



# Gesture-based interaction and implication for the future

Xu Yan

**Department of informatics**  
Human Computer Interaction  
Master thesis 1-year level, 15 credits  
SPM 2011.01

Nuerrennisahan Aimaiti

**Department of Computing Science**  
Computational Science and Engineering  
Master thesis 1-year level, 15 credits  
SPM 2011.01

# Abstract

*Currently there exists an advanced and natural form of interaction, named gesture-based interaction. It has been applied in some fields successfully, especially in the form of game applications. Although people are filled with wonder at the new interaction, it has not replaced the traditional interaction, like keyboard and mouse. From the user experience point of view, gesture-based interaction has advantages which traditional interactive form cannot offer, but also shortcomings which people seem dissatisfied with. This thesis focuses on expressing user experience of gesture-based interaction by conducting interview method. Finally, this paper presents a new design and tries to find implications for its practical usage in the future.*

## 1. Introduction

In present-day society, with the development of computer science, the software and hardware are very advanced. But the form of interaction between people and machine is developing slowly and even become an obstacle to the inherent technological development. Therefore, a great number of researchers start to divert their attention from computer screen or programming language to human-computer interaction (HCI). The research field of HCI has raised much attention and interest. Many new computational applications have appeared and play increasingly important role in our life, such as tangible, robotics and gesture-based interaction.

There is no doubt that gestures play an important role in interaction between people. A gesture is a motion of the body and contains much information (Kurtenbach & Hulteen, 1990). Waving goodbye is one example. The most importance of gesture is that it is a natural way. People usually use a broad range of gestures naturally to accompany speech. Traditional interaction, like keyboard and mouse, is almost totally free of gestures, and depend on direct manipulation. Gesture-based interaction provides a new form for people to interact with devices and shows great breakthrough in history of human computer interaction. In this technology, devices can get visual input and recognize people's gesture without touching keys or screens. Therefore, in the field of human computer interaction based on user-centered theory, gesture-based interaction has received great attention around the world and even is considered as the trend of future. This paper basically studies gesture-based interaction. It is motivated by the interest of a successful commercialized product, Xbox360 game console. This kind of console is very attractive, there are lots of friends, familiar people and students around us have already experiences of playing Xbox game console, which helps us to collect data easily. Compared with keyboard and mouse, gesture-based interaction is a more advanced technology and more natural form of human computer interaction (Dourish, P., 2004). However, except of its success in game industry, we haven't seen such good performance in other fields. Therefore, our research questions are what are the advantages and disadvantages of the gesture-based interaction? And from those what implications can we find for its practical usage in the future.

The structure of the rest of this paper is as follows. The next section will position the

description of gesture-based interaction and current applications. After that, we take an Xbox game console as an example to collect the data from several participants by interview method. Section five and six describe the results of the studies and discuss advantages and disadvantages of gesture-based interaction comparing with traditional interaction. Section seven poses a new application on mobile phone by this interaction technology.

## 2. Related work

### 2.1 Two methods of gesture-based interaction

There is no doubt that gestures play very important role in our daily life when people talk with others. It is very natural to accompany speech. Therefore, direct use of hands as an input device is an attractive way for providing natural communication between humans and computers. It fully complies with the naturality of embodied interaction (Dourish, P., 2004). Actually, gesture-based interaction has been explored for about 30 years, and there are a great number of researches and systems that are related to this work. Some of the work described below.

The most important problem in gesture-based interaction is how to make hand gestures recognized by computers. The approaches mainly include “Data-Glove based” and “Vision based” approaches (Garg, P. & Aggarwal, N. & Sofat, S., 2009). The Data-Glove method is an early form. The glove is equipped with a great number of sensors and connects to computer by an electric line. The user with the glove just needs to stand in front of screen and move his/her hand. The glove collects the hand and fingers movements and transmits the information to the computer. Although it was proved that data gloves provide very accurate results, the devices are quite expensive and bring much unpleasant experience to the users (Garg, P. & Aggarwal, N. & Sofat, S., 2009). For example, the line limits the scope of user’s activities; the size of glove does not fit different users. In contrast, the Vision Based method has gained more attention in the recent years. The system can get visual input and recognize people’s gesture by a camera without the use of any extra devices. In other words, users do not need to touch anything. This system can overcome some limitations of the related to the data glove. User can feel totally free to control interface without encumbrance. As such the interaction between humans and computers has become more natural. Although it up to now cannot provide the same accuracy like data glove, it has for many applications met the necessary requirements (Kurtenbach & Hulteen, 1990).

Due to the superiority of Vision Based interaction, it has become the focus of researchers’ attention in the development of HCI. In daily life, we can find that vision based interaction is desired in many applications. For example, in a room, users need to control the display or play a game, but the remote controller or joystick is not accessible. Another example, some people are discussing in the meeting room. They may need to show their ideas to everyone by drawing some pictures in a big screen. However, it is unrealistic and not very convenient to offer everyone a mouse and keyboard let them operate together. In these situations, vision based interaction can solve all above problems. In addition to these applications, it is worth to mention that this system has no cumbersome devices, only requires a camera. It is very easy for people to understand the basic concept. After catching the image by camera as an input, the first step of the process is to distinguish between body and background. Then the system analyzes and recognizes the gesture based on modeling database. Finally, the information is translated into commands to perform corresponding task.

There are currently existing systems that are developed based on the concept of gesture-based interaction and wildly used in various application areas, such as robot control, medical research, navigation system and game entertainment applications, etc. Here some

examples are taken, five researchers at Georgia Technology University (Lee et al., 2005) have developed gesture-based games designed to help deaf children learn sign language. Gesture-based interaction screen makes the computer, cell phone, and iPhone much fun and amazing. Moreover, gesture-based interaction can be used as input methods of games and musical instrument applications for entertainment. Kinect is a controller-free gaming and entertainment experience developed by Microsoft for the Xbox 360 video game platform. Some of the most common application areas will be described further in the section below.

## 2.2 Embodied interaction technology

Embodied interaction is becoming an important part in our everyday life. So what is embodied interaction? To this question, the clear definition is given on CSISWiki website. Embodied interaction is the creation, manipulation and sharing of meaning through engaged interaction with artifacts. Embodied interaction is when people interact mentally and physically with technology. It is a position in cogitative science and the philosophy of the mind emphasizing the role that the human body plays in shaping the mind. This can be used in science, robotics, music, and gaming (wiki.csisdmsz.ul.ie, 2010).

So far, there have been many designs using gesture-based interaction technology. For example, In 2003 Cybernet Systems Company had a product called “Gesture Storm” that enables TV meteorologist to control the computerized visual effects of on-air weather displays through using hand gestures and body movements (Poddar et al., 1998). Instead of handwriting an on-air report for broadcasting where the timing of computerized maps is memorized, the weather broadcaster can go direct to display the weather picture in real time as it is happening. Use of this system has allowed the meteorologists to reduce his or her preparation time for weather forecasts significantly.



*Figure 1: Hand movements to interact with Gesture Storm (Teixeira et al., 2006)*

In 2004, Canesta Company developed vision recognition technology in PDA (Personal Digital Assistant). The device can project the virtual keyboard onto desk and sense user’s fingers movements on the keyboard to realize the operation of PDA (Teixeira et al., 2006). Georgia Institute of Technology in America had a subject about safer drive with gesture recognition.

The research group designed a “gesture panel” to replace common instrument panel (Westeyn et al., 2003). The driver just need to do certain gesture to control the temperature of air-condition or the volume of audio without diverting driver’s attention from the road.

In the gaming world, embodied interaction has become a huge aspect. People want to physically take part in the game not just mentally participate. A lot of games now involve physical tasks designed to test the peoples’ abilities not just their mental capacity. Technology today allows the games to record peoples’ instant movements making the games more and more realistic. The most successful application of gesture-based interaction technology is in game industry, like Xbox of Microsoft Kinect. Xbox console is a very popular video game console (Oskoei, M. A. & Huosheng Hu., 2009). It brings great fun of games and entertainment to life in extraordinary new ways without using a controller. The user is the controller, easy to use and instantly fun, Xbox game console gets the user whole body in the game and uses a motion sensor that tracks the user entire body. So when the user is playing, it is not only about the user’s hands and wrists, but also about all of the user’s arms, legs, knees, waist, hips and so on. Xbox game console is the user’s connection to more games, entertainment and fun.



*Figure 2: Playing volleyball on Xbox360 game console (Kinect sports website)*

### **2.3 User experience**

In our research, we paid much attention to participants’ feelings when they use gesture-based interaction. User experience (UX) is very important concept in the field of human computer interaction (Benyon, D., 2010). So what is user experience? To this question Hassenzahl gave a clear introduction in his paper (Hassenzahl, M. 2008). He defined user experience as a momentary, primarily evaluative feeling (good-bad) while interacting with a product or service. By that, UX shifts attention from the product and materials to humans and feelings-the subject side of product uses.

According to human-centered viewpoint, people’s experience, feelings and perceptions should be considered carefully. To a certain extent, they even can decide the future of a

product or a technology. Therefore, we could not make hasty conclusion that the most advanced technology was equal to the trend of future. For example, the speech dialing of mobile phone, which based on the advance speech recognition technology (Dobler, S., 2000) has not been in widespread use. The reason might be that the user does not want people around know to whom he is dialing, or perhaps the phone dials wrong number because of the noisy environment. Users certainly could not bear the trouble by such unstable and error-prone speech dialing. And pressing keys is easy enough for people to make calls. Similarly, the traditional interaction has existed for a long time and continued to be dominant. As an advance technology, gesture-based interaction is paid more and more attention and widely used in various application areas.

Presence is also an important component of interaction. The definition of cognitive presence implies that a highly present user will be strongly focused on the virtual environment (Nunez, D. & Blake, E. H., 2001). In other words, users experienced as a pleasant environment, produced a low level of presence; users experienced as both unpleasant and exciting, a high level of presence are reported. The higher presence requires more attention.

## **2.4 Advantages and disadvantages of gesture-based interaction**

We have read some articles which would be explaining about the different opinions on advantages and disadvantages of the gesture-based interaction technology. That helps us to make further understanding, enlarge our thinking, and guide us in our later related work.

Derpanis said that traditional interfaces, keyboards and mice present a bottleneck in application that rely on heavy interaction of the user with the machine due to the unnaturalness of the interaction.(Derpanis, K. G., 2004). From reading lots of related articles, we have learnt that recent efforts have attempted to eliminate this bottleneck by developing different ways of interacting with computers, for example: speech, handwriting and gesture recognition.

Bhuiyan and Picking thought gesture technology can provide more entertainment opportunity for any type of users (Bhuiyan , M. & Picking, R., 2004). According to our observation, we found that in the game industry, game products have been successfully using this technology, such as Sony Eyetoy, Wii, Microsoft's Xbox, etc. Bhuiyan and Picking also presented that physical simulation can improve the realism of the resulting gestural animation in several ways. Besides, this technology can be developed for training and education purpose (Bhuiyan , M. & Picking, R., 2004).

Garg and Aggarwal described many successful applications of gesture recognition in varied fields including virtual environment, sign language translation, medical system, etc. However, they also discussed some open issues. This technology is suitable in a controlled lab setting but does not generalize to arbitrary settings. If there are no high contrast stationary backgrounds and ambient lighting conditions, the recognition is very likely to make mistakes. And the machine cannot recognize the start and end points of meaningful gestures from continuous motion of the hands (Garg, P. et al., 2009).

### **3. Methodology**

To collect data, in the beginning we had intended to take an observation method by visiting Giganten which specializes in selling electronic products and located in Strömpilsplatsen 5, Umeå, Sweden. Before there was one Xbox game console sample that let the customer play for free to experience the feeling of it. Unfortunately, when we went there and wanted to try to experience Xbox game console by ourselves, we found that Xbox game console has been already dismantled. So finally we decided to collect data using interview method.

A pilot study and a main study were conducted during which we collected the data from several participants. We adopted interview method which belongs to qualitative research. We need to get in depth information around the topic from participants. Interview and open-ended questions are particularly useful for getting the story behind a participant's experiences (Valenzuela D. & Shrivastava P., 2002). Our research question is open-ended, in order to focus on finding out the advantages and disadvantages of gesture-based interaction. Therefore, interview is more suitable than questionnaire to get the useful data related to our research questions. Most of questions were built around how people feel about gesture-based interaction by playing Xbox game console. The pilot study was conducted to get feedback about the wording of questions. After that, we did the main study with modified questions. Our aim is exploring the advantages and disadvantages of gesture-based interaction compared with traditional interaction, and finding implications for its practical usage in the future. From the participants' opinions, we evaluated the user experience of gesture-based interaction and made a conclusion about our research questions. Besides, we design a prototype of a new application based on the results of interview.

#### **3.1 Pilot study**

Pilot study is a crucial element of a good study design. Conducting a pilot study does not guarantee success in the main study, but it does increase the likelihood (R. van Teijlingen, E. & Hundley, V., 2002). Pilot study is used to identify potential practical problems in the following main study, like whether the wording and the order of the questions are suitable or not. The first step what we did was planning the interview. We thought about how an interview would be executed, and decided whom to interview and the interview framework. The second step was conducting the interview. We made an appointment with participants that made sure he or she had enough time to answer our questions carefully. After collecting data, the third step was analyzing results to find out problems and improve our questions.

##### **3.1.1 Participants**

Our pilot study was conducted with interviewing two people. One participant is a male 25 years of age. He is an international student studying master's program in Marketing in Umeå University, Sweden. He comes from China and has been here for one year. He has an Xbox controller which he bought from Japan at the end of 2008. Therefore he has a rich experience of using gesture-based interaction technology since he has been playing Xbox console over than two years. The other participant is a Swedish female 22 years of age. She is an Umeå University student studying master program in Psychology. She has not previously experience



in playing Xbox game console, so she is not familiar with Xbox, but she is familiar with Wii controller which is a little bit similar with Xbox game console.

### 3.1.2 Reflections on the pilot study

The main concern what we had during the pilot study is about the selection of participants. We would like to choose participants who must have previously experience on playing Xbox game console. In pilot study, one interviewee mentioned Wii game. Then we searched the information about Wii from the internet. The Wii makes users controlling the game by physical gestures and traditional button presses. We noticed that users must always hold the sensor bar to point at the screen while playing the game, and pressing buttons still played an important role in it. Therefore, we did not think Wii game belonged to a real sense of gesture-based interaction. In the following main study, we still focus on Xbox as an example.

Another potential problem is that we did not want to interview people about Xbox game console. The main purpose is to draw this form of gesture-based interaction from the game. But when we talked about Xbox game console, the interviewees gushed on and on about their exciting experiences and feelings. When we put aside this game, they suddenly had less to say. We realized that a good interview was not depending on the participant but on the researcher. Therefore, we have to reduce the questions about Xbox console, divert their attention to gesture-based interaction and ask more their opinions about this form of interaction technology.

People usually adopt pilot study to find out potential problems of interview, but in our pilot study, two participants gave us very useful information about gesture-based interaction. So we decided to consider their opinions as a part of our following discussion.

## 3.2 Main study

We found an interview was quite suitable for collecting data and then we decided to use this method in following the main study. According to the results of pilot study, we made slight changes of questions. Then we chose six people as our interview options for collecting data, just as we did in pilot study. After collecting data, we analyzed the data and made discussions of the results of this studies.

### 3.2.1 Participants

The participants of this study consisted of individuals who are studying in different departments of Umeå University as international students. Three of them were male and three were female. They ranged in age from 22– 28 years old. They all have played Xbox360 game console. Here are their detail personal profiles as the following table:

No	Sex	Age	Country	Education background	Xbox game console experience
1	female	28	Bangladesh	Master in Marketing	Played it three times.
2	female	26	China	Master in Chemistry	Played it several times in her friend's house.

3	male	26	Russia	Master in Marketing	Played it for free in a electronic shop.
4	male	27	Turkey	Master in Physics	Played in his friend's house.
5	male	28	China	Master in Marketing	Played in an exhibition.
6	female	22	Swedish	Psychology	She has her own Xbox console

### 3.2.2 Questions

There are 13 questions. According to the interviewees' answers, some of questions were slightly changed. There is a certain sequence in our questions. Firstly we asked some facts before asking some controversial matters of people's feelings and opinions. Q1 to Q3 were starting close-ended questions about their experiences being user of Xbox game console. By this way, people can more easily engage in the interview. In the next part, the questions drew gesture-based interaction from Xbox game console and gave data about interviewees' feelings and opinions. From Q9, we talked about the future of gesture-based interaction technology. By comparing with traditional interaction, we asked participants about whether gesture-based interaction would be the trend or not. The last question was to encourage interviewees to provide any new ideas and plans on new applications field that they preferred to add.

After pilot study, we modified the wording of questions. Our final questions were neutral and open ended. We avoided wording that might influence answers, such as interesting, amazing, etc. Because the interviewees came from different countries, we made the wording clear to make sure everyone can understand the questions correctly. Besides, we cut down several "Why" question. Because we found that too many "Why" questions would make interviewees feel complex to answer and bother them easily.

## 4. Results

### 4.1 Pilot study

Although the main purpose of pilot study is finding out potential problems of our interview, the two participants still gave us very useful information about gesture-based interaction. Our first focus was to get idea about how often they used to spend on Xbox game console. In response of our inquiry the man told that he nearly played Xbox every day for a week after he got it. Then he just played it at the weekends. Later he never used it unless his friends came to play with him. The woman told us that her friend had Wii game and they often played it at weekend's party.

When we asked about whether they liked this form of game, both of them expressed their deep affection at the first time when they played it. It provided them totally new experience for entertainment. They felt great pleasure that other game tools could not offer, and playing with friends could also provide much more pleasure. When they immersed themselves totally in the game, they even forgot everything all around and time. But the man said it was very tiring to play it for a long time since it had very liked real sports and required the player to move the whole body.

Besides, they both said that if gesture-based interaction replaced traditional interaction, the world would become quite amazing, which was as the world as in a science fiction movie. The woman had great interest in imagining this situation. But the man considered that such kind of thing was not possible to come true. He said this form of interaction just could be complement of traditional interaction rather than replacement of it. Because he thought that gesture recognition was more difficult and tired to control than pressing keys.

### 4.2 Main study

In this project, we asked some questions (the most basic 13 questions, see appendix) to the participants using those questions as our starting point, tried to achieve a different understanding of gesture-based interaction technology. During the interview, the interviewees were not required to answer all those questions. Actually, we talked about some issues that we found interesting and challenging derived from these questions. The whole idea was great in many ways. Data collected through interview yielded the following research insights.

#### Feelings about Xbox game console

All the interviewees used the word “interesting” to describe this game. It provides them with very new experience for entertainment. The new way of experiencing game is so exciting. They all expressed their wonder and affection.

*Participant (man, P4) said: “It is amazing. I played for three hours at the first time. It is the finest game machine I have ever played.”*

*Participant (woman, P6) said: “I like doing exercises with my friends very much at sports center. Since I have had an Xbox game console I have not very often gone there. Now I can do various sports with my friends at home and also achieve the same enjoyment.”*

## Feelings about gesture-based interaction

When we came to this question, two female and one male participant simply expressed their ideas that they liked this form of interaction. They felt using gestures to control the computer was very cool and advanced. One participant (man, P3) said he did not like this form of interaction.

*Participant (man, P3) said: “ Although Xbox game console is very interesting, this kind of interactive mode does not touch anything, which makes the user felt very unreal as if not really in an operation. Actually, I prefer the feeling of touching the entity. ”*

The participant (woman, P2) did not give us an explicit answer. She had mixed feelings about this kind of interaction; it seems very amazing but not practical. The participant (man, P5) mentioned gesture-based computing, and gave us some useful and helpful information about it, which is his favorite one. Unfortunately he did not have any experience of using it, but he had read some news and articles from the website.

## Troubles of use

Four participants said that Xbox game console had a high accuracy and they had not ever met any big troubles when they were playing Xbox game. However, one participant (woman, P2) expressed some disappointment and she did not think that Xbox was a high level of accuracy interaction device. Therefore, she tried to explain the reason:

*Participant (woman, P2) said: “Sometimes when playing table tennis, I feel I received the ball, but it shows ‘fail’. Sometimes when playing multiplayer game with some friends, I or my friends unknowingly run out of the activity area, camera cannot detect me or my friends’ gestures or actions correctly, How disappointing!”*

Another participant (man, P4) told that he felt Xbox console was more difficult to operate than keyboard. Xbox console requires the user must focus his/her attention. For example when selecting an option of the game, the cursor on the screen needs to be kept on the little options for 2 seconds without moving the hand, the critical thing is that because of some inner or external factor, it is hard to keep the holding the hand in one point for 2 seconds without moving. So he thought that it was a little bit difficult to achieve some tasks by gesture-based interaction. Some participants had the common opinion that in this kind of interaction technology, the requirement of the users operation was much higher than pressing buttons.

## The trend of HCI (human computer interaction)

Every interviewee likes Xbox game console, but not everyone think this kind of interaction will be the trend of HCI. Four of them considered that it would be applied in many applications in our lives and become dominant gradually. One participant (woman, P1) told us her thoughts about the future trends of the new technology. She likes to read news and magazines regarding to future technology.

*Participant (woman, P1) said: “I always imagine our future life, such as we will be living in a virtual science fiction world, where everything around us is holding the high level of technique. For example the electrical house furniture is controlled automatically by using gesture or voice, instead of touching any*

*buttons and screen as well. Nowadays, according to the current high speed of developing science and technology, I believe that one day we will certainly enjoy such a life as science-fiction world.”*

But another participant (woman, P2) felt that it unlikely to come true. She said the traditional interaction was also good and had been accepted by people for a long time; people did not have any reason to change it. She told us that in the future it might be possible that various interactions would coexist and complement each other.

### **Comparison between gestured-based interaction and traditional interaction**

For this question, we spent a little bit longer time than others because of each interviewee had different ideas and different opinions. It was hard for us to come to one common idea. Most of them argued that just like “Each coin has two sides” both gesture-based interaction and traditional interaction have their own advantages and disadvantages. In the certain circumstances, for some person, the advantage of gesture-based interaction brings some inconvenient problem; therefore it is hard to judge that one is better than the other. All participants talked about their own opinions.

*Participant (woman, P1) said: “Comparing to keyboard, gesture-based interaction is more advanced, it allows me to reduce my time, and most interesting thing is that gesture-based interaction gives me real feeling like I can feel myself being in a real occasion when I play Xbox game. I think it would be awesome if traditional interaction can be replaced by gesture-based interaction.”*

Most interestingly that participant 2 is very optimistic and funny she told us her own experience of playing Xbox that:

*Participant (woman, P2) said: “I am a little bit lazy guy, do not like to do a lot of exercises, just from my point I still prefer doing operation with traditional interaction such as mouse. I can also enjoy the food while playing computer games; it seems like two birds with one stone.”*

In some cases, one’s advantages may become the other’s disadvantages, take a simple example, if we use keyboard, we just sit and can have a good rest, and therefore we are able to keep on working or playing for a long time, while gesture-based interaction makes the user getting tired very easily. So participant (woman, P2) said it was impossible that gesture-based interaction could replace traditional interaction.

### **Advantages of gesture-based interaction**

We have got some interesting and meaningful answers from the interviewees when we asked this question. Most people gave answers about getting much pleasure.

*Participant (woman, P1) said: “I would like to say that gesture-based interaction gives us a kind of reality feeling. The way we control computer is not just boring press action. It becomes much richness and more accord with our behavior.”*

*Participant (man, P3) said: “Because we don’t need to touch machine, so it is not easy to destroy machine.”*

*Participant (man, P4) said: “Every time when I play Xbox games with my friend, I forget almost everything all around me since the environment inside the Xbox is so attractive. This way brings me much pleasure.”*

### **Disadvantages of gesture-based interaction**

As we all know, everything has two sides, there is no perfect thing without any missing in the world. Two participants (man, P3 and man, P4) have the same idea that this kind of interaction makes the user feel exhausted easily since it is relatively large range of motion. This situation if being a problem depends on its future application. However, some interaction applications such as only needing to identify the gestures (just hand) do not make the user too tired.

*Participant (man, P4) said: “I can play other computer games for a whole day, but when I play Xbox, I get very easily tired within very few hours.....”*

A participant raised his point of view of the accuracy of this interaction.

*Participant (man, P5) said: “This kind of technology is not very high precision, but, with the development of the science and technology, I believe that the accuracy will be improved in the future, and then this kind of interaction will be applied more occasions.”*

Finally, we had a short discussion with some participants about this interaction approach how to be used by some disabled persons. Most of us argued that some disabled person might not conduct a certain operation as a normal person, but there would be some special design for them and help them to enjoy this kind of interaction technology.

### **Applications of gesture-based interaction**

As we all know everyone wants to pursue living a convenient life. Every participant expressed that it would be great to improve people’s lives by this technology. One participant (woman, P2) suggested this form of interaction can be used to help the deaf and mutes who communicate by sign language. People can design new device to translate sign language to voice in order to make normal people understand what they mean. Another participant (man, P4) said he had learned from internet that there was a new TV set which could be controlled by hand gesture of people sitting in the sofa. He thought it was a great idea and should be in widespread use.

## 5. Discussion

Our aim is to explore the advantages and disadvantages of gesture-based interaction compared with traditional interaction, and find implications for its practical usage in the future. There is no doubt that gesture-based interaction is an achievement of high technology in current society and the form of interaction is considered as the most natural based on embodied perspective (Dourish, P., 2004). But according to the data we collected, there is an argument about whether gesture-based interaction will replace the traditional interaction and become the trend of future. Most people cherish the feeling of affection and praise for this interaction. But there must be some reasons that it has not been applied widely in our daily life since it has been explored about thirty years ago. While getting our data from different participants, we got some viewpoints of gesture-based and traditional interaction. We will discuss it from the user experience based on the results of the interview.

### **Advantages:**

From our interview we can make a brief conclusion about gesture-based interaction technology. There is no doubt that most people like trying to use and enjoy new device. Based on the results of our interview, the advantages of the gesture-based interaction design have been highlighted as the following:

- It provides a simple, usable and interesting user interface and satisfies the need for more freedom in a human computer interaction environment.
- The expectations of the users, the cognitive and psychological design aspects of the gesture-based interaction technology are met perfectly and an easy to understand and use.
- It provides people new experience and great pleasure which traditional interaction could not offer. It makes the interaction between human and computer more natural. It has been illustrated in science fiction movies that this technology can improve people's lives if it is applied rightly.
- Based on the interviewees' feelings, the gesture-based interaction device e.g. Xbox console is an amazing new device, well worth of trying. While there are some shortcomings (no device would ever be perfect), it is truly an amazing device and quick access to every feature. We think that just about anyone would love it.
- It is considered as a powerful tool for computers to begin to understand human body language (Nearchou, A., 2011), thus building a richer bridge between machines and humans than primitive text user interfaces or graphical user interfaces (GUI), which still limit the majority of input to keyboard and mouse.
- It is widely used in various application areas since it gives the user a new experience of feeling. Related approaches that support gesture-based interaction have been developed in various application areas, such as sign language, navigation system, medical research, robot control, browsing, game applications, and augmented reality applications (Nearchou, A., 2011).

### **Disadvantage:**

Two participants (man, P3 and man, P4) said they felt very tired when they played Xbox games for long time. The main reason is obvious that using this interaction need user to do

various gestures. In traditional interaction, people just need to move hands or fingers slightly by keyboard or mouse. So people can spend the whole day sitting in front of computer, but it is impossible for them to do sports the whole day, even just gestures. However, in current society, people use computers to do almost everything and spend much time on it. Therefore, it is unrealistic that gesture-based interaction replaces the traditional interaction.

Besides, another reason made people tired is about the concept of presence (Benyon, D., 2010), which is also an important component of interaction. In Xbox game console, moving body provides user the real sense of sports, which requires a high level of attention. Therefore, according to our interview, gesture-based interactions produce and require a high degree of presence, much higher than the traditional interaction. One participant (woman, P2) said she can speak with others or eat food when she is surfing on the internet. But nobody can do anything else when they are playing Xbox games; actually they often forget everything around. In the other word, people must focus their attention on the interface when they use gesture interaction. One participant (man, P4) said he must stare the interface to make sure the cursor is on the option because he did not touch anything and his hand is always shaking slightly in the air. It is much difficult to control than mouse. Too much attention can also make people soon tired. Therefore, that is another reason that we think gesture-based interaction cannot replace the traditional interaction.

We noticed that gesture-based interaction should get visual input based on human intentional behaviors. However, the camera detects the user's every gesture and translates it into commands, including unintentional behaviors. For example, in Xbox game, the meaning of raising hand is to start the game. At that time if the user raises his hand to take off his hat, the system will detect it and translate it into starting command. It will make the user annoyed and become an unpleasant experience. A good interaction should not let the user follow a machine to do every gesture exactly. As far as we know, researchers have not solved the problem that how the machine recognizes the start and end points of useful gestures from continuous motion of the user's body.

In addition, one thing to be mentioned is that one participant (woman, P2) said "*I unknowingly run out of the activity area, camera cannot detect me. How disappointing!*" Vision-based interaction uses camera to get visual input, which offer users larger freedom than traditional interaction. People can do various actions without any chain. But using camera means there is a fan-shaped area of activity. If the user runs out of this area, he will be invisible to the camera. Actually the user does not know where the boundary is exactly. E.g. many people are taking a photo together, the outmost person does not know whether he is in sight of the camera or not. Therefore, in gesture-based interaction, the invisible boundary of activity area is a potential problem, especially for multiplayer or a wide range of action.





*Figure 3: the fan-shaped area of camera*

In summary, based on our results we argue that gesture-based interaction will not replace the traditional form of interaction. The biggest challenge for gesture-based interaction is the application. In the future, if it can be applied appropriately, it will be complement of the traditional interaction and very helpful to improve people's lives.

According to the discussion above, we recognized that gesture-based interaction provides the user positive experience. It is very amazing and interesting; so many users are very easily attracted. Besides, this kind of interaction is the process that computer recognizes the user's natural gestures to perform the relevant command rather than let the user follow the instruction or guides of the system to operate. Therefore, it can be used to design a simple user interface and satisfies the need for more convenience. However, the whole body recognition, long time manipulation and much attention could make people tired soon. Moreover, the invisible boundary of the camera sight is a potential problem which should be considered carefully. In the next section we give some implications for the future use of gesture-based interaction, based on our findings.

## 6. An general idea of new application

Although gesture-based interaction technology is used in many areas such as robot control, navigation system, medical research, it has not fully embedded into our daily life. Based on the results of interview and opinions we got from the participants in this study, we hope that this technology is more extensive used in our everyday life, and make it serve people better.

In today's society, one of the most popular electronic products is mobile phone. It is definitely occupying a top position in what technologies are imperious for human activities. Using mobile phones is a top priority for anyone living in the world, from young to old. Therefore, we want to combine gesture-based interaction technology and mobile phones, let this technology be better embedded into our daily life. Texting is the most basic function of the mobile phone; there are many ways of text messaging, however, efficiency is not very high, therefore, we want to apply gesture-based interaction technology to change the way of text messaging and improve efficiency.

Although Xbox game console and the phone we are going to design are completely different uses, both of them are using gestures interactive mode to operate related task. From the interview, we got a lot about advantages and disadvantages of gesture-based interaction technology used in Xbox console. In order to allow this technology to better serve the people, we need to address its some shortcomings; therefore, we consider that this interaction can be applied in a small and widely used device, mobile phone, and which can cover some shortcomings existing in Xbox game console application. The details are described in the following section.

### 6.1 Motivation

The traditional interaction mainly uses keyboard and mouse to perform text input. But for mobile phone or similar handheld devices, because of the limitation of keys' amount and size, the efficiency of text input is quite low. Usually one key contains more than three English alphabets. User needs to press a key several times to input one alphabet that he wants. Moreover, different language has different input methods, which make text input more difficult and complex.



*Figure 4: the traditional keyboard of mobile phone (image.google.com)*

Handwriting input on touch screen is a more natural form of interaction. It improves the rate of text input and solves some difficulties in inputting foreign words. But due to limited writing area, it is not convenient enough to operate. Therefore, we try to find out a more efficient way to perform text input on mobile phone by gesture-based interaction.

### 6.2 Prototype

In our design, we provide people with the same experience of handwriting input, but the writing area inspired by the PDA’s projected keyboard is transferred from a small screen to a table, i.e. the user have much bigger space to write. In the preceding section we fully recognized that gesture-based interaction technology can capture the movements of any part of body by camera. Therefore, we are thinking that camera of mobile phone could be used to perform text input by detecting and recognizing the tracks of user’s finger.

A small camera is embodied in the mobile phone. It projects a fan-shaped area on the desk where the movements of finger can be detected. According to the results of our discussion, for camera, the invisible boundary of sight is a potential problem. Therefore, in order to avoid the finger moving out of camera sight, there are two special micro-lights on each side of the camera, which project two visible light beams to set the boundary of writing area.

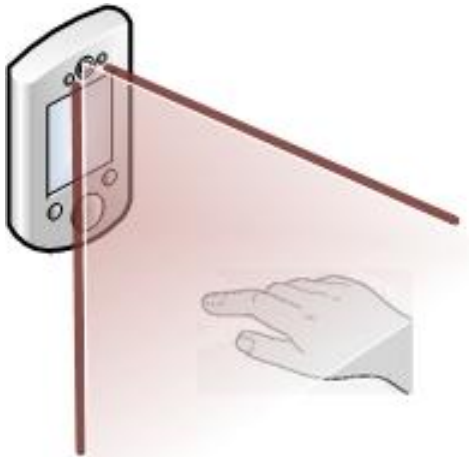


Figure 5: the new design on camera of mobile phone

The camera can detect the tracks of finger by gesture-based interaction technology. Then it recovers and recognizes the handwriting based on database of phone. In this way, there is not a limit to language. The phone can recognize different language, supported by powerful software. Finally, the result will appear on the screen. The general process looks like the following illustration.

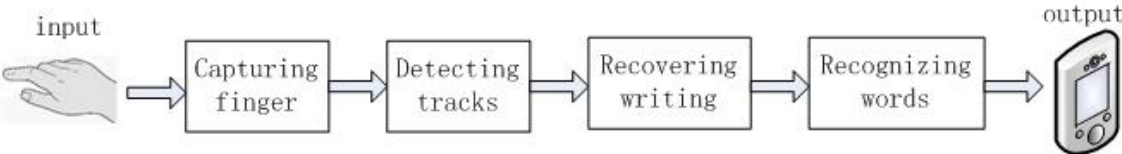


Figure 6: the flow chart of text input

### 6.3 Operational scenario

A supposed case: A user will use this special phone to perform text input. Firstly, there is a language option in the corner of the interface. User chooses English from them. Then he opens the micro-lights to know the writing area. After that, he can write with his finger on the desk in front of mobile phone, see figure 7. When he finishes a word and is about to the next one, he needs to raise his finger a second for disconnection. This action can avoid connections between words and improve the accuracy of the text. Then user press language option to change from English to Chinese and start to input Chinese. Besides, user can press the right key to cancel the last word. The screen will appear the words while writing. The illustration is seen as the following figure:

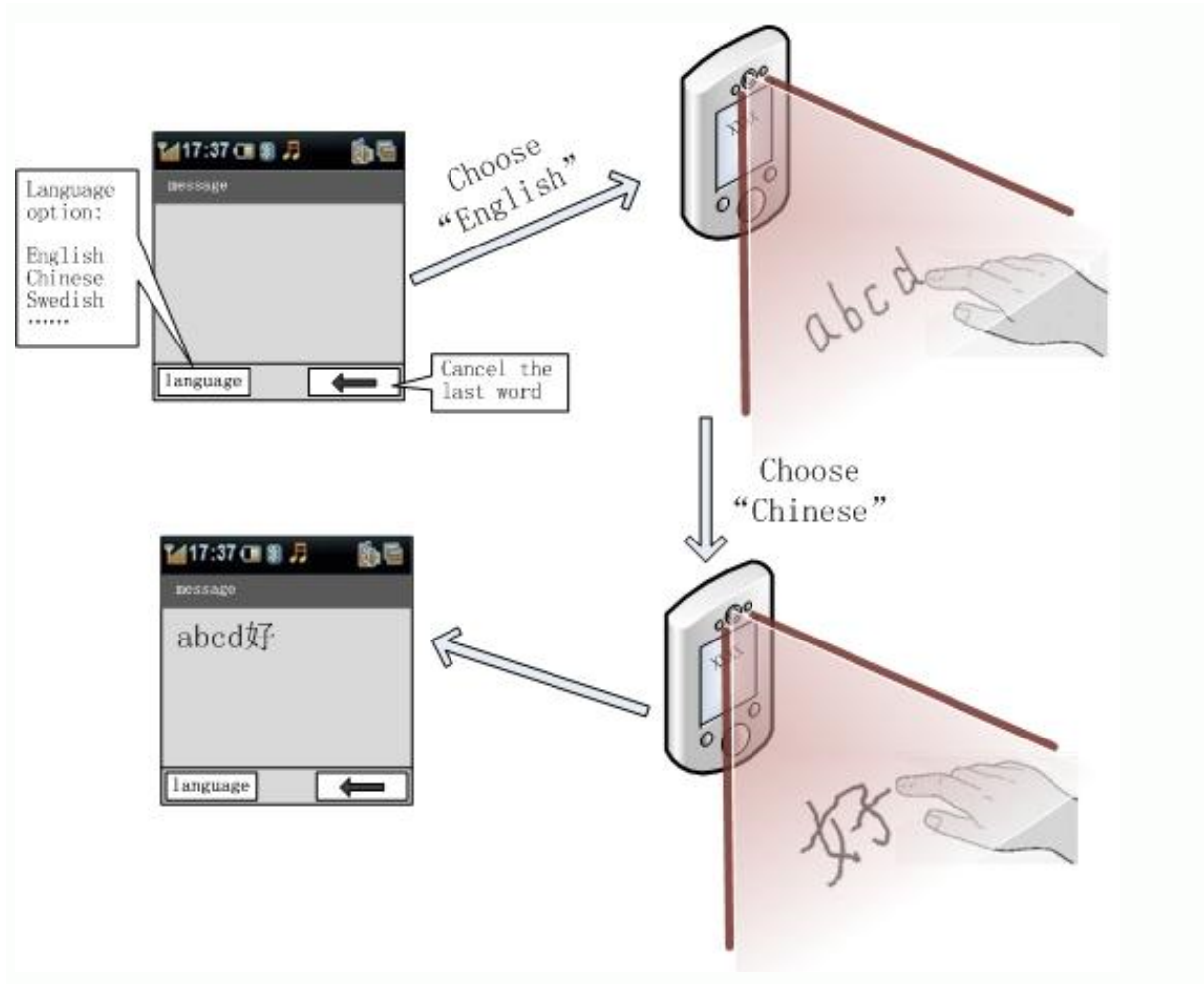


Figure7: the process of inputting "abcd好"

There are some advantages in this design. First of all, it replaces various input methods of different languages. Users have more freedom to input the foreign words which they would like to use. Secondly, mobile devices can be designed smaller size, but which can not affect the size of writing area. Thirdly, users do not need any writing tools, such as pen, keyboard, touch screen, etc. Finally, because users do not touch device, to some extent, it can protect devices from being dirty or destroyed.

## 6.4 Discussion

According to our interview, all of the participants are attracted by this form of gesture-based interaction; based on our findings we argue that gesture-based interaction could be widely used in our daily life. So we combined this technology with one of the most widely used electronic products- cell phone. It can support a simple and useful user interface, so we provide a new form of texting input. In our design, the user is allowed to choose any languages that they want to use by language options. The camera on the phone is able to detect the tracks of finger to perform the text input without complex input method.

In the interview, some participants argued that they got very tired easily when playing Xbox game console with a whole body for a long time. In our design, the user is just required to use his or her one finger to operate, which does not need to take much time. So the user will not get tired soon.

Regarding to the problem of invisible boundary of the camera sight, we designed two special micro-lights on each side of the camera, which project two visible light beams to set the boundary. In this case, the user can avoid to running out of the writing area. Besides, in the whole process of texting input, there will be less unintentional behaviors.

## 7. Conclusion

This research was motivated by a commercialized product of gesture-based interaction technology, Xbox360 game console. As an advance technology, gesture-based interaction has been applied successfully in game industry and paid more and more attention. But the traditional interaction has existed for a long time and continued to be dominant. We collected the data from several people by interview method and discussed advantages and disadvantage of gesture-based interactions. It provides people new experience and great pleasure which traditional interaction could not offer. It makes the interaction between human and computer more natural. It has been illustrated in science fiction movies that this technology can improve people's lives if it is applied rightly. But there are still some disadvantages which may bring troubles and make users dissatisfied. Hours of use make users tired soon. Machines cannot distinguish between intentional behaviors and unintentional behaviors. Because of the invisible boundary existed , which cannot be seen , the user is very easily running out of the boundary, as a result, the camera fixed on the device cannot detect the user's actions, so there is no any reactions on the system.

Therefore, we can make a conclusion that gesture-based interaction will be complement of the traditional interaction rather than replacement of it in the future. Besides, in order to find implications for practical usage in the future, this paper presented a new design of performing text input on mobile phone by gesture-based interaction. Reviewing the development of gesture-based interaction technology, there will be a huge potential in the future.

## **8. Acknowledgement**

Firstly, we are deeply indebted to our supervisor Karin Danielsson Öberg from informatics department in Umea University, whose kindly guidance, stimulating suggestions and encouragement helped us in all the time of doing our project and writing of this thesis. She not only provided us with a good advice but also provided valuable information and materials, which gave us a huge help. Besides, we gained a lot of knowledge and new ideas from our each meeting which held once a week. Thank you!

Secondly, we would like to acknowledge and extend our heartfelt gratitude to all those who actively involved in our interview and shared their personal experiences, gave us help, support, interests and valuable hints to complete this thesis.

Thirdly, we would like to extend our sincere gratitude to Umea university library for the use of its resources, such as online databases.

Finally, both of us also would like to say many thanks to each other. In the process of writing this paper, we had a good co-operation. We solved problems together, overcame the difficulties together we encountered. We felt extremely happy to work together.

## References

- Benyon, D. (2010). *Designing Interactive Systems*. Second edition.
- Bhuiyan, M. & Picking, R. (2009). Gesture-controlled user interfaces, what have we done and what's next?, *Proceedings of the Fifth Collaborative Research Symposium on Security, E-Learning, Internet and Networking (SEIN 2009)*, Darmstadt, Germany, 26-27 November 2009, pp59-60.
- Derpanis, K.G. (2004). A Review of Vision-Based Hand Gestures. Unpublished, internal report. Department of Computer Science, York University. February 12, 2004
- Dobler, S., (2000). Speech recognition technology for mobile phones. First published in Ericsson Review no. 03,2000
- Dourish, P. (2004). Where the action is: the foundations of embodied interaction. *Cambridge, Mass: MIT Press: 2004: x, 233 s. ISBN: 0-262-54178-5.*
- Garg, P. & Aggarwal, N, & Sofat, S. (2009). Vision Based Hand Gesture Recognition. *World Academy of Science, Engineering and Technology 49.*
- Hassenzahl, M. (2008) User Experience (UX): Towards an experiential perspective on product quality, IHM '08: *Proceedings of the 20th International Conference of the Association Francophone d'Interaction Homme-Machine.*
- Kurtenbach & Hulteen (1990). Chapter 14: GESTURE BASED INTERACTION <http://www.billbuxton.com/input14.Gesture.pdf>
- Lee, S. & Henderson, V. & Hamilton, H. & Starner, T. & Brashear, H. (2005): A Gesture-Based American Sign Language (ASL) Game for Deaf Children.
- Nearchou, A., (2011). Innovative gesture-based interaction. B. Sc. Computer Science.
- Nunez, D. & Blake, E. H. (2001). Cognitive presence as a unified concept of virtual reality effectiveness. *UCT Technical Report CS01-11-00.*
- Oskoei, M. A. & Huosheng Hu. (2009). Application of Feature Tracking in a Vision Based Human Machine Interface for XBOX. *Proceedings of the 2009 IEEE International Conference on Robotics and Biomimetics* December 19 -23, 2009, Guilin, Chin.
- Poddar, I. & Sethi, Y. & Ozyildiz, E. & Sharma, R. (1998). Toward Natural Gesture/Speech HCI: A Case Study of Weather Narration. *Proceedings of 1998 Workshop on Perceptual User Interfaces.*
- R.van Teijlingen, E. & Hundley, V. (2002). The importance of pilot studies. Published by Department of Sociology of Surry Guildford GU25XH United Kingdom, social research update. ISSN: 1360-7898.
- Teixeira, J. M. & Farias, T. & Moura, G. & Lima, J. & Pessoa, S. & Teichrieb, V. (2006). Gefighters: an experiment for gesture-based interaction analysis in a fighting game. In *SBGames* (Brazil).
- Valenzuela D. & Shrivastava P. (2002). Interview as a Method of Qualitative Research. Bryman: Social Research Methods, *Oxford University Press.*
- Westeyn, T. & Brashear, H. & Atrash, A. & Starner, T. (2003). Georgia Tech Gesture Toolkit:



Supporting experiments in gesture recognition. *Published in the International Conference on Perceptive and Multimodal User Interfaces.*

## **Website**

Embodied Interaction, (2010). Available: [http://wiki.csisdmsz.ul.ie/wiki/Embodied\\_Interaction](http://wiki.csisdmsz.ul.ie/wiki/Embodied_Interaction) (Accessed 8th June, 2011).

Kinect sports-the new motion sports ever made, Available: <http://www.buy-cheap-video-games.us/kinect-sports-the-new-motion-sports-evermade/> (Accessed 25th April, 2011).

## APPENDIX

Here are the questions which we have used as guideline during our interview: According to the participants' answers, these questions were slightly changed.

We only interviewed people who had played Xbox360 or knew this form of interaction at least. Therefore we chose the participants in advance and made appointments with them. The questions are following:

1. Do you like playing games? Do you like games on the real world or games on the network?
2. You know, Xbox is different from traditional computer games. Have you ever played Xbox360 game or just heard about it? When?
3. If you have Xbox game, how many hours a week do you spend on it currently?
4. What do you think about Xbox, compared with other game consoles?
5. Which aspect do you like best about it?.....(If participants don't mention gesture interaction) How about this gesture-based interaction?
6. Do you like this form of interaction, using gesture to control computer?
7. Have you ever met any trouble when you were playing Xbox? Is it because you are dissatisfied with this form of interaction or the level of technical is low?
8. Is there any disadvantage about this form of interaction?.....(If so) Do you have any solution? Or do you think it will be solved in the future?
9. In science fiction film, we often see people using this gesture interaction. Do you think gesture-based interaction will be the trend of HCI or unrealistic? Why?
10. If gesture interaction is the trend, does it mean keyboard is outdated? Can gestured-based interaction replace traditional interaction?.....If not, which advantage do keyboard have that gesture interaction cannot offer?
11. Compared with traditional interaction, as a more advanced interaction, gesture interaction must have its own greatest advantage. Do you think what it is?
12. If gesture-based interaction is applied in many aspects of our daily life, what do you think?
13. If so, do you have any suggestion about application?