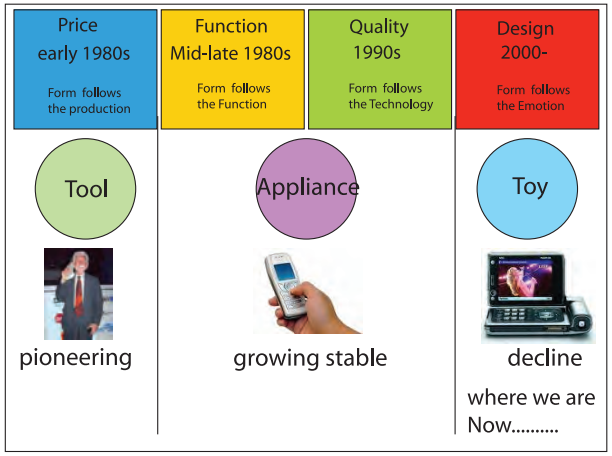

Image 5

Schematically describes the processes of development used to facilitate the design of mobile communication devices produced by Zhu Yu Lin

Since telecommunication has become commercially and publicly available, there are many ways to map the vectors of the development of mobile technologies. From the 1980s to the 1990s, the mobile phone culture changed from being the domain of European and American production to being thoroughly refashioned through manufacturers, equipment suppliers, network operators, and a growing number of new intermediaries. These intermediaries include air-time, content wholesalers and retailers as well as various types of third-party suppliers and partners. These make and secure a mass consumer culture for mobile phones, with a global reach and local intelligibility (Wang, 2005). The mobile phone culture is now a far larger, more diverse, collection of meanings, practices, and technologies than it was in the 1980s. Current mobile phone design is not compatible with the phenomena concerned in this project however (cyclists talking and making calls, or sending and receiving text messages whilst riding their bicycles). This phenomenon and the associated hazards will be discussed in the next section.

Wireless technology emerged in communication devices relatively recently although modern technology no longer limits communication to merely talking on the phone. Now the mainstream product of the electronic handheld device market is the mobile phone, which is likely to remain the most popular personal communication device in the near future.

In preparing for this work, a wide range of portable personal devices have been studied for its life circle development by using the sunrise and sunset diagram (Kunkel, 1999). These include mobile phones, MP3 players, digital cameras, headphones, PDAs (Portable digital assistants) and USB flash drives that have been researched, mapped and compared (Kunkel, 1999, see the sunrise & sunset diagrams, in appendix). The mapping diagrams reflect a few points, for handheld devices the more innovative forms tend to have complicated functions and cost more to produce. Conservative forms are simpler, have less function and are also cheaper. Some wearable gadgets have simpler forms and are more likely to be used in an on-the-go situation. People use them at the same time as when they use their mobile phones, such as an MP3 player, except some mobile phones has this function included (see mapping diagrams in appendix)

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The design of mobile phones today is radically different from early models. Ten years ago, the mobile phone was mainly defined as a handheld device (Hedge, 1998; see the diagram of "design of hand-operated devices" in appendix). Today's mobile phones are becoming increasingly specialized. From 'display-less' phones with giant buttons (in contrast to older mobile phones whose buttons occupy much more space on the user interface), to phones that can test your blood sugar. These latter devices were the most influential in this research because they represent a shift in design from standardization to specialization.

Convergence is a trend in manufacturers and technology's needs; lots of products are created with some cross cutting functions. For example mobile phones had been seen as an integral handheld gadget with different functionalities. Convergence in this instance is defined as the integrals of information technologies, wireless network, media content interfaces and interaction as a result of services operated by a single device (Shin, 2006). The reason people chose one product over another is never due to the product's function only. Buyers also consider how products can be incorporated into their daily lives and activities in an easier, more convenient way. Products designed for 'on-the-go' use give the user control of the style of communication, so that they do not need to sacrifice their focus and concentration for their connectivity when cycling or participating in other activities. Because of this, there is an increasing number of products designed to be wearable or portable. The mobile phone has already become too small to operate easily, even in a static situation. While there is a trend towards a convergence of high technology and function, their appearance is developing toward simplicity and minimalism (see images 6 and 7). It is compressed enough so that it can be held in a hand or be put in a pocket. It has become very portable and less cumbersome. But the smaller it becomes, the harder it is for cyclists to use whilst cycling.

Image 6 by Zhu Yu Lin

Image 7 by Zhu Yu Lin

The camera phone has experienced greater change since the first mobile phone incorporating a camera, the Nokia 7650, was released in 2002. Now, camera phones are commonplace, with many mobile phones featuring highly sophisticated cameras. In fact, a mobile phone 2008 barely has any resemblance to phones of ten years ago. Its visual language and semantics have evolved rapidly, drastically changing, and has become even more inseparable from our lives. Two applications now available on mobile phones are group game playing and video conferencing. Especially with their ability to interact with regular PC users employing desktop video conferencing software.

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What kind of emerging technologies will be important to society in the future? Software development is dependant on future technological development. Compression technology, fiber optics, and more advanced wireless networks need to be developed to enable high-definition full-frame video and multi-channel surround-sound, for home users. The table below shows the three most popular functions used by mobile phone users, apart from calling and sending SMS, since the year 2004. MP3 and other digital audio formats have changed how music is distributed and downloaded, as well as demonstrating how technology can significantly alter media distribution systems. Napster revolutionized the recording industry, which has now adopted online sales through websites such as Apple's I-Tunes. Digital Video is rapidly becoming a mature technology and The Apple iPod became photo and video capable in 2004 (Lloyd, D 2004). Image resolution will also continue to improve, with the trend towards high-definition television, the OLED (Organic Light Emitting Diodes), and the mobile phone. The video gaming industry has been at the cutting edge of technology. Video games have surpassed feature films in visual effect, and a new genre of three-dimensional computer-animated feature- films has emerged. The development of technology with regards to this can be seen in the following table:

Table 1.Leading Trend of Multimedia on Personal Digital Devices

	2004	2005	2006.....
Gaming	Three-dimensional wireless video game becomes popular in mobile markets	Intergradation of console games & mass media increase link to main stream consoles	Allow multi-player games over the mobile phone network
Imaging	Sending of photographs across the radio link	Peer 2 peer streaming,True video capture +p2p broadcast	High definition televisions have gone mainstream
Music	Mobile music compared to network music markets (figure: mobile music, MIDI music, online music)	Stereo audio mainstreamed	Personalizing ones digital gadget with a variety of music

Taking digital photos has become very important to the mobile phone user (Diagram of the Leading edge of digital gadgets-Appendix). A camera increases the value and visual quality of the mobile phone itself, and allows the user to create a stronger connection to their phone, through personalized background images and avatars assigned to different callers. More and more users, particularly teenagers and young adults, regularly use the camera function on their mobile phones to take photos and send these totheir friends as a means of communication and self expression (Gye, 2007). As a result many mobile phones now feature integrated VGA digital cameras, giving users the ability to capture and record live action anywhere they take their mobile phone.

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The casing of high quality mobile phones generally needs to be thin, solid, durable and insulated in order to protect the intricate electronics inside, and to keep the phone small and in high quality. Producing this kind of casing requires the usage of more expensive plastic and materials, increasing the cost of manufacture, whereas a mobile phone with less complicated functions is less prone to damage and can be manufactured from a cheaper, lower caliber material. The Brick, one of the original analogue Motorola styles, so-called for its robust construction, has now been re-released in retro-style, somewhat smaller than the original, but digital. Its stripped down functionality is in stark contrast to the modern trend, and it is still robust enough to be dropped regularly. Almost every component in the mobile phone seems capable of being diminished to meet the minimum requirements of its user. The keypad and screen size remains limited by our hand and finger size and the aspiration for visual quality. The mobile phone has met a big design challenge. The contradiction between visual effect and the screen size of mobile phones is becoming crucial and uneasy to balance.

An even more important aspect of this is that new interactive activities have the ability to link the virtual and the real for users. This union of interactivity and artificial intelligence technology has been used in media gaming activities. In speculating about potential developments in wireless mobile communication technology, we can begin to imagine a completely new type of interactive interface. This would create an invisible interactive experience for cyclists “on-the-go”, to stay in contact while minimising the distractions to their cycling. This would bring a new experience to cycling, while keeping the cyclists as safe as possible. This phenomenon led this research to look into new areas of perceptual interface (see chapter 3).

Although handheld devices are sold under a variety of guises, they are specially designed for particular user groups. However none provides a complete package with specialized form, features, and communication services designed for a particular context, while many digital “fitness devices” play music or track data none are designed to enable mobile communication. Nor do they take advantage of services that a mobile network could provide. iPhones and Blackberrys are becoming part of the contemporary media convergence together with mobile internet, mobile television, and other wireless technologies. A great many people still choose to wear a watch, despite the fact that they can easily check the time on their mobile phone. Some mobile phones can be used as a music player as well, yet many people still like to hang a mini i-Pod around their neck. There is much debate about whether these devices will converge into hybrid equipment, or keep their separatefunctions, and how such a convergence culture would be navigated by consumers (Jenkins 2005).

Most handheld devices have similar interfaces, such as handwriting recognition and on-screen keyboards. This kind of function creates an accident potential. With touch panels on the screen, mobile phones today can usually support one-handed operation. You can use two hands to speed up some tasks, but most operations can be completed using only one finger (Amy K. Karlson, Benjamin B. Bederson 2005). Generally one hand is used to hold

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the device while the other acts as a controller (actuating, moving, and pushing buttons). There will be many touch screens appearing on mobile phones over the next few years (iPhone for example is a start). Handheld devices, such as some digital gadgets, MP3 players and recorders by contrast usually require two-handed operation. With their touch-screen and point & click actions they have some advantages though (customizable interfaces) but also present some challenges. Sending an SMS message requires the user to spell out their message by clicking the buttons quickly and accurately. This is very difficult to accomplish whilst cycling, and draws too much attention away from safely riding the bicycle and navigating traffic.

GPS navigation systems have been widely used in mobile phones while driving vehicles (such as cars and trucks) to help drivers navigate roads that they may not be familiar with. This avoids the distraction of having to look at a map at every red light, while driving. The GPS shows where and when to make turns, and what distance to travel down a specific road, allowing drivers to concentrate on obeying traffic signals and driving safely. Cyclists have the same problems as vehicle drivers but it is impossible to use a mobile phone as a traffic guide for cycling, as it requires cyclists to look at the screen and click the buttons frequently. This would be dangerous for cyclists and for their fellow road-users.

The diagram below illustrates conventional mobile phones on the market and shows size and shape or form, ranging from traditional brick-shaped phones to clamshell phones, and pen phones to pendant phones. There are six basic mobile phone types: candy bar, angle rotating, clam shell, sliding, rotating, and touch-panel.

Table 2. Mobile phone types produced by Zhu Yu Lin

					
Candy bar	Angle rotating	Clam shell	Sliding	Rotating	Touch panel

Since the iPhone reached the market, its “keyboardless” interfacehas been copied by numerous competitors (Evans,R. 2009). The six different phone types above are novel ideas but make it more difficult to operate for cyclists who have, at most, one hand to control the phone. Some candy bar types, such as the Blackberry, or the iPhone with its touch screen panel,can only beoperated with two free hands. (Amy K. Karlson, Benjamin B. Bederson 2005).

A cyclist may not need or want to view the entire contents of a message at first if they already knew who might send it. However, they may wish to receive an unobtrusive notification that a message is available, along with an indication of how important it is. That way, the rider can make their own decision, whether or not to stop their bike and access the contents of the message. The limitations and disadvantages of the mobile phone interface in an ‘on the move’ situation are clearer than before. Using mobile phones

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to make calls send texts or perform other functions while riding a bicycle is as dangerous as when driving or walking on the street. The user is exposed to traffic, distracted by noise, signals and lights, they have to concentrate on riding their bikes and they can only use one hand to operate their phone while cycling.

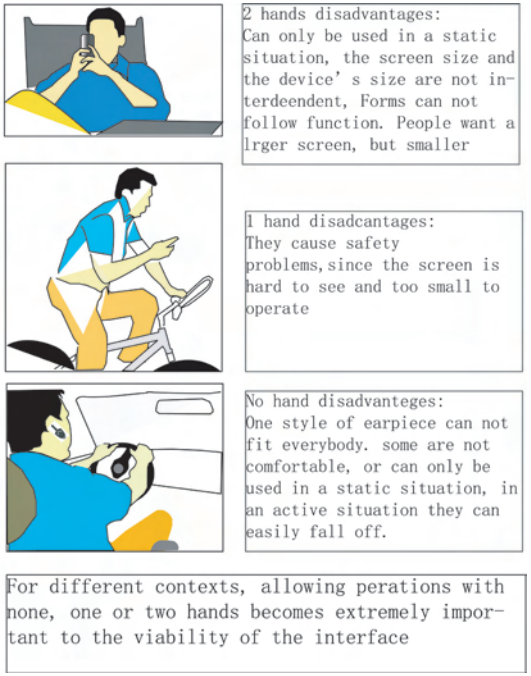

Image 8

The disadvantages of hand's operation for mobile phone users in different situation produced by Zhu Yu Lin

Earpieces are mostly used with mobile phones when users are "on-the-go". Although the earpiece is the most suitable accessory for "on-the-go" situations, its problems are not limited to causing distraction that can result in accidents, and discomfort when worn for long periods of time. based on a large quantity of data; cyclists senses need to be all alerted to avoid tragedy, and their sight and hearing are important to navigate the traffic although it is legal to wear headphones, listening to music or talking on a phone whilst cycling (Levy 2010).

Many mobile phone users like to play music on their phones. Incoming calls cause the music player to automatically stop playing and switch to receiving the phone call. Using an earpiece to receive phone calls seems more sensible than holding a mobile phone in the cyclist's hand, but many accidents occur whilst walking or riding, when people listen to music with the volume turned up so loud they are unable to hear other sounds around them. Earpieces can also be intrusive and catch cyclists off guard when they make unexpected or sudden sounds, especially because loud noises in close proximity to the cyclist's ear can damage the delicate and sensitive ear tissue. The earpiece itself is easily lost, and can fall out of the cyclist's ear as they ride, and dense traffic makes it impossible to retrieve such a small item. Some earpieces usually can't be worn in conjunction with sunglasses, hats, or other headwear. Sound is a reliable way to alert someone about an event. But we can't turn away or close our ears sometimes. We can't be inattentive if someone else's device is ringing, especially when the device has the same ring tone as yours. This causes confusion and distraction to other people and brings unwilling attention to people who make phone calls as well. Earphones or Bluetooth earpieces distract cyclists from hearing warnings and sounds in their surrounding. As a very important accessory for

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mobile devices, feedback on ear piece from some female interviewees through online chatting revealed that they felt the design of ear phones (head phone) or ear pieces didn't match their clothes well, such as lady's suits, or formal dress required in particular situations, and that this was a concern to them as consumers.

Wearing ear pieces may help cyclists remain reachable when they are called. But this doesn't mean this behavior should be encouraged, as it would jeopardize, safety. Inputting mandarin language into a mobile phone for texting and other purposes also adds another layer of difficulty for "on the go" users. An improper input implement can falsely affect user's behavior, resulting in bad habits becoming established. Examples of this would be abbreviations and acronyms, which are commonly used when writing text messages, using the key pad on a mobile phone.

Image 9
Taken by Zhu Yu Lin

Here is a Blackberry's (Business phone and smart phone with video, software and services to connect to the internet. It is a wireless email solution for mobile professionals. It provides easy access to your business email wherever you go). 26 button keypad (see Image 9 above), like a QWERTY computer keypad. Symbols, numbers and letters appear on the same button. English users can just type the words easily. But for Mandarin input it is much more difficult, and requires a lot more of the user's concentration. (see table 3 below), and one button could have three to four "Pin Yin" letters on it. Chinese "Pin Yin" is often used with English abbreviations in texting now, because it saves time and makes the text look novel and interesting. The table below illustrates the different input characters used in Chinese mobile phones and English.

Table 3. Comparison of English and Chinese characters

English text	English word	pinyin in Chinese	Text in Chinese
C	SEE	kan (look)	看ing (looking)
U	YOU	ni	你
L8	LATE	chi dao	晚/迟到
R	ARE	shi	是
4	FOR	wei le	为了/ 是
B4	BEFORE	zhi qian	前/
2	TO	qu	去ing (going)
OMG	OH MY GOD	tian a	
LOL	Laugh out loudly	da sheng de xiao	
BRB	BE RIGHT BACK	ma shang hui lai	
Y	WHY	wei shen me	

If using literature, abbreviation saves time and makes an emotional connection, it will be more intriguing to search into the driving force behind it, so as to find a familiar and better way to help cyclists keep connected.

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In this chapter, I have stated the safety problems of using a mobile phone while cycling. There are several reasons that safety is compromised. First of all, due to the traffic being chaotic, with the number of cars and congestion increasing; talking or texting distracts cyclists from pedaling. Second, the population of mobile-phone users is growing, and evidence shows that texting is increasing. This has effects on cultural behaviour, changing the way people interact with each other. Third, mobile phones are becoming an increasingly important part of many cyclists' lives, creating a new form of social expression as they want to be connected at all times. Even when they are pedaling their bikes. Fourth, mobile phones are becoming smaller in size while the number of features is increasing thereby making mobile-phone use while cycling increasingly hazardous. As such the key to helping people interact may not be in technological convergence. We rather need to look into a new direction to design our devices to make it suit human behaviour better.

During the chapter some reasons for why a new interface design for communication devices is needed have been discussed from mobile phone user's point of view. In the following chapter more evidence will be shown and discussed as to why the current mobile phone's interface is not suitable for cycling. And how to design an interface to solve the issue using a user investigation questionnaire.

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In the previous chapter, an argument about whether cyclists' behavior of calling while cycling can make the cyclists safe has been built and discussed. In this chapter the safety issues will be further discussed to argue that adding a mobile phone to an already dangerous situation will no doubt bring more safety problems to cyclists and other people on the street. For this purpose Beijing has been used as a case study, it being a typical large metropolis in China. Research revealed that similar occurrences can be observed in Shanghai as well as other major cities (Li & Hu, 2007). Thus it is believed that what is learnt from Beijing is applicable and transferable to many other major Chinese cities such as Shanghai, Guangzhou, and Shenzhen.

Chapter 2

2.1Traffic system problems in China's urban cities

At present, there are too many people and too many cars in China's modern urban cities. Experiencing traffic jams during peak hours is a frustrating part of nearly every citizen's daily routine (see image 11-12 below). To allay these effects of modernity the number of ring roads encircling the city of Beijing was recently extended from three, in the 1990's, to six ring roads. By 2005 fifteen new roads had been constructed to connect these new ring roads, creating a spider-web of highways and including the outer districts in the city's transportation system. Other roads have been repaired and upgraded to handle the increasing volumes of traffic (see the image 10 Beijing map in appendix). Extreme traffic flow in and out of the Beijing CBD causes a severe build up of traffic at each intersection during peak hours. The city's traffic problems are not simply a matter of the traffic system alone, but are the result of competing pressures as the city reaches a certain stage of development. In other words, it's not simply an issue of more cars and less roads, but problems such as urban expansion, dense population and changes in life style all have an impact on the problematic city traffic. For example, urban expansion is forcing many people living in rural areas to move to the city to earn a living, which causes dense population in cities. These new city residents also have to make changes in their lifestyle to get used to life in a new environment. Many of them use a bicycle and tricycle as transportation tools, to carry big things, or to sell food and other goods on the streets, even on very narrow roads. This causes an inconvenience for car drivers, cyclists and pedestrians passing by. Below are some images and sources to show the traffic problems that occur in Beijing:

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Image 11

These images highlight the traffic that has become a headache for Beijing residents, (Hua,Z 2004) "traffic issues causes corner in Beijing"ChinaDaily from website: Http://www.chinadaily.com.cn/english/doc/2004-05/13/content_330515.htm Accessing date: 2005-07-15

Image 12

Fair warning ... Beijing road rules might come as a shock as drivers seem eager to challenge the physics principle that no two objects can simultaneously occupy the same space / Reuters (Wills. K. 2008) "Survival guide to driving in Beijing" News.com.au from website: Http://www.news.com.au/travel/world/survival-guide-to-driving-in-beijing/story-e6frfqb9-1111115599661 Accessing date: 2008-04-12

The number of cars is increasing rapidly in Beijing. According to relevant data (Fan,J & Yan,G.L 2009), the number of registered vehicles in Beijing had increased to three million by May of 2007. With more than 1,000 new cars taking to the roads daily, the number is expected to top 4 million by 2010. The government is thereby attempting to encourage residents to use public transportation to reduce traffic congestion in Beijing. Workers are encouraged to walk, cycle or take the bus to their jobs. Bus ticket prices have been dropped from CNY 1 per person to only CNY 0.4, in 2007. Likewise the price of subway tickets was reduced from CNY3/4/5(depending on how far you are traveling) to CNY2, allowing travelers unlimited travel until their final destination.

There is lack of adherence to road laws, and car drivers, cyclists and pedestrians can often be seen traveling against traffic (see image 13-15 below). The images provide an overview of the current traffic situation in Beijing. As can be seen, during peak hours Beijing's roads resemble one big parking lot and riding a bike or even walking is often faster than driving. Indeed, cars cannot move once they get stuck on the road, but bikes still can. Cyclists and pedestrians making their way between buses and cars in all directions are routine.

Non adherence of traffic laws is common everywhere. Examples of this was a man being escorted by a street cleaner crossing the street illegally, and people riding against traffic, even when a police car was parked nearby. Drivers try to avoid hitting pedestrians; however this act of illegally crossing the road is very frequent. Under the new law, if they are hit by a car, the pedestrian is held responsible for the incident. (source: The Road Traffic Safety Law of the People's Republic of China) when accidents occur between pedestrians or non-motorised vehicles and motor vehicles, except for the case where the pedestrian or the non-motorised vehicle

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deliberately causes the incident, motor vehicles, except for the case where the pedestrian or the non-motorised vehicle deliberately causes the incident, the motorist must always bear responsibility. Responsibility for the motorist is reduced if the pedestrian or non-motorised side violated rtraffic laws.

Cyclists carrying people on the back seat of their bicycles is a phenomenon that can be seen frequently in cities in China. Many parents carry children on the back seat of their bicycles and young couples often go out this way (see images 16-18 below). It is illegal for people to carry another person on their bicycles, but this does not apply for tricycle users. A lot of parents carry children on the back seat of their bicycles. The image 17 shows a mother carrying her daughter, and riding against traffic on a street in Beijing. This is also popular amongst young couples. It is a very convenient way for them to go anywhere they want.

Image 13
(left) edited from you tube video "Beijing traffic" website: http://www.youtube.com/watch?v=R5H8y-UJNDo&feature=related
Accessing date: 2008-04-12

Image 14
(Right) edited from you tube video "traffic stand off in china you first please" Website: http://www.youtube.com/watch?v=nw-ZlHXs4Q8&feature=related
Accessing date: 2008-04-12

Image 15
Edited from you tube video "how to cross the street in china" website: http://www.youtube.com/watch?v=6IgUDVJWH84
Accessing date: 2008-04-12

Image 16
Taken in China 2007 by Zhu Yu Lin
A couple riding their electric bike on the street in beijing

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Image 17
Taken in China 2007 by Zhu Yu Lin
A mother carrying her daughter on her electric bike seat

Image 18
Taken in China 2007 by Zhu Yu Lin
A mother carrying her daughter on her bike seat riding against traffic

2.2 Un-Safe Road Conditions and User distractions

Beijing is an important historical city with several thousands of years of history; but it has a severe shortage of land resources. Protected historical sites take up 40 percent of the land inside the 2nd ring road, approximately 62 square kilometers (Beijing traffic-CCTV). This lack of useable land makes it impossible to carry out large-scale road construction projects here. The bicycle remains the most practical means of transportation in Beijing, as cycling avoids parking problems and traffic jams. The city streets and hutongs are an ecological symbol, a living museum of Beijing (see image 19 “Hu tong”). Due to traffic congestion, energy consumption and people’s health, bike lanes have been restored (Matthew, 2008). Traveling in Beijing is best done by bicycle, and it is very unlikely to be replaced by cars. The long tradition of using bicycles as a transportation tool has created many typical images of Beijing. I will discuss this from a number of different aspects: bicycle paths, traffic assistants, people who repair bicycles on the streets and so on.

Image 19
“Hu tong” reproduced by zhuyulin
Beijing hutongs, lanes or alleys formed by lines of siheyuan (a compound with houses around a courtyard) The word "hutong" originates from the word "hottog" which means "well" in Mongolian. Beijing hutongs are inequable ranging from 40 centimeter to 10 meters in width. The longest have more than 20 turns. There are no defined bicycle paths in hutongs, because most are too narrow and old. Image is from Beijing Hutong China highlights website:http://www.chinahighlights.com/beijing/hutong/Accessing date: 2008-04-28

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Beijing's many road issues combine to make the current traffic situation problematic and create a Sensory overload for cyclists in traffic. People, automobiles, noise (vehicle horns and the whistle of traffic assistants) and lights (hard to follow traffic lights) all contribute to this. Cycling also presents the kinesthetic problem of maintaining balance whilst riding. Negotiating city traffic is already dangerous without the added distraction of mobile phone use, especially if one is required to hold the phone.

Using bikes for transportation is still the most practical way of getting around Beijing, as cycling avoids parking problems and traffic jams. Most traffic movements in Beijing are by bike, even during the winter (see images 21-25). You can see people using their bicycles for work to deliver goods in dense urban environments and for other purposes. The images also show how people use tricycles for delivery purposes. There are many peddlers selling things on the street, these can ride much faster than going by car. They usually don't move at a great speed because of the heavy loads on them. Generally they are not so concerned with traffic situations, and often the traffic light changes color whilst they are still crossing and in the middle of the intersection. Bicycle based courier and delivery services in Beijing contribute to the city's transport logistic system. This also helps a lot of newly arrived people from rural areas to find a job and living in Beijing (Zhao, 2006).

It is difficult to see the traffic lights when people cross junctions and intersections in Beijing, traffic lights are often hidden behind passing trucks and buses, especially when traffic is heavy. The traffic signals in China's cities are also insufficient. The poor traffic light systems cannot indicate to cyclists how to go through intersections or junctions safely (image 20). People listen to Mp3 music players and make phone calls whenever, with no regard to the dangerous traffic conditions around them.

Image 20
"Traffic light", shows the difficulty encountered when trying to see the red light hidden behind an umbrella within a certain distance and angle (image taken by Zhu Yu Lin in 2007 Beijing).

Image 21
Edited from you tube video "Laocai bicycle from china" Retrieved from website: http://www.youtube.com/watch?v=BozS8aYaSeg&feature=related Accessing date: 2008-03-20

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Image 22
Taken in China 2007
The left image is a man was searching for somewhere he could stop randomly to sell his bean curd.

Image 24
Taken in China 2007
A man whose professional job is polishing knives is riding his bike to get to his customers.

Image 22
Image 24
Image 23
Image 25

Image23
Taken in China 2007
A man is delivering water to his clients

Image 25
Taken in China 2007
A cleaning man is doing his job on the street

- ***Undefined Bicycle Paths and Obscure***

In China, there are many uncompleted bicycle lanes on the major roads in the cities. In 2006 there were 27 million motor vehicles in the country, and that number could reach 130 million in 15 years (AFX News, 2006). There also are no separate bicycle lanes on typical traditional roads in China, including lanes and “hutongs”, because these are too narrow and winding. There are no clearly marked bicycle lanes on roads to define the road separately for driving and cycling. Beijing’s unorganized traffic system does not satisfy the demands for a safe cycling experience. The vice minister of construction has called on local governments to preserve or restore bicycle lanes in order to halt the decline in cycling commuters. As rapid car ownership growth threatens China's energy security and urban quality of life (AFX News, 2006). Images 26-27 shows the dangers of inadequate bike lanes on major roads in urban cities in China, as cyclists and car drivers must use the same road space (edited from the You Tube video “Traffic in Shanghai” from : http://www.youtube.com/watch?v=xDAx4eYx2Vw, 2010-3-5). There are many roads in China like this. In image 26, edited from the Youtube video “traffic in shanghai”, there is no defined bike lanes on the street, and cyclists and motorcycle riders and car drivers all use the same road. Image 27 shows a bicycle lane that is clear enough to be seen, you can see two cyclists on the left of bike lane, only allowed for cars and buses, which shows another example of conflict for space.

Image 26
Traffic in shanghai Reproduced from website: http://www.cathygellis.com/mt/archives/2006_08.html accessing date: 2008-05-20

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Image 27
Traffic, Edited from you tube video "Beijing traffic" website: http://www.youtube.com/watch?v=uv6bA5tBk7I&feature=related accessing date: 2008-0521

- ***Traffic Wardens***

There are many traffic wardens (Traffic warden is also called flag man or woman. They assist policeman to maintain the traffic. They are employed by the government.) working on each intersection at peak hours in Beijing (image 28 shows a female traffic warden at an intersection in Beijing). Usually there are 4 traffic wardens working at the same time on each side of the intersection. The "flag woman" in the image is stretching her right arm to show the man it is safe for him to cross the street. The wardens help maintain road discipline and encourage travelers to obey traffic laws, preventing cyclists and pedestrians from rushing ahead before the traffic lights turn green. They don't have the authority to fine or catch people however. Instead they use flags and whistles to get people's attention and persuade them to follow the rules and not break traffic laws.

Image 28
Edited from you tube video "The Traffic Assistant in Beijing" website: http://www.youtube.com/watch?v=27cyhNXo4Fs Accessing date: 2008-05-20

- ***Bicycle Services***

There is no provision for secure bicycle parking at train stations, bus stops and residences. Theft is common when bicycles are not safely locked up in homes. It is easy to find people on the street to repair your bicycle. This means cyclists do not need to worry too much if their bicycles get damaged during cycling (image 29 fixing a bicycle). This availability of bicycle maintenance helps cyclists to travel for longer distances.

Image 29
Fixing a bicycle
Taken in 2008 Beijing

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• *Noise and Air Pollution Impact*

In China, traffic is extreme during peak hours, resulting in high levels of noise and pollution from vehicles. The air quality is accordingly poor and the fumes can become unbearable for cyclists. There is clear evidence showing that high noise levels interfere with speech and communication, cause sleep disturbances, and decrease learning ability and scholastic performance. As well as increasing stress-related hormones, increase blood pressure and ischemic heart disease, and the use of psychotropic drugs and medicines (WHO, World Health Organisation 1998, Averting the three outriders of the transport apocalypse). Road traffic is the main source of exposure to noise.

• *Lifestyle, Culture and City Orientation*

China has a cycling culture and cycling is part of people's working schedule, their exercise and recreation, in fact it is part of all aspects of people's lives. This dependence on cycling has some inconveniences however. Cycling is not convenient for the office lady who has to think about changing her clothes after cycling to work for example.

The authorities in Beijing are starting to pay attention to how non-motorized transportation can help address community problems with traffic congestion, poor air quality, health, safety, and the rate of obtaining employment. Promoting the use of electric bicycles and developing a good bicycle network will be beneficial for the environment and economy in China, due to the growing industry of electric bicycle will help to increase cycling behaviour and lower coal emission (Lijing, 2008). In Lijing's article, three advantages of using bicycles are addressed; the first one being its affordable price, the second is it's performance advantage with a bicycle you can go anywhere you like, and bicycles are good for fitness and reduce traffic., and the third its advantage for environmental protection. The electric bicycle is a growing industry that is widely welcomed by many cities in China. With the electric bicycle the cyclists can travel longer distances and with less energy required. Lots of bicycle retailers change their business to sell electric bicycles to earn better profits. The above article also mentioned a questionnaire conducted by China Bicycle Association in Beijing, Shanghai and other regions showing that 45.5 percent of answerers "want to buy a bicycle in the near future". Further, 84.2 percent of answerers buy bicycles to use them as transportation tool, 6.4 percent of them for exercise, and 9.4 percent for short-distance transportation. These potential consumers are largely aged 21 to 35, and earn about RMB 1000 per month. Out of the total amount of bicycles in China, 72 percent have been used for more than 10 years, most of which have not been repaired (Lijing. 2008). In Chapter one, data was presented showing that it is expected that there will be more mobile phone users in China in the near future. The above findings show that China will continuously have a stable consumer market of mobile phone users and a profitable bicycle industry. It is argued that this would lead to the phenomenon of there being more people making phone calls while cycling.

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- ***Legal and Political Issues***

A helmet is not legally required while cycling, and there is no speed limit in China for bicycles (source: The Road Traffic Safety Law of the People's Republic of China). Pedestrians are in a particularly difficult situation. In cities such as Beijing, some places have "self-service" traffic lights providing pedestrians with easy access across the road, just push a button, wait, and go when the light changes. Unfortunately, unless these traffic lights come with supervising cameras connected to police surveillance, some drivers are unlikely to stop at the pedestrian traffic lights, making these pedestrian crossings very dangerous (see image 30).

Crossings with no cameras of any kind are likely to have chaotic traffic, as the police would likely not be present to enforce the law (image 31). In image 31 there is a cyclist riding against traffic, passing a police car without getting caught. Actually, in many places in China this kind of incident occurs regularly. On the roads, people only look after themselves.

There is long-standing tenet that the larger vehicle involved in an accident is to assume responsibility, e.g., if a car collides with a bicycle the car driver is at fault. If a bicycle and pedestrian collide it would be the fault of the cyclist. Practically, this understanding emboldens pedestrians and cyclists to take liberties with cars and trucks. Impeding the progress of these by moving into the flow of traffic under the assumption that larger vehicles will give way (Article 47 of the new Road Traffic Safety Law of the People's Republic of China). This is in spite of the fact that this law allows for only one case in which drivers are not at fault for hitting a pedestrian -- that is, if the pedestrian purposely violates traffic laws (Article 76 of the law).

Very few drivers will slow down when approaching a pedestrian crossing. Even fewer will actually stop for pedestrians waiting to pass by. When this happens, however, a quick wave back by the pedestrian, indicating gratitude is not uncommon. The penalty fee for vehicle drivers ranges from CNY 20 to CNY 200. Cyclists and pedestrians shall be warned and fined no less than 5RMB but no more than 50 RMB, if refusing to pay the vehicle may be confiscated (Article 89-90 of the law).

People often break cycling rules but do not get fined because there are so many people breaking the rules. There are still lots of people in China who cannot afford to use private cars and instead use bicycles and public buses for transport. So cycling won't decrease public transport users, as car drivers do, in China. There is a growing trend towards using bicycles for transportation in crowded inner city areas.

Within this context to prohibit cyclists from making phone calls while cycling is unlikely to be an effective deterrent. If an accident occurs do to a cyclist using a mobile phone whilst cycling, the guilty party will not be the cyclist if the collision happens between a car driver and a cyclist. As the guilty party is always considered the driver and not the cyclist (traffic law article 47). As such this law won't help in making cyclists more aware of their own safety. In the section 2.3 I will further discuss why law enforcement is not the best way to cope with the cyclists' safety problem.

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Image 30
Edited from you tube video "how to across the road in Beijing" as you can see, the traffic light is still green, but pedestrians have to stop and wait for the bus to go first. From website: http://www.youtube.com/watch?v=hxGTFfZ_aEk&feature=related Accessing date: 2008-05-21

Image 31
Edited from you tube video "Beijing traffic" citing from website: http://www.youtube.com/watch?v=aZDhNo6Nwkw&feature=related Accessing date: 2008-05-21

Table 4. Climate (citing from Beijing's weather website)

	unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature	'C 'F	-4.7 23.5	-1.9 28.6	4.8 40.6	13.7 56.6	20.1 68.1	24.8 76.6	26.1 78.9	24.8 76.6	19.9 67.8	12.8 55	3.8 38.8	2.8 37
Precipicution	mm. in.	76 3	76 3	76 3	102 4	152 6	203 8	305 12	254 10	178 7	152 6	102 4	76 3

• *Weather Conditions*

In the northern part of China, where the city of Beijing is located, the temperature plummets to –10 degrees Celsius for a few weeks during winter and it is very cold for cycling. Below is a table of annual temperatures in Beijing (table 4). Beijing's climate is cold and dry during winter whilst the summer is hot and dry. January is the coldest month and July is the warmest. Winter begins in the end of October, June to August are the summer months, wet and hot with about 40 % of the annual precipitation. After snow the roads become icy, and it is very difficult, and dangerous, to cycle on the roads. Sometimes during spring it can be windy and sandy for a few days as well.

In indoor conditions, mobile phones with small text size may work well for most users, but in a mobile condition the screen could become unreadable in bright sunshine or in dimly lit places. It is hard to read the screen when cyclists expose themselves on the street in cities, especially during the summer, as the hot, dry and strong sunlight reflects on the road reducing the cyclist's vision. (See images 33). Thereby distracting cyclists from being aware of the traffic environment.

People usually put their mobile phone in the pockets of their coats; and wear cumbersome clothes with lots of layers in winter. They are more likely to make phone calls while cycling, because it is easier to reach their pockets. Although there are more difficulties and inconveniences to cyclists wanting to use their mobile phone while cycling. During rainy days people wear rain coats. When the cyclist takes out the mobile phone, the rain drops smear the screen, making it very hard to read and creating a threat to cyclists' safety. (Image 32). In the summer, people wear less clothes so there is no pocket

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in their clothes, especially when girls don't like their phones to stick out from their dress. They choose to put the phone in their bags, rather than to carry it on their back or put it in the front basket on their bicycles.

There are two consequences of putting their phone in bags: Cyclists won't hear when the phone calls, they will lose their connection or they will try to stretch their arms to get the phone out of their bag and not concentrate on cycling. Either way is not a good option.

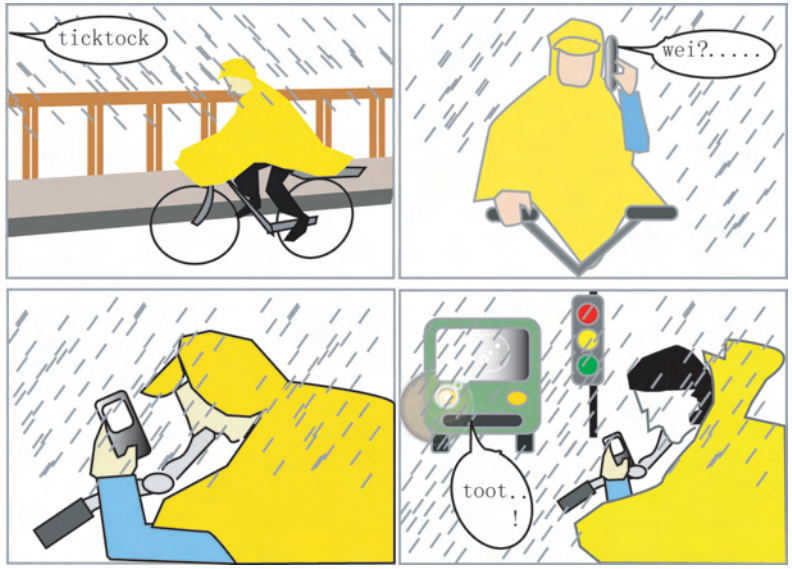

Image 32
Disadvantage of using mobile phone in rainy day by Zhu Yu Lin

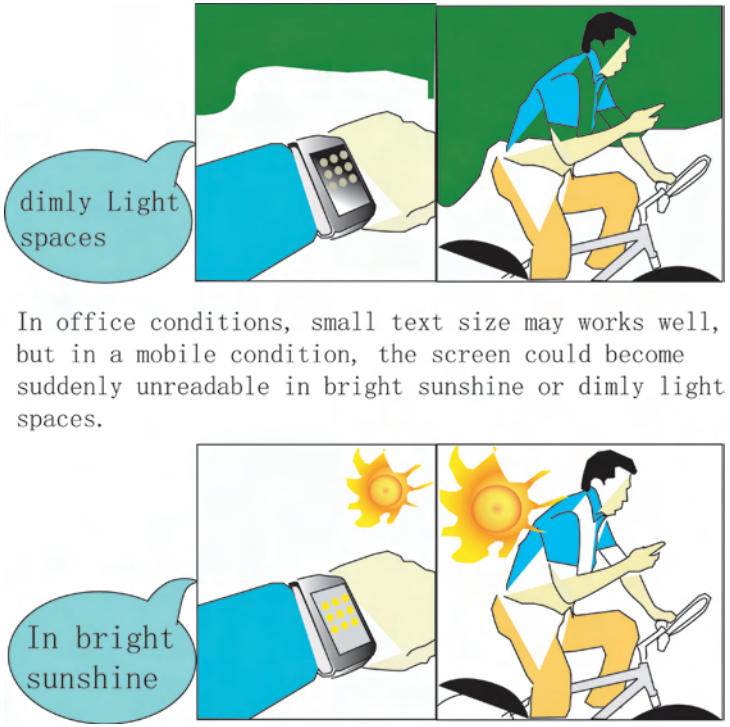

Image 33
The disadvantage of using mobile phone in too dark or too light situation by Zhu Yu Lin

2.3 Cyclists making phones calls while cycling in urban cities in China

In the following paragraphs, I will use a number of images taken in Beijing as examples to illustrate the dangers associated with making calls whilst cycling, why this is occurring (refer back to chapter 1) and why this is a growing problem in large cities in China. The series in image 34 shows a man trying to take his phone out from his pocket, it is a real struggle and it finally falls down on the ground. This kind of things can be seen often. Sometimes serious accidents happen, resulting in critical injuries.

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These observations help inform the design specification, which support some research findings in the previously mentioned questionnaire.

Image 35 shows a young cyclist trying to make a phone call while crossing an intersection. He rushed across the street without waiting for the traffic light to turn red, while holding a phone in his hand and calling someone.

Image 36 shows a man ready to turn left in an intersection; calling someone while waiting for the traffic light.

Image 37 shows a girl in grey making a call whilst cycling, slowing down her pedalling, putting her hands on the bike's handle bar before she had to stop and wait for the traffic light in front of an intersection.

Image 38: Shows a man who has stopped and put one of his feet on the curb, whilst text messaging someone.

Image 39: Shows a cyclist in Shanghai talking on his mobile phone while maneuvering the city's streets during rush hour.

Image 34
Phone dropped when cycling taken and produced by Zhu Yu Lin in 2007

Image 35
Cycling against traffic light while talking on the phone taken by Zhu Yu Lin in 2007

Image 36
Cycling against traffic light while talking on the phone taken by Zhu Yu Lin in 2007

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Image 37
Slowing down and talking on the phone taken by Zhu Yu Lin in 2007

Image 38
Had to stop to send a text taken by Zhu Yu Lin in 2007

Image39
Copied from "China's cell phone frenzy". Source from: http://www.dailyherald.com/special/crossingchina/part2.asp Accessing date: 2009-12-14

2.4 Discussion of Possible Methods to Tackle

- ***This Safety issue***

There are three main methods for tackling the problem of cyclists making phone calls while cycling in China. The first method is by law, to ban cyclists from engaging in mobile telecommunication while they are cycling. The second is through infrastructure design, such as road construction, traffic signals, more traffic assistants etc, although this would be a long term strategy and take a much time costs as well as being unlikely to control the problem Thirdly, through creating interventions focusing on the interface design between the user and their communication device. This would reduce cognitive distractions and allow users to make simplified choices regarding their use of mobile telecommunication whilst riding in traffic.

- ***The First Approach***

Regulating the user of mobile telecommunication via legislation is always an alternative choice or dual strategy but would most likely not be a successful solution to the core issue on its own. China has the largest population in the world and also the world's largest amount of cyclists and mobile phone users. Even in normal situations, people tend to disregard laws such as those regarding traffic lights, due to difficulties crossing the street in highly congested areas. Another reason may be that the traffic lights are obscured behind passing buses and other vehicles. The policemen and traffic assistants are already too busy maintaining some degree of traffic balance everyday to be able to police new laws.

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They are simply too busy to keep one eye out for cyclists making phone calls. Such laws may also be hard to enforce with limited evidence of cyclists making phone calls once the action is finished.

- ***The Second Approach***

Referring to previous research, building infrastructures and roads in large urban cities will not help to ease the traffic problems, but only create more serious urban expansion problems. Even if building more roads could make our streets less crowded for motor drivers, cyclists, pedestrians, and everyone else, it does not mean the traffic environment would be safer for cyclists. On the contrary the cyclists are more likely to lose their caution and be driven by their habits. The growing urbanization of China is making cities expand very quickly, and the pace of people's lives in the city is going to become faster and involve more interaction with others. This will inevitably lead to people needing to make contact with others (via use of telecommunication devices) when walking the street, catching a bus, in the train, and while cycling. Better infrastructure may help cyclists, reducing accidents, but the central problem of cyclists communicating remains, as do the associated dangers

- ***The Third Approach***

Communication devices, such as mobiles phones have become an important piece of social technology, an important part of our everyday lives. In China, everyone who wants and can afford one will most likely have one. They offer new ways for communication to occur in different kinds of places, and by different groups of users. The ways we interact personally with mobile phones can elicit subtle changes to our lifestyles, behaviour and habits. But the mobile phone is not just a piece of social technology; rather it is also coming-of-age as a central cultural technology item.

Although mobile phones are perceived as personal private devices to serve the individuals who own them, they are also social artefacts. People's behaviour and communicative practice is influenced by the owner's lifestyle, social networks, and the social contexts in which the phones are used. Furthermore, how has it changed our behaviour, and how might it continue to do so? What new rules may us what to impose on its use?

In this context the mobile phone has brought telecommunication into the on-the-go situation, and as a consequence has impacted on cycling habits and safety. Because there is currently no interface on mobile phones suitable for cyclists "on-the-go" (see chapter 1), it is believed that through good design the problem can be reduced in a more effective manner.

It is believed that the best approach to solve this safety problem is a multiple strategy involving all three options, because all of these factors together lead to behavioral change. But the approach through design would be the most effective and easiest one to implement. Observing real people in real life situations has

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significantly helped to highlight the problems that need to be handled in this project and how these are best to be tackled. The dynamic images, caught in the moment, reflect the motivation and intentions behind cyclists' behaviour. What I've learned from these observations is that people are aware of their safety when they make phone calls whilst cycling. They take some actions to prevent accident happening, such as slowing down their pedaling, stopping, or making phone calls when they reach safer places where there are less cyclists, pedestrians and vehicles on the street. But because the situation is over complicated and exasperated by poor interface design many unexpected things that could happen without any prior warning to cyclists, all of which could possibly result in injuries or even mortalities. So it is crucial to design an intervention which can address this problem

2.5 Questionnaire Investigation

The questionnaire form had been created and calculated in statistic software called "SPSS". SPSS refers to SPSS (originally, Statistical Package for the Social Sciences) it is a software system based on the idea of using statistics to turn raw data into information essential to decision-making. (Wikipedia, http://en.wikipedia.org/wiki/SPSS) It is designed and aimed to collect information about the motivation of these mobile phone users, making phone calls whilst cycling in urban cities in China. It covers the important points related to making phone calls whilst cycling, as covered in previous studies, and help to find further research directions, and the creation of User Persona and Scenario Design. For office workers, the questionnaire form had been sent through email and their feedback has been received online. Sometimes phone calls were used to request a friend to answer the questions or call people to remind them to return their feedback by email. An investigation has been carried out among office workers in the big cities of Shanghai and Beijing. For sensitive and personal questions, such as salary and age, respondents were recommended not to use their real name, and were told that their answers would be kept confidential.

Questionnaire forms were distributed via Internet and street dissemination (see the questionnaire form in appendix). It included general information on target consumers' personal backgrounds (recorded in anonymous forms), and how they would like to keep contact with others whilst cycling (e.g. texting or calling). Further, where they usually carry their mobile phones whilst cycling, and their own opinions on making phone calls whilst cycling, which were to be rated on a three to five-point scale. The questionnaire helped to define the user group and to clarify the user focus, and design direction of wearable and haptic interaction. It helped to understand more basic user representations and build the User Persona and scenarios to make better design decisions.

Target interviewees were selected based on previous studies, to fit certain criteria of user group of this project. They were required to complete these forms in their spare time. In order to receive a response, and minimize non-responses, the questionnaire form sticks to the essential, useful information, keeping the questions simple, interesting and easy to complete.

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2.5.1 Questionnaire Findings

The questionnaire forms have been distributed to 100 people in Shanghai and Beijing via Internet. Around 85% of the forms have been returned and validated for analysis. There are some important findings discovered from the feedback of those who completed the questionnaire forms:

• Most people who completed and submitted this questionnaire were young office workers who have daily cycling experiences and own at least one mobile phone. They have a high education background, and interests in advanced technology and digital gadgets.

• Most responded that they use the mobile phone to make phone calls or send text messages (usually they send around 10 messages per day).

• They were people of an age ranging from the late teens (18 +) to mid thirties, who see it as very important to stay in contact with others.

• Most people think it's important to stay connected, or to be able to contact others at anytime. They think it's dangerous to make phone calls whilst cycling because they don't have a spare hand for holding their phone.

• Interviewees who use their bicycle as a transportation tool would like to use GPS navigation when cycling to a new place. Usually they just use bicycles to get to work, and so they do not get lost during their daily routine.

• Everyone who makes phone calls whilst cycling agrees that it is dangerous, although they still might do it more than occasionally.

• People feel it is intrusive when suddenly receiving phone calls from others whilst cycling. Interaction is always risky when people are 'on-the-go'. People need a good sense of balance, and also have to avoid other cyclists, cars and pedestrians on the street; because cyclists are often seen riding against each other on the cycling lane and it is difficult for them to obey traffic rules (see video references and images 18, 26-27, 31). For instance, especially during rush hour, many larger vehicles drive on the cycling road to catch up on time and overtake other cars (refer to images 11-14), regardless of whether there are people cycling or walking in that lane.

• Many accidents are caused by people listening to music with the volume set too loudly to hear warnings from cars or buses.

• Almost every interviewee has had experience of making phone calls or texting whilst cycling, but when they want to text someone they always have to stop riding their bicycles. Most people responded that they don't like to make calls while cycling, but they still do it sometimes, without conscious thought.

• When people are cycling, they like put their phones in their pockets on the side of the hand they usually use to operate their phone. Alternatively in the basket on their handle bar along with

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hard keys, wallets, or other things, that makes it inconvenient for them to take it out whilst cycling. Most put their phones in their pant's pockets. Sometimes the phone falls down and may be broken or lost when attempting to retrieve it from their pocket in order to make or answer a call. So it appears better to buy a cheap and solid phone rather than a fragile and expensive one.

• Most interviewees have an ideal mobile phone type in their mind that they wanted to purchase in near future.

From the feedback of interviewees in the questionnaire forms, two personas have been created to define the target audience. One is for the biggest consumer group, which we may refer to as the generation of 'self expression', and another one is for people who work in delivery services (see chapter 5: User Personas). Since China is well known as a low labour cost country and now that E-businesses are becoming increasingly popular, there are more people getting involved in delivery services in big cities such as Beijing and Shanghai.

In the next chapter, I will further explore how to use design to deal with the safety problem. Research will be focused on the mobile wireless technology interface design based on the findings in chapters one and two.

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In the previous chapters, the interfaces of currently used mobile communication devices were shown not to adequately support on-the-go communication. Several inconsistencies have been listed and discussed. In chapter one the contradiction between the small size of the mobile phone itself, and the large screen size, as required for ergonomic usability was shown. The keypad or the touch panel requires handheld operation and this can not be used by cyclists who need both hands for safe cycling. Chapter two unveiled that the currently used mobile phone's interface is only suitable for a static situations, and not the noisy, and disorderly streets in China. The purpose of this chapter is to discuss the mobile technology and interface design, particular focus being on a haptic interface, as a way of enabling "on the go" mobile telecommunication and reduce cognitive distractions for cyclists.

Ubiquitous use of mobile phones has created a mobile phone culture, while on the move use of mobile phone communication has created a type of tribal culture (see chapter 1. Image 2). An evolution in recent years has led to increased mobility and at the same time a strong desire to instantly access information and communicate easily and comfortably. Current mobile phones already have a type of haptic interface. Haptic , in general, refer to the sense of touch. I-phone, for example, has haptic buttons and a touch panel. Many mobile phones have since some time a vibration mode, while in 'silent mode'. This project expands this basic function into a much more sophisticated interface concept. Aiming to find a way of using some already existing wireless mobile technologies, and designer's common sense, to create an interface that can be used by cyclists "on-the-go". The discussion on research into haptic interfaces will be conducted based on three main factors. The first of these factors is some current haptic interface applications, that many leading universities and companies (e.g. MIT, Microsoft) are engaged in. Second, there is the wireless technology that frees us from the restraints of location. Examples of the NTT DoCoMo. Inc (is the predominant mobile phone operator in Japan). This company's mobile phone services will be used to support and explain how technology can be incorporated into the design concept of this project. Thirdly there are the electronic textiles, which integrate sense, perception, and wearable design to pave the way for designing haptic interfaces, opening a new way of thinking about how to deal with safety issues. It is expected that wearable technology will exert more influence, in addition to that already made by portable devices, and fashion design. Manufacturing techniques, materials and technology for mobile devices is currently being studied, as well as some new areas that researchers are focusing on, such as electronic textiles and smart fabrics, which is an advanced combination of fashion and technology. Augmented social interaction is likely to increase, with more people possessing a greater variety of ways to connect with others, without requiring physical touch or proximity. People will be able to spend most of their time staying in contact, and communicating with each other, especially when in mobile situations.

City residents now have the ability to communicate within groups, access media and entertainment content and manage their 'digital lifestyle' through SMS, mobile email, pictures and video. These innovative applications are not yet fully explored in a real

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mobile situation. Mobile technology can enhance and augment the digital world, and connect people to the physical world in new ways through new user interface design (Howard, 2003). Haptic technology enables digital systems to engage with the sense of touch for greater realism, accuracy, and performance. They can then work together to inform us about pressure, texture, stretch, motion and vibration.

3.1 An overview of the key haptic interface application

There are definitions of a haptic interface that can be found on the internet. One explanation described a haptic interface as a communication, or interface, with a computer through a tactile method involving a device that senses body movement. Leading universities such as MIT and the Carnage Mellon University, and leading companies such as Nokia and Microsoft have been doing research on people's ability to sense change and on people's perception. There are many haptic interfaces currently being used or applied to products in the fields such as medicine (for training and surgical simulation), chemistry (education about complex objects), creative 3D work (modeling and product design) and interaction for the disabled. Further it is used for interaction in 3D and VR environments, and other risky or specialized areas such as: space travel and mechanics. (See Image 40 in appendix). While answering questions about the Microsoft Surface Computer (Fried, 2009), Bill Gates commented that the computer keyboard and mouse would give way to more intuitive technologies, within five years. He predicted that touch; vision, and speech interfaces would become increasingly important. (MXNews, 2008) Gates believes that the idea of natural user interfaces will redefine the computer experience. Consequently, researchers at Microsoft are active in undertaking research into HCI (human computer interaction). In the interview, Gates also mentioned the success of the I-phone and the controller for the Nintendo Wii (Wikipedia, Citing from website: http://en.wikipedia.org/wiki/Wii) game console (see Image 41&42 Wii in appendix). The Wii is the fifth home video game console released by Nintendo. A distinguishing feature of the console is its wireless controller, the Wii Remote, which can be used as a handheld pointing device and detect movement in three dimensions. Another is WiiConnect 24, which enables it to receive messages and updates over the Internet while in standby mode. These interactive interfaces are considered to have been a huge success amongst customers.

3.2 Potential and current applications for haptic interfaces on wireless technology and mobile devices

Wireless sensor technology offers potential major advancements in many aspects of our lives. It is also likely to play a very important role in the future. As wireless networks expand, it is possible that we will come to expect ubiquitous Internet access. We might get online through 3G, wi-Fi or Bluetooth, or some other new technology. Many technologists have proclaimed wireless

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technology as a promised field of the future. Freed from the restraints of location, it may enable all kinds of communication to be experienced more artistically. This is already apparent in the case of mobile phones, PDAs, and videophones, which began as voice-only devices evolving into camera phones with Internet access. This is not to suggest that face-to-face communication and telephones will diminish in importance. Rather it is suggested that wireless handheld, and other portable devices, will add a new dimension to our daily life. People want to make phone calls, access email and perform the odd web search, but also desire to use applications to keep in touch with friends, getting emotionally connected to other people, and so on. In the short term there will most likely be an overlap of networks and technologies, so that our mobile devices will be able to switch seamlessly between them as required. The shape of these devices will doubtless undergo complete changes, with smart phones, PDAs, blackberry, Tablet PCs other handheld devices constantly evolving, mutating, and improving. It's almost certain that most people will have some multifunctional mobile gadget, and it is safe to assume that its primary function will be to keep us permanently connected. Not just to a mobile phone network, but also to the Internet.

Several mobile phone handsets currently employ haptic sensory perception. These include the Nokia 5500 Sports Phone, and the NTT DoCoMo D904i Sports Cell Phone (see Images 43-44 in appendix) with 3D accelerometer sensors embedded (Will, 2007). Motion sensing is now used for real applications within consumer products, apart from just launching applications and playing games. The NTT DoCoMo Company also launched their I-mode service for mobile phones recently, offered by Japan's leader in wireless technology (Will, 2007). NTT DoCoMo, unlike most of the key players in the wireless arena, was a run away success in Japan with the I-mode (Moggridge, 2007, video reference from designing interactions). Moggridge met the key designer from DoCoMo, Takeshi, Natsuno, who said their shopping could be done simply by clicking keys on a mobile phone. I-mode is no doubt a wonderful design for mobile phone technology, but the mobile phone has a complicated interface, making it difficult to use. This is seen in the video (Moggridge, 2007), in which it took a Japanese girl 35 minutes to use her mobile phone to buy a drink from a machine at Seven-Eleven. This including the time she had to spend calling the customer support service. Undoubtedly, new interfaces will emerge as cutting-edge technology becomes more ubiquitous. This will help to simplify the process of doing everyday things in our daily life. The paradigm of the keyboard, monitor and mouse may remain for some time, but new interfaces will augment and may replace these in time. Haptic interfaces are being developed to heighten the tactile experience. The haptic device would help cyclists maintain focused on cycling, not having to be occupied with their mobile phones until they choose to stop and make a call.

3.3 Fibers and electronic textiles lead wearable design to a new stage

The two goals of setting out an improved haptic interface and improving cyclists' safety on-the go have been set out so far in this project. Because cyclists would have to carry the perception

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interface with them, electronic textiles and wearable design have been considered the best way to design a device that could lead us to deal with the cycling safety problem more effectively. Wearable computing technology was first only affordable by the military, and some industrial sectors funded largely by the military and used for soldiers (Lee, & Subramanian, 2003). Now textiles and wearable electronics are often applied in the areas of fashion leisure, functional sportswear, and medical and safety wear. An example of this would be the NuMetrex new line of Heart Sensing Sportswear with electronic sensing technology integrated into the fabric of the sportswear (Julia, Talk2myshirt; http://www.talk2myshirt.com/blog/archives/192, 25/5/07). The traditional process of cutting and sewing is coming under threat from clothes that can be sprayed-on, grown, programmed, or constructed from smart textiles that respond to our individual needs (Suzanne, 2005). A typical system architecture design of a wearable electronic or photonic product is shown in a diagram (see Image 45 in appendix), which comprises several basic functions. These include interface, communication, data management, energy management and integrated circuits (Tao, 2006). This evolution proposes that computation becomes embedded into fabrics and textiles. Our clothes and personal wear is about experimenting to express the symbolism of our own individualities (Luo & Zhang 2006). The design and manufacture of fashion and textiles have been closely related to scientific and industrial innovation. Textiles might act as a switch to receive a wireless signal, sensing the posture and gestures from the human body (Tao, 2006). A wearable device with an appealing form, and friendly and comfortable use, together with an affordable price will have a market (Tao, 2006). Phillips was the first company that started researching haptic interfaces and wireless sensor technology. Philips Design and Philips Research have come up with a range of prototypes for electronic clothing that integrates communication technologies with garment construction. The collection provides enhanced functions in combination with high-performance knitted, woven or printed materials.

Fashion design is the most relevant area where haptic interfaces and wireless technology can be applied to solve problems in our daily lives. The choice of materials has become a priority and is crucially important in today's product design, manufacturing, and the design of consumer strategies (Heath & Jensen, 2000). Choosing the right material for a wearable design, a material that would be able to allow sensors and circuits to be woven into the fabric, will be the next stage that researchers will be focusing on. Wearable technology has a strong economic impact on the electronic and fashion industries as well as in society at large. In 2003 the Venture Development Corporation estimated that global market volumes for smart fabrics and intelligent clothing, which includes wearable electronics, would reach 720 million US dollars in 2008(Tao, 2006). Power supply is not an issue that has concerned the fashion designers of the past, but it's always a problem for portable products which are designed to be used in a mobile situation. How to power clothing effectively has now become a critical issue. Size, weight and battery life have become fundamental obstacles in the proliferation of wearable technology. Finding a fabric solution to the power issue has been a slow process. Existing types of batteries, as used in consumer electronic handheld devices, have been pocketed or strapped to the body, but this is unsatisfactory for clothing.

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Currently, our sense of fashion is embedded in our daily lives. Our personal objects are very much inspired by things we still know little about, new technologies, new inventions, and new events that have just appeared all over the world. Over the next few years, smart clothing (wearable electronic textiles) is likely to emerge, from being a niche technology, and become much more prevalent in areas of mobile communication design. New types of electronic equipment or interface designs will appear in the near future, as wireless devices are built into clothes and accessories. Haptic interfaces and sensor interfaces can facilitate the use of technology in mobile situations and better allow us to adapt mobile telecommunication to different and varied environments. Its aim is not to design low cost, low power devices, but to interact with the world through every single object in your daily life, as in a piece of paper, a pen and so on (Dourish, 2004). These will improve safety and productivity by communicating with each others and with the outside world. New synthetics have been developed in order to create new dynamic shapes, styles and decorations. These represent the future of wearable products.

3.4 How haptic interfaces can be used as a design tool to cope with the sensory overload of riding in traffic

In this design project, the mobile phone is considered as a hub to contribute to our culture and lifestyle and it is likely to continue to be the most useful personal device for many years. The haptic device would be separated from our mobile handsets, and used as an independent wearable device to alert cyclists via Bluetooth. An elastic material would be preferred for this device, with electronic circuits woven into it, making it the fabric of the future. Images and diagrams have been used to describe how the haptic interface will work together with mobile phones, and as a system (images46-53). There are mainly two systems that allow haptic interfaces to be used together with mobile phones. One is the GPS navigation system (Image 46 in the appendix), and the other is the perceptive alerting system (Image 47 in the appendix). In terms of safety and perceptual limitations while cycling, it is not recommended to have more than 3 types of perceptive vibrations. Two possible reply messages have been defined, one saying that the user will call back later and the other to cancel the call. With haptic device, the user can identify the caller and make their own decision on whether to reply or not by using movements as a means of replying through a haptic device (see Image 47). Image 47 shows how the haptic device works with user's mobile phones to identify callers by sending different haptic messages to the user. Different supporting technologies have used this technology, one example of its usage being in massage machines. The accelerometer sensor will be embedded in the fabric of the haptic device. So any movement of the user's hand or arms can be recognized as a code to send messages replying to the contactor. The reason why I propose that haptic and wearable design is the way to deal with safety problems is because in using the haptic GPRS function, this saves the time of cyclists, as they are not required to look around for their direction. Hence, they will be able to pay better attention to the dangers and demands of the environment around them. Haptic interaction then makes "on-the-go" communication quick and safe. It helps to limit distractions when cycling by identifying the caller without the user

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having to bring out the phone to look at on screen messages. This also causes fewer kinesthetic problems.

The diagram in image 48-49 shows how haptic techonology can be implemented in terms of hardware and software. A wireless receiver or transmitter would be encased in the haptic device, connecting the device to a mobile phone via Bluetooth. The mobile phone would be used as a media hub, acting as a user interface to update the haptic device and to download vibration tones from the Internet.

People often don't follow traffic laws in China, leading to a traffic situation where there is no guarantee of safety for anyone on the streets. By using haptic interfaces, cyclists can physically 'feel' their interface and any feedback provided, thus reducing the visual and aural demand, and allowing for greater safety in traffic.

- ***Why is haptic interface important in this design project?***

My argument is that if haptic and wearable interfaces were applied in "on-the-go" communication for cyclists that this would overcome many of the identified problems, and allow for quicker and safer "on-the-go" mobile communication. The potential benefits of this would be cyclists being alerted by tactile messages, thereby indirectly helping to maintain a better traffic system by reducing noise, and the rate of accidents occurring as a result of cyclists making phone calls. Haptic interfaces can enhance our interaction, harness people's sense of perception in order to keep cyclists' conversations private, allowing them to stay connected while being alerted discretely. The use of a haptic interface will reduce the current sensory overload problems for cyclists, and, because it's wearable, will no longer require cyclists to use their hands to hold and click the phone, thereby also causing fewer kinesthetic problems. Using minor movements to reply to messages will greatly diminish the dangers of using mobile phones whilst cycling.

- ***How could haptic interface work in my project?***

Immersion Corporation(website: http://www.immersion.com/) is a recognized leader in developing digital touch technology. They developed the VibeTonz system, which is a haptic feedback system for mobile phones. Since 2005, three of the leading handset manufacturers in the world have aquired licenses to use the VibeTonz System in their mobile phone handsets. These are LG, Nokia and Samsung. Immersion corporation also provides an existing technology (immersion haptic technology, refers to the content introduced in their website), that can be adopted to solve the basic issues of this project. Iphone has shown us that tactile feedback can be added to button presses, using standard mobile phone vibrotactile actuators. This can be beneficial for mobile device users, increasing typing speed and reducing errors. Images 50-53 in the appendix illustrate the schematics of the technology of haptic interface. Images 50 in appendix further illustrate how the movement of sensors technologically works in dealing with the cyclists' gesture and action whilst cycling. Although most interactive operations can be completed using only one finger or hand in a static situation, this is either impossible, or it creates a great deal of distraction, for cyclists "on-the-go". Any extra kinesthetic movement of cyclists besides controlling the handle bar and pedaling should

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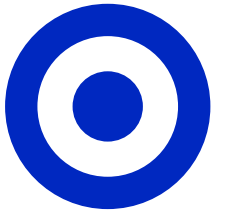
be prohibited or minimum to a tolerant level, which also inclined to the early discussion in section 3.2.3 the number of replying messages (perceptive vibrations) should be limited with two, due to the reason of perceptual limitations whilst cycling.

- ***Potential Benefits***

The potential benefits of using a haptic interface are unlimited, as what we see on the screen could become what we perceive from our haptic device. This design project will benefit users in several ways. These would include a reduction in fatigue, an increase in productivity and comfort while helping to maintain a more balanced and healthier traffic system.

Mobile and wireless sensor technology will influence, expand, and enrich the social region of our public urban life in “on-the-go” situations. It is known that the rapid adoption of Bluetooth in mobile devices, and the widespread influence of wireless technologies, is expanding across our urban landscapes. In the future, the digital and physical worlds are expected to be seamlessly integrated, and interoperated by a highly pervasive, highly mobile, and highly distributed information space. This would be entirely managed by sensors and, in a small way, this project may contribute to this digital mobile future.

In the next chapter, bearing this haptic device in mind, I will be doing some design attempts, exploring potential forms of haptic devices in order to obtain ergonomic usability of the device. Further additional functions that could be added to the haptic device will be explored in order to find the optimal position for the haptic device to fully suit cyclist’s patterns of behaviour.



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Before I discuss the aims of this chapter, concerning my design investigation, I will first restate the main issues which this project seeks to address, which the dangers are caused by cyclists making phone calls whilst cycling in China. In Chapter 3, this project outlined the fields of haptic interface and wearable design. The possibilities of design and technology support as a way of alleviating the dangers of cyclist using mobile phone whilst cycling has been explored and an argument made for the feasibility of this design option.

The aim of this chapter is to discuss the investigation into the optimal positions for wearable devices, for cyclists wishing to interact with others using mobile technology in an “on-the-go” situation and the relevant design propositions and user scenarios which were developed to inform and test these design propositions. The design explored in this chapter is largely based on concept design and user personas, and is divided into two parts; image personas and video persona. With the purpose of creating a better scenario, the user personas will be discussed in detail in Chapter 5. The design investigation and scenarios are all based on the research done on user personas. The design methodology used was focused on exploring ideas through sketching, form studies, models, and evaluating scenarios. The design process was approached from a user centered perspective, and developed user personas based on data collection and analysis. This will be further elaborated on in Chapter 5. The methodology of scenario design has been employed to generate an evaluation of design concepts from a number of aspects. These include the background of the ideas, how they would work, why they might be successful, and the problems with each design.

4.1 The optimal wearable design positions for the haptic device on the cyclists’ body

Cyclist's safety has been considered with the aim of finding the most optimal wearable design position and for developing a design solution for mobile communication whilst cycling Studies on the culture surrounding mobile phone use has shown that making phone calls, and sending text messages, have become an essential part of people’s day-to-day interaction in most Asian countries (see findings in chapter 1 and questionnaire). Leading research in the field of wearable design has been undertaken by Carnage Mellon University. Some references to optimal wearable positions on the human body are shown below (Image 54 from website:http://www.ices.cmu.edu/design/wearability/forearm.html). Further references can be found in the attached appendix.

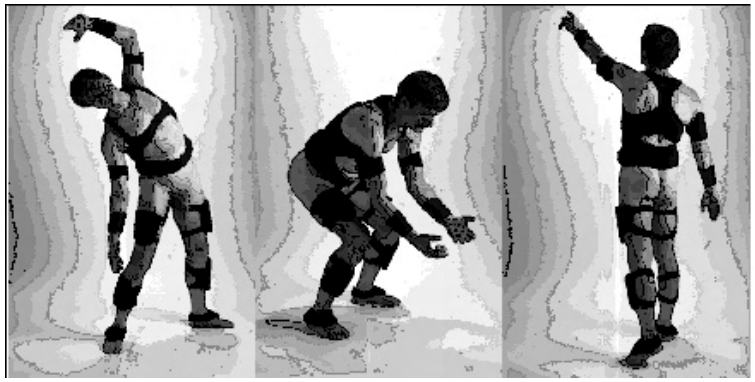

Image 54
From website:http://www.ices.cmu.edu/design/wearability/forearm.html. Further references can be found in the attached appendix.

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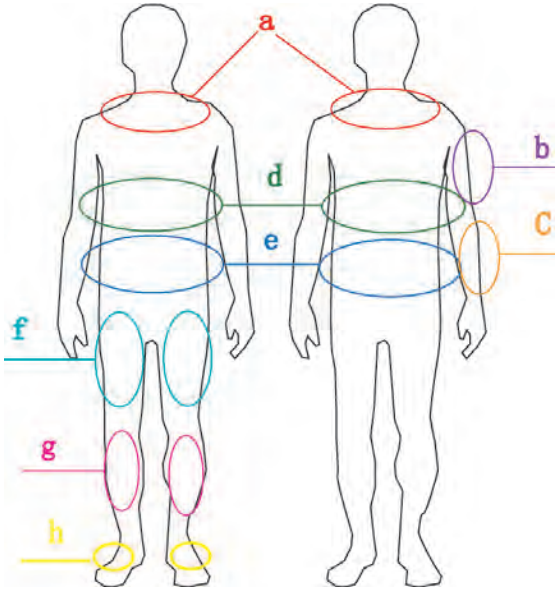

Image 55
Reproduced by Zhu Yu Lin
Design for wearing map (Image reproduced by Zhu Yu Lin from "design for wearability" Carnegie Mellon University).

The general areas we have found to be the most unobtrusive for wearable objects are:

(a) Collar area,
(b) Rear of the upper arm,
(c) Forearm,
(d) Rear, side, and front ribcage,
(e) Waist and hips,
(f) Thigh,
(g) Shin,
(h) Top of the foot.

In order to find the optimal position for cyclists wearing this haptic device, I have adopted the research method from Carnegie Mellon University for my own investigation. In the images56&57 a girl is shown trying to imitate a cyclist's action, testing the suitability of those positions. She stretched herself to test the comfort in these postures. She can also be seen nodding her head up and down to test the visibility in various positions to see where the best place for the haptic device would be.

Image 56
Testing experiment taken in China

Image 57
Testing experiment taken in China

The numbers that can be seen below refer to the 5 positions on the body stated in the diagram (image 58). Referring to the best sensibility and flexibility of these body parts (Gemperle 1998), following a series of tests, the head and collar, thighs and shins', as well as the feet have been abandoned as potential areas. This was

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done as placement of haptic devices in these areas cannot eliminate distraction for cyclists, sometimes adding risks to cycling. For example, the earpiece as has been discussed, is not a successful means for keeping cyclists connected. The ringing and sound from mobile phones distract cyclists from riding their bikes. Wearing a haptic device on our thighs and shins could make it cumbersome, as it would not be easy to take off and put on. The forearm, the front ribcage and the rear were chosen for the following test. This test involved a concept generation and a scenario evaluation to find the best position for the wearable device. Some reasons for the exclusion of other areas as ideal positions for the haptic device are listed below.

Head and collar: placement of haptic devices around the neck, over the shoulders, and around the ears. It is ideal to hang some smaller gargets around the neck, but this can easily be made uncomfortable. This also means that many items, such as glasses, hats and earmuffs, cannot be worn at the same time, nor is it convenient to use haptic devices placed around the head, when frequently having to turn to observe traffic.

Thighs and shins: wearing the device on the outer part of the leg keeps it out of the way for cycling, allowing for unrestricted movement of the thighs and knee joint. These areas are however insensitive to vibrations from the haptic device.

Feet: the device could interfere with the movements of the foot and ankle as well as being inconvenient for use whilst wearing shoes and cycling.

These three positions for the haptic device have been eliminated due to the above stated reasons. The further concept design will be focusing on the remaining areas; that is the front rib cage, as well as the upper arm and forearm. .

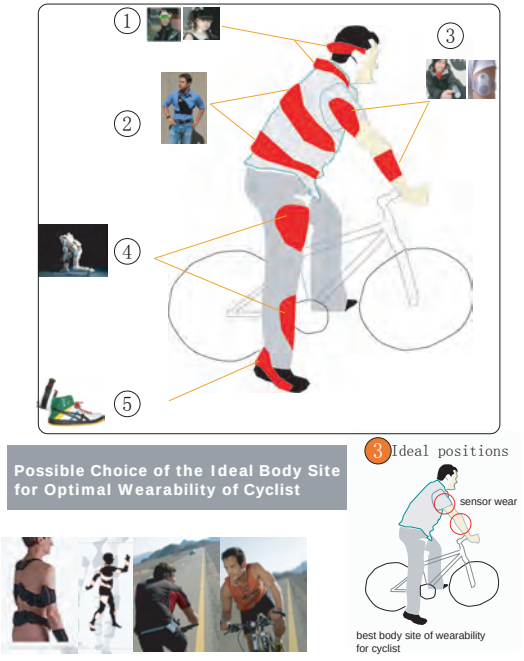

Image 58

Possible choice of the ideal body site for optimal wearability for the cyclist produced by Zhu Yu Lin

Image 59

Concept image of rear side and front ribcage produced by Zhu Yu Lin

Image 58

Image 59

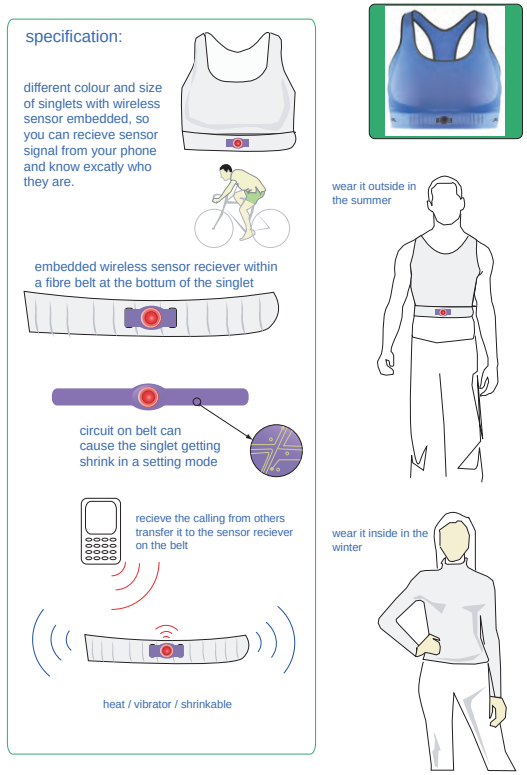

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Image 60

Scenario 1 of rear side, and front ribcage produced by Zhu Yu Lin

First you can set up the I singlet on your computer, choose different tones for different people you want to keep contact with.

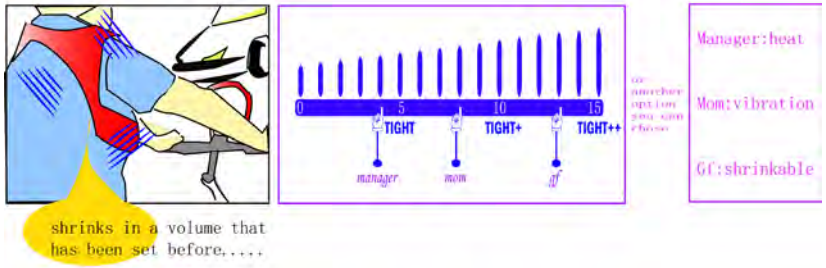

Image 61

Scenario 2 of rear side, and front ribcage produced by Zhu Yu Lin

The I-singlet shrinks or vibrates when your mobile phone receive contact, you will be able to identify who the caller is by the tones you set up.

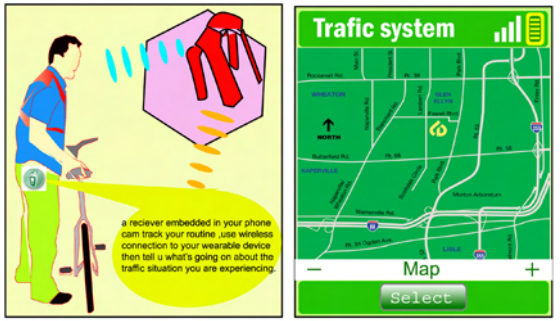

Image 62

Scenario 3 of rear side, and front ribcage produced by Zhu Yu Lin

Technologically, it's wirelessly connected with your mobile phone and GPS system; it tells you which direction you should go to.

Image 63

Scenario 4 of rear side, and front ribcage produced by Zhu Yu Lin

LED light can be used on the I-singlet to tell others to be attended and to keep themselves safe.

Wearing a device on your upper body allows for a freer movement of the arms. However, this is not suitable in extremely hot or cold conditions. These limitations can be identified as an inability to wear extra items due to the uncomfortable effects of these in extreme heat conditions and in colder climates. The usage of an extra layer of clothing makes the use of the device highly inconvenient. This is because the device requires close contact with the skin. During high heat conditions in the summer, extra devices on the body can lead to heat stress, and during extremely cold conditions, it is highly inconvenient to get access to the device because of protective

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multiple layered clothing. The haptic device needs to be close to your skin, in order to make it possible to feel vibrations, for the proper operation, and for feedback control. Thus, this makes it unsuitable for usage in these conditions. Further, it requires a high standard of safety in order to be worn on the body, making it inconvenient to device users in these conditions.

The design concepts for the upper body, the upper arm and the forearm seek to investigate what form this device should take, and which style would best suit cyclists on the go, while keeping them safe.

Images 64, 65, 66 mock up testing

Upper arm and forearm: placing the device between the shoulder and elbow, and behind the wrist joints, is designed to make it unobtrusive, and allow the cyclist's shoulder and elbow joints to move freely. The forearm is also free to move around. The wrist is an especially sensitive area, and is very suitable for sensing vibrations. Items and devices worn of the forearm are well suited for efficient interaction with the cyclist whilst being easy to access.

4.2 Design propositions, design methodology, and design investigation

The Design propositions of the design are based on the idea that the current mobile phone interface could be substituted with a haptic interface, that would better suit conditions for cyclists needing to communicate in 'on-the-go' situations, in China's large cities. Audio and visual cues would be replaced by silent perceptual messages to alert cyclists through sensory signals via a wireless connection.

Scenarios (image and video) were used as design methodology in order to put the design concepts back into the user context, and to promote a better understanding of the suitability of the design, and how well it addressed the original issue.

Having established a number of possible positions for the device on the cyclist's body, I began exploring these. The intention of this research is to develop a safer interaction system, which will facilitate cyclists' use of mobile telecommunication, whilst cycling. The purpose of the following design investigation is to look into whether a product design solution could be offered to create a haptic interface, which, incorporated with existing mobile phones, would help cyclists remain in contact with others, while reducing the risk of traffic hazards. People would be able to choose different vibration tones, downloadable from the Internet to their mobile handset, or their haptic device. It is recommended that the number of tones be limited to three, as it takes time for people to establish an awareness of different vibration tones. Usually it's better not to

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have more than 2 or 3 of these, due to cognition bias often affecting thinking, leading to errors in judgment. Too many different tones would lead to it taking longer for cyclists to identify the message or information in an “on the go” situation. This would be dangerous, and would decrease the mood of cyclists. Each tone could represent one person, and each message would send a unique vibe-tone, to alert the cyclist and identify the sender of the message, so as to allow for a decision as to whether to reply or not. GPRS alert systems provide convenient traffic navigation information for cyclists, through perceptual signals, so as to guide cyclists as to their direction.

The development of my design has been informed by research into cycling conditions in China, existing mobile phones, and other handheld devices that are being used in China. This study has focused on technological development, trends, and materials suitable for haptic interface. These studies have led me into further research in the field of wearable design, in order to find the best position of wearing the haptic device for cyclists. By creating scenarios at each design stage, I was able to put the ideas and design concepts back into context (defined in the beginning of this project), and analyze and evaluate each concept based on the scenario results. I’ve gotten a clear vision of what the scenarios design should be achieved at the end of this research project.

In the following section, I will explain the development of my design ideas since the start of the investigation. Scenarios will follow each design stage to evaluate the ideas, and to get to the best one.

4.3 Design concepts and scenario evaluation

This chapter has been divided into two sections to develop the concept of a wearable design on the one hand and explore how haptic interaction can help solve cyclist's safety issues. This is done in order to design a comfortable wearable haptic device to suit cyclists’ behaviour while improving safety. The first stage focused on having the device on the arms of cyclists and on the handle bar of bicycles. In the second stage the wrists of cyclists and their hands where the main focus. Each concept was created with concern having been paid to relevant factors relating to the behaviour of mobile phone users as well as cyclist's safety and comfort. Picture and Video scenarios have been used for this purpose to evaluate each design concept and clarify the main concerns of this project, communication safety "on the go".

4.3.1Concept stage 1

- ***On the arm***

I initially looked into wearable design, and tried to find a solution to designing a communication device that would help people stay in contact whilst remaining mobile. My understanding of the design objectives was limited to people who are frequently in ‘on-the-go’ situations, and need to communicate in public; on the bus, at bus stops or on the street. But mobile phones are mostly designed as hand held devices, and are not very convenient for people to use inmobile situations. Generally one hand is required to hold the

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device and, often, the other hand is needed to perform tasks such as pressing buttons and scrolling through menus. So I wanted to design a device that would facilitate communication for people in mobile situations. At this stage, my target users were defined as people who used their mobile phones, whilst walking, running, and cycling, at a general level.

- ***Background to the ideas***

After completing the initial background research, I looked at what people used their communications devices for, whilst in 'on-the-go' situations, and found that making and receiving calls, reading text messages, listening to music and taking photos were the most common. My ideas were influenced by findings from previous research, such as the optimal wearable position on the human body. Further it has been influenced by research into user personas and user needs, and the development, and history, of the mobile handset. The first design concept, completed early on in the project, only served to make the mobile handset wearable, but not necessarily comfortable or more usable (see image 67. The first rendered concept (image 67 was a bracelet mobile phone. It was not much different from most existing mobile handsets on the market, except that it was in the form of a bracelet. It would still be cumbersome, might not suit different wrist sizes, and cyclists could find it uncomfortable to wear as it would be quite heavy. Further, it might not be much easier for them to feel the vibration tones from the wrist device than holding a mobile phone. Ideas were then further developed, taking into account research into optimal wearable positions on a cyclist's body, electronic fabric, wireless technologies and haptic interaction. Some basic models and prototypes were made (Images 68 to 70) Images were taken showing the ergonomics and functionality of different ideas as implemented on cyclists. Image 71 is the rendering of another possible idea of wearing the haptic device on cyclists.

- ***How these would work***

The idea in the first rendering (image 67) was similar to the existing mobile phone. Comfort became the primary issue to be addressed, to make the haptic device more wearable and to prevent it from obstructing normal behavior. Next, I developed concepts based on the material's attributes and features, to see how these would affect the design. To make cyclists comfortable when wearing the device, I chose to use electronic fabrics, this would allow the circuit to be embedded and woven into the fabric and textiles. From previous research I discovered that some electronic textiles could be made waterproof, to prevent the circuit from being damaged by rain or sweat during cycling. Image 72, the picture scenarios evaluated how the ideas of image 68 to 71 work. I attempted to develop a number of concepts that would help cyclists to operate their existing devices via simple actions, which would not distract cyclists' attention from cycling. At meanwhile, the problem is the haptic device itself will be taken off when it is not used, so it possibility will get lost, fall from the body of cyclists.

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Image 67
Square bracelet, concept designed and rendered by Zhu Yu Lin

After evaluating the first rendering, new concepts were formed, focusing on providing more comfort and flexibility for the cyclist by using electronic textiles. The vibration function was removed from the mobile handset and put into a separate haptic interface, which would make it easier for cyclists to receive the perceptual signals. When cyclists sense the message, they can use another hand to control the device, easily and simply, and it would not take much time. They could also choose to stop and make a phone call, depending on the urgency.

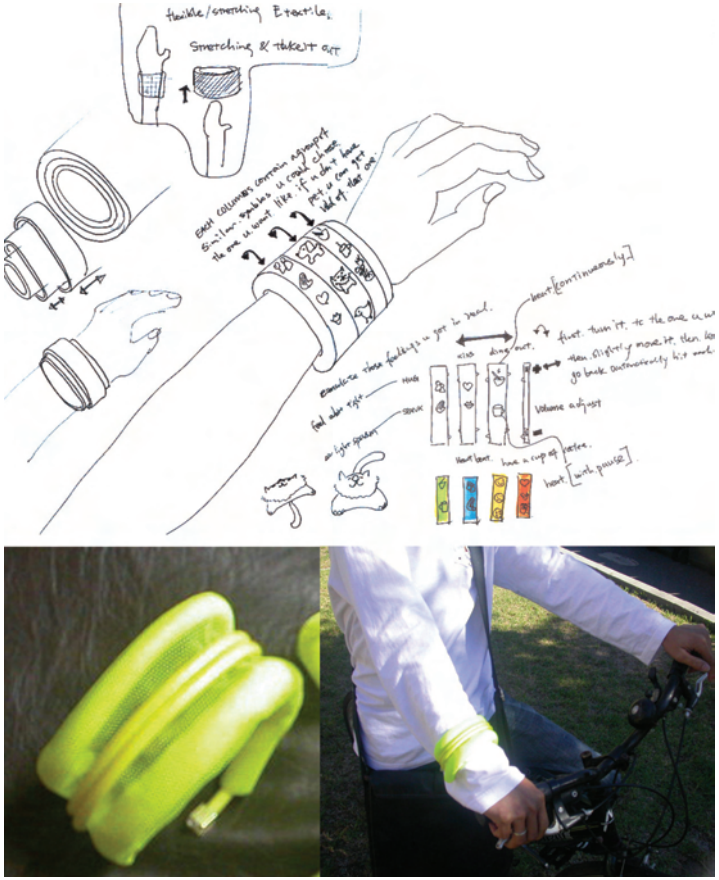

Image 68
The idea created and tested by Zhu Yu Lin

The sensors are embedded in each side of the device and are connected through the fabric, which the electronic circuits are woven into. The device is wirelessly connected to the mobile handset, and on the other side it is connected to the circuit. Different meanings could be transmitted through different shapes formed by the fabric (for example, it could be twisted like the sketch shows below). Cyclists could roll it up or down to send messages, which contain the content or meanings of the icons on their mobile handset.

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Image 69
The idea created and tested by Zhu Yu Lin

Another idea was to try to find an easier way to make the device wrap around the forearm, namely spirally. The material could be made from soft rubber or latex with the circuit encased in the hollow middle space. There is a small screen on the other side of the wire, to show the identity of the sender or caller, cyclists could then decide whether to stop and answer the call (or read the message) or to ignore it and continue cycling. So basically the vibe-tones would only alert the cyclist to phone calls or text messages, but the cyclist would need to watch the small screen to find out who the caller is. The screen could double as a rear mirror, when the LED back light is turned off. However, the screen and image size is still a problem.

There are some images below, which showed the comfort test on a cyclist's arm.

Images 70
Mock ups and idea test by Zhu Yu Lin

Image 71
Rendering of concept "spiral", concept designed and rendered by Zhu Yu Lin

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Scenarios 1 and 2

Scenarios 1

Scenarios2

Image 72
Produced by Zhu Yu Lin
The cyclist feels the vibration on his left arm, and he identifies the caller from the vibe-tone emitted by the device. He can now decide to either turn it around to cancel the vibration, ending the call, or he can roll it up and down to send a signal to his mobile handset via wireless or RFID, which would automatically send a default message to the caller,, stating: " I am cycling and cannot answer the phone, I will contact you later…".in the image of scenario2, Cyclist can tell the caller from the image shown on the screen.

Next I attempted to design some thing can be worn on cyclists and put on the bicycle's handle bar to make cyclists operate it easier. The device itself won't be lost easily.

- ***On the arm or handle bars of bicycle***

The use of mobile phones, and internet-based communication technologies such as email, instant messaging and online chat, is now widespread in modern Chinese cities. The mobile phone is no longer purely a communication tool; it has a pervasive, persuasive influence on people's thoughts, behaviour and lifestyles. A number of studies provide evidence that they have become integrated into the everyday life of many people (Boase et al., 2006). Social relationships that originate from online interaction are taken into and continued in the offline world and vice versa (Mesch, 2005). From this, I have been inspired to adopt emotion icons (emoticons), used in online chat programs, to my haptic device, so the cyclists could receive the perceptual messages from their online friends as well. Emoticons are very popular amongst young people who chat online, and provide a way of indicating moods and feelings, and providing a 'tone' to text based communication. Because people are so familiar with these icons, they could easily be transferred to a haptic device. A survey could help to select the most frequently used icons to be added to the device.

I sought to solve the problems from previous scenarios of it being inconvenient to operate and control the haptic device when worn on the arm, tried to move the interface to the bicycle handle bar, and explore more opportunities for the device to expand its functional margin. This included trying to add icons to the interface, so that the cyclists could reply to the caller with emotion options, simply by clicking or pushing a button (Images 73, 74, 75)

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Image 73
Produced by Zhu Yu Lin
This concept is similar to the above one, the difference being that, as well as sending out a vibration, this device also displays an image of the person sending the message or making the incoming phone call. The cyclist feels the device vibrating and looks at the small screen on his upper arm to identify the caller, and then he can move his arm to cancel the vibe-tone and send a reply message through a simple hand or arm action.

Image 74
Produced by Zhu Yu Lin
The device can be worn on the cyclist's wrist or put in their chest pocket, depending on which way they could better feel the vibration signals.

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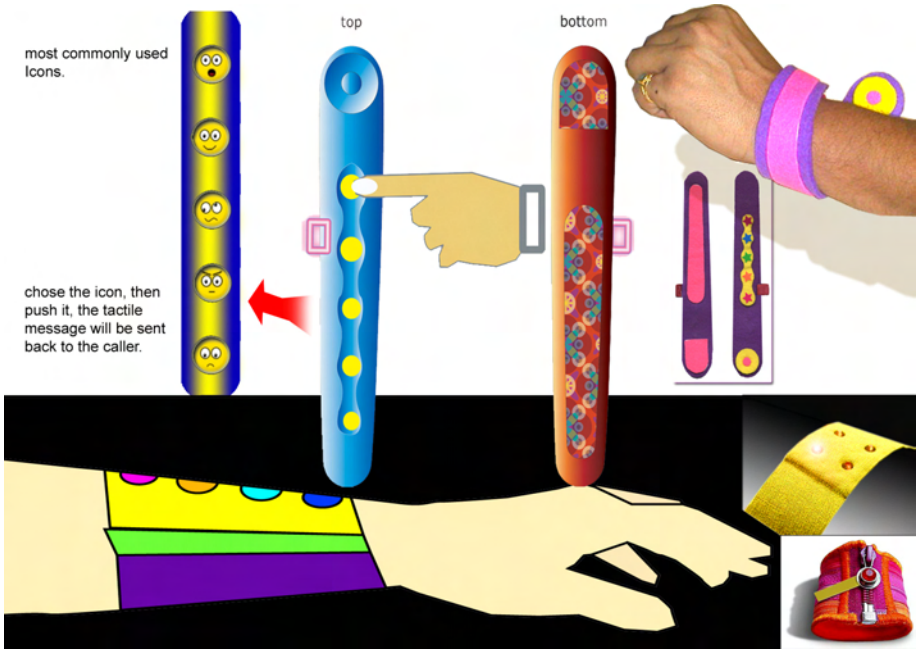

Image 75
Produced by Zhu Yu Lin
The icons are limited to the six most commonly used when chatting or surfing on the Internet (if there are too many icons, it may be too complicated and confusing for the cyclist). The material of the device is an elastic fabric with the vibration actuator woven into it. Cyclists can wrap it around the bicycle handlebars when cycling, or wear it on their wrists. When the device vibrates, they can stop riding, and click the icons to send an emotional message to the person who contacted them.

Scenario 3

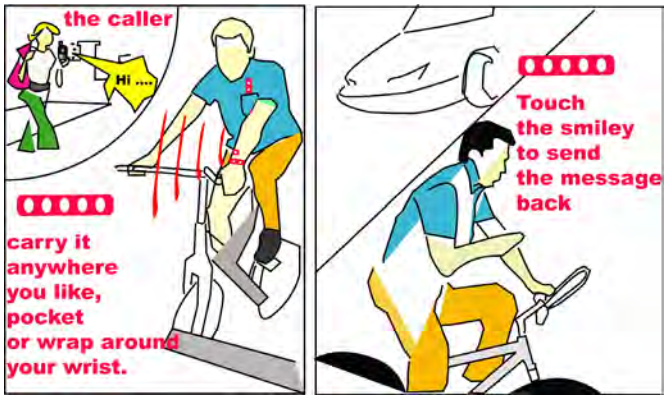

Image 76
Produced by Zhu Yu Lin
The cyclist puts the haptic device in the left chest pocket on his shirt (it can also be wrapped around his wrist). He feels the vibration,, and then stops cycling to check his mobile phone. There is a message from his girlfriend that reads: "lunch is ready, hope you will be back soon". He pushes the smile icon on the device to send a sensing message back.

- ***The pros and cons of the concepts; on the arm or handle bars of the bicycle***

Wearing a haptic device on the arm probably makes it unsafe for cyclists to use it, and it may be difficult to use this device when wearing thick clothes, as the fabric of clothes may prevent cyclists from perceiving the haptic signals.

The material would need to be comfortable to wear, and integrating the circuit into it could be expensive or hard to implement in the near future. It would be more suitable for use in summer than in winter, because cyclists wearing many layers of clothing may not be able to feel and identify the vibrations from the device. I also noticed that often when cyclists take their phone out

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from their bags or pockets, the phone will fall to the ground and be damaged. I'm afraid the previous ideas could have the same problems, particularly when cyclists take the risk to try and reply without stopping as can be seen from the picture scenarios (Image 76).

4.3.2 Concept stage 2, glove phone

- ***Background to the idea***

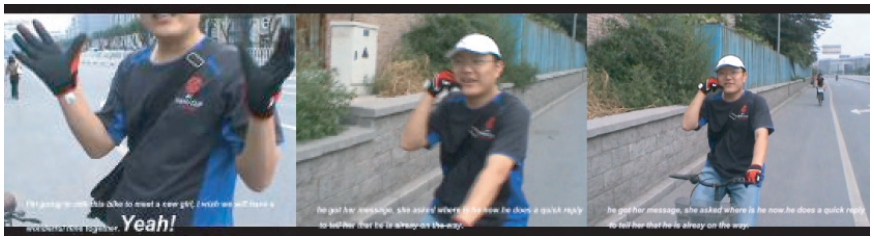
Generally cyclists in China wear gloves when cycling. Wearing a glove phone could prevent the device itself from falling to the ground and being damaged, and two versions of the device could be designed, to make it suitable for use in both summer and winter. With the glove phone, cyclists wouldn't need to stop or click something on the device. Instead they would use hand gestures to reply to the callers. The principle of how gestures could be used, in conjunction with sensors, to reply and navigate has been described previously. Using gestures, the cyclist can still control the bicycle with one hand, so they won't need to stop cycling to reply.

- ***How it would work***

The receiver and speaker could be assigned to whichever fingers the cyclist chooses. Usually the speaker would be on the small finger and the receiver on the thumb. There is a switch operating the power supply on the wrist, power limitations would be implemented to prevent cyclists from talking too much whilst cycling. The vibration actuator would be integrated within the glove. The cyclist would be able to feel the vibration on their hand and uses gestures to reply (Images 78to 82).There are further studies in the video scenarios to how to define gestures, and as to what the specifications of the glove phone would be.

- ***The pros and cons of the concept; glove phone***

The design of most modern bicycles is such that the rider's hands remain on the handlebars whilst cycling, this position leaves the hands relatively inactive. Because of this, and since the hands do not have a great deal of muscle mass, it would be quite possible to perceive the sensory message wearing a glove. You could make a phone call with just a simple gesture, making it quick and easy to use.



Images77

Snapshot from the video scenario

Following the video scenario (see Image 77 the video in DVR) to evaluate this idea, the conclusion is that safety problems still exist. It could be worse if there are no time limitations on talking with the glove phone, and people don't stop cycling. In fact, this concept makes it easier for cyclists to make a phone call whilst cycling potentially exasperating and not alleviating the safety concerns. The material the glove is constructed from would also need to be waterproof, flexible and safe. It could be expensive and hard to implement.

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Image78
Idea created and tested by zhuyulin

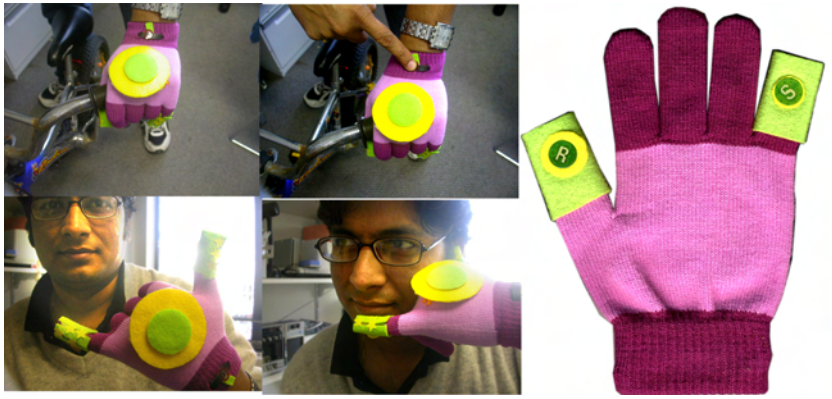

Image79
Idea created and tested by zhuyulin

Image 80,81produced by Zhu Yu Lin

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Image 82
Produced by Zhu Yu Lin

This rendering is a concept using a USB connection with the mobile handset. The screen is used to identify the caller, the vibe-actuator is on the other side. Cyclists can watch the screen to see who the caller is, while feeling the vibration.

4.3.3 Design evaluation for my design investigation

This design investigation has focused on designing a personal product that cyclists could use to interact with others while on the go. Texting, communicating, taking pictures, and playing music are the functions most commonly used on people's mobile handsets. I tried to reorganize these functions with a haptic interface and electronic textile to create a new product. Whenever I tried to add additional functions to the device I had to consider how it would affect cyclist's safety. As such, if the glove could be used as a phone, then there would have to be limitations on talking time. These ideas could be further developed in the future, to create different products for specific target users. But the core issue I am dealing with is the safety issue, which led me back to the original criteria for safety and GPS navigation.

What constitutes a good communication device from the view of users? Depending on the user, it could be anything from issues of portability, comfort and convenience of use to protection against theft or loss, independent power supply, or reducing the distraction for cyclists. From a technological point of view, using wireless technology, haptic interface, and electronic textiles would be a good combination for creating a design piece to help cyclists navigate in traffic.

The purpose of this project is to create a haptic interface in conjunction with a broader interaction system (wireless network, mobile communication, traffic) for cyclists in China. It is believed that a personal device is an essential interface for every individual to interact with each other. The interface design should include the following features:

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- Comfortable to wear
- Portable
- Simple to understand
- Safe
- Easy to use
- Independent power supply
- Discreet
- Quick accessibility
- Fashionable

Design and evaluation both share the common goal of usability, but each takes a different part in trying to achieve it (Christine E. 2005). Design evaluation is a system, a certain procedure undertaken to achieve the design goals, and make good use of data and resources explored in earlier research to inform and improve the design. The evaluation of my design project is from a user centered, and interactive approach, looking at users needs, comfort, affordability, and so on. These are the basic standards based on which I undertook my design investigation, and the criteria used to evaluate the design concepts.

The design objectives are based on the principles of how to create a personal digital device, including factors such as:

- Flexible, light
- Ease to carry, attach, use, and difficult to lose
- Easy to be cleaned up, if some electronic components are not washable they should be easy to remove
- Using finger gestures to reply to haptic messages received, the number of gestures is not recommended to be more than 3, due to the safety issues whilst cycling.
- Instead of responding to ordinary traffic lights, the device interacts with GPS traffic systems to alert cyclists when to cross junctions or turn.
- Reduces distraction while cycling, and helps to build a safer cycling environment
- It can be used as an accessory to a normal mobile phone, reducing the electronic waste from the dumping of old phones, and promoting sustainable and responsible design.

In order to evaluate my design concepts a number of factors need to be taken into account. These are as follows:

1. Whether the device can minimize or completely avoid interfering with the cycling ability. How does the wearer perceive the communication, and does this interfere with his being able to hear traffic sounds that might affect safety? Would it help to reduce the risk of danger or accidents while cycling? Does it lead to a cognitive overload? In other words, can it help to prevent accidents by reducing the information overload that cyclists have to deal with whilst cycling?

2. Suitability for different age and gender groups.

3. Can it be worn in different seasons or weather conditions (material)? How can we best protect against theft?

4. Can the product's function satisfy the cyclist's needs for for communication and safety, whilst reducing distraction?

Chapter 4

Design investigation and Scenario evaluation

5. Can it provide better interaction behaviour between cyclists and their phones?

6. Can it be put on and taken off easily and conveniently?

This design investigation has indicated how appropriate each concept was, and offering the possibility of being further developed, to create a mature product. Creating a product is not the aim of this research however. This study is mainly about dealing with the safety problem. However, none of the design attempts in chapter 4 can perfectly represent the design direction of the final scenario design, but by doing these design attempts, the core safety issues become clearer, while allowing cyclist to remain connected. So the design focus has been clarified as to deal with cyclists' safety, and to create user scenarios. User personas will be used to define the audience group. In the next chapter, I will describe and explain how, and why, the user persona can represent users in the scenarios, and how design can help to solve the problem of safety for cyclists.

Chapter 5

User Scenarios

The primary intention of this chapter is to explore my design proposition from the user's perspective. To aid and inform this objective, personas were generated as a starting point for the scenario design process. A questionnaire (refer to the questionnaire in Chapter 1), contributed to further narrow down the target users, and divide the users addressed in this project into two groups (the primary and the secondary persona). Research on haptic interface and relevant technology helped define the design direction and scope, leading to the design attempts in Chapter 4. The personas were used to explore user requirements, characteristics, intentions and secondary tasks. From these, different scenarios and narratives were created and used in each concept stage to specify users' mobile communication needs and requirements. In the end, the scenario designs had been created with regards to the user personas, to tackle the problem to be solved in this project.

An overview of mobile phone culture, and cycling in general, is initially provided in order to give a context to this project.

5.1 Background Information

The mobile phone has a strong cultural influence on our daily life. It will soon become the most important platform, changing human behavior (Fogg BJ. Eckles D. 2007). Eckles explains how by using mobile applications, individuals become aware of long term trends, such as information sharing and privacy. Personalized mobile devices penetrate new urban spaces creating a need for innovative products and services. These are required to account for shifting social, cultural and psychological conditions. Connectivity while cycling presents a risk of distraction. Receiving a call 'on-the-go' takes cyclist's attention away from the road and other vehicles. Whether people are walking, cycling or driving down the street, when their mobile phone rings, people are immediately distracted from people and activities around themselves. It is a link to another context outside of our physical surroundings. Sometimes this link is desired, such as when we are alone in a restaurant or waiting for a train, but more often it creates interruption and distraction from our primary context. It is difficult to mitigate this potential for distraction without sacrificing what we are doing in our current activities. To be truly mobile, our relationship to a device that affords us availability needs to adapted, so that we are not controlled by its call, but are in control of our connection, as well as the level of disruption we permit.

In an attempt to understand the reasons and motivation behind the prolific use of mobile communication by cyclists, the investigation of this phenomenon started by drawing on my own personal experience.

I have taken my phone with me whilst cycling on several occasions. On some occasions I needed to be available while cycling. It has never been easy though; either I carry the phone in my hand whilst cycling, or I store it in my pocket, weighing down the fabric and resulting in a low-swaying pendulum sensation around my knees. If it rings while it is in my pocket I usually miss the call, because I do not hear the phone over the traffic noise or the music I am listening to. It is very dangerous to listen to music whilst walking or cycling are more likely to be involved in accidents,

Chapter 5

User Scenarios

as their awareness of changes in traffic around them is greatly diminished. If I do hear the call, I need to stop, pull out the phone, look at the screen, and decide whether or not to take the call. By this time I have already stopped however, and I might as well answer it. The technology created for this convenience suddenly becomes more of a hindrance than of assistance. In addition, the interaction on most phones relies on visual feedback, which requires the user's attention and visual coordination.

The point is, people are not likely to stop doing this because it's dangerous or there is the posibility of a traffic fine. It should be made less of a problem for cyclists. One option is phones that can be integrated with bicycle better. But it would cost a lot to make a new bike. In previous research this option has been eliminated. On the other hand, speech converted into perception need to be further developed, which is why I propose to use a haptic interface to make the substantial sense contact. This way people won't have to get their phone out to be able to use it.

In chapter two, page 32, there is a series pictures taken that shows a man trying to get his phone out of his pocket. Many cyclists who I observed stumbled on the street when holding a handheld device... Because the use of mobile phones can compromise public safety, some jurisdictions have banned their use while driving. However, these laws are difficult to enforce, and, presumably, a law for cyclists would be equally difficult to enforce. Even if people slow down their peddling to increase their safety, using mobile phones decreases safety. The people who make phone calls are not aware of the social context surrounding the person who will receive their calls (Keating, E. 2007). As such the action of using mobile phones while cycling is endangering everyone else on the street. A research report from the AAA foundation on traffic safety (2008) shows that over half drivers investigated admits to text messaging while driving. Young drivers were found more likely than older drivers to text and talk on the mobile phones while driving. People with higher levels of education tend to text and talk on their mobile phones more often while driving.

5.2 User-Persona

In this section I will discuss how a user persona has been developed based on a large quantity of data collected in previous research. The user persona has been built to focus on two groups of people –office workers and delivery people. Personas are not real people; they are hypothetical archetypes of actual users accurately defined. One of the goals in using personas is to achieve an understanding of the target group, by getting to know individuals in the cast of a persona. For the personas to be useful, they need to mediate the information necessary for practitioners to be able to make reasonable assumptions about them (Pruitt, J & Adlin, T. 2006). User personas can help to better reflect the user's perspectives, sort similar individuals into one group, and help the designer to become more accurate in design aimed at this group of people. The user persona is a preparation for the user scenarios; it helps the designer to understand the user's needs, and then work out what to do next. The benefits of using personas in this research project are as follows.

Chapter 5

User Scenarios

1. Instead of focusing on individuals, personas have been created to make assumptions about users that are fully and clearly expressed or demonstrated. The design in chapter 4 was useful in developing a design direction for the project, but lacked a closer connection to the user. Getting a connection to the users is the function of the persona development in this chapter.

2. Creating personas is a technique, using abstract representations of users, and focusing on specific users rather than on every individual. Two user personas have been generated to represent different target user groups.

3. Personas help define the design options, and produce interest towards user data collection and study. Personas are a device to help the designer make better decisions. Design decisions have to be made to suit these two user groups' mutual purposes and needs.

4. It can also represent a users' consciousness of brands and help to specify target customers in marketing strategies for business proposes (Pruitt, J & Adlin, T. 2006 pp.14-20). With these two personas, more design solutions can be created to attract certain customers.

Young people, and their use and understandings of technology, raise a number of problems for the designers of mobile systems. Traditional and frequently applied design heuristics, such as user interface (UI), consistency, and minimizing time-on tasks, do not seem to reflect the primary areas of concern for cyclists. The novel and inventive ways they might choose to interact with technologies also makes it difficult to predict the form factors or user interfaces that might be considered the most useful or popular (Saffer, 2006). In an attempt to address such issues, this research seeks to understand how mobile communication devices are incorporated into young people's everyday practical activities. The aim of this research is to discover how young people mediate their social communication using mobile devices and, from this, determine what aspects of mobile technologies provide the potential to support their cycling experiences.

- **Primary Persona**

The 'persona' is a typical amalgam of multiple people who share similar goals, motivations, and behaviors in using their digital communication devices everyday. Two different types of personas are listed below.

The **primary persona** represents the middle-class young generations living in China now, spending most of his daily life 'on-the-move'. He is always doing something, and has an optimistic attitude towards life; always preparing himself the best he can each day. He uses his bicycle to go to places not far from his home. As a businessperson, it is very important for him to keep in touch with his clients and his boss at all times. Thus he wears the Bluetooth earpiece all the time, whenever he drives his car, rides his bicycle, takes the train, or is in a public place. He cannot use the Bluetooth earpiece in the gym, so he has to carry his mobile phone with him while exercising on training machines, and has to check his mobile phone frequently during the hours in the gym.

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User Scenarios

Image 83
Character of Primary persona taking by Zhu Yu lin

LIU LU

He has a decent job in the technology sales field. He belongs to the rising middle class, expanding in China. He is very expressive and confident, with a strong brand consciousness. He is technologically enthusiastic, and likes surfing on the internet both for work and as a hobby. He believes that "If I'm not connected, I feel like I'm missing something."

Personal information:
Age: 25
Occupation: sales manager
Location: Beijing
Marital status: Single
Education: graduated from a business school
Salary: 8000 CNY
Hobby: computer games, surfing on the internet, sports, indoor exercises, music, cooking.
Key differentiations: Active lifestyle

Device Usage:
Computer: Desktop (Always the latest type)
Mobile phone: PDA, Cell phone, SONY ERICCSON, / MOTOROLA (always updated to the newest type of mobile phone)
Other: MP3 players, earpiece, watch
Primary Device: cell phones, music player
Web: 50 hours/week, almost connected all the time (chatting, gaming)
Phone: 10 hours/week, 70-80(up to 100) text messages/ week
Programs: Email, Word, IE, games etc.

The information above are all based on real persons, not only one single case, but is an assembling of several real cases.

- **Usability of his device**

Application:	Objectives:	Purpose:
• Message centered • Phone centered • Phone size • Blue tooth ear piece • Taking pictures	• Quick phone list • Quick pen input for messenger • Voice recorder/web access • Digital camera, good quality of the screen on mobile handset	• Stay connected to the office – keep in touch • Stay in touch with family and friends • Long battery life • Self expression

Chapter 5

User Scenarios

- **Using different devices in different situations:**

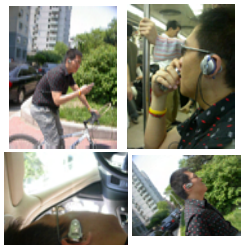
DAILY ROUTINE	PICTURES	PERSONAL DIGITAL OBJECTS
HOME (relax)		
COMPANY (office)		
GYM (sports)		
STUDYING CLASS (education)		
ON-THE-GO (Cycling, driving, public transportation)		

Image 84

Scenario of Liu Lu's daily activities

He gets up in the morning around 7:30am. Before breakfast he checks his email, he likes to do some exercise on his Treadmill at home.Then he rides his mountain bike to work. In general he visits his clients by car during his working time. After working the whole day, he goes to the gym to do some fitness training with friends. He also learns English at school a few times a week.He needs his bike to go to the nearest store to buy some daily products……...

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User Scenarios

• Secondary Persona (combination of realistic data and narratives)

The **secondary persona** is used to highlight and assess the requirement for the GPS function in the haptic interface for cyclists. People from rural areas leave their home and come to large cities in search of a new life and higher wages. E-businesses, and all kinds of delivery services, are gaining popularity in cities as many people like to shop online, ordering food, drinks, and many other things. Working as a delivery person, the GPS navigation system is very important when he is cycling. A young male wearing a uniform was used to create this persona, as men are more likely to do this kind of job than women. Not showing the face of the character, readers can focus n what he is doing.

Image 85
Character of Secondary persona reproduced from online source

Xiao Li

His surname is Li; people call him "Xiao Li", he is a recently migrated worker from a rural suburb who moved to Beijing in order to try to make his living there. He got a part time delivery job at "Pizza Hut". His needs can be summed up as : "being connected is crucial for my current work, I need to contact our clients and find the quickest way to get to them.

Personal information:
Age: 21
Occupation: part time pizza deliveryman, full time student in an informal college
Location: Beijing
Marital status: Single
Education: high school
Salary: 2000RMB
Hobby: watching TV, sports, reading, cooking.
Key differentiations: a busy struggling lifestyle

Device Usage:
Computer: desktop (affordability is most important)
Mobile Phone: the cheapest mobile phone to make phone calls and send text messages, with little brand consciousness or belief in 'good brand good quality'
Other: Music player, watch
Primary Device: cell phone
Web: only used for study, checking email and so on. Internet is expensive
Phone: 2-3 hours/week, around 60 text messages/ week
Programs: Email, IE, games etc.

• Usability of his device

Application:	Objectives:	Purpose:
• Messaging centered • Phone centered	• Quick phone list • Quick input for messenger	• Stay connected to his boss • Stay in touch with family and friends • Long battery life

Chapter 5

User Scenarios

- **Using different devices in different situations:**

DAILY ROUTINE	PICTURES	PERSONAL DIGITAL OBJECTS
HOME (relax/study)		
Pizza Hut restaurant (delivering)		 
STUDYING CLASS (self/re-education)		 
ON-THE-GO (transportations)		 

Instead of staying in a rural suburb to be a poor farmer without a future, Xiao Li, a 21 year old young man, decided to move to the city to make a new life and earn his living. Without a tertiary education (he had only gone to high school), he could not find a good job with a good income. While he should have an education to prepare himself for the competitive future, useful skills are required to earn enough money to support himself. A part time job working in Pizza Hut restaurant on weekends, and week days after school, helps him to achieve this. As a newcomer, he is not familiar with the roads and streets in Beijing, and his mobile phone is with him all the time. This is especially the case when he goes to work delivering pizzas to customers by bike. Calling the customers when he can't find their place is something that always happens on his working time.

There are subtle relationships between individuals and their belongings; scenario design shows the critical impact objects can have on people's emotions, character, lifestyle and interaction with other people and brands. The mentality, philosophy, and ability to purchase a product for the 'user', in China is significantly different from 20 years ago. People are giving more consideration to the choices they make when buying a product. They care about how a product will reflect their own values, and self-expression more than the product itself.

5.3 The Methodology of Scenario Design

Designers usually use scenarios and storyboards to organize, justify, and communicate ideas amongst design teams. More recently, scenarios as a methodology has begun to be used in system design, product development, and research in human centered interaction (Pruitt, J & Adlin, T. 2006). Scenario-based design methodology is one of the design methodologies used among designers and researchers. Scenario design is used as a parallel methodology for giving a future perspective to current design concepts. Picture scenarios have been used as a design methodology, to describe context more dynamically and efficiently than could be done in written form (Pedell, 2008).

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User Scenarios

In this research project, a number of concepts have been created and evaluated by putting them back into the context of picture scenarios and video scenarios. It helped to create a balance between problem solving and further design suggestions, through the use of contexts represented in scenario designs. Using pictures in scenarios is more systematic in expressing a specific context. Furthermore, as pictures usually convey some shared understanding, it is crucial to use details in pictures carefully. It is very important to keep the scenarios simple and clear, as it causes fewer misunderstandings and less confusion for the audience or people engaged in the design scenario (Alexander, 2002). Picture scenarios are a good way of getting to know what people are doing while mobile, and to know the needs of people in changing contexts before starting the design. Scenarios can encourage reflection during the design stage by putting new ideas back into the user context. They are concrete yet flexible, and are easily revised and extended. They can be viewed from multiple perspectives and can be abstracted and categorised. Scenarios tend not only to reflect the users but the whole system, in which the users are one component (Carroll, & Rosson, 2002). Summing up, a scenario is a very useful design methodology, and has six main functions.

1. Facilitate learning about context.

2. Discussing actions of everyday life that are hard to capture and understand.

3. Explore the design within the context of the story.

4. Allow the audience to understand the design through the story.

5. Evaluate how successful a design is by understanding the problem and the opportunities of design in the context of use.

6. To open a space for users or audiences to imagine themselves as actors in the story, giving them the chance to make a good choice and purchase the right product for them.

5.4 Design Scenarios of I-Band

In this section, two scenarios have been created to illustrate how to use haptic interfaces to solve the core problems in this research. “I-singlet” is a scenario created, and the primary persona has been used to fit the context of cycling in China to show how a haptic interface can solve the problems that this research project is focused on. Much effort has been put towards describing the user interfaces, of how to set up the route, and the different perceptual signals. The “I-band” is the final scenario, where primary and secondary personas are both used and help deal with safety and the GPS navigation system.

Using the I-band, cyclists and their family and friends can instantaneously stay in contact while cycling on the street. By being navigated through touch without adding visual and audio distractions, cyclists can have a much safer cycling journey. I-band aims to give full control to the users-cyclists who can choose whether to reply to the caller or not, and when to turn right or left without having to listen to the traffic assistants, or having to see the traffic lights. Using gestures can be a distraction for cyclists, if the

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User Scenarios

action of the gestures is too complicated or takes too long to do. It is not recommended to have more than 2 gestures, as discussed in chapter 3. One of these would be to cancel the message, another to reply to the message by sending anautomatic message to the caller informing him or her that the cyclist is currently not available, and will reply later. The automatic reply messages could also be personalized by the cyclists themselves. In order to keep the scenarios simple and clear so that the reader (audience) can concentrate on the continuous story, user personas have been simplified.

The primary persona (man in blue top) has been used in the scenarios 1, 2 and 3. The secondary persona (man in grey top) has been used in scenario 4. Readers can distinguish each persona by the different color of the figures in the scenarios. These two user scenarios indicate what the usage of mobile communication devices could be like in an “on the go” situation. Scenarios are not like showing product rendering presentations to users; it rather tells a way of thinking, suggesting that every member of the audience could be a designer. The audience can then imagine the design experience itself instead of just evaluating or accepting the devices given to them. The scenarios contain core information about user device experiences that is very important for this project. The audience will not be made to accept the whole product in itself with functions and usability already set. By looking at the scenario, users can take the initiative and experience something with the designer of this project.

Chapter 5 has mainly focused on the behaviour of the target users, to create user personas and the final design scenarios. There is no perfect product that could last forever; sooner or later issues will appear as caused by the technological developments or so called ‘precise logical high-tech systems’. With a product of this kind, in the future people will eventually either upgrade the model or abandon it for a new design. These are not faults of human behaviour. Every product has been designed and produced to serve people, in an understanding that the total experience is more important than the functions (Lucchio, 2008). With the memory of experiences being more important than reality, emotions become more important than logic. ‘It’s all about the experience’ (Norman, 2002). That is why I have chosen scenarios as a design methodology to present my thinking about design to deal with the cyclist’s safety problem. In the next sections I will list scenario designs to demonstrate the suggested haptic device user experience.

Image 86
Rendering of I-Band produced by Zhu Yu Lin

Scenarios design of I-Band-story 1.

Scenarios design of I-Band-story 1.

The following scenarios visualise what user's experiences might be like in using this haptic interface to collaborate with his mobile phone. The user group is various, It could be anyone no matter what their gender, social status or incomes are, as long as they are riding their bicycles.. the scenarios below tell a story of Liu Lu wanting his mom to cook something for their dinner.

Scenarios
haptic interface for urban cyclists

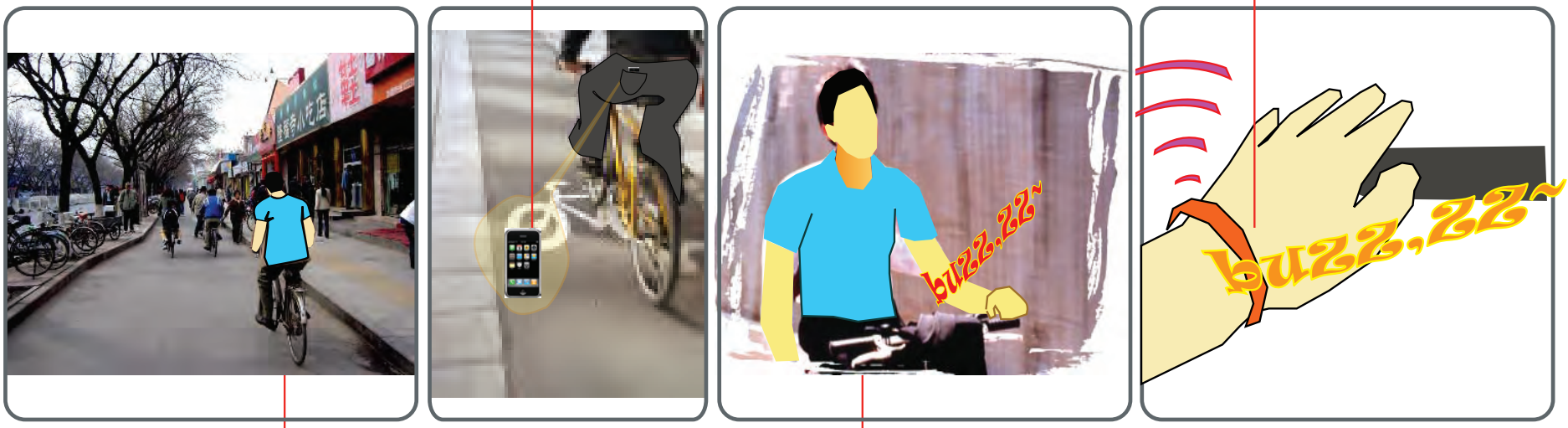
Liu Lu calls his mom from work
tell her to bring the lobster from the
fridge and cook it

after calling his mom, he is ready
to rush home, and he puts the "I-Band"
on his left wrist

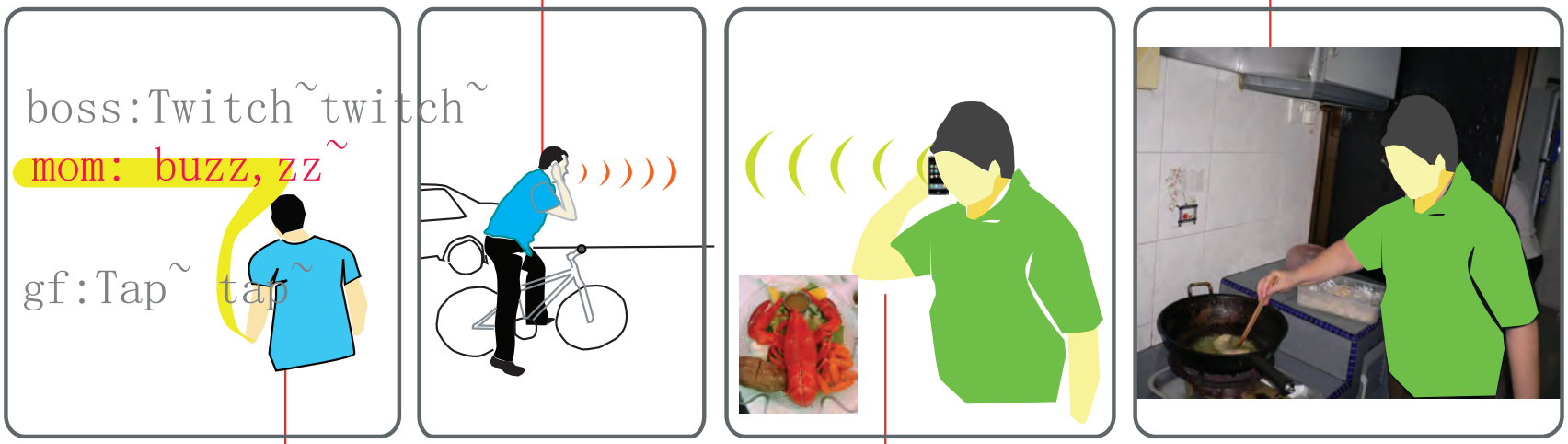
Liu Lu is a sales manager, this afternoom
before he finish work, he wants his mom
to cook the lobster for him at dinner time

his mom knows he will be at home
soon and told him she already
brought the lobster out of the fridge and
also bought lots of other food he
loves to eat. she asks him how long it
will take him to get back.

Scenarios design of I-Band-story 1.



Scenarios design of I-Band-story 1.



he regonizes it's his mom's phone call because each contact number can be programmed with a mode different from the others

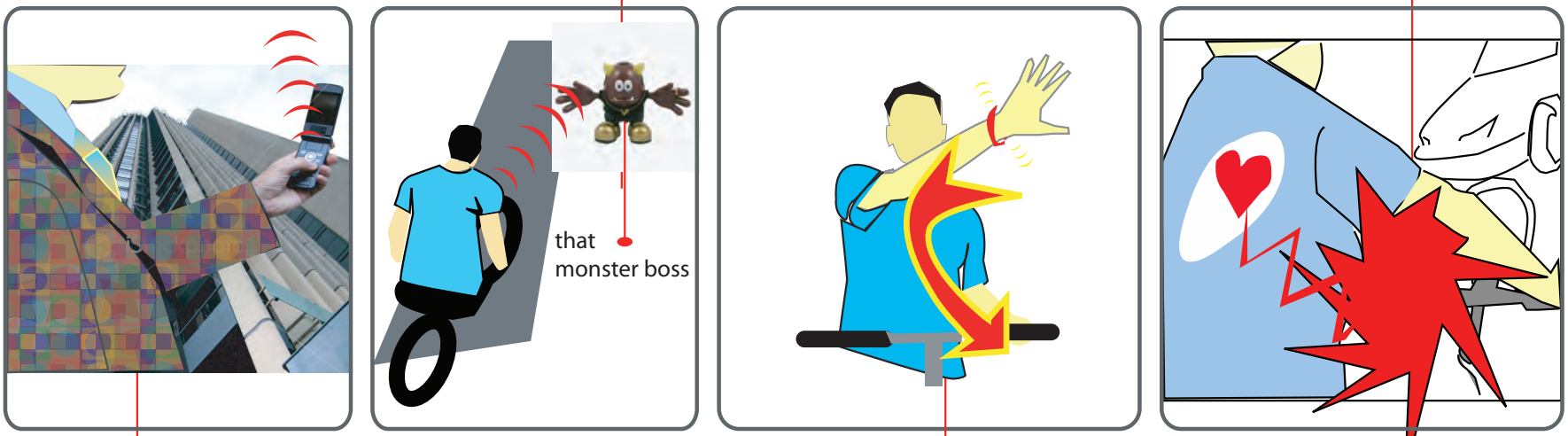
as soon as he indentifies it's his mom, he realise it is an important call. he stops riding and talks to his mom on his phone

his mom knows he will be home soon and told him the lobster is already done and everything else will be ready too when he get home

after calling to her son, she keeps on cooking for him

Scenarios design of I-Band-story 1.

Scenarios
haptic interface for urban cyclists



on the way home, his boss calls him

soon he found out it is his boss from the vibration tones he doesn't want to do anything more after working time

he just use a simple gesture waving and cancel the vibrating, at the same time the caller will get a message " the person you are calling is out of servise" automatically

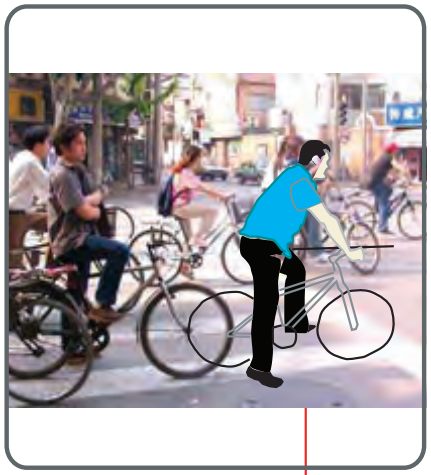
he is so hungary, he rides his bike quickly tu rush home

Scenarios design of I-Band-story 2.

Scenarios design of I-Band-story 2.

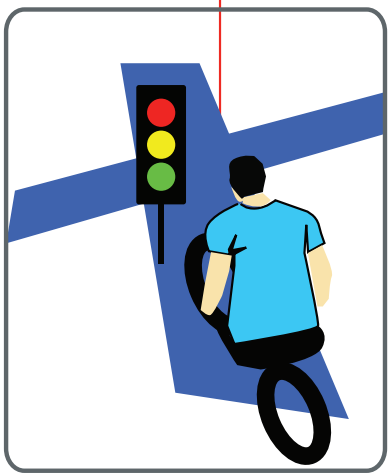
Today, Liu Lu finishs his work as usual, and he is going to choose a new route to go home by bike. let's see what happen and how does he use I-Band as a nevigation tool to guide him to go home and catch the dinner time.

Scenarios
haptic interface for urban cyclists



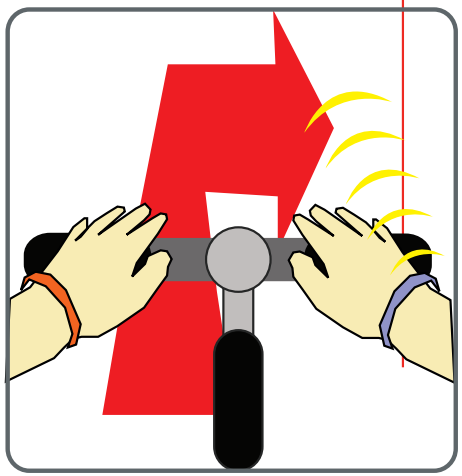
he decides to go home without delay
he choose a new road to ride that he never used before to save some time

the traffic light is still there as he never used before. He stops at a traffic light



there is another function of his I-Band
It can work with the GPS system
in his mobile phone., to tell him which way to go by vibrating

the one he wear on his right wrist is vibrating so he knows he should turn right.(if the left one, then turn left. if both vibrate then it means go backward).

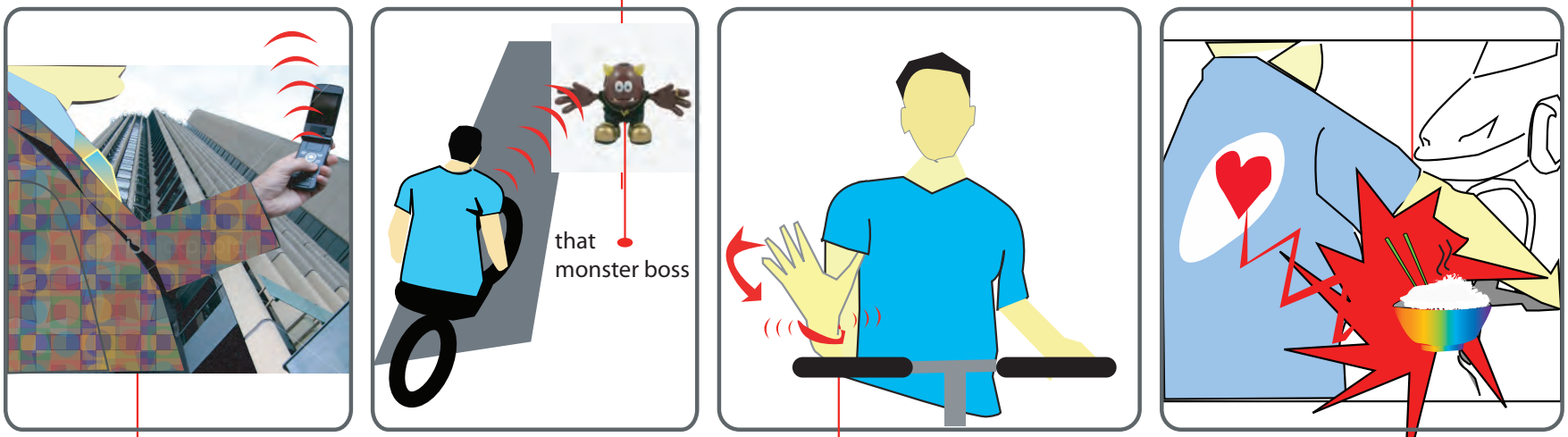


Scenarios design of I-Band-story 2.

Scenarios
haptic interface for urban cyclists

the vibration tones tell him it is his boss
but he he doesn't want
to do anything more after working time

he is so hungry, only thinking about
dinner



on the way home, his boss calls him

he just use a simple gesture waving,
to cancel the vibrating, at the
same time the caller will get a
message " the person you are
calling is out of service"
automatically

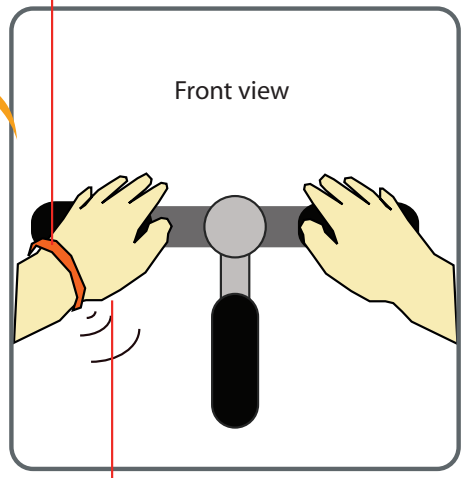
→ Scenarios design of I-Band-story 3.

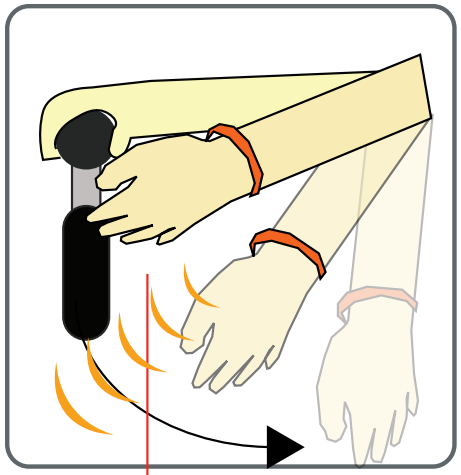
Scenarios design of I-Band-story 3.

Today, Liu Lu finishes work as usual, he is going to invite his girlfreind to have a dinner at his home, let see how they communicate to catch up at his house.

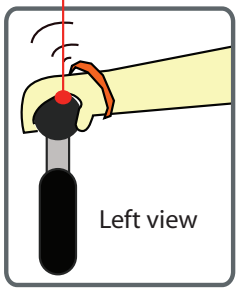
it vibrates in a particular rhythm he set for his girlfriend so he knows it is his girlfriend calling.

she gets a text from her boyfriend soon, it said:"sorry I am riding a bicycle, i will reply you very soon".





His girlfriend calls him after work and asks if she can go to his mom's house to have dinner as well.



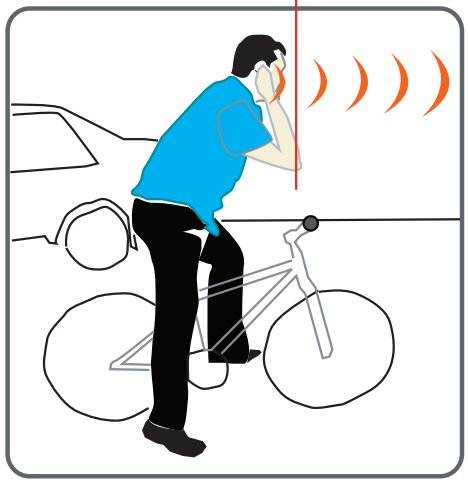
he uses his right hand to control the bicycle and using gesture: move his left forarm up and down to reply his girlfriend's call by automatically sending her a mesage back

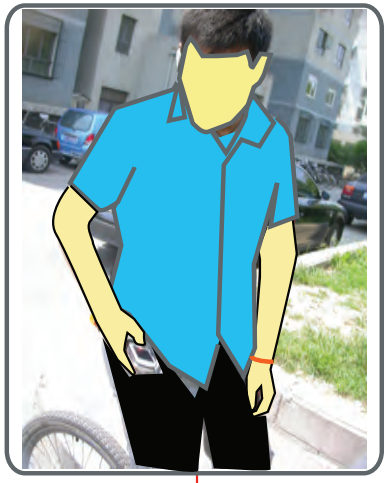
Scenarios design of I-Band-story 3.

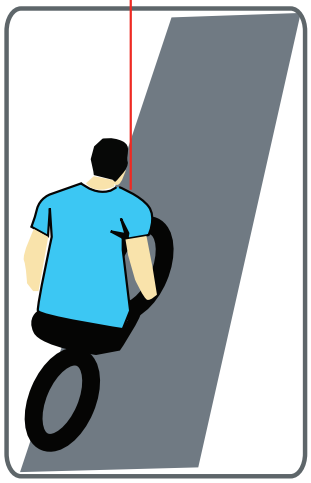
Scenarios
haptic interface for urban cyclists

he is calling his girlfriend, and tell her when he arrives home he shall see her there as well

he keeps riding, rushing home







He stops riding his bicycle take our his phone, to call his girlfriend back

he puts his mobile phone back into the pocket on the right side of his pant

Scenarios design of I-Band-story 4.

Scenarios design of I-Band-story 4.

The following scenarios visualise what the user's experiences might be like when using this haptic interface with his mobile phone. They are delivery men in China. Most delivery men are still using their bicycles as their transportation tool to work. . They spend most of their time cycling.

Scenarios
haptic interface for urban cyclists

huge boxes delivery

Package delivery

crops delivery

pizza delivery

egg delivery

flour delivery

normal merchandise delivery

internet shopping delivery

other kind of delivery

1

The user group includes various people , no matter what their gender, social status or incomes are. As long as they are riding their bicycles.

Scenarios design of I-Band-story 4.

The following scenarios visualise a deliver guy 'Xiao Li" using his I-Band(haptic device) collaborating with his mobile phone to deliver a pizza to a customer

a female customer calling the pizza restaurant to order pizza delivery

he is not so familiar with the route to her place , he is thinking about how to get there on time

a delivery guy coming out from the restaurant and ready to send her the pizza

First he find her place on the GPS in his mobile phone. lets the GPS remind him on his way there

Scenarios design of I-Band-story 4.

The following scenarios visualise a deliver guy 'Xiao Li" using his I-Band(haptic device) collaborating with his mobile phone to deliver a pizza to a customer

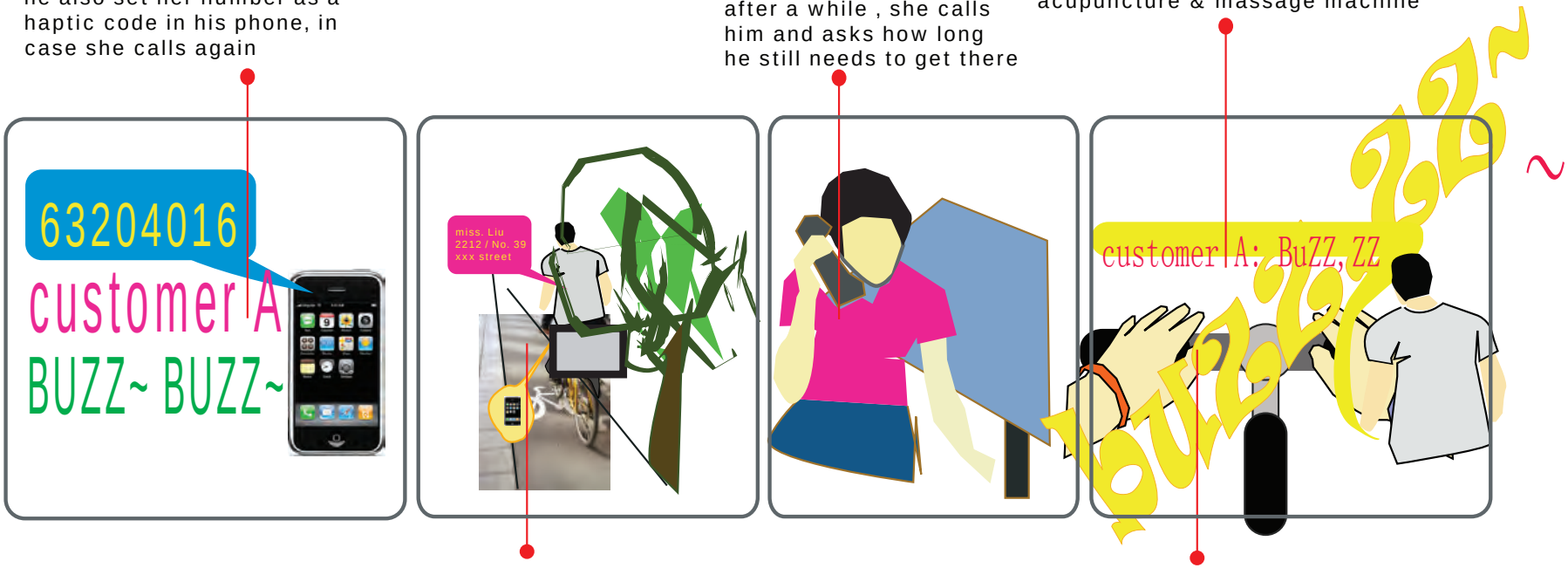
Scenarios

haptic interface for urban cyclists

using Medin frenquency pulsation technology: a small electricity motor or ultra sonic wave imitates skin twitching. The same principle used in acupuncture & massage machine

he also set her number as a haptic code in his phone, in case she calls again

after a while , she calls him and asks how long he still needs to get there



he has her address and phone number and puts his phone in his pocket and start riding

her calling is encoded to haptic message and perceived by him through the haptic device worn on his wrist, so he know it is her. He stop riding and calls her back ,telling her he is on the way

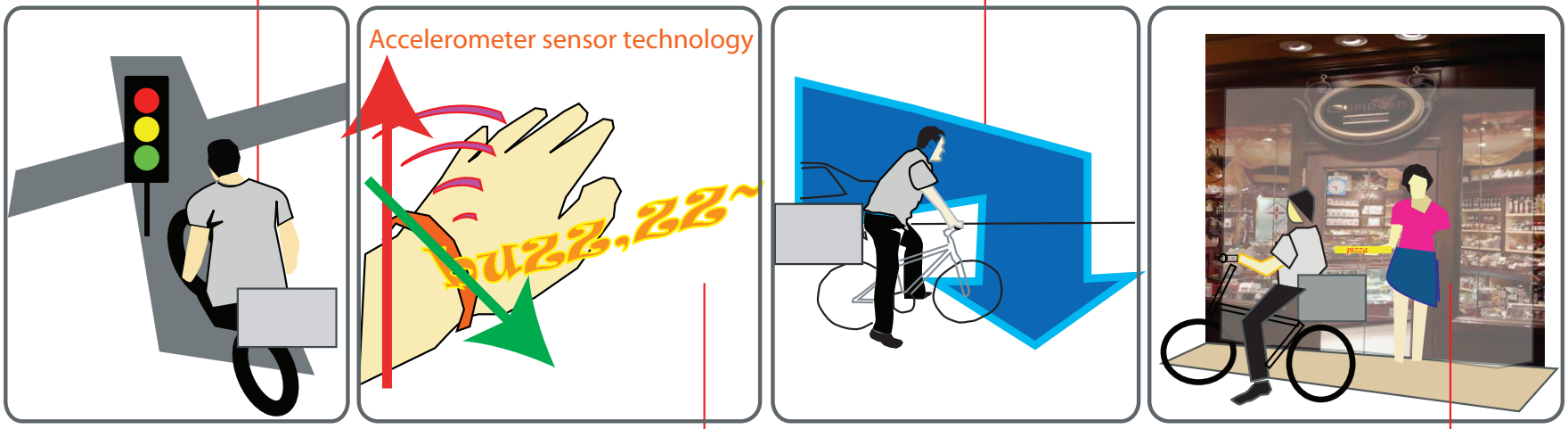
Scenarios design of I-Band-story 4.

The following scenarios visualise a deliver guy 'Xiao Li" using his I-Band(haptic device) collaborating with his mobile phone to deliver a pizza to a customer

he rides to a intersection

Accelerometer sensor technology

so he turns right as the GPS guided him



the device viborates in a certain way that he can regonize to inform him to turn right

he finally finds her place and gives the pizza to her

Conclusion

This research project began by investigating the design of mobile communication devices for ‘on the go’ situations. Early investigations involved observing actual users such as people jogging, exercising, out doors and in the gym, and so on. I was observing how people use their mobile communication and other electronic devices such as MP3 players whilst undertaking these activities. I quickly realized that the user interface of these devices was not suited to such ‘on-the-go’ activities as it required fine motor skills and hand eye coordination that are difficult to execute whilst moving or undertaking other activities. The interface design of these devices is primarily designed for static use. I also realized that the notion of ‘on-the-go’ situations had a very broad scope. For example people exercising at the gym have differing needs to people walking. Thus following further investigations I identified the serious and prevalent problem of cyclists making phone calls whilst cycling in China, especially in large cities such as Beijing and Shanghai. The research now focused on cyclists as the primary user group for this project.

Using mobile communication devices whilst cycling is a major, and well documented, safety and traffic management problem, as it is with other vehicle drives such as those of cars and trucks. To build a consolidated base for this project, I initially investigated various possible options to alleviate this safety problem, such as legislative laws (fines) against cyclists, or the installment of better infrastructure such as bike lanes; but concluded that design conclusion was reached by reasoning that minor traffic laws are could potentially offer a viable solution to the safety problem. This very difficult to police in large Chinese cities, that user behavior is difficult and complex to change and infrastructure changes slow and expensive to implement.

The research drew from a wide range of sources, to suggest methods for enhancing the safety of cyclists engaged in mobile communication. The research identified the user interface as central to furthering safer and more effective mobile communication for cyclists in China, aiming to find a better design solution and to bring more awareness to cyclists who put their lives in danger. If the interface could be designed in such a manner as to substantially reduce the cognitive load and distraction towards the cyclist, then indeed a safer alternative was possible. To achieve this aim the use of haptic interface technology was identified as the most promising direction to realize these design objectives.

Working as a designer at the nexus of a range of disciplines, my role has been to draw together elements from different research areas and distil them into this design project. The current issues regarding mobile communication interfaces were explored and criticized for causing a cognitive overload, in requiring hearing, sight and software or hardware navigators. These complicated motor-actions cause danger to cyclists. The phenomenon of cyclists making phone calls in China is not a simple problem that can be solved by designing a new type of mobile phone or interface. It is more about how to incorporate interfaces into a system which includes wireless network systems, traffic systems, and interaction activities between cyclists (users) and their surrounding environment. This aim was addressed through a variety of sources.

Conclusion

- ***The primary design methods; Scenario Design and User Personas***

Scenario design was the primary design method employed in this research as it enabled a disciplined approach to user experiences facilitating the understanding of how haptic interfaces could interact with mobile communication devices to aleviate cycling accidents. Other supporting, but equally important, design methods that were used include video and photographic studies, questionnaires, and literature studies. A large quantity of video and photographic studies were undertaken to analyze and document the behavior of cyclist and cycling conditions. Questionnaires and the subsequent development of user personas were used as tools to better understand users needs and focus the design direction. Following this user scenarios were generated with the aim of developing a design proposition to address the systematic traffic problems in China's big cities.

Scenarios were also used to evaluate design concepts and as a method for contextualizing the user experience, placing the hypothetical user into relevant stories and scenery to better understand and explain the usability of haptic interfaces in the cycling experience and help improve cycling safety and navigation within a complex social and traffic situation.

- ***The Design Proposal and Potential***

Making phone calls while cycling is a very simple and common action but also potentially dangerous. This research has identified a number of design innovations, which together could facilitate safer mobile connectivity for cyclists. By inserting a haptic interface between users and devices the cognitive load could be minimized, thereby reducing the potential danger. Through the incorporation of such tactile modalities into our mobile communication devices, we could send text or call messages which would be translated into haptic messages, sensed by users who are wearing or touching the sensory receivers. This investigation into unconventional ways of sensing and communicating information also points towards new modes of interaction.

An important aspect of this design proposal is that it is proposed to works with current advanced (3G) mobile phones thus avoiding the need to dispose of and replace the current mobile phone, reducing environmental and economic impact.

- ***Future Directions***

My research has demonstrated a potential range of ways to stimulate intuitive mobile connections between cyclists and their family, friends, clients and so forth, as well as ways to encourage the use of remote GPS navigation. One of the main outcomes of my research has been the development of awareness as to the potential for using haptic interfaces to make our cycling safer and more enjoyable. Whilst I have attempted to delimit the scope of the research to the time constraints of a master thesis, each sector of the subject field has generated as many questions as answers. As such the research has primarily been a generative process, laying the foundation for further design projects. Similarly, whilst the simulated user testing generated interesting issues, and some tentative conclusions, it is far from conclusive. Future research would be required to reach the next level of project resolution,

Conclusion

which would assess the effectiveness of the current prototypes, and propose new prototype forms. That, however, is something which remains beyond the scope of this master's project.

This research has drawn together information from a wide variety of fields, to suggest directions of augmented modes for practical implementation, and to create scenarios in relevant research fields. First of all, the design concepts developed in this project can be further developed and prototyped to satisfy user needs. For example, research into the use of icons, chitchat, and the behavior of people who use the internet can be investigated in detail to develop a mature product with a haptic interface. Icons and 'smiley's' can be defined more specifically into perceptual information so that people can identify them through haptic sensations. Secondly, impaired people who have listening and speaking problems would be able to recognize sensory messages through a haptic interface. The hearing and speech impaired for example, have generally developed higher levels of sensitivity to recognizing different sensory information that the device might convey. This could provide equal opportunities for interaction to certain people with impairments. Furthermore haptic messages, coupled with our mobile communication devices, point towards unexplored potential for cognitive extension. Such extensions, facilitated through accelerometer sensor technology, wearable design, and wireless technology, may enable us to remotely connect in deeper and more meaningful ways, irrespective of location.

Conclusion

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Bibliography

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Appendix

Investigation form

Thank you for filling this form, I'm doing a research project about communication device for Chinese cyclists. I want to know some information about your habit of using it and what do you expect for it. Please choose one or more options if you want.

Date of filling this form: *Location of filling this form:*

Personal information

Your age: □ 18-25 □ 25-30 □ 30-35 □ 35-40
□ 40-45 □ 45-50 □ 50 -55
others: _____

Your gender: □ male □ female

Your occupation: _____

Your education: □ High school □ College □ Bachelor
□ Master □ PHD
others: _____

Your salary:

□ ＜2500RMB □ 2500-4000RMB
□ 4000-6000RMB □ 6000-10000RMB
□ ＞15000RMB □ others: _____

Do you ride a bicycle? (Bicycle, electronic bicycle, tricycle and motorcycle are inclusive)

□ yes □ no

□ everyday □ sometimes □ rarely □ never

How long do you ride your bicycle every time?

□ around 15 minutes □ around 45 minutes
□ around 1.5 hour □ above 2 hours

How often do you ride a bicycle to go to work?

□ everyday □ sometimes □ rarely □ never

Do you ride your bicycle for shopping?

□ everyday □ sometimes □ rarely □ never

Do you ride bicycle for exercise?

□ everyday □ sometimes □ rarely □ never

Do you want to keep in touch with others whilst riding a bicycle?

□ very much □ good if I can
□ not really necessary □ no I don't want

Could you tell me why if you don't want to be connected with others whilst riding your bicycle?

□ quality of talking is bad □ environment is too noisy
□ inconvenient to pick up a phone call while cycling
□ dangerous □above all
□ other reasons : _____

Appendix

Do you make phone calls whilst cycling?

□ very often □ only some times and very short time
□ yes where not many others around
□ yes stop riding my bike, pick up phone call
□ switch my mobile phone off

Who do you think is the most important people to you; that you have to pick up their phone calls even while you are cycling?

□ parents, family □ good mates
□ gf/bf □boss/client
□ colleagues □ above all □others

Do you feel save to make a phone call while cycling?

□ yes safe □ I don't care □ no, it's dangerous

Where do you put your mobile phone when you riding?

□ bag □ handbag/ basket on bike
□ pocket □ neck □ other places

communication while cycling?

□ yes use it all the time
□ yes not often
□ yes when I listen to music a call suddenly come in
□ no

What's the type of mobile phone do you like?

□ candy bar □ shell □ slip cap □ rotate □ others

What kind of input do you prefer?

□ none keyboard □ computer keyboard
□ mobile phone keyboard □ others

Would you like to use shortcut key?

□ yes □ no

Which way would u like to use to browse?

□ hand writing □ touch panel □ touch board
□ joy stick □ direction key □ others

How many texts do you send every week?

□ less than 30 □ 30-90 □ 90-150 □ above 150

How many texts do you receive every week?

□ less than 30 □ 30-90
□ 90-150 □ above 150

Have you ever texted while cycling?

□ very often
□ reply immediately when the message come
□ depends on the road situation
□ no, need to stop riding first

Do you want to Use GPS to guide you when you cycling?

□ yes very much □ it doesn't really matter
□ it's not necessary □ no better not have this

Appendix

Do you want a screen on your communication device while you cycling?

□ one screen □ more than one
□ a wide one □ no

Do you want a screen on your communication device while you cycling?

□ one screen □ more than one
□ a wide one □ no screen □ other opinion:

What kind of functions do you usually use when you are riding a bike?

□ making phone calls
□ text
□ Multimedia information transfer /receive
□ Video
□ Picture
□ Music Player
□ Others

What kind of communication device do you use now? What do you want to use in near future? What's the function do you need mostly? Would you like to use those functions while you riding your bicycle?

	Now (brand/type)	Near Future (brand/type)	Main usability	Functions needed whilst riding a bike
Mobile phone				
Smart phone				
PDA phone (blackberry)				
Palm				
Mini laptop				
Mp3 player				
Game boy				

Foundmental working system

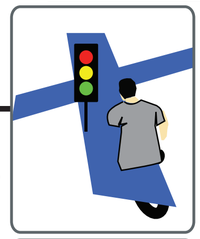
Foundation Working System

CORE PROBLEM

cyclists making phone calls whilst cycling:
sound, visual distraction &
people are lack of security awareness

mobile phone & mobile phone culture in China

- Mobile phone quickly developed in China
  - marketing of mobile phone
    - market segmentation in China 2005
      - international brands domain the top & mid tier of China's market
        - relationship: company, customer & product
          - brand Identity
            - visual identity
              - product Identity
                - different brands have similar product identity
              - corporate identity
                - NIKE
                - Apple
                - Sony Ericsson
                - Sumsung/ LG
                - Nokia
                - Motorola / SIEMENS
                - PHILIPS
                - not to design a new type of mobile phone
                - Customer's feedback of 3 Brands
    - presenting situation of mobile phone in China
      - diagram of product life circle
        - SUNRISE/ SUNSET
- User study : Being connected
  - mobile culture tribal connecting
    - psychology
      - Tech-enthusiastic
        - symbolic value of technology
      - Self-expression
        - advocacy of self expression
          - "ME" Generation "WE" Generation
            - perception
              - expressing through Design,material,objects
      - customer's view
        - psychological
          - economic
            - function
      - emotion
      - usability
      - innovation

Questionaire investigation

Users Persona

let users interact by themselves, express themselves

communication in future will be an intergrated experience

- internet access
- electronic money
- email telefax
- computer interaction
- voice control

functions are intergrated in one mobile phone

- USB
- music player
- digital camera
- headset earpiece
- PDA

- gaming
- imaging
- music

multimedia interaction

Design appearance

Hand operated

- 5 phone types
- input
- text

create a different input interface enable cyclists stay in contact without distracting them from riding

conditions of cycling in China

6 aspects

- incomplete bicycle road
- bicycle infrastructures
- serious un-safe on road condition
- weather outdoor nature condition
- culture lifestyle city orientation
- legal aspects & political aspects

questionaire & investigation feedback

limitation of traditional interfaces on bike

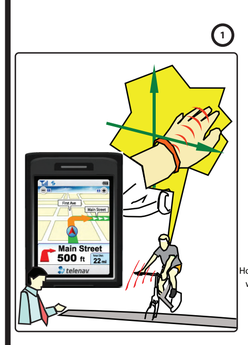
not to design a new equipment for bicycle

Haptic interface & Haptic interaction

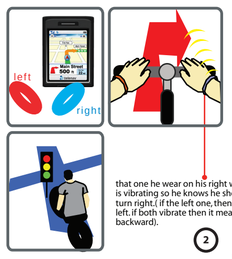
- optimal body sites for cyclysts
  - wearable Design
- bluetooth
  - sensor technology
    - wireless technology
- electronic textile smart fabric
  - New materials
- physical perception
  - Haptic interface

- Two gestures are easy to be remember & don't disturb cycling:
  one is for cancle the coming call / message
  another one is for auto-reply the contacts
- Using different physical perceptions (programmed code) for different individuals, avoid an increas of visual &sound distraction, improve user's safety awareness
- Using GPS as a coordinate function to navigate cyclists synchronizing vibration tags cyclist where to go
- Concept design investigation

User scenarios



How haptic interface to cope with the sensory overload problem when riding in traffic

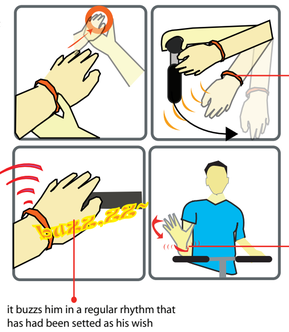


1 Tag the direction you want to go to

that one he wear on his right wrist is vibrating so he knows he should turn right.(if the left one, then turn left. if both vibrate then it means backward).

2 Reply to the caller through a simple hand movement

Up t o Two gestures to reply the contact mobile phones



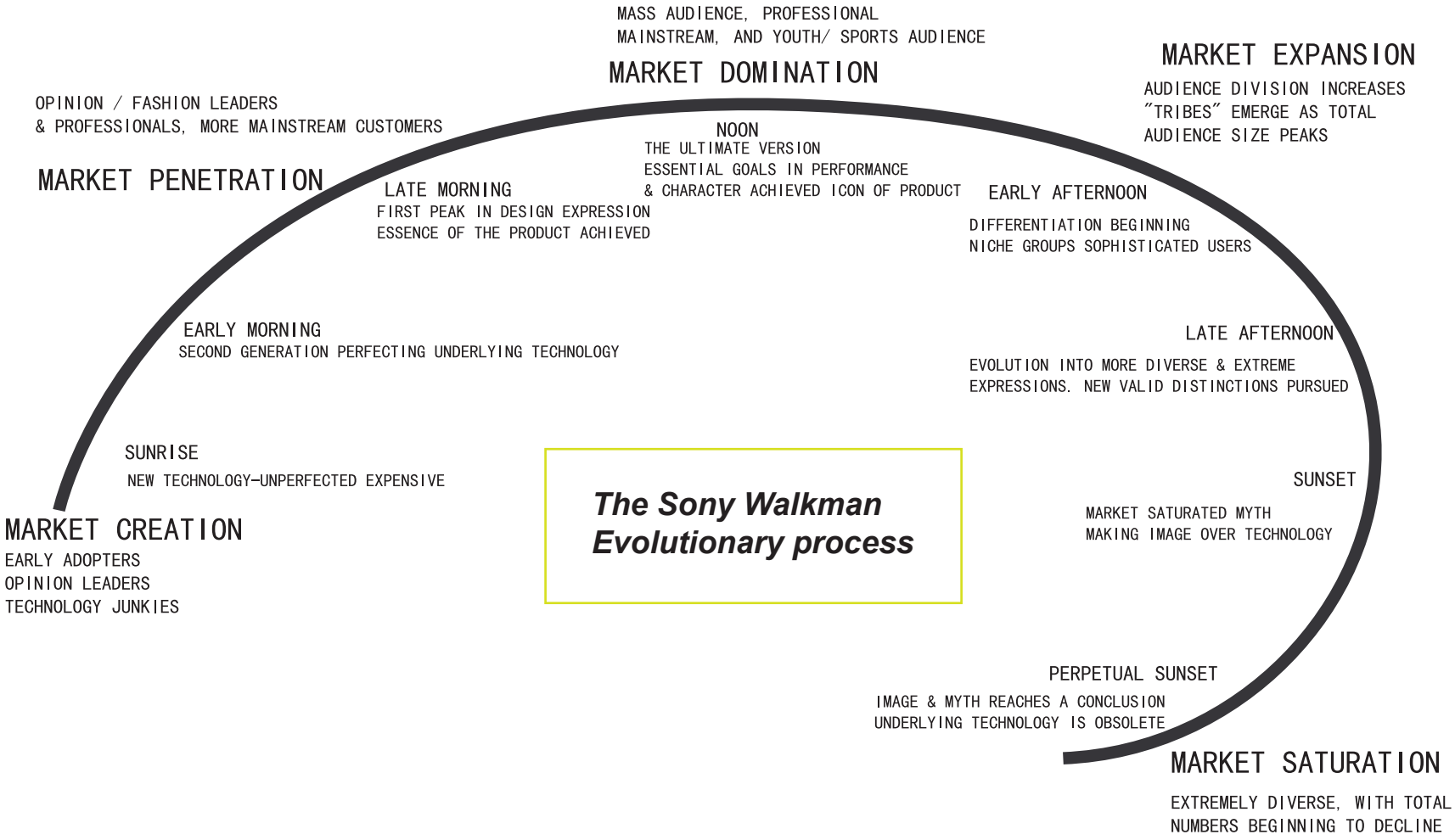
he use right hand to control the bicycle and using gesture: move his left forarm up and down to reply his girlfriend's call by automatically sending her a mesage back

he just use a simple gesture waving and cancel the vibrating, at the same time the caller will get a message " the person you are calling is out of servise" automatically

it buzzs him in a regular rhythm that has had been setted as his wish

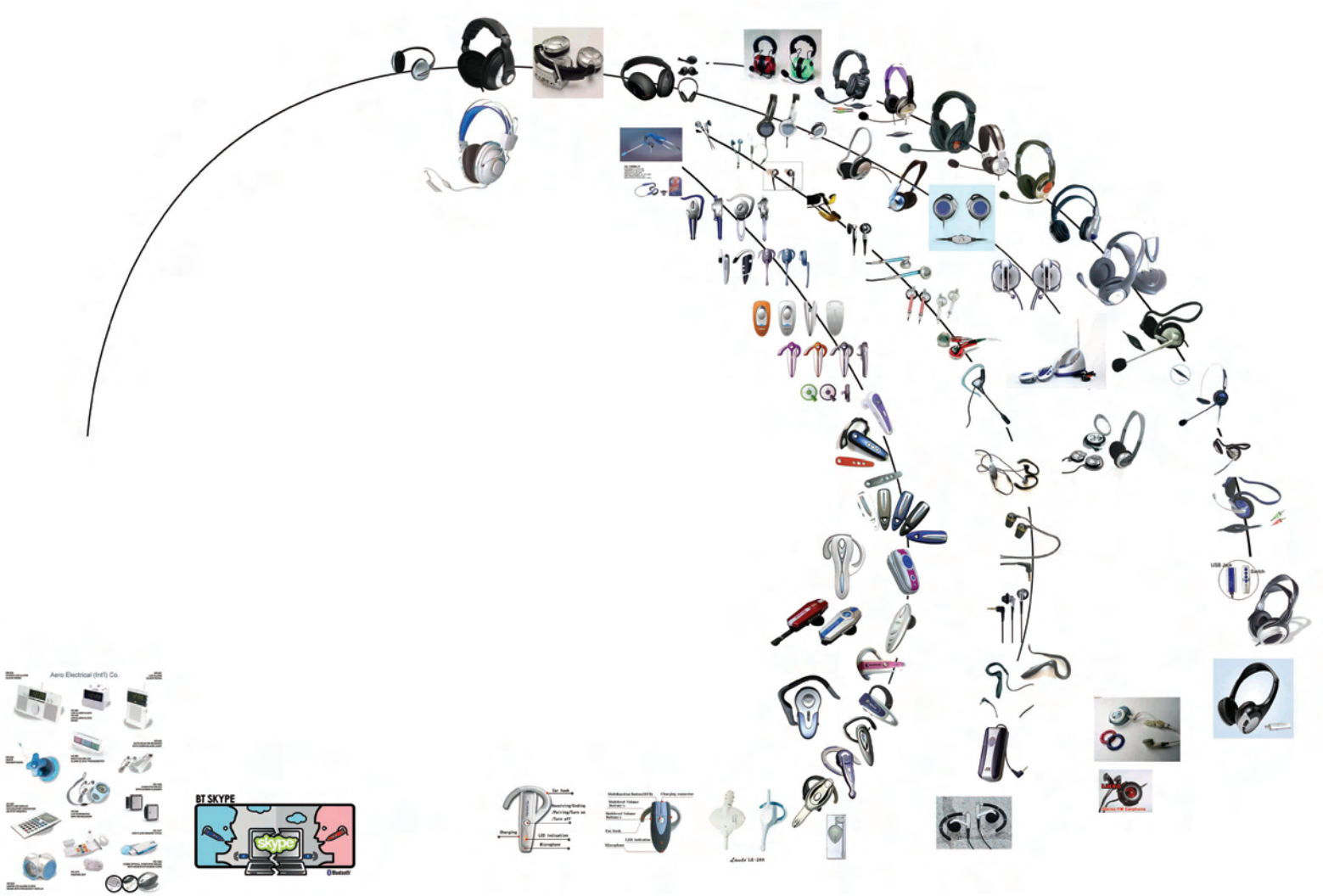
Appendix

product history lifecycle



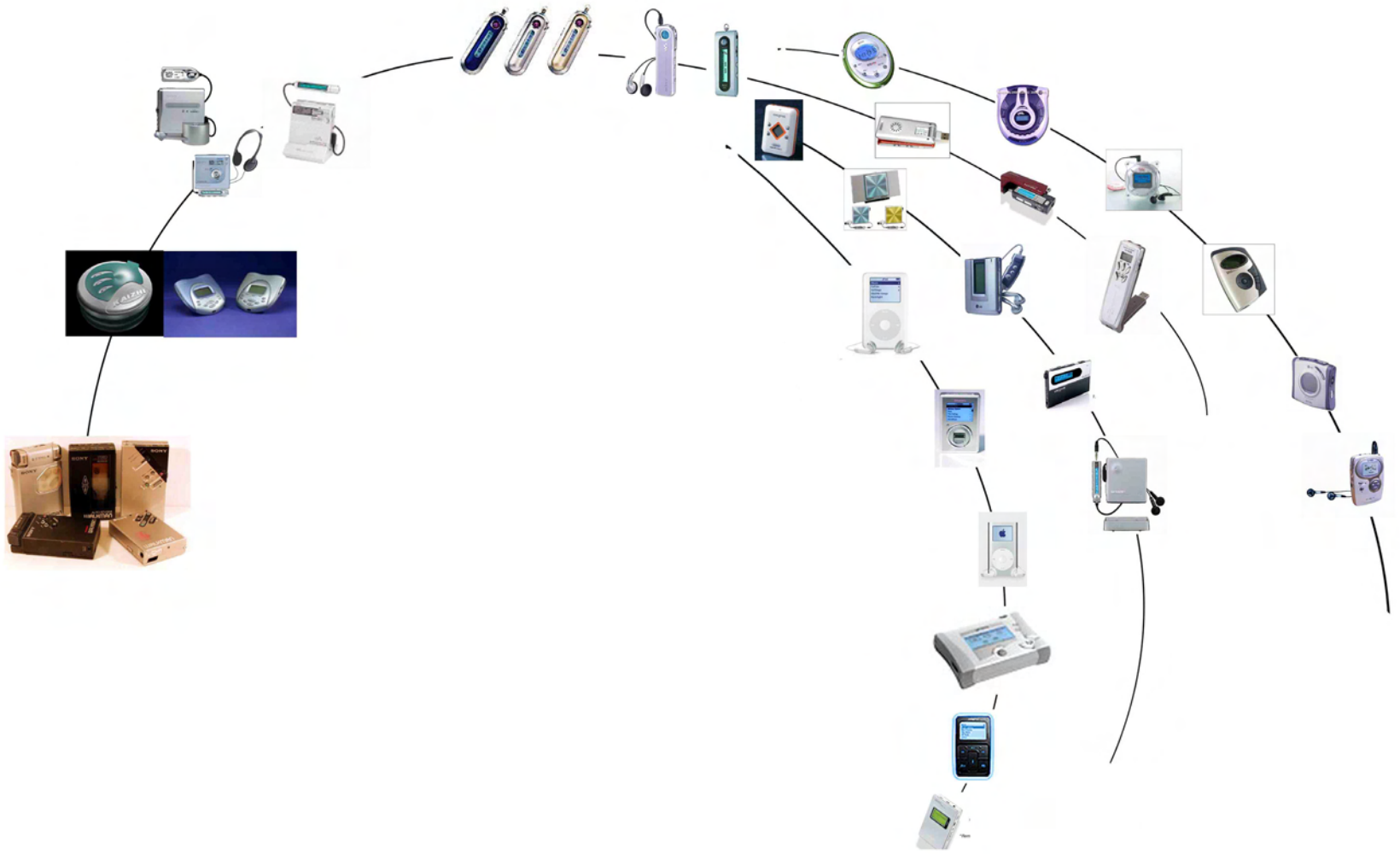
SOURCE: DIGITAL DREAMS – THE WORK OF THE SONY DESIGN CENTRE PP. 28–28.

Appendix



Sunrise-sunset Diagram

Appendix

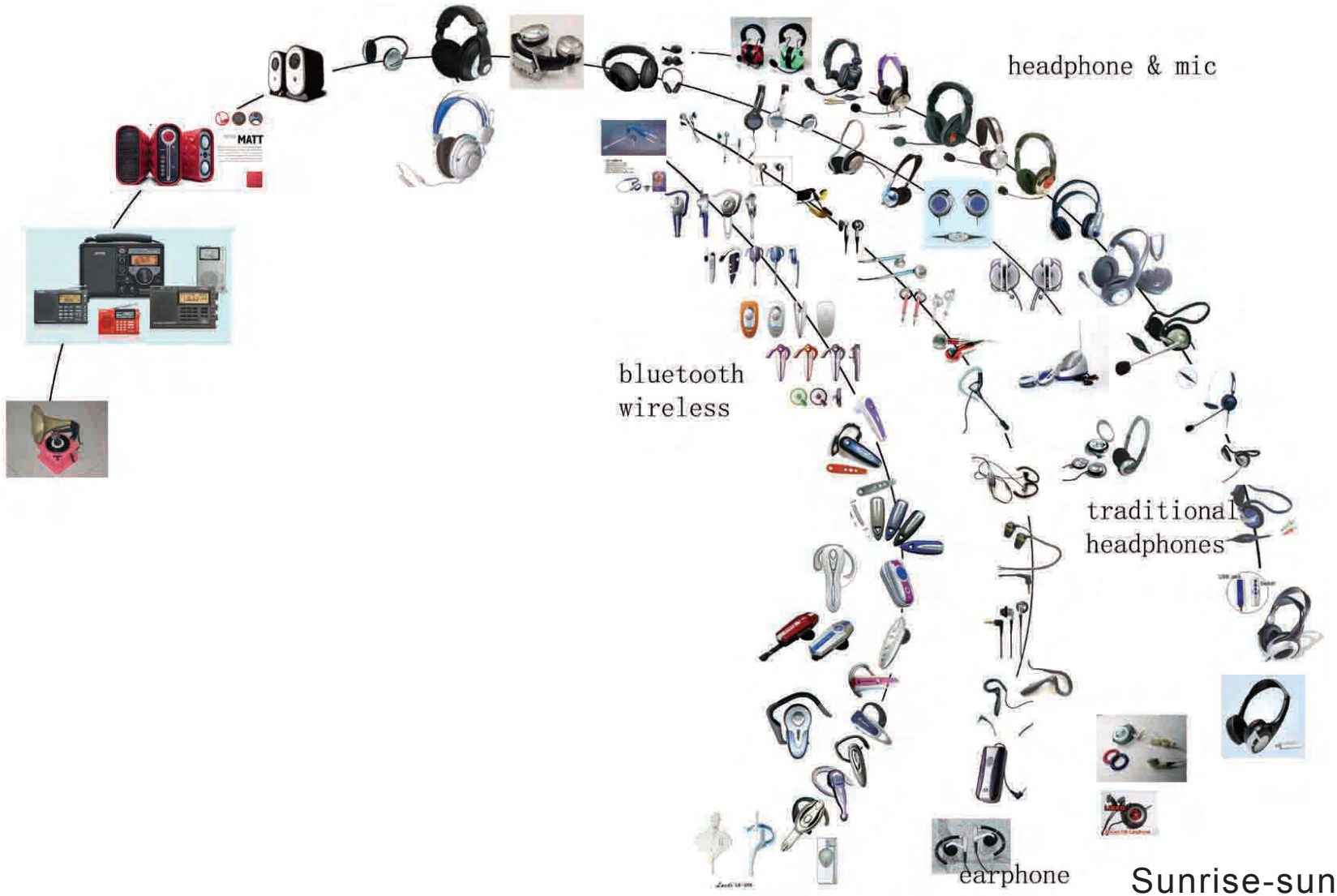


Sunrise-sunset Diagram

Appendix

Sunrise-sunset Diagram

Appendix



Sunrise-sunset Diagram

Appendix

Sunrise-sunset Diagram

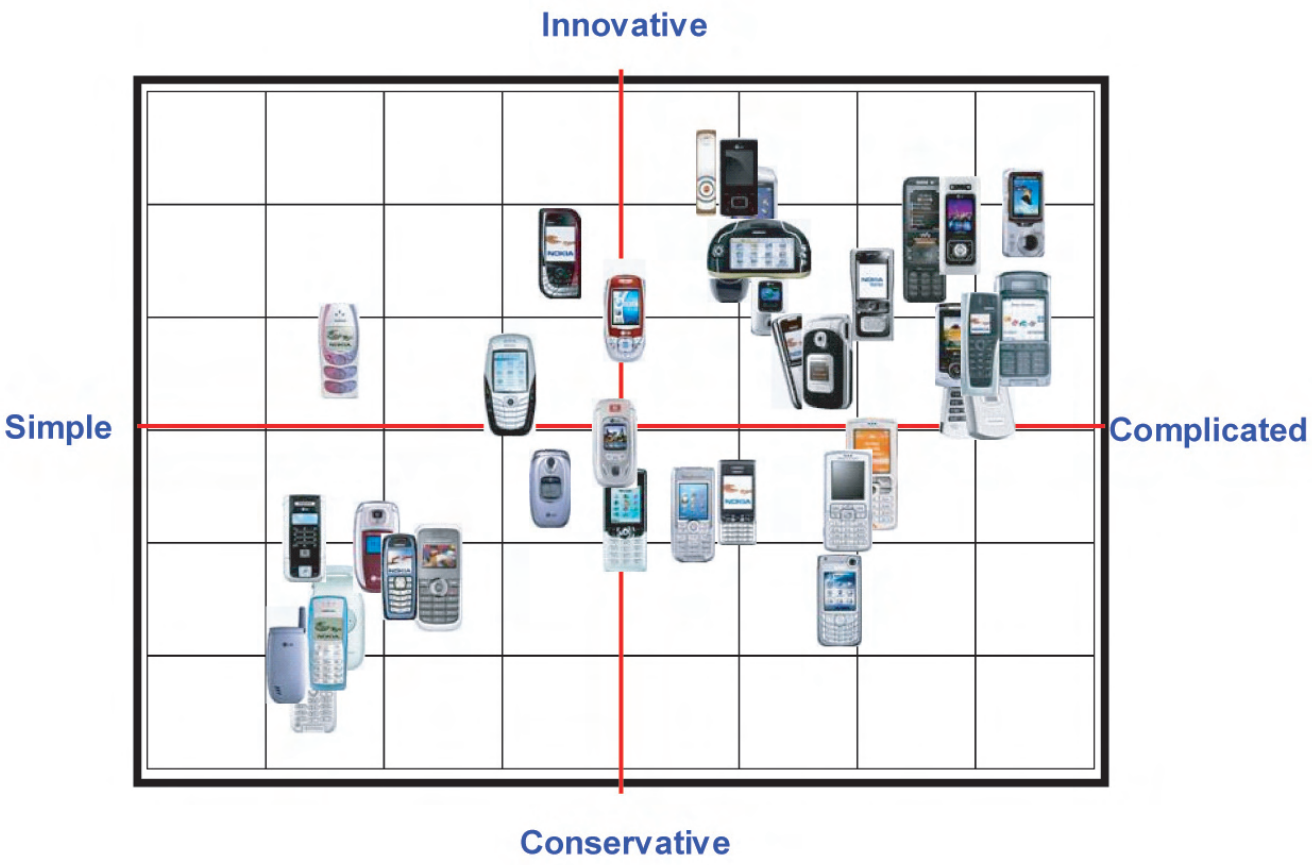
Appendix

Sunrise-sunset Diagram

Appendix

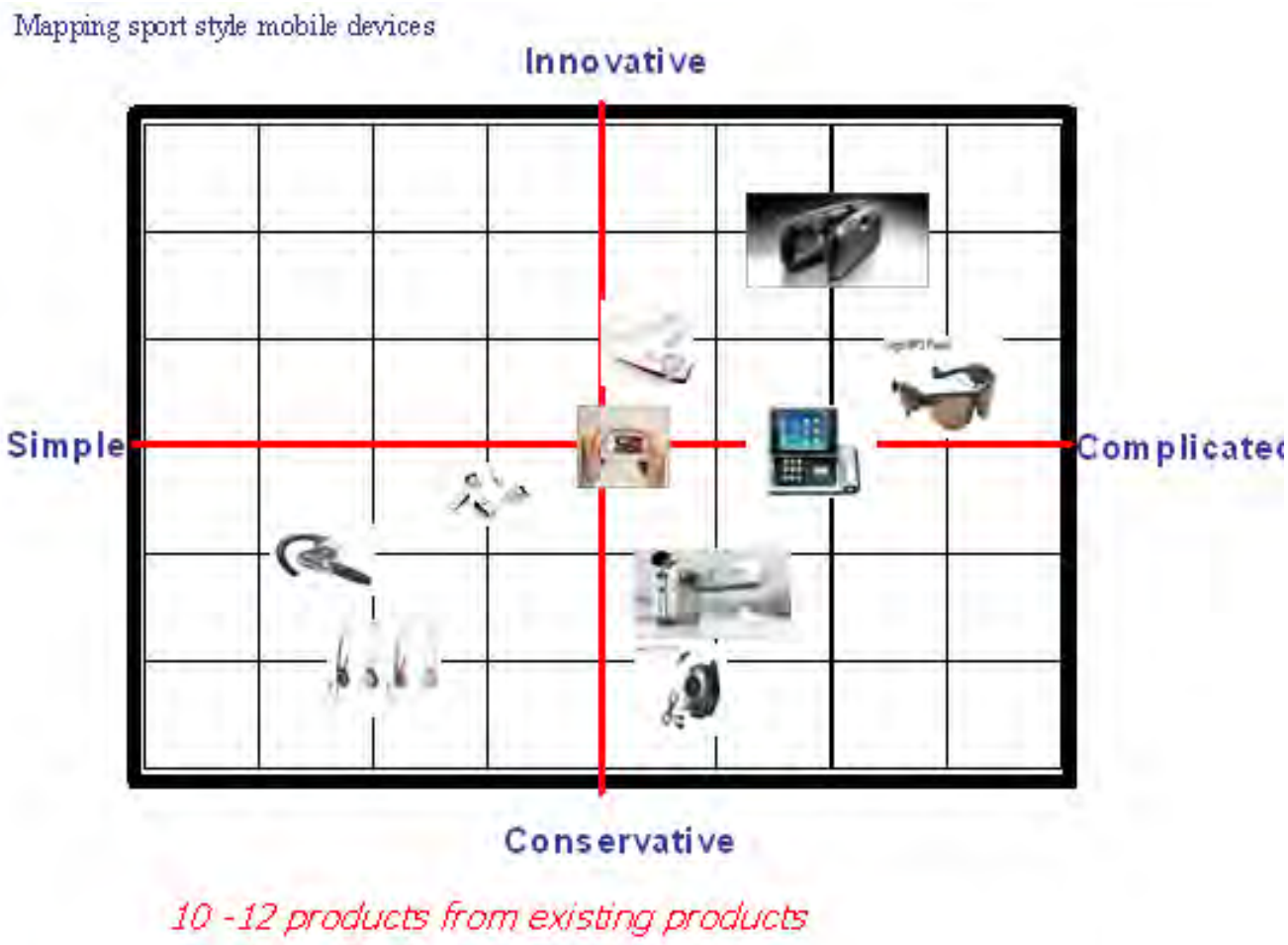
Sunrise-sunset Diagram

Appendix



This diagram illustrates some existing products in the market. These devices had been catalogued in to different types. These show the developing trend of mobile phones.

Appendix



This diagram illustrates some existing products in the market. Simple wearable products are easier to be carried by cyclists than those complicated high-tech hand held PDA phones.

Appendix

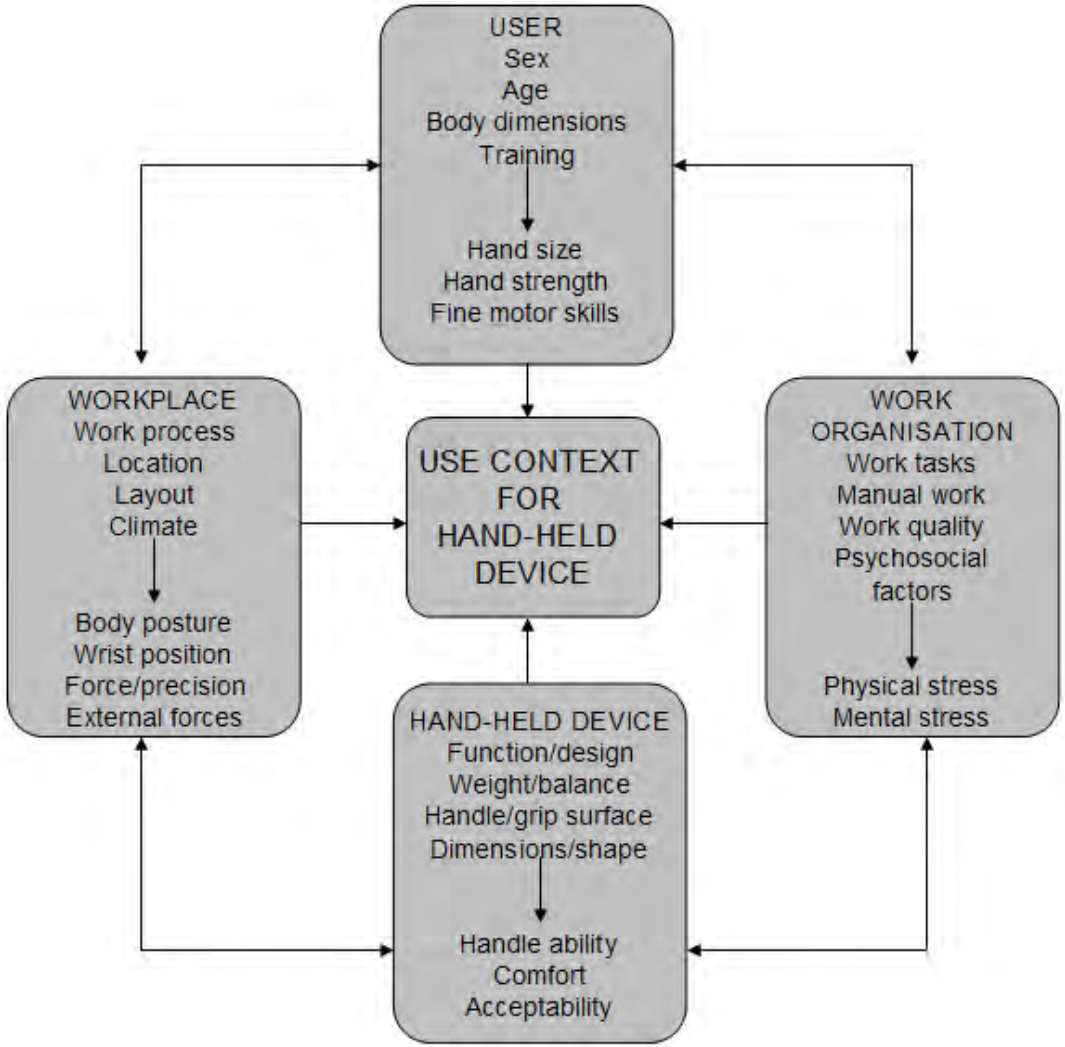


Diagram: "Design if Hand-Operated Devices" Citing From: p.205, Human Factors in Consumer Products (Hedge, 1998)

Appendix

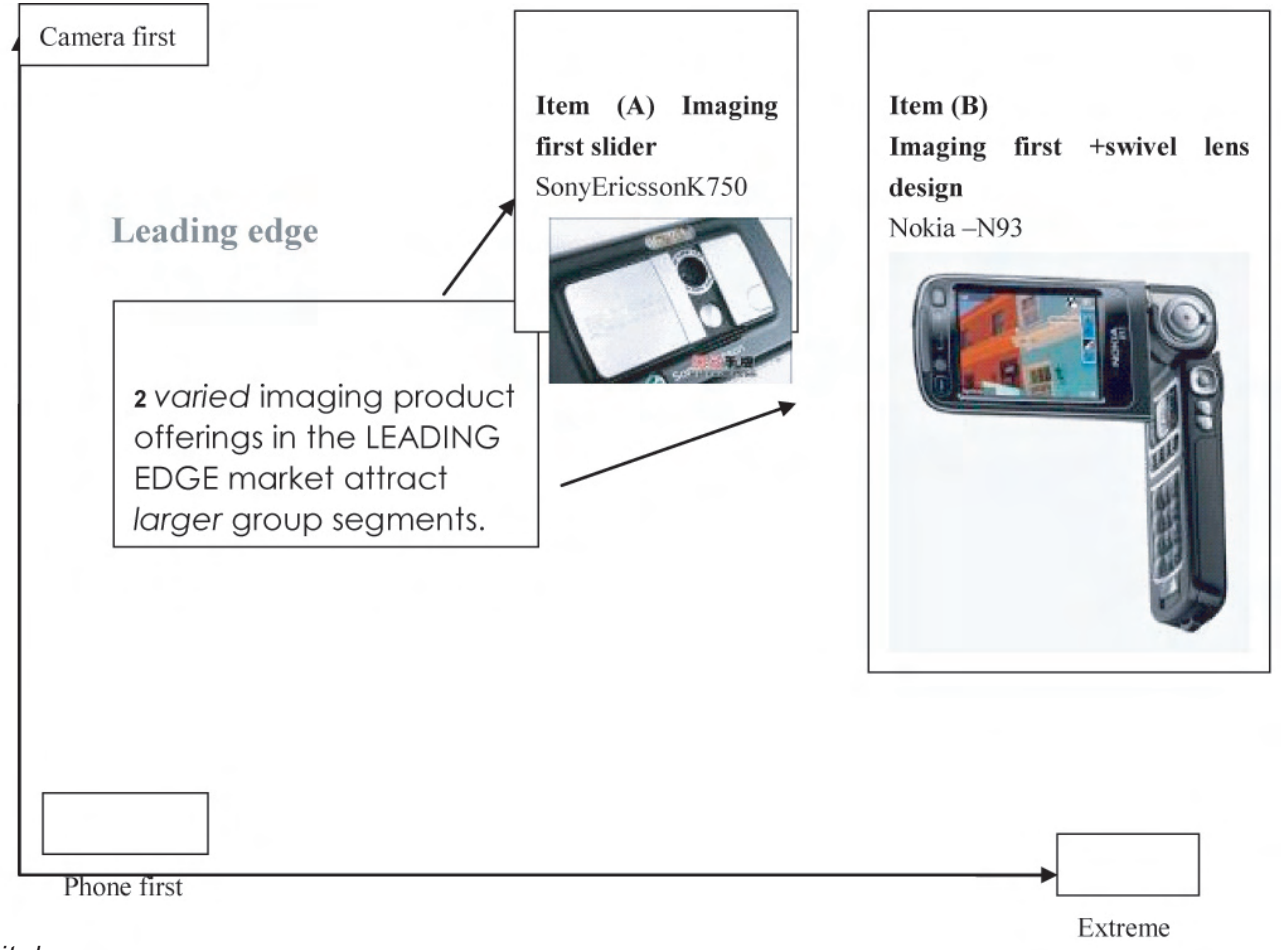


Diagram of the Leading edge of digital gadgets produced by Zhu Yu Lin

The picture above shows the extreme pursuit of visual effect and image quality.

Appendix

Image 10

Beijing map

Citing from website: http://www.tour-beijing.com/weekend-

Appendix

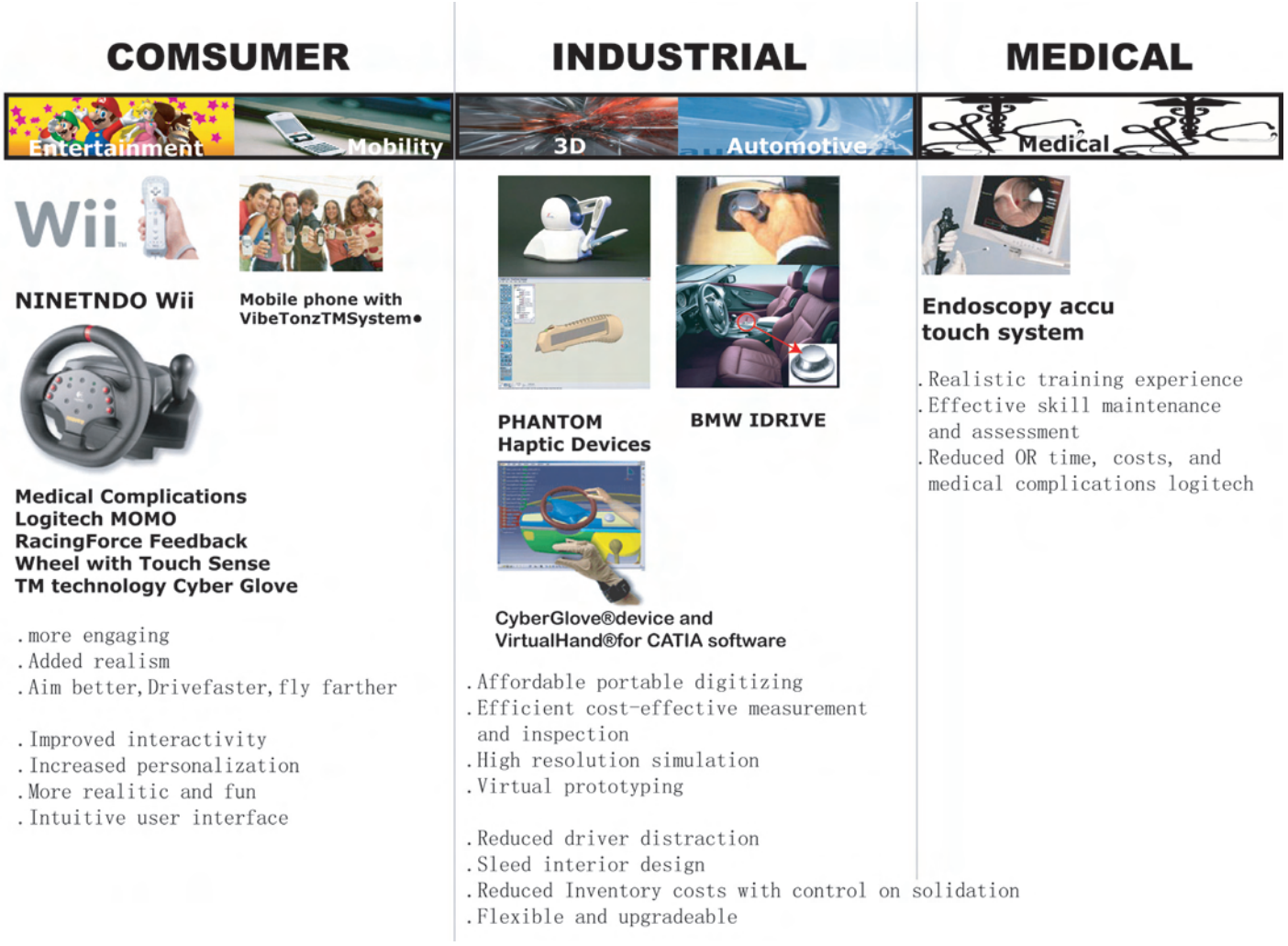


Image 40

Key haptic interface applications produced by Zhu Yu Lin

Appendix

Image 41
Reproduced by Zhu Yu Lin
Retrieved from website:www.shepherd.edu/libweb/services/libtech/wii/

Image 42
Reproduced by Zhu Yu Lin
Wii, Picture reproduced by zhuyulin Retrieved from website: news.cnet.com/8301-17938_105-9774947-1.html

Appendix

Image 43
Reproduced by zhuyulin
Image retrieved from website: www.joystiq.com/.../

Image 44
Reproduced by Zhu Yu Lin
Retrieved from website:
www.shepherd.edu/libweb/services/libtech/wii/

Appendix

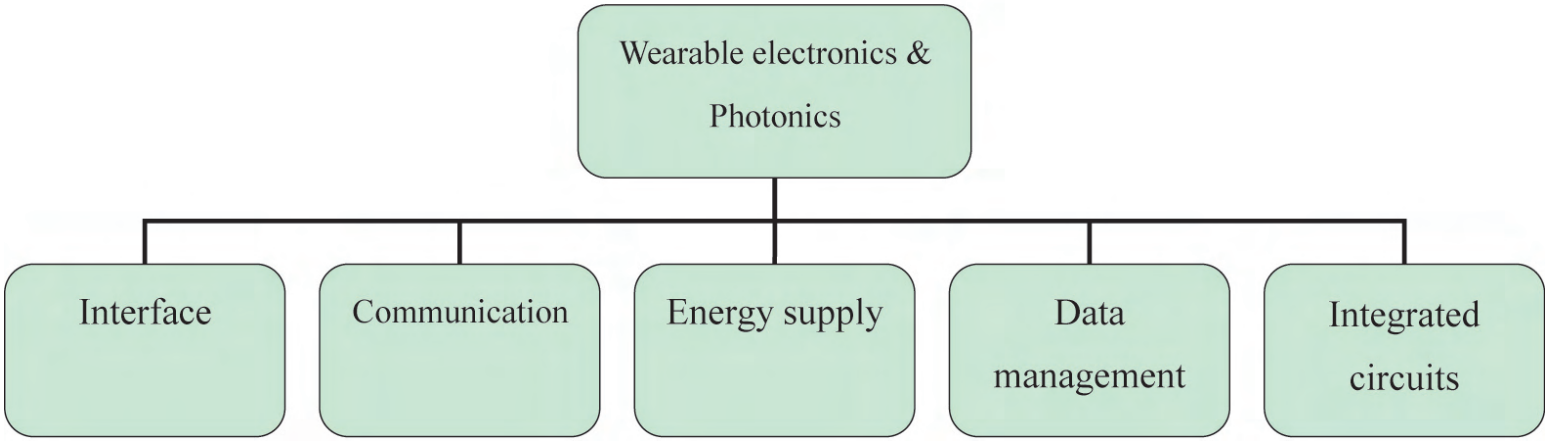


Image 45:
General system configuration of a typical wearable electronics and photonics product. (Tao, 2006)

Appendix

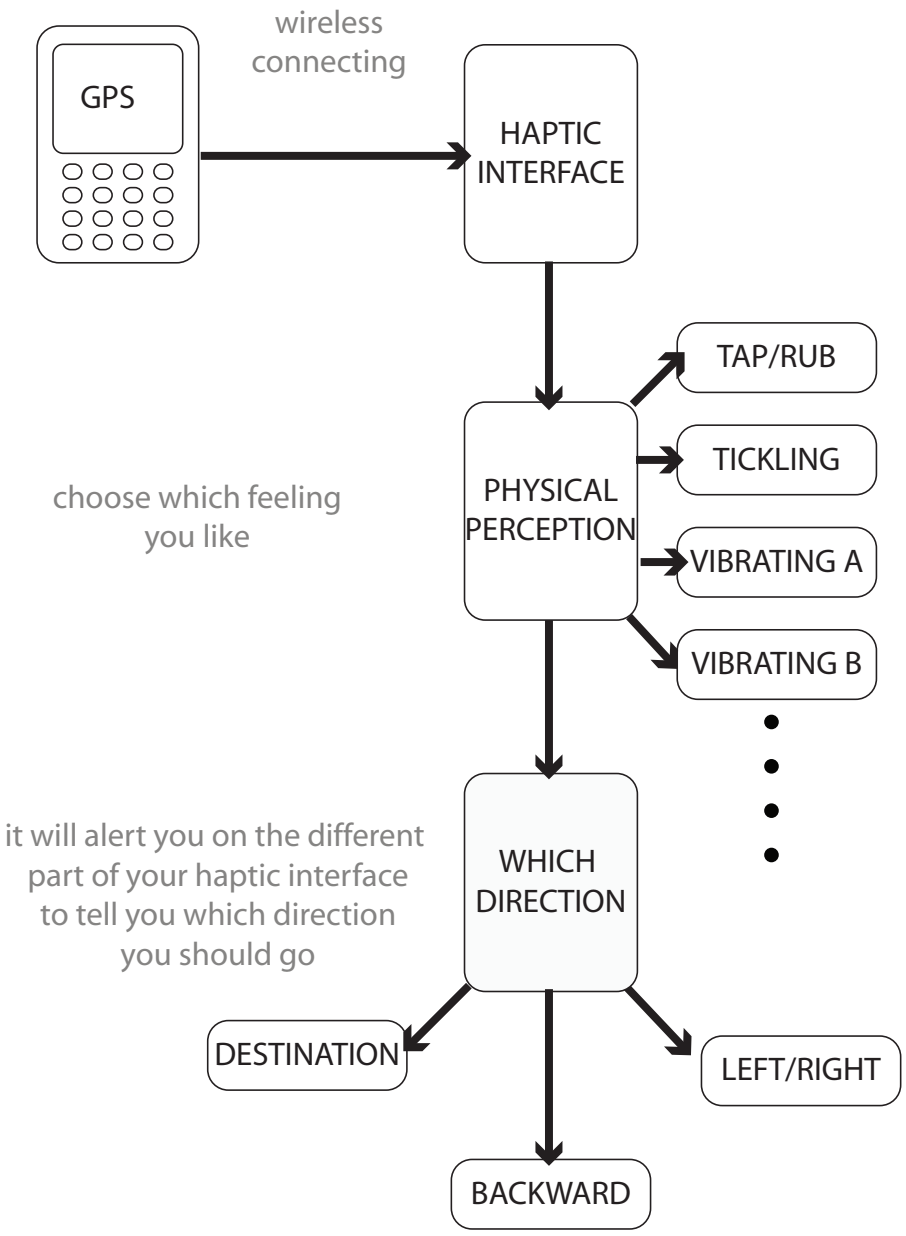


Image 46:
GPS navigation Image 46 Produced by Zhu Yu Lin

Appendix

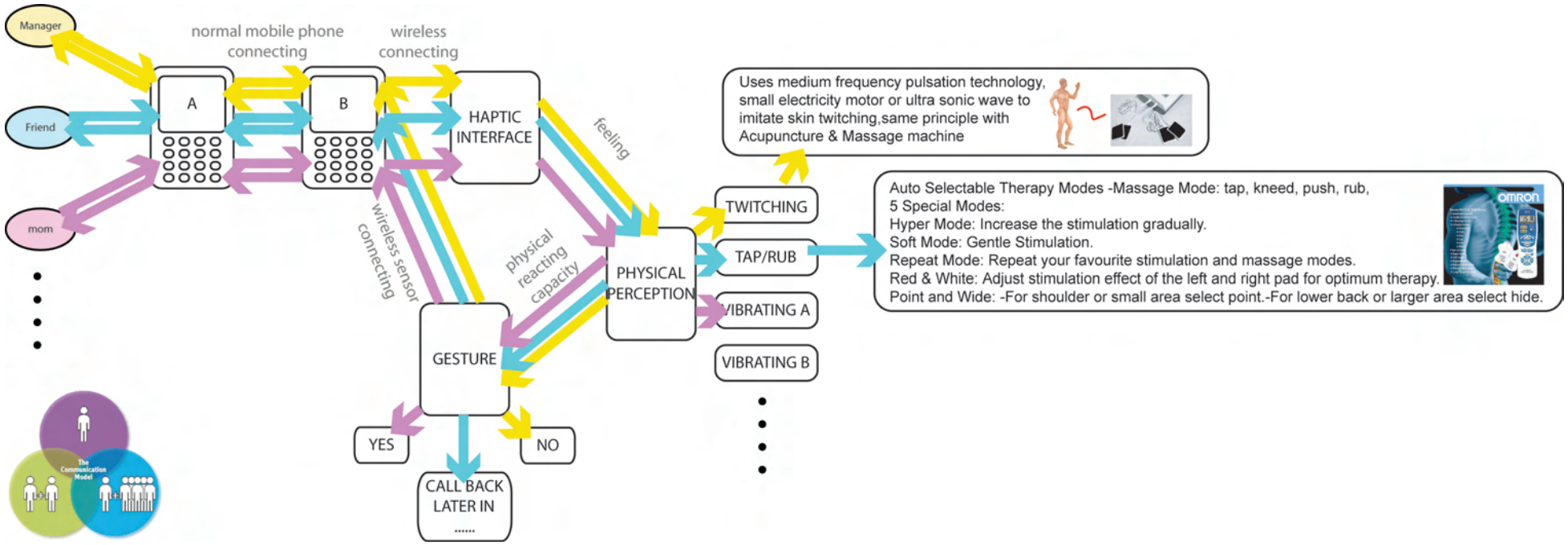


Image 47:

Haptic message working system produced by Zhu Yu Lin

Appendix

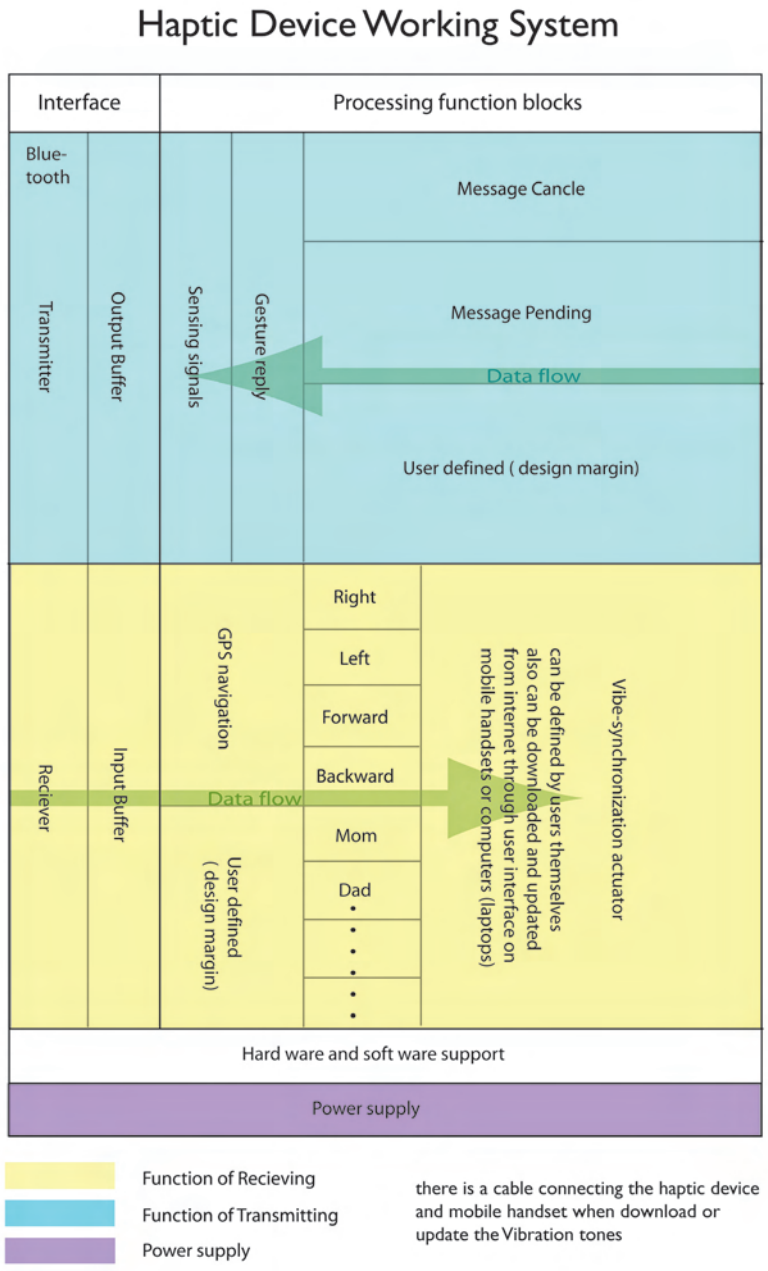


Image 48

Produced by Zhu Yu Lin

Consulted with Henrry Wu & Si yuan Chen from RMIT building 87 level 3

Appendix

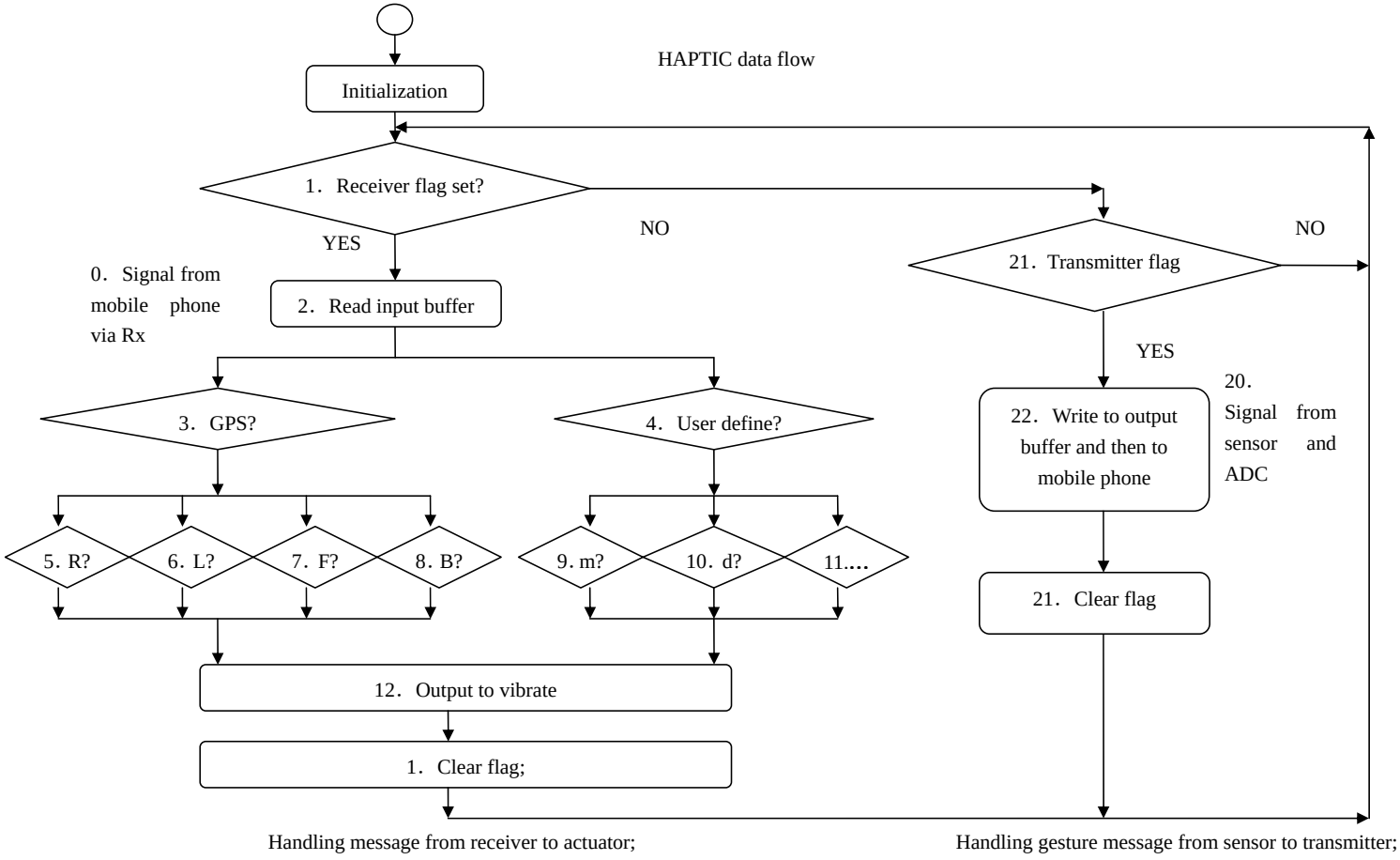


Image 49

Haptic data flow schematic produced by Zhu Yu Lin Consulted with Henrry Wu & Si yuan Chen from RMIT building 87 level 3

Appendix

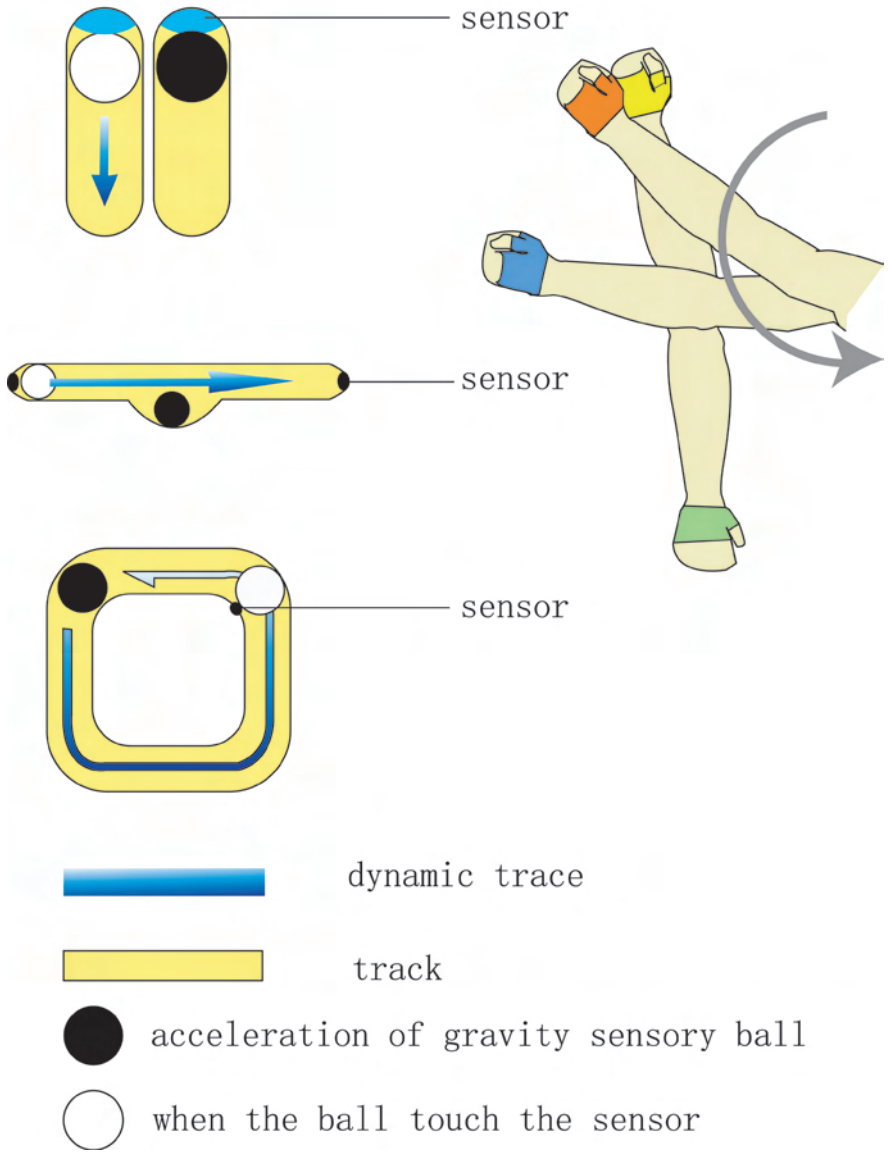


Image 50

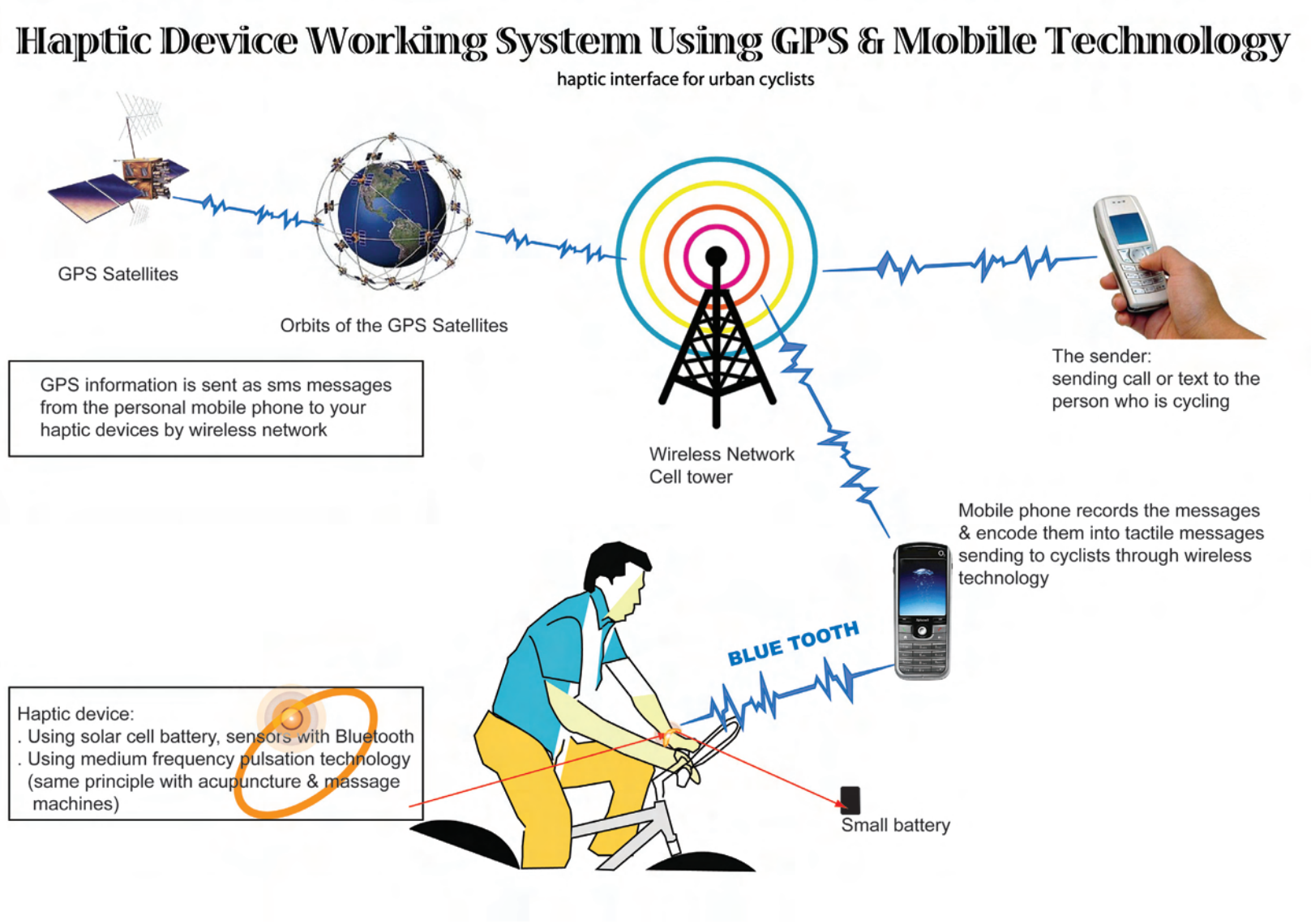
Produced by zhu yu lin how to use the accelerometer sensor with gesture reply the movement range of gesture reply is limited by the space around cyclists. In this case, cyclist can not stretch their body language too far.

Appendix

Picture 51

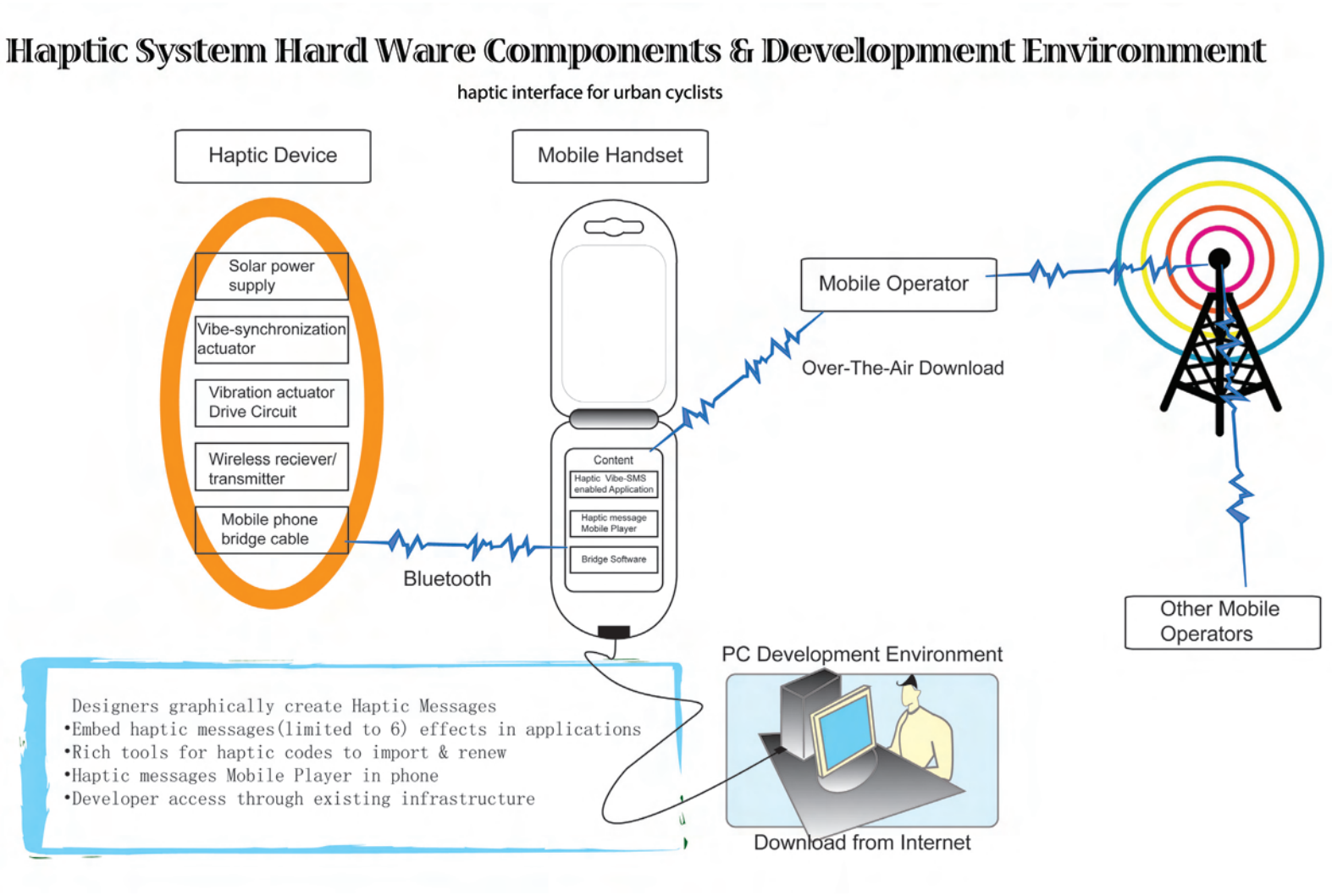
Accelerometer sensor working system on haptic interface with mobile handset

Appendix



Images 52

Appendix



Images 53

Appendix

Table 5. “Corporate identities of prestigious brands in China”

Corporate identities of Prestigious brands in China	
Nokia	**Connecting people**
Motorola / Siemens	**Intelligence everywhere be ‘cool’**
Samsung /LG	**Life is good**
Sony Ericsson	**Design is streamlined and centralized**
Apple	**Minimalist, professional, high-tech**
Nike	**Just do it**
Philips	**Easy and simplicity(let’s make thing better)**

Table 6.”PERCEPTIONS” Diagram citing from materials & design the personal dimension. pp 77

Perception	Opposite	Perception	Opposite
Aggressive	Passive	Elegant	Clumsy
Cheap	Expensive	Extravagant	Restrained
Classic	Trendy	Feminine	Masculine
Clinical	Friendly	Formal	Informal
Clever	Silly	Hand-made	Mass-produced
Common	Exclusive	Honest	Deceptive
Decorated	Plain	Humorous	Serious
Delicate	Rugged	Irritating	Loveable
Disposable	Lasting	Mature	Youthful
Dull	Sexy		

Appendix