OULU UNIVERSITY OF
APPLIED SCIENCES

Hung Nguyen

HUMAN COMPUTER INTERACTION IN GAME DESIGN

HUMAN COMPUTER INTERACTION IN GAME DESIGN

Hung Nguyen
Bachelor's Thesis
Spring 2012
Business Information Technology
Oulu University of Applied Sciences

ABSTRACT

Oulu University of Applied Sciences
Business Information Technology

Author: Hung Nguyen
Title of Bachelor's Thesis: Human Computer Interaction in Game Design
Supervisor: Ilkka Mikkonen
Term and year of completion: Spring 2012 Number of pages: 75

Computer and Video Games are one of the most popular and the most important products of the software industry. One of the greatest contributors to this success is the rapid improvement of technologies. However, the Game Development processes still have to face some difficulties. In fact, the lack of guidelines and theoretical foundations are the major causes for most of Game Designers need to bring their own experiences and intuitions into the Game Design. Therefore, it is essential to increase the involvement of the Human Computer Interaction (or HCI) knowledge in the processes of designing games.

The Thesis's intention was presenting the overview of HCI and Game Design in many aspects; the relationship between HCI and computer game, and the discussion of how HCI's processes and methodologies have been used in Game Design. In addition, the Thesis work followed the qualitative approach. Information was summarized and collected from a variety of published sources.

The Thesis result concluded with there is a weak link between the HCI and the Game Design. For the reason, the idea of bringing HCI in the Game Design process is a new concept. Moreover, the Thesis also pointed out the important roles of the Heuristics in the Game Usability inspection, since Game Heuristics have the potential to improve the Game Design process.

Keywords: Human Computer Interaction, Game Design, User Interface, Game Usability

CONTENTS

FOREWORD

The Thesis was a research about an application of Human Computer Interaction study in Game Design. As the needs of consumers in the game industry rise every year, technologies have also improved rapidly in order to keep up with new standards. However, Game Designers still struggle with their own problems which are the processes to decide what games should be, and how to make them better.

The idea for this topic came from one of the course that I had a chance to study during my second year (User Interface Design). During this course, I had made user testing plans for a new game and the result was not as expected from the product, since most of the users did not satisfy with how the game was played. At that moment, it came to me that the process of designing a game is very important. Although it is such a decisive step, many game companies have taken it lightly, or have had trouble with it. The lacking of theoretical foundation and limitation of data are the main reasons for the failure of computer and video games in the market; they have proven the needs of reliable sources for Game Designer to use.

Consequently, this Thesis was made solely for the purpose of collecting and summarizing data from other researches. The following contents will give the readers a better understanding about how human can interact with systems, what Game Design is and how to apply this knowledge in Game Design process.

1 INTRODUCTION

The 21st century has been a witness to a great improvement in game industry. Computer and video games have become one of the fastest growing and most economically successful kinds of software. The worldwide market for these games, interactive entertainment hardware and software is expected to grow rapidly. In the US alone, retail sales of video game, hardware, software and accessories grew annually 10% in the last few years (RocResearch 2004). In addition, the industry continues to grow at an incredible rate, bringing in more than $10 billion in revenue in 2009. What even more surprising is that only $500 million of that came from computer game sales; the majority of gamers in 2009 were still spending their money on traditional consoles and accessories (Jackson 2011). Furthermore, Jackson also wrote in his article (Video Game Industry Statistics): “The point, though, is that even my stepfather, a man who otherwise spends every waking hour in the office or on his boat, has played video games. Who hasn't?”

There are many elements which have contributed to those achievements in the game industry. The one that should be mentioned is the development of technologies. However, while technologies have been improved rapidly, Game Design has evolved slowly. In fact, according to Zaphiris and Ang, many Game Designers face the fact that creating a game which can be easily learned, effectively played, and enjoyed is the real challenge. Since the limitation of data, and the lack of theoretical foundation in Game Design, most of games have been developed based solely on own experiences and intuitions of the Designer. As the result, about 80% of games fail on the market every year. (Game Software Industry Report in AlienBrain product catalog. NxN software. 2001)

On the other hand, the Human Computer Interaction (or HCI) has been a focusing topic for the past few years. HCI is the combination of Computer Science, Sociology, Anthropology, Ergonomics, Psychology, and Linguistics (Hewet et al. 2009, 8); in simple terms, it studies how human interacts with systems. The reason why it is an interesting field is because its innovative ideas and methodologies have solved a number of problems in software industries; while some of those are related to Game Design (e.g. HCI provides recommendations for User Interface Design such as menus, icons, forms, etc.). According to Zaphiris and Ang, although the application of HCI in Game Design process is still a new idea, it has been proved that once it is learned and used by a

Game Designer, HCI's processes, and methodologies can improve the playing experiences for the user in computer and video games. In addition, some of the relevant works and studies of Game Design have been conducted with the involvement of HCI. An example of this statement is the research of game technologies in 3D aspects (Zhou et. al. 2004) to enhance engagement and immersion in game playing.

1.1 Research questions and methods

The Thesis is made completed with the intent to introduce an overview of Human Computer Interaction (HCI) in many aspects (the concept, the foundation and the principles of visual design); the relationship between HCI and computer game, and the discussion of how to use HCI's processes and methodologies in Game User Interface Design. Therefore, the main issues will be based on these following questions: What is HCI? Why is HCI an importance element in Computer Science field? How does HCI expand its involvement within the development of the computer game industries during the past decades? Finally, why is it so necessary to use HCI in Game Design?

Consequently, this study consists of three main parts: the first two parts constitute an introduction of the Human Computer Interaction and the Game Design, and then the final part is about how to utilize the knowledge of Human Computer Interaction in Game Designing process. The information will be collected in order to write these chapters in the manner of summarizing what had been written or developed. Thus, there is no development task will take part in this Thesis.

1.2 The structure of the Thesis work

As mentioned in the previous part (1.1), this Thesis will be divided into three main parts. The first and second parts are used to introduce to the readers what Human Computer Interaction and Game Design is. However, the contents of these parts are only limited to an introductory level, since its main purpose is to provide the readers with an overview knowledge of what these terms mean and their importance which is contributed in the final part of this Thesis (the applications of Human Computer Interaction in Game Design). The content will be broken down into many different elements, and their relationships to each other are presented as in the following figure (figure 1).

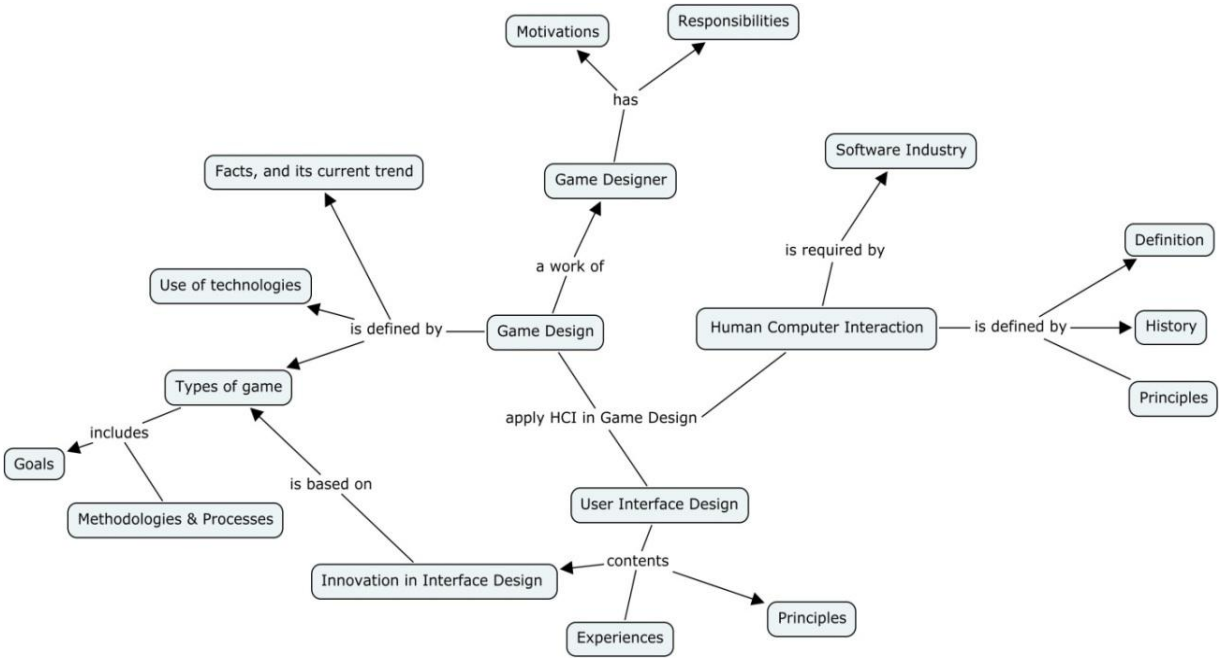

FIGURE 1. The main elements of the study.

The first chapter deals with the Human Computer Interaction. It includes three main elements to be discussed which are the fields of study in HCI, the foundations of HCI and the HCI's design principles. The Human Computer Interaction is a combination of many fields; each of them has a unique characteristic which will be discussed separately. Additionally, the three fundamental components of an interactive system will be introduced: the human, the computer and the interaction. The final section of this chapter will define the purpose of visual design in HCI, and from that to generate a set of visual design steps and design's principles. These steps are viewed as an effective way to respond to the human problems in designing a user interface, while these principles provide possible enhancement for the quality of the final product.

The second part is the Game Design chapter. For that, I will present important information about games. Firstly, the culture of games will reveal the roles of games in the past, and also in the present. These roles will be formed into different game genres in next section of this chapter. Secondly, a list of the popular game genres is chosen and is mentioned along with their goals and methods of interaction. Thirdly, in order to create a better experience for the player, there is a necessity for the principles of Game Design. They can also be viewed as guidelines for the Designers to improve their skills. The final section of this chapter is about the Game Designer. A

brief description of the Game Designers includes their roles and skills will be the main contents of this section.

The third part (chapter 4) will be a discussion about the role of the Human Computer Interaction (HCI) which has contributed to the Game Design process. Some of the HCI's issues will be pointed out at the beginning of this chapter. Furthermore, the game interface design processes will also be presented as one of the application of HCI. And in order to improve the usability of the game interfaces, it is essential to use the HCI evaluation techniques. The Heuristic Evaluation will be their representative, since it is designed specifically for games. By understanding these Game Heuristics, the Game Design processes can be improved significantly. The last section of this chapter will be a case study; I will use the Game Heuristics to evaluate the usability of a popular game.

2 HUMAN COMPUTER INTERACTION

Nowadays, when an enormous number of computer-based systems exist, the human activities are being computer mediated. Commonly, in designing the interfaces to those systems, the Human Computer Interaction is left behind without consideration. It might be the case where people do not really understand what Human Computer Interaction is, and thus its important role in the Computer Science field. This chapter will, respectively, introduce the Human Computer Interaction (in short HCI)'s theoretical foundations: the definition, the field of HCI and the foundations of HCI. What more are general principles of visual design in HCI will also be reviewed.

The term Human Computer Interaction or Interactive System Design is well known in Computer Science during the past three decades, for the reason, it is designed to make things can be easier to accomplish with the computer. Daily used technologies such as a computer mouse; a touch screen mobile phone; a program on a Mac or Windows machine that includes a trashcan, icons of applications and folders, and a pull down menus in a webpage; they all have the same thing in common -- a mean of communication between human and computers.

Moreover, the study of Human Computer Interaction is one of sub-disciplines of Computer Science. The term Human Computer Interaction (or HCI) was adopted in the mid-1980s as a mean of describing and acknowledgement that the focus of interest is broader than just design of the interface and is concerned with all those aspects that relate to the interaction between users and computers. Although there is still no official definition, the following definition was used to indicate HCI as "a set of processes, dialogues, and actions through which a human user employs and interacts with a computer" (Baecker and Buxton 1987, 40). In addition, a more recent definition has given HCI more broader characterization: "Human Computer Interaction is a discipline concerned with the design, evaluation and implementation of interactive computer systems for human use and with the study of major phenomena surrounding them." (Preece, J. et al. 1999, 7)

The interaction with computers has come a long way since punched cards and binary codes; a User Interface (UI) of Human Computer Interfaces is presently how a human interacts with systems. There is not only expert users can use computer these day but also the average users. It

means that the majority of the population in the developed world now encounters computer applications as part of their daily routine; in the market, embedded in domestic products, in school, at work. Therefore, HCI helps with designing screens and menus that are easier to use; "it studies the reasoning behind building a specific functionality; long- term effects that systems will have on humans." In general, the developers of computer systems now have to deliver beneficial services to the user, and more importantly deliver them in a usable way. (Hewet et. al. 2009, p.5)

Furthermore, as a part of the HCI study, the Human Computer Interface can be described as the point of communication between a user and a computer. The flow of information between the human and computer is defined as a loop of interaction (figure 2). This loop of interaction has several aspects to its content. (Singh, G. et al.)

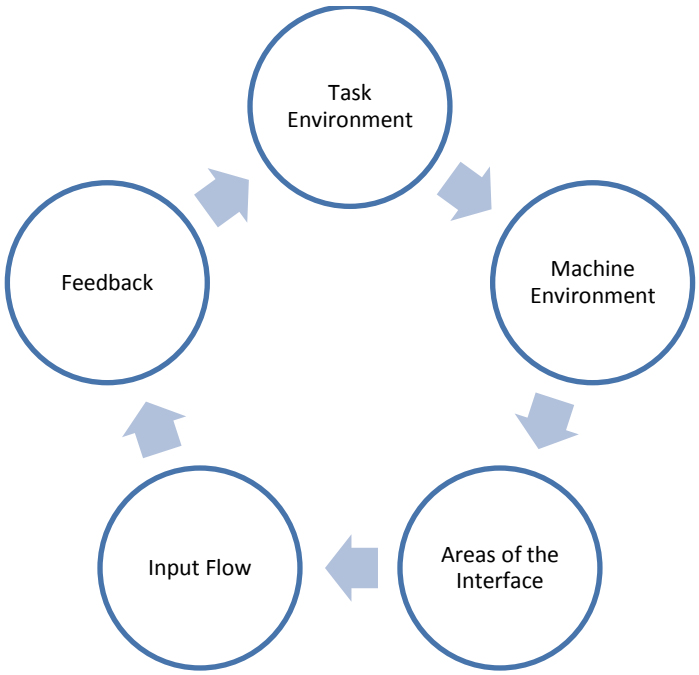

FIGURE 2. The HCI's Loop of Interaction

According to the above figure, the HCI's Loop of Interaction begins at the **Task Environment** and the **Machine Environment**. The **Task Environment** includes the conditions and goals which set upon the user, while **Machine Environment** is the environment that the computer is connected to. For instance, a laptop is connected in a college student's dorm room. Additionally, in order for the user to communicate with the computer, a point of interaction is required. It locates in **Areas of the Interface**. By definition, it is "the non-overlapping areas involve processes of the human

and computer, and not pertaining to their interaction. Meanwhile, the overlapping areas only concern themselves with the processes pertaining to their interaction." (Singh, G. et al.)

Finally, the communication between the user and the computer is defined by the flow of information between an input data and an output result, or vice versa. First of all, **Input Flow** is the flow of information that begins in the task environment, when the user has some task that requires using his or her computer. Secondly, **Output** is the flow of information that originates in the machine environment. More importantly, it is essential for every communication to have a **Feedback** which will loop through the interface that evaluates, moderates, and confirms processes as it pass from the human through the interface to the computer and back. To simplify, feedback provides the users with their action's status when interacting with the systems. (Singh, G. et al.)

2.1 The field of HCI

To outsiders, the Human Computer Interaction may simply provide recommendations for the User Interface/ Human Computer Interface design such as menus, icons, forms, data display and entry screens; however, it requires a sufficient amount of knowledge. A recent research has shown that HCI is actually a multidisciplinary field (figure 3). "The ideal designer of an interactive system would have expertise in a range of topics, since it is not possible to design effective interactive system from one discipline in isolation." (Dix, A. et al. 2004)

FIGURE 3. The field of Human Computer Interaction (Nanni 2004)

Computer Science: The discipline of computing is the systematic study of algorithmic processes that describe and transformation information: their theory, analysis, design, efficiency, implementation and application. The fundamental question underlying all of computer is: "what can be efficiently automated?" (Denning et al. 1989, 12)

Sociology and **Anthropology** show interactions between technologies and human systems. Thus, the reason of applying social science method of analysis to HCI is for a more accurate description of "the interactions between users, their works and the technologies that they use and the environment in which they are situated can be obtained." (Preece, J. et al. 1999, 41)

Ergonomics or human factor's purposes are to define and design tools and various artifacts for different works, leisure and domestic environments to suit the capacities and capabilities of every user. The objective is to maximize a user's safety, efficiency and reliability of performance, to make a task easier, and to increase feelings of comfort and satisfaction. Moreover, in HCI, ergonomics concern any kinds of hardware design or software design that may have adverse physiological effects on the human such as readability of information on visual display units. (Preece, J. et al. 1999, 40)

Psychology is concerned primarily with understanding human behavior and the mental process that cause it. To account for human behavior, cognitive psychology has adopted the notion of information processing. That includes everything the human see, feel, taste, touch, smell and do, and it is couched in terms of information processing. The objective of cognitive psychology has been to characterize these processes in terms of their capabilities and limitations. (Preece, J. et al. 1999, 39)

Linguistics is "the scientific study of language" (Lyon 1970). From the point of view of HCI, there are several issues that may be better understood by applying knowledge and theories from linguistics. For example, in the early days of command languages, there were some debates about whether or not the object to which a command applied should come before or after the command itself. Within HCI itself, understanding the structure (syntax) and meaning (semantics) is important in developing natural language interfaces, and more recently conversational analysis,

which is being used to understand how the users interact with computers in natural environment. (Preece, J. et al. 1999, 40)

Engineering is an applied science which relies heavily on model building and empirical testing. Therefore, it essentially takes the findings of science and utilizes them in the production of artifacts. (Preece, J. et al. 1999, 42)

Design contributes creative skills and knowledge. It is a well-established discipline in its own right which has potential benefits when applied to HCI problems. The development of HCI as a field of study and partly the increasing in interest and involvement of graphic design such as screen design has meant that professional graphic design has gained importance in computer system design. (Preece, J. et al. 1999, 42)

2.2 Foundation of Human Computer Interaction

In this chapter, the fundamental components of an interactive system will be introduced including the human user, the computer system and the nature of the interactive process. At first, the Human sub-chapter is the about the psychological and physiological attributes of the user, which provides with a basic overview of the capabilities and limitations that affect the user ability to use computer system. It is necessary to have an understanding of the user at this level so that we can understand what makes for successful designs. Next is the Computer sub-chapter, it considers the computer in a similar way to the Human sub-chapter. Input and output devices are described and explained and the effect that their individual characteristics have on the interaction between the user and the machine. After the approached interaction from both the human and the computer side, it is essential to turn the attention to the dialog between them. Therefore in the Interaction sub-chapter, we will take a look at different models of interaction.

2.2.1 The Human

In Computer Science view, Humans are seen to be limited by their capacity to process information. It is known that information can be received and responses given via a number of input and output channels: visual channels, auditory channels, haptic channels and movements. Once a human is given with information, he or she will use some abilities to process and apply, and

such skills are reasoning, problem solving and acquisition skills. After information is processed, it is stored in the human's memory. Although the common of humans share the same capacities when dealing with information, some individuals are different. These have important implications for system design (figure 4). (Dix, A. et al. 2004)

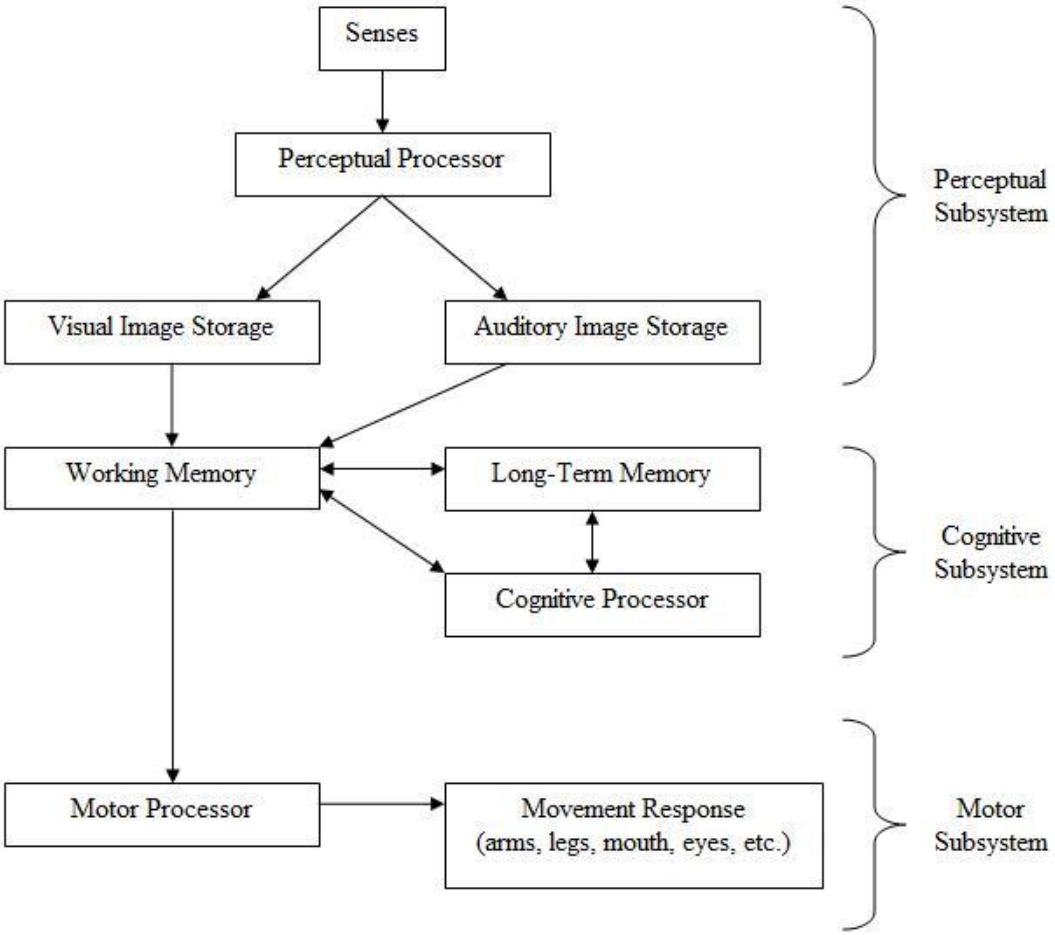

FIGURE 4. Human Process Model (Card, S.K. et al. 1983)

In addition, an interaction between a person and computer is proceeded by chained activities which starts from the user receives information that is output by the computer, and responds by providing input to the computer. The input in human can come through many different senses, but mostly occur in five major senses: sight, hearing, touch, taste and smell. Among these, the first three are the most important to HCI's study. Although taste and smell currently do not hold any significant roles in HCI, vision, hearing and touch are central in designing computer systems. (Dix, A. et al. 2004, 12)

For the main purpose of this Thesis, which is about the visual application of HCI in Game Design, therefore, only the sense of sight is chosen for the following discussion. In fact, sight is the most important of human's sense, and User Interfaces are largely dependent on visual information they produce. The human vision is a highly complex activity with a range of physical and perceptual limitations, and yet it is the primary source of information for the average person. Vision begins with light; the eye is a mechanism for receiving light which is reflected from objects in the surrounding environment. Understanding the important of vision, nevertheless, does not stop at explaining the physical mechanism but the visual perception is more than this. The visual perception can possibly be divided into two stages: the physical reception of the stimulus from the outside world, and the processing and interpretation of that stimulus. Additionally, there are three important aspects in visual perception that should be taken into account in practical design. (Dix, A. et al. 2004, 14)

First of all, **Perceiving size and depth**, according to the law of size constancy, are related to each other. By assuming looking from the hilltop view, there are a number of cues, which can be determined by which can use to determine the relative positions and distances of the objects. If these objects overlap, the object that is partially covered is perceived to be in the background, and therefore further away. Similarly, the size and height of the object in the human field of view provides a cue to its distance. A third cue is familiarity: if a human expects an object to be of a certain size then he or she can judge its distance accordingly. Consequently, the perception of size and depth are one of the most important elements in 2D and 3D designs. (Visual Perception, date of retrieval 21.12.2011)

Second of all, **Perceiving brightness** is, in fact, a subjective reaction to level of light. It is affected by luminance, which is the amount of light can emitted by an object. The luminance of an object is dependent on the amount of light falling on the object's surface and its reflective prosperities. What is more, contrast relates to luminance: it is a function of the luminance of an object and the luminance of its background. In the nutshell, visual acuity increases with increased luminance. For example, in gameplay, an interactive object is always brighter than other objects for it is easier to be found by the player. (Visual Perception, date of retrieval 21.12.2011)

A third factor that needs to consider is the **Perception of color**. Color is usually regarded as being made up of three components: **Hue** is determined by the spectral wavelength of the light in which blue has short wavelength; green has medium and red has long wavelength. Approximate-

ly 150 different hues can be discriminated by the average person. In addition, **Intensity** is the brightness of the color. In the RGB color model, the amplitudes of red, green, and blue for a particular color can each range from 0 to 100 percent of full brilliance. These levels are represented by the range of decimal numbers from 0 to 255, or hexadecimal numbers from 00 to FF. And lastly, **Saturation** is the amount of whiteness in the colors. It expresses the relative bandwidth of the visible output from a light source. As saturation increases, colors appear more "pure." As saturation decreases, colors appear more "washed-out." (Visual Perception, date of retrieval 21.12.2011)

The eye perceives color because the cones are sensitive to light of different wavelengths. There are three different types of cone, each sensitive to a different color (blue, green and red). By combining these primary colors, secondary color will be created; they are known with the term “color wheel” in visual design. It is also important to point out that the use of colors in designing is the most vital element and the most difficult to apply, since the capabilities and limitations of visual processing in considering the way in which the humans perceive images they have already encountered some of the capabilities and limitations of their visual processing system. (Visual Perception, date of retrieval 21.12.2011)

Furthermore, the Gestalt Laws of Perceptual explain there is a need for interpreting observation besides sensing light and movement through human vision. Accordingly, Gestalt Laws define how a human groups different shapes while observing them which are essential for User Interface (UI) design (Tuck 2010, date of retrieval 9.2.2012):

The Law of proximity posits that when humans perceive a collection of objects, they will see objects close to each other as forming a group (figure 5).

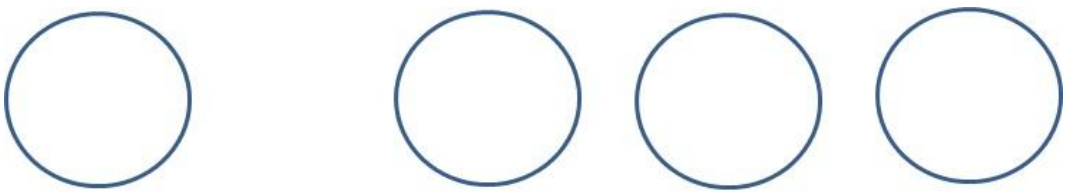

FIGURE 5. Law of proximity (Tuck 2010, date of retrieval 9.2.2012)

The Law of similarity captures the idea that elements will be grouped perceptually if they are similar to each other (figure 6).

FIGURE 6. Law of similarity (Tuck 2010, date of retrieval 9.2.2012)

The Law of connections points that objects that are connected are observed as grouped (figure 7).

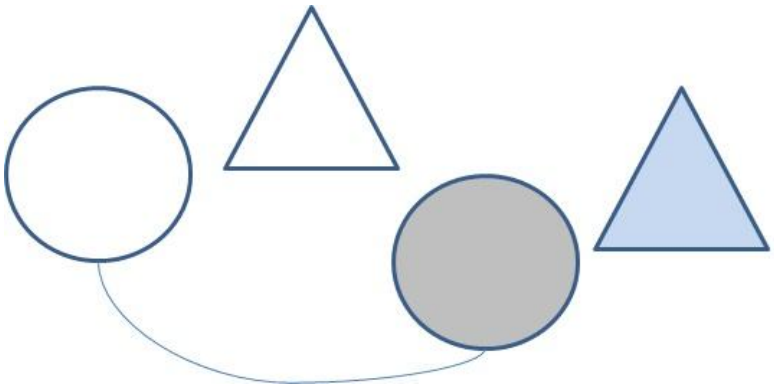

FIGURE 7. Law of connections (Tuck 2010, date of retrieval 9.2.2012)

The Law of closure posits that perceptually close up, or complete, objects will be viewed as a group through the human's vision. (figure 8).

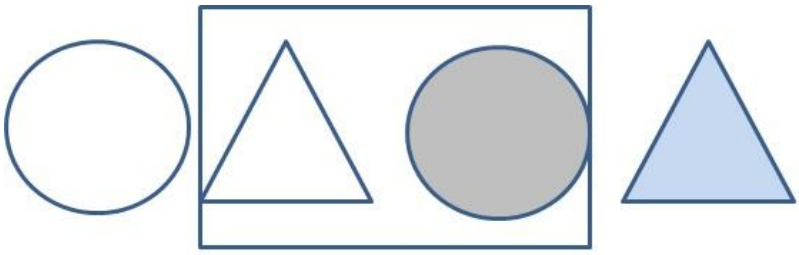

FIGURE 8. Law of closure (Tuck 2010, date of retrieval 9.2.2012)

2.2.2 The Computer

When users interact with computers, they are either passing information to other people, or receiving information from them. Therefore, in term of the computer science, interaction is a process of information transfer, from the user to the computer and from the computer to the user. A computer system comprises various elements, each of which affects differently to the user of the system. Among those components, there are two important mechanisms which are widely applied in every computer systems. (Dix, A. et al. 2004, 59)

The first component is input devices. Input is concerned with recording and entering data into the computer system and issuing instruction to the computer. In order to interact with computer systems effectively, users must be able to communicate their intentions in such a way that the machine can interpret them, and input devices are used to serve for that purpose. In general, an input device is any peripheral used to provide data and control signals to an information processing system such as a computer. They are for interactive uses which allow text entry, drawing and selection from the screen. Depending on purpose of usages, there are traditional keyboard, speech, handwriting recognition, mouse, touchpad, and the most recently developed-- 3D interaction devices. (Dix, A. et al. 2004, 59)

One of the key aims in selecting an input device and deciding how it will be used to control events in the system is to help users to carry out their work safely, effectively, and efficiently. In another word, the choice of input device should contribute as positively as possible to the usability of the system. Generally, the most appropriate input device will be the one that, firstly, matches the physiological and psychological characteristics of users, their training and their expertise. For example, inexperience user may be unfamiliar with keyboard layout. Secondly, it should be appropriated for the tasks that are to be performed. An example is a graphical tablet that allows a drawing task which requires continuous movement. And thirdly, it needs to be suitable for the intended work and environment. For instance, speech input devices are useful when keyboard is not available, but it becomes unsuitable when used in noisy conditions. (Preece, J. et al. 1999, 212)

Output display devices are the second component. They are used when converting information coming from an electronic, internal representation in a computer system into some form perceptible by a human. Until recently, the most common form of output was visual and two dimensional (2D); it was presented on a screen or as hard copy from a printer. However, recently, various new trends and possibilities in the managing of output have started to evolve (Preece, J. et al. 1999, 238-239):

- Graphical user interfaces (GUI) and multi-window systems have become common-place.
- Output devices that can fit in laptop and pocket computer (e.g. Ipad) are become commonplace.
- Vision, moving pictures, sound and, touch are being combined in hypermedia system.
- Various forms of three dimensional (3D) outputs are also available for specific purposes.
- The use of both speech and non-speech audio output has become more common, with facilities for synthesized speech and sampled sound now standard on many machines.
- Specialized forms of output that stimulate sense of touch are available. Those are for use in specific market, or aimed at people with particular disabilities.

As the mean of communication between the human and the computer, output devices have been considerably played a significant role, and according to (Preece, J. et al. 1999, 239), they should be presented in a way not only to normal users, but also the needs of disable users should be taken into account. Disabilities such as blindness, color-blindness, hearing impairment involve a significant number of people. Therefore, many researches have been conducted in the developing of effective and efficient output devices which concern the physical aspects, such as brightness, and many more aspects need to be considered -- “There is a large body of literature on all these aspects” (Oborne 1985).

2.2.3 The Interaction

There is a number of ways in which the user can communicate with the system. At one extreme is batch input, in which the user provides the computer all the information at once and leaves it to perform the task. Although this kind of approach involves the interaction between the user and the computer, it does not support many tasks well. On the other hand, in highly interactive input devices such as direct manipulation and the applications of virtual reality, the user is required to

constantly provide instructions to the computer and vice versa, the computer sends feedback to the user. This type of interaction has been widely applied in many modern systems. (Preece, J. et al. 1999, 263)

This chapter introduces different styles of interaction, but at first, in order to make sense of various styles of interaction, it is useful to take a look at history perspective. The early command-driven applications and form-fill applications matched the user requirements and task requirements at the time relative well. In the early command-driven applications, it tended to be used by expert users, or knowledgeable people who were not afraid of computers and could be expected to overcome any obstacles by sheer perseverance. The development of form-fill application, on contrary, was aimed at a completed set of users and tasks. This type of interface was designed for clerical workers who had little experience with computers, to enable them to carry out repetitive clerical data collection tasks. These interfaces mimicked paper forms, with the aim of retaining as far as possible the characteristic of entering data that are part of the manual task, while benefiting from the data processing power of a computer system. (Preece, J. et al. 1999, 263)

Furthermore, the interaction styles which are mainly use in design tasks can be divided into three categories: command entry, menu, and direct manipulation. While they are now described separately, they are not mutually exclusive; many systems nowadays use those styles in combination. (Preece, J. et al. 1999, 263)

At first, **Command entry** provides a way of expressing instructions to the computer directly. They can take the form of function keys, single characters, short abbreviations, whole words or a combination of a function key and a single character. The advantage of using single characters or function keys is that only one or two keystrokes are required to execute the command; therefore, it is useful in time saving. However, the disadvantage with using single characters is that it is generally more difficult to remember, especially there are a large number of them. Consequently, command entry should only be recommended to trained user because of its efficiency. (Preece, J. et al. 1999, 263)

Another interaction style is **Menu.** It is a set of options displayed on the screen where the selection and execution of one or more of the options results in a change in the state of the interface (Paap and Roske-Hofstrand 1988). Contrasting with command-driven system, menus have the advantage that users do not have to remember the items they want; instead, they would rather

recognize them. As a result, menus are more effective and popular to average users. Furthermore, in the past, there were the problems of using menus is that they take up a lot of space on screen. Two solutions have been commonly used are: pull-down and pop-up menus. In pull-down menu, it is dragged down from a single title from the top of the screen, an item is selected and the menu automatically returns back to its original form. Pop-up menu, on the other hand, appears when a particular area of screen, which may be presented by an icon, is clicked on and the menu remains in position until the user instructs it to disappear, in some cases, the close function. (Preece, J. et al. 1999, 265)

Finally**, Direct Manipulation**, according to Shneiderman (1983), is the term which describes the system that have the following feature: visibility of the objects of interest; rapid, reversible, incremental actions; replacement of complex command language syntax by direct manipulation of the object of interest. What more is the term 'direct manipulation' describes the style by its interaction features rather than the underlying technology required. In addition, a typical direct manipulation system has icons representing objects, which can be moved around the screen and manipulated by controlling a cursor with a mouse. However, one of the problems with direct manipulation is that not all tasks can be described by concrete objects and not all actions can be performed directly, which cause conceptual problems for the users. Nevertheless, direct manipulation has been much heralded within HCI as the way forward in interface design. (Preece, J. et al. 1999, 270)

Along with the Game Design process has gradually gained its importance, more and more non-specialists became computer users. Moreover, age and gender of game players also have changed significantly. The Game Designers need to start catering for a much wider range of users, from expert users to others complete novices, from different group of ages and from male to female. The tasks, therefore, have become much more varied too. More supportive communication styles, such as question and answer sequences, were developed. Moreover, there is also a need for hybrid systems that catered for different user preferences. (Preece, J. et al. 1999, 263)

2.3 Visual design in HCI

For every system to be widely accepted and used effective they need to be well designed. This is not to say that all systems have to be designed to accommodate everyone, but that they should

be designed for the needs and capabilities of the people, for whom, they are intended. Donald Norman (1988, 1999) wrote in his books, “The Psychology of Everyday Things” and “Turn Signals are the Facial Expressions of Automobiles”, many examples of everyday things that do not present a clear and obvious image to their users. In this case, with the complexity of most computer systems, it is clearly to see that the potential of poorly designed is very high. (Preece, J. et al. 1999, 5)

For this reason, a study of visual design is needed. As written by Davis, Hawley, McMullan, and Spilka (1997), the nautilus shell is an example of synthesis between form and function found in nature (figure 9); its form is the result of evolution, which is both transparent and beautiful. The nautilus shell is a perfect analogy for design and the design process because it creates valuable user experiences and usable interfaces.

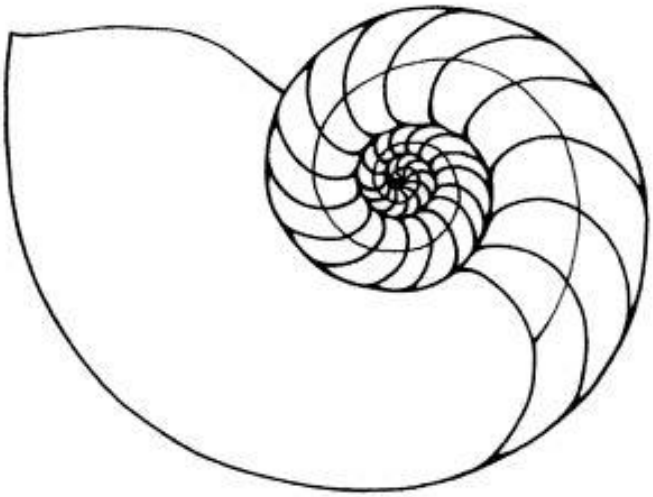

FIGURE 9. The nautilus shell (Watzman and Re)

The word design functions as both a noun and a verb. Many people use it to refer to the outward appearance or style of a product. However, design also refers to a process that of intentionally establishing a plan or system by which a task can be accomplished or a goal reached. It includes tangible and intangible systems in which objects or processes are coherent organized to include the environment in which these objects and processes function. Consequently, design can affect all people in every aspect of what they do. A good design performs for people; it is concerned with economics and the transmission of ideas. Thus, the challenge presented to a design team is to plan a prototype with a clear purpose that is easy to use, meet user needs, addresses com-

mercial considerations, and can be mass-produced. Its visual form, whether two or three dimensional, digital or analog, logically explains its purpose and efficiently leads the user through its function. (Davis et al. 1997)

Moreover, design is not a series of subjective choices based on personal preference, at best a cosmetic afterthought considered if time and money are leftover. Good design is the tangible representation of product goals. An iterative and interactive proves that requires active learning, design unifies a wide range of disciplines. Good design is a significant activity that reveals multiple solutions to each problem. Design equally values different ways of thinking. It allows people with a variety of skills and learning abilities to work cooperatively to bring insights and expertise to problems and opportunities in order to better develop new and innovative solutions. (Davis et al. 1997)

To sum up, understanding the fundamentals of visual design is clearly an effective way responds to human problems. For this reason, the design processes/steps are required, and will be described using the following table (table 1):

TABLE 1. Visual Design Steps (KimBell 1997)

STEPS	**DESCRIPTION**
Problem identification and definition	A need or problem is identified, research, and defined.
Gathering and analyzing information	The focus is on learning what is not known. Assumptions are questioned. Wide and broad research is used to located information and general ideas.
Determining performance criteria for a successful solution	Research continues as imagery is selected. Rules are declared and what is known is specified.
Generating alternative solutions and building prototypes	Multiple solutions are generated. A variety of methods for analysis, such as drawing, interviewing, modeling or evaluating statistics, are used.

Implementing choices	Project content, scope, and intent are formally established. Initial possibilities are represented and presented as prototypes.
Evaluating outcomes	Prototypes are assessed, tested, evaluated, and judged. The knowledge gained is incorporated into further studies and refinements.
Production	A prototype, which is synthesis of the initial solutions made using this process, and specifications are released for making multiples to manufacture.

The visual design decisions are based on project goals, user perspective, and informed decision-making. These are the responsibilities of the role of the Designer. While many aspects of design are quantifiable, there are visual principles that are measurable but equally important. In fact, nowadays, the Designers face great challenges. There are many questions such as: How products that are seen, read, understood, and acted upon can be created? Given increasing variety and complexity, how the power of new technologies can be harnessed? And how informed visual choice can be made? Consequently, the visual design principles will act as guidelines for the Designers on how to make informed design decisions – "design that provides the best, most thoughtful and appropriate integration of both form and function." (Watzman and Re 2009)

There are no universal rules, only guidelines. If there were rules, everything would look the same and work perfectly according to these rules. Each situation is different with its own context and parameters. (Watzman and Re 2009)

Remember the audience: be a user advocate. It is necessary to think about audience needs first throughout the development process. Some possible questions require answers such as: Who is in the audience? What are their requirements? The evaluation criteria used in the design development process springs from answers to these and other questions. Therefore, Designers must understand and advocate for the user. (Watzman and Re 2009)

Structure the messages. The Designer needs to analyze content to create a clear visual hierarchy of major and minor elements that reflects the information hierarchy. This visual layering of information helps the user focus on context and priorities. (Watzman and Re 2009)

Test the reading sequence. It is essential to apply the squint test. How does the eye travel across the page, screen, or publishing medium? What is seen first, second, and third? Does this sequence support the objectives and priorities as defined in the audit (a critical step in determining the scope and parameters of an organization's corporate graphic standards)? (Watzman and Re 2009)

Form follows function. The Designer should be clear about the user and use environment first. An effective interface design represents and reinforces these goals. (Watzman and Re 2009)

Keep things simple. The Designer needs to remember the objective is to communicate a message efficiently and effectively, so that users can perform a task. Fewer words, type styles, and graphic elements mean less visual noise, and greater comprehension. An obvious metaphor enhances intuitive understanding and use. As the result, the goal is to transfer information, not show off features or graphic. (Watzman and Re 2009)

People don't have time to read. When there is text involves in the design, it must be written as clear and concise as possible. Design information in an economical, assessable, intuitive format that is enhanced by a combination of graphic and typography. Graphics are very powerful and can be efficiently and effectively provide explanations while saving space on page. (Watzman and Re 2009)

Be consistent. The design must be consistency in using of type; page structure and graphic and navigation elements can create a visual language that decreases the amount of effort it takes to read and understand a communication piece. Thus, the goal is to create a user experience that seem effortless and enjoyable throughout. (Watzman and Re 2009)

Start the design process early. The development team of Designers, usability professionals, engineers, researchers, writers, and user advocates should be assembled at beginning of the process. Successfully applying the principles of good design enables an organization to communicate more effectively with its audiences and customers, improving the worth of its products and services and adding value to its brand and identity. (Watzman and Re 2009)

Good design is not about luck. A good design for usable interfaces appropriately applies the fundamentals of visual design to interactive products. However, creating the most useful, successful design for an interactive product is difficult. For the reason, the design process is iterative and experiential. There are usually several possible ways to solve a problem, and the final design decision is dictated by the best choices that work within the parameters at any particular time. Advocate on behalf of the user. Users are the reason why Designers are here and have this work to do. Users are everywhere, often in places not yet imagined. As the world grows smaller and becomes even more connected, the opportunity lies in where and what has not been discovered. (Watzman and Re 2009)

3 GAME DESIGN

As a subset of game development, Game Design is the process of designing the content and rules of a game in the pre-production stage and design of gameplay, environment, storyline, and characters during production stage. In this chapter, only some of the aspects of the Game Design are presented such as the culture of Game, Game Design by definition, an introduction to some popular genres in Video Game and Computer Game, and the Game Designers and their skills.

Game design is the process of creating content and rules of a game. And according to Jesse Schell (2008, 14) said in his book – "The Art of Game Design", "Game Design is the act of deciding what a game should be. That's it. On the surface, it sounds too simple." The notion of Game Design is quite easily explained; it is what determines the form of the gameplay. So, the Game Design determines what choices players will be able to make in the game-world and what ramifications those choices will have on the rest of the game. Moreover, the Game Design determines what win or loss criteria the game may include, how the user will be able to control the game, and what information the game will communicate to him, and it establishes how hard the game will be. In short, the Game Design determines every detail of how the gameplay will function. (Rouse 2005)

A good Game Design is the process of creating goals that a player feels motivated to reach and rules that a player must follow as he makes meaningful decisions in pursuit of those goals. Therefore, Game Design has to be player-centric. That means that the player and his or her decision are truly considered. Rather than demanding that the player do something by following the rules, the gameplay itself should motivate the player in the direction the Game Designer wants him or her to go. This technique is widely used in persuasive design, which is about making the user follow the Designer intent, and also helping the user to follow his or her intent (Fogg 2003).

In addition, a good Game Design happens when the game is viewed from as many perspectives as possible. Those perspectives are usually referred as lenses. Each lens is a way of viewing the design; they are small sets of questions that the Game Designers should ask themselves about their design (E.g. The lens of Fun, The lens of Challenge, The lens of Character, etc.). They are

not blueprints or recipes, but rather are tools for examining the design. And it should be important to mention that none of the lenses are perfect, and none are completed, but each is useful in one context or another, for each gives a unique perspective on the design of game. The idea is that even though the design cannot be assembled in one complete picture, but by taking all of those small imperfect lenses and using them to view the problem from many different perspectives, the Game Designer will be able to use his or her discretion to figure out the best design. (Schell 2008, 26)

3.1 Anthropology of games

By definition a game is an activity involving one or more players. This can be defined by either a goal that the players try to reach, or some sets of rules that determine what the players can or cannot do. Games are played primarily for entertainment or enjoyment, but may also serve as exercise or in an educational, simulative or psychological role. (Wikipedia Contributors, "Game", date of retrieved 10.2.2012)

While games are well known for their enjoyable ability, they can also be used for educational purpose. This was mentioned in the previous paragraph. In fact, play is human nature; people play in order to learn and practice; for example, sensorimotor, intellectual and social skills. Throughout the history of human, games have been implied as an important part of the human's life. The Chinese strategy game Wei-Hai from 3000 BCE is the oldest known game, which has been used for military simulations. In physical education, Polo is known as one of the oldest known ball games, which were born in around 500 BCE. Furthermore, as role-playing games became popular in the social sciences and management decision-making, the first widely known business game, The Top Management Decision Simulation, was developed in 1956 by the American Management Association. (Jouhtimaki 2006)

Furthermore, the year 1947 was noted as the turning point in the history of game, it is believed to be the first year when a game was designed for playing on a Cathode Ray Tube (CRT). This very simple game was designed by Thomas T. Goldsmith Jr. and Estle Ray Mann. Although the history of computer and video games spans five decades, computer and video games themselves did not become part of the popular culture until the late 1970s. The first significant computer game, Space War, was release by MIT student Steve Russell and his team in 1962. In a way, it was

recognized as the starting point of the video game industry. Over the decades, video games have become extremely popular, either in the form of hand held consoles, or with games that run on computers or attached to TVs. The term 'digital game' is used to cover all the game played on digital devices. (Jouhtimaki 2006)

Since it was created, digital games have evolved into many genres. The first commercial video game, Pong, was a simple simulation of table tennis. As processing power increased, new genres such as adventure and action games were developed that involved a player guiding a character from a third person perspective through a series of obstacles. This "real-time" element cannot be easily reproduced by a board game, which is generally limited to "turn-based" strategy; this advantage allows video games to simulate situations such as combat more realistically. Additionally, the playing of a video game does not require the same physical skill, strength and/or danger as a real-world representation of the game, and can provide either very realistic, exaggerated or impossible physics, allowing for elements of a fantastical nature, games involving physical violence, or simulations of sports. Lastly, a computer can, with varying degrees of success, simulate one or more human opponents in traditional table games such as chess, leading to simulations of such games that can be played by a single player. (Jouhtimaki 2006)

3.2 Genres in Video Game

Video game genres are used to categorize video games based on their gameplay interaction rather than visual or narrative differences. Video game genres are defined by a set of gameplay challenges. They are classified independent of their setting or game-world content, unlike other works of fiction such as films or books (Apperley 2006, date of retrieved 15.2.2012). The following is a listing of commonly known video and computer game genres with brief descriptions and an example of each:

Action: The action genres consist of two major sub-genres: first person shooters and third-person games. Although the first-person games are played as if the screen was the player's own vision, third person, on the other hand, is played with avatars that are fully visible to the player. These sub-genres are demarcated through a remediation of terminology from cinematic perspective, which is based on the literary definitions of narration. In reality, there is an invisible link between these two sub-genres. Whether the perspective is first or third person, in order to experi-

ence the virtual world of the game, the player and game must be linked by a static physical locator that acts as an indexical axis that connects the player's gaze and kinesthetic actions to the virtual game world. (Apperley 2006, date of retrieved 15.2.2012)

Moreover, action games in particular are often intensive performativity, in a manner distinctly different from other genres of performativity games, since action games will often require the player to engage in extreme non-trivial action in order to make them enjoyable. In many action games, the player must actually perform a desired action by selecting the correct inputs, while in other genres of video games, the player will merely select the desired action and the computer will determine the performance of that action. For example, in the action game The Lord of The Rings (was released in 2003), in order to attack a foe, the players must maneuver their avatar in range of the selected foe and then select an attack based on a combination of buttons. (Apperley 2006, date of retrieved 15.2.2012)

Adventure: The adventure games were some of the earliest game created, beginning with the text adventure Colossal Cave Adventure in the 1970s. Unlike adventure films, adventure games are not defined by story or content. Somewhat, adventure describes a manner of gameplay without reflex challenges or action. They normally require the player to solve various puzzles by interacting with people or the surrounding environment, most often in a non-confrontational way. Because they put little pressure on the player in the form of action-based challenges or time constraints, adventure games have had the unique ability to appeal to people who do not normally play video games. As it is mentioned earlier, the first form of adventure games were text adventures, also known as interactive fiction. Games such as the popular Zork series of the late 1970s and early 1980s allowed the player to use a keyboard to enter commands such as "get rope" or "go west" while the computer describes what is happening. A great deal of programming went into parsing the player's text input. (Wikipedia Contributors, "Video game genres", date of retrieved 15.2.2012)

Educational games: These games emphasize learning. They are designed to teach or reinforce a learned concept. Educational games look like games of other genres, but they are their own genre because they emphasize education. The most basic educationally designed game would be text exercises like fill-in-the-blank, multiple choices, or essay. With a little imagination, the player could turn the multiple-choices game into a fun game show where the host asks the student an educational-oriented question and correct answers earn points or virtual cash. History

games could be also turned into adventure games or RPGs, where the student plays the key character and must answer relevant historical questions or resolve a historical situation properly. (Pedersen 2003)

Role- playing: Role-playing games (RPGs) are vast worlds to explore where parties of players roam the terrain seeking treasures, objects of desire, and ways to increase their experience and health status, to destroy monsters and obstacles that get in their way. RPGs started as dungeon crawls through paper labyrinths created by "masters" (dungeon designers). A master would create an elaborate labyrinth filled with traps, monsters, and evil magic. The party would enter the maze armed with individual skills, magical abilities, and weapons. On each turn the party would try to outwit, out-spell with magic, and outfight the master's creation. The world of the Internet has enabled millions of RPG fans to explore larger terrain and more exotic quests. (Pedersen 2003)

Additionally, one of the form belongs to the RPG is MMRPG. This acronym stands for massively multiplayer RPG (Role-playing game), a game in which parties of friends or groups from around the world form to explore, collect, and fight other parties and monsters. MMRPGs have numerous parties, each on various quests and with their own goals. An RPG has a specific goal, and after many hours of play, there is an ending. Conversely, MMRPGs may have no specific ending and can be played until players have completed all the quests or until another MMRPG or Internet game requires their time and attention. (Pedersen 2003)

Simulation: The simulation genres include video games that simulate sport, flying and driving, and games that simulate the dynamics of towns, cities, and small communities. Simulation games (or Sims) let gamers experience real-world situations from a safe, practice area. Since the 1950s, the Departments of Defense in developed countries such as USA has trained the military with computerized simulators like flight Sims, tank Sims, and war-gaming Sims (missiles launching and combat). Simulations are exciting and have a real world feeling to them. Since most of the real-world applications that the gamers are trying to simulate would be extremely dangerous and very expensive outside of the computer, navigating and reproducing practice scenarios are more practical and easier to set up inside a simulator. (Pedersen 2003)

What is more, simulations can be classified as either a "vehicle simulation" or a "managing simulation." Vehicle Sims are trucks, cars (stock, Formula-1, high-performance), airplanes, helicopters, boats, submarines, spaceships, space stations and motorcycles. Managing Sims include

managing a nuclear power plant, a brokerage company trying to predict the stock market, being mayor of a city or president of the United States, being owner of a golf club, being manager of the city zoo, being Emperor of the Roman Empire, being owner of an amusement park (rollercoasters and rides), and even managing the lives of families (The Sim series). (Pedersen 2003)

Strategy: Strategy video games focus on gameplay that requiring careful and skillful thinking and planning in order to achieve victory. Strategy games differ from other genres not only because the Designer creates rules and goals, but also it is the gamer who decides what strategy to use to achieve those goals and outwit one or more opponent(s). War games are strategy games although they are usually simulations of actual or fictitious events. (Apperley 2006, date of retrieved 15.2.2012)

Strategy games can be played as real-time or turn-based games. Both of these sub-genres give a similar aesthetic, a general god's eye-view of the actions taking place. However, in real-time strategy, this sub-genre is usually applied only to certain strategy games. The actions in these games are continuous, and players will have to make their decisions and actions within the backdrop of a constantly changing game state. Real-time strategy gameplay is characterized by obtaining resources, building bases, researching technologies and producing units. One of the most popular real-time strategy games is Blizzard's Starcraft (1.5 million copies were sold in two-day sales). Turn-based strategy games, on the other hand, are characterized by the expectation of players to complete their tasks using the combat forces provided to them, and usually by the provision of a realistic (or at least believable) representation of military tactics and operations. A player of a turn-based game is allowed a period of analysis before committing to a game action, and some games allow a certain number of moves or actions to take place in a turn. The first game of the genre was Combat Mission in 1999. (Wikipedia Contributors, "Video game genres", date of retrieved 15.2.2012)

Above is the list of some popular game genres, it is by no means complete or comprehensive. Furthermore, in the recent years, there have been some changes in the statistical data of the best-selling video game and computer game super genres. More new types of game have made their way into the league of popular game genre, including children and family entertainment (figure 10, 11). The rapid improvement of new technologies has opened new ways of entertainment. An example for this statement would be the Xbox 360 Kinect, a controller-free gaming and entertainment experience. Since it was first announced on June 1st 2009, the Kinect has introduced to

the players a whole new level of experience for the party games (e.g. Kinect Sports, Dance Central and Kinect Adventures). Moreover, it is also interesting to point out that, from 2005 to 2010, the action genre had dominated in video game (30.1% and 22.3% respectively), while the most popular game genre in computer game is strategy (30.8% and 33.6% respectively). For the reason, the main input devices of strategy games are keyboard and mouse.

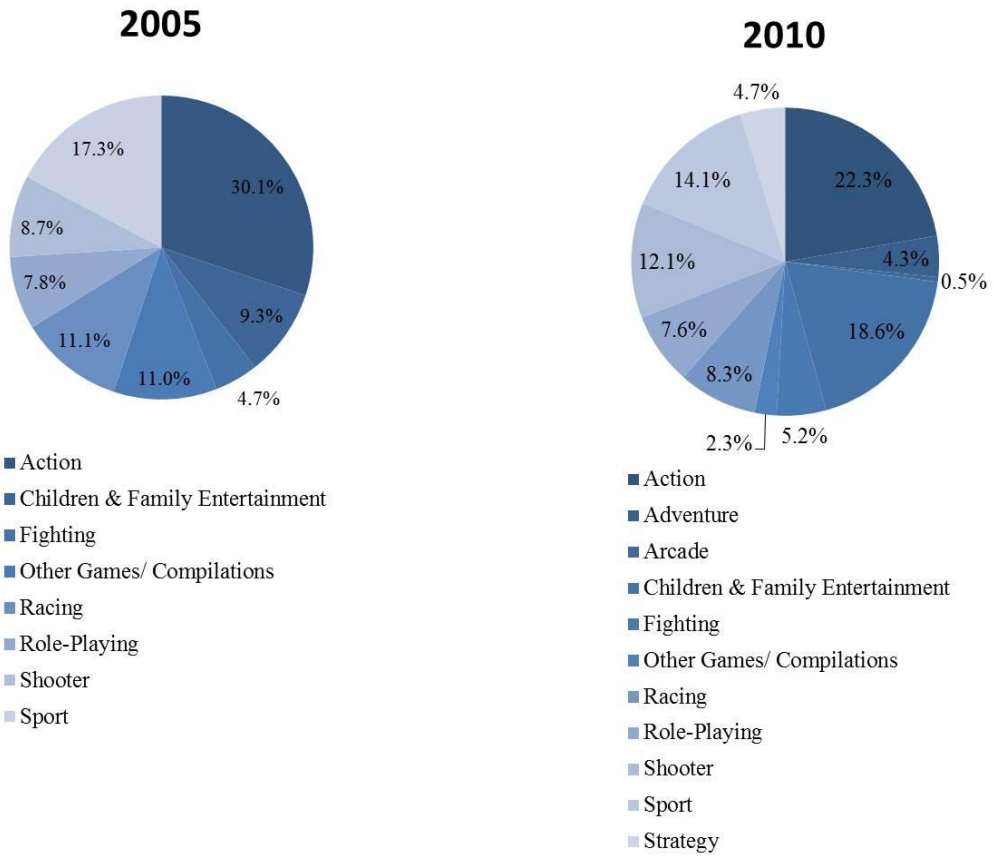

FIGURE 10. Best-selling video game super genres by unit sold in 2005 and 2010 (The NPD group/ Point of sale information)

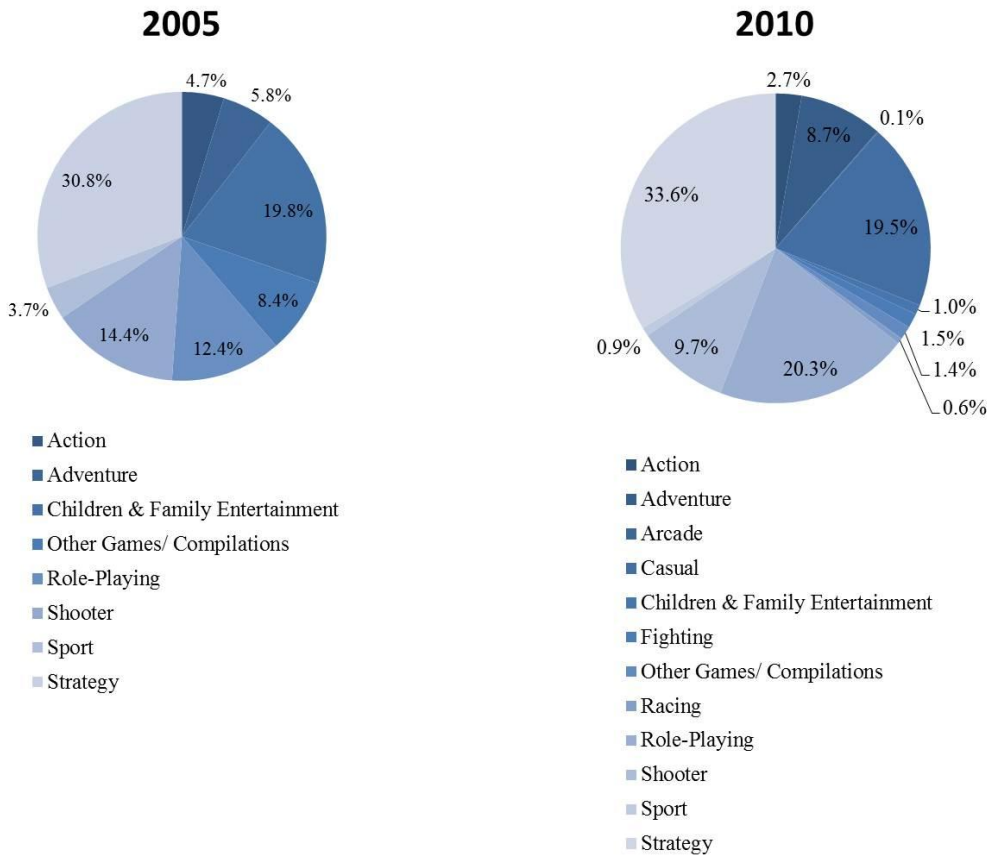

FIGURE 11. Best-selling computer game super genres by unit sold in 2005 and 2010 (The NPD group/ Point of sale information)

3.3 Principles of Game Design

Many people assume that to best study the principles of Game Design, one would naturally study the most modern, complex, high-tech games that are available. However, this approach is completely wrong. Video games are just a natural growth of traditional games into a new medium. Therefore, the rules that govern them are still the same. A Game Designer must, at first, understand the simplest forms of game. According to Marc Prensky (2001), here are what a game should be:

"Games are a form of **fun**. That gives us enjoyment and pleasure.
Games are form of **play**. That gives us intense and passionate involvement.
Games have **rules**. That gives us structure.
Games are **interactive**. That gives us doing.

Games have **outcomes** and **feedback**. That gives us learning.
Games are **adaptive**. That gives us flow.
Games have **win states**. That gives us ego gratification.
Games have **conflict**/ **competition**/ **challenge**/ **opposition**. That gives us adrenaline.
Games have **problem solving**. That sparks our creativity.
Games have **interaction**. That gives us social groups.
Games have **representation** and **story**. That gives us emotion."

During the past decade, many Game Designers have argued about what are the best principles for Game Design, and which of them should be applied for all game designing's processes. In fact, there is no such thing as that; design principles should come from everywhere because design is everywhere, and design is the same everywhere. With each principle is based on the design's experiences and intuitions, the process of deciding which principle to choose should be an "open book" between Game Designers.

For the following part of this sub-chapter, some of the published principles were chosen and will be presented respectively. There are ten principles in total, and according to Roger E. Pedersen (2003) and Bob Bates (2004), these principles can efficiently and effectively enhance the playing experience for the user:

Understand the role of the Designer: The Game Designer is the visionary, somewhat like a book's author. This person has outlined the scope and description of the product with sufficient detail so that others can understand and develop the product. Just as a book author sees his creation develop differently when made into a film, the Game Designer needs to accept and solicit modifications from the team members, the publisher, and the public during the development process. Often one of the Game Designer's tasks is to create the project bible - the game's lengthy design specification. This document details the gameplay, describes characters and settings (possibly including diagrams or drawings), includes level descriptions and possibly maps of areas to explore, positions and actions for each character or class of character. (Pedersen 2003)

Moreover, Game Designers should research their subject matter and evaluate outside suggestions and opinions. The audience demands and expects films and books to seem realistic and accurate. The computer and video game's audiences should accept nothing less. For instance,

when undertaking the development of a sports game (e.g. baseball), a Game Designer may feel that he knows the sport from playing it and viewing it on TV. However, much more research must be undertaken to create an immersive experience for consumers. Whether the game genre is sports, RPG, adventure, or simulation, the first step is to research similar titles in that game genre. There are many to accomplish this step such as surfing the Internet, visiting the local store and purchasing competitive games, reading reviews of similar genre titles, collecting marketing materials and advertisements from other publishers' web sites. This information is invaluable when put in use to design a new product. (Pedersen 2003)

Player Empathy: A good Game Designer always has an idea of what's going on in the player's head. This empathy for the player is crucial, since the Designer must develop the ability to put himself/ herself in the player's shoes and anticipate his reaction to each element of the game. He or she must be able to imagine what the game will look like, all before a single line of code has been written. Naturally, no Designer has completely accurate foresight. "That's one reason you have testers. Testers not only hunt for bugs, but also provide feedback on things they want to try in the game but can't". (Bates 2004)

Feedback: The basic interaction between a player and a game is simple: if the player does something, the game will do something in response. This feedback is what distinguishes a game from every other form of entertainment. It is the interactivity that makes games unique. Without it, the player would just be watching a movie on the screen. Every input the player makes in the game should give him a discernible response. No input should go unanswered. This "answer" can take many forms. It can be visual feedback, aural feedback, or even tactile feedback (if the controller is so equipped). It can be positive feedback or negative feedback, but there must be some feedback. Generally, this is easy when the player understands the game and is progressing nicely through it. It becomes more difficult when he is doing something "wrong." Because nothing is more frustrating for a player than pressing a key, clicking the mouse, or pushing on the controller and having nothing happen. "For every conceivable input, be sure to give the player some feedback about it." (Bates 2004)

Grounding the Player: The player should always know where he is in the game and why he is doing what he is doing. At any given point, he should have a long-term goal, a medium-range goal, and an immediate goal (This is true even of software toys, games that ostensibly have no goals, but in reality have a series of goals the player creates for himself.) Computer and video

games are usually huge, and it is easy for a player to feel lost. Also, games are not always played start-to-finish in one sitting. “If a player has an overall map in his head, it encourages him to come back to the game again and again until he is done.” (Bates 2004)

Interface Design: Creating a good-looking yet functional interface is one of the most underrated tasks of Game Design -- but it is vital to get it right. The Designer must decide what the game looks like on the screen, how information is passed along to the player, and how the player uses the controller, keyboard or mouse to input commands. So, he or she cannot rely on the instincts to get this right. The interface needs to be tested, first with team members and later with testers. “What is intuitive to you can be awkward to someone else.” (Bates 2004)

Moreover, elegance and ease of use are more important than increased functionality. Achieving this compromise is never easy. Frequently, the team will have to argue about it for months. If including a non-vital feature comes at the cost of messing up the interface, it is much better off without it. Usually, there are several interfaces within a game. “Look at all of them. Get people to test them early, and listen to their feedback.” Most importantly, the Designer must play his/ her own game before everyone else. (Bates 2004)

Customizable Controls: Giving the player as much control over the interface as possible, and making everything as adjustable as the Designer can are important tasks. This includes game controls, monitor settings, volume. It is important to provide the users with everything, and let them change whatever and whenever they want. Since, different things are important to different players, one player might want to optimize for speed instead of graphics because he is an action addict. Another might prefer a higher resolution, even though it slows down the game, because he likes to look at the pictures. A third might want to remap the commands to different buttons or keys, because that is what he is used to. Whenever possible, the player must be able to customize the game to his/her liking. (Bates 2004)

Design within Limits: Designers often forget that building a game is actually a software development project. Thus, it has a cost and a schedule, and its ultimate success or failure hinges not just on good gameplay, but on whether the team can deliver that gameplay on time, on budget, with technical features that work, and without crashing the player’s machine. The person who makes this happen is the “tech lead”, and the Designers must work with him to make his job easier to accomplish. Even if Game Designers are not a programmer, they should read books about

the software development process and adapt their design to the technical specifications and the budget. Consequently, as a Designer, he/ she must limit him/ herself to features that can possibly be implemented on the target machine. (Bates 2004)

Schedules are like Laws: Laws are created by legislative bodies and meant to be obeyed, but they are also designed to allow exceptions if evidence warrants special circumstances. Likewise, milestones created at the beginning of the project may need to be changed based on problems that occur during development. For instance, the decision to change the original game specification (e.g. to support a new computer, a new 3D card, alter preplanned artwork or audio clips) in order to make a better product is a situation that may warrant "breaking the law" of the schedule. If another month of development time would greatly improve the gameplay, remove non-show-stopping bugs, or allow for better visuals or audio effects, then circumstances justify deviating from the schedule. To ship a game on a target day, month, or year, regardless of the state of the product at that time, can spell disaster for that product (not to mention the harm it does to the publisher's reputation). The team and publisher must agree that the additional time will substantially benefit the product. (Pedersen 2003)

Be truthful to your license: Games are based on licensed products often cause players to make certain assumptions about those titles. There are preconceptions about the gameplay, content, and target audience. In stores, it is the licensed titles that get noticed first, regardless of their marketing and advertising. Game Designers must understand this customer mentality. And the Designer must understand everything about that license in order to provide the kind of entertainment that the target consumers have anticipated. For instance, a baseball game that uses a particular baseball team's manager in its title suggests a strategy sports game. Players would probably assume that they would be responsible for making decisions about the players and batting order. On the other hand, a licensed product linked to a professional baseball player would suggest an emphasis on sports action, such as pitching and batting. There is one reason why licenses are expensive. Therefore, Designers and producers must use the license and the game's characters to leverage consumer preconceptions to the title's benefit. (Pedersen 2003)

There is no magic formula for success: It is essential to keep in mind that no one individual or company of any size has discovered the formula for what makes a successful product. Like film, art, and music, games appeal to a variety of consumer tastes, and of course taste is subjective. Some developers of past hits have credited their success to the underlying technology that their

game used. Other developers claim that their game transports the player into a surreal and immersive universe. Nevertheless, others feel their game is success is due to the way it engrosses the player in a realistic simulation and challenges them with its compelling design. Behind each successful title is a unique list of traits that made it popular with consumers. The bottom line is quite simple. A well-designed product based on a team effort with a simple, user-friendly interface developed within a reasonable time frame will be successful. (Pedersen 2003)

3.4 The Game Designer

By this point it should be obvious what a Game Designer does; he determines what the nature of the gameplay is by creating the game's design. The terms "Game Designer" and "Game Design" have been used in such a wide variety of contexts for so long that their meanings have become diluted and hard to pin down. Some seem to refer to Game Design as being synonymous with Game Development. These people refer to anyone working on a computer game, whether artist, programmer, or producer, as a Game Designer. "I prefer a more specific definition, as I have outlined above: the Game Designer is the person who designs the game, who thereby establishes the shape and nature of the gameplay." (Ogden, S., Falstein, N. 2005)

Although, it is important to make the distinction between "Game Developer" and "Game Designer", noted that Game Designers are just one of species of Game Developer, Designer is rather referred as a role than a person. So, anyone who makes decisions about how the game should be is a Game Designer. Almost every developer on a team makes some decision about how the game will be, just though the act of creating content for the game. These decisions are Game Designer decisions; therefore, when a person makes them, he or she is a Game Designer. For this reason, no matter what role on a Game Development team, an understanding of principles of Game Design will enhance the quality of a game. (Schell 2008, 25)

Furthermore, there are some tasks in which the Game Designer may be involved. Firstly, the Game Designer may do some concept sketches or create some of the art assets that are used in the game. Secondly, the Game Designer may write the script containing the entire dialog spoken by the characters in the game. Thirdly, the Game Designer may contribute to the programming of the game or even be the lead programmer. Fourthly, the Game Designer may design some or all of the game-world itself, building the levels of the game (if the project in question has levels to be

built). Fifthly, the Game Designer might be taking care of the project from a management and production standpoint, keeping a careful watch on the members of the team to see that they are all performing their tasks effectively and efficiently. These are some tasks that may be the job of the Game Designer; however, he may not need to do all of them. All someone needs to do in order to justifiably be called the Game Designer is to establish the form of the game's gameplay. Without a doubt, many Game Designers perform a wide variety of tasks on a project, but their central concern should always be the Game Design and the gameplay. (Ogden, S., Falstein, N. 2005)

After having a better understanding about the role of a Game Designer, in the next part of this sub-chapter, a list of skills is presented (according to Jesse Schell in 2008), which are required for any Game Designer to have. It should also be mention that Game Development is a collaborative process involving multi-disciplinary teams. Designers must be able to communicate their vision to artists, programmers, producers, marketing staff, and others involve in the development process, and accept feedback on their work. This involvement is presenting their ideas both verbally and on paper, for which they need writing and basic visual design and drawing skills. A good technical knowledge is also needed, with some programming skills at least at scripting level and awareness of the various games platforms and technologies.

Animation: Modern games are full of characters that need to seem alive. The very word "animation" means "to give life." "Understanding the powers and limits of character animation will let you open the door for clever Game Design ideas the world has yet to see." (Schell 2008, 32-33)

Anthropology: Game Designers will need to study their audiences in their natural habitat, trying to figure out their heart's desire, so that their games might satisfy that desire. (Schell 2008, 33)

Architecture: Game Designers will be designing more than buildings — they will be designing whole cities and worlds. Familiarity with the world of architecture, in this case, understanding the relationship between people and spaces, will give them a tremendous leg up in creating game worlds. (Schell 2008, 33)

Brainstorming: Game Designers will need to create dozen or even a hundred ideas for a game. (Schell 2008, 33)

Business: The game industry can be considered as an industry. Most games are made to make money. “The better you understand the business end of things, the better chance you have of making the game of your dreams.” (Schell 2008, 33)

Cinematography: Many games will have movies in them. Almost all modern video games have a virtual camera. Game Designers need to understand the art of cinematography if they want to deliver an emotionally compelling experience. (Schell 2008, 33)

Communication: Game Designers will need to talk with people in their team, and even more. They will need to resolve disputes, solve problems of miscommunication, and learn the truth about how their teammates, client and audience really feel about their game. (Schell 2008, 33)

Creative Writing: Game Designers will be creating entire fictional worlds, populations to live in them, and deciding the events that will happen there. (Schell 2008, 33)

Economics: Many modern games feature complex economies of game resources. An understanding of the rules of economics can be surprisingly helpful. (Schell 2008, 33)

Engineering: Modern video games involve some of the most complex engineering in the world today, with some titles counting their lines of code in the millions. New technical innovations make new kinds of gameplay possible. Innovative Game Designers must understand both the limits and the powers that each technology brings. (Schell 2008, 33)

History: Many games are placed in historical settings. Even ones placed in fantasy settings can draw incredible inspiration from history. (Schell 2008, 33)

Management: Any time a team works together toward a goal, there must be some management. Good Designers can succeed even when management is bad, secretly “managing from below” to achieve a successful result. (Schell 2008, 33)

Mathematics: Games are full of mathematics, probability, risk analyses, and complex scoring systems, not to mention the mathematics that stands behind computer graphics and computer science in general. A skilled Designer must not be afraid to delve into math from time to time. (Schell 2008, 33)

Music: It is the language of the soul. If a game is going to truly touch people, to immerse, and embrace them, it cannot do it without music. (Schell 2008, 33)

Psychology: The goal is to make a human being happy. Game Designers must understand the workings of the human mind; otherwise, they are designing in the dark. (Schell 2008, 34)

Public Speaking: Game Designers will frequently need to present their ideas to a group. Sometimes they will speak to solicit their feedback; sometimes they will speak to persuade other people of the genius of their new idea. Whatever the reason, the Game Designers must be confident, clear, natural, and interesting, or people will be suspicious that they do not know what they are doing. (Schell 2008, 34)

Sound Design: Sound is what truly convinces the mind that it is in a place; in other words, "hearing is believing." (Schell 2008, 34)

Technical Writing: Game Designers need to create documents that clearly describe their complex designs without leaving any holes or gaps. (Schell 2008, 34)

Visual Arts: Every game will need to be full of graphic elements. Game Designers must be fluent in the language of graphic design and know how to use it to create the feeling they want their game to have. (Schell 2008, 34)

Of all the skills mention in the previous sections, one is far and away the most important. In fact, the most important skill for a Game Designer to have is listening. "By listening, I don't mean merely hearing what is said. I mean a deeper listening, a thoughtful listening." (Schell 2008, 34). So, Game Designers must always listen to many things. These can be grouped into 5 major categories: Team, Audience, Game, Client, and Self.

Firstly, the Game Designers will need to listen to the **team**, since they will be building their game and making crucial Game Design decisions together with them. A team can bring together a big list of skills. If the Designers can listen deeply to their team, and truly communicate with them, all will function as one unit, as if sharing the same skills. As the result, tasks are easier to be done, and problems are simpler to be resolved. (Schell 2008, 35)

Secondly, the Game Designers will need to listen to the **audience** because these are the people who will be playing the game. Ultimately, if they are not happy with the game, it means failure. And the only way to know what will make them happy is to listen to them deeply, getting to know them better than they know themselves. “You will need to listen to your **game**. What does this even mean? It means you will get to know your game inside and out. Like a mechanic who can tell what is wrong with a car by listening to the engine, you will get to know what is wrong with your game by listening to it run.” (Schell 2008, 36)

Thirdly, the Game Designers will need to listen to the **client**. The client is the one who is paying the Designers to design the game, and if they do not give them what they want, they will go to someone else who does. “Only by listening to them, deeply, the Game Designers will be able to tell what they really want, deep in their hearts.” (Schell 2008, 36)

And lastly, the Game Designers will need to listen to **themselves**. This may sounds easy; however, it is considered the most difficult kind of listening. A clear understanding of how to use it will be one of the powerful tools that can support their creativity. (Schell 2008, 36)

4 APPLYING HUMAN COMPUTER INTERACTION IN GAME DESIGN

Computer games and video games are one of the most successful application domains in the history on interactive system. This success has appeared despite the fact that games were considered to be different from most of the accepted paradigms for designing usable interactive software. What has made games different is they focus on system performance over consistency; games have always ignored the windowing systems, the standard widget libraries, and the toolkits that define the look and feel of conventional systems which leads to a very different design environment. This environment does not place restrictions on how thing must look or how interaction must be carried out with the user. Instead, it does strongly reward innovation and performance – the driving forces in Game Design are user performance, satisfaction and novelty. As a result, games have both become early adopters of new HCI technologies as well as innovators in the area of HCI interaction design (Dyck, J. et al.).

The previous chapters have offered the basic knowledge of the study of Human Computer Interaction and the Game Design. Understanding the important roles of Human Computer Interaction which is not only in the Computer Science field, but also in Game Design, is essential. Therefore, it is necessary to discuss how the HCI has been implementing in the Game Design process. This chapter is written to answer this question.

4.1 Key issues of HCI in Gaming

As mentioned earlier, it is important to understand what Human Computer Interaction is, and why it is so important in gaming. A relatively new field, HCI was founded in 1983 with the following definition which is still applicable today: “The key notion, perhaps, is that the user and the computer engage in a communicative dialog whose purpose is the accomplishment of some task. … All the mechanisms used in this dialog constitute the interface: the physical devices, such as keyboards and displays, as well as the computer’s programs for controlling the interaction.” (Card et. al., 1983)

Consider every operating system found in the PC – whether Windows, Mac or Linux -- and desktop or notebook which found in millions of homes and offices around the globe. The present PC is more powerful than it used to be; however, the methodology and technology for interacting with the PC remains little changed – a keyboard (based on the 19th Century technology of a typewriter) and mouse (invented in 1963 by Douglas Englebart and his team) for input, and an LCD (or in the past CRT) display combined with speakers for output. These components are still considered as the basic interaction tools for computer games nowadays, especially in the strategy genres. The Total War series, Warcraft and Starcraft are the examples in this case. (Barlow 2011)

Moreover, considering the modern gaming platforms in all their diversity – from the PC, through consoles (the Microsoft Xbox 360, Sony PlayStation 3, and Nintendo Wii), handhelds (Nintendo DS and Sony PSP) and the rapidly growing area of gameplay on mobile phones (best represented by the iPhone and other touch phones). On these platforms, gamers use devices ranging from microphones through touch-screens, accelerometers, cameras, gamepads and remotes to sing, strum, dance, swing, and otherwise conduct a range of physical activities – far richer than those afforded by a keyboard and mouse – in order to play their games. Without a doubt, in the past decade, the game industry has seen a genuine new start in HCI (Human Computer Interaction) technology with new styles of interaction and play being supported, and these technologies achieving mass market penetration. Furthermore, new technologies such as several Brain Computer Interface (BCI) products have emerged in the past years (the NCI OCZ, the Emotiv EPOC headset) aimed squarely at, and priced for the game market. (Barlow 2011)

What is more, despite the escalating economic importance of the computer and video games, indicated by the rapidly growing revenue within the game industry over the past few decades, it cannot be the sole value in measuring video game cultural value. As the matter of fact, although with some forms of play such as education and communication, computer and video games continue to receive negative recognition from the society. They are still held in rather low value by policy makers. Most schools and organizations have currently banned such form of activities in the class room or at the workplace. (Zaphiris, P., Chee, S.A.)

This is intensified by an excess of research writing that over-emphasis the negative effect computer and video games have from various perspectives. At first, it is claimed that the prolonged use of computer games contributes obsessive, addictive behavior, dehumanization of the player, desensitizing of feeling, health problems, and other disorder (Setzer and Duckett 2000, date of

retrieval 22.12.2011). Others argue that computer and video games encourage the development of anti-social behavior among game players (Williams and Skoric 2001). In addition, perhaps, the most debated issue concerning games and players, especially teenagers, is their connection to violence. A growing body research is correlating violent computer games play to aggressive cognitions, attitudes, and behaviors. A number of studies have shown a positive association between the amount of video game play and aggressiveness among children, adolescents and even adults (Bushman and Anderson 2002; Gentile et. al. 2004).

Consequently, there is an increasing interest in approaching game studies from the perspectives of HCI. Some researchers investigated novel forms of interaction such as tangible interfaces (Price et al. 2003) to encourage collaboration and techniques of gathering user requirement for design educational game (Bekker et al. 2003). While other studies focused on the human behavior and physiological responses such as frustration (Scheirer et al. 2002) in order to better understand the interface design toward building affective computer through the study of computer gameplay. In term of research in Game Usability, Federoff (2002) attempted to generate Heuristics and usability guidelines for the creation and evaluation of fun in video games by working closely with game developers. In addition, to the study of HCI in computer game, is the work of Malone on educational games. Malone in his early work on the motivation of computer game based learning proposes, the Heuristics for Game Designers and researchers. The Heuristics for the fun factor of computer games consists of three main elements that draw largely from Csikszentmihalyi's (Csikszentmihaly 1990) flow theory: challenge, fantasy and curiosity. Apart from these, there has also been research on the evaluation of the usability of games (made by Höysniemi, Hämäläinen and Turkki in 2003).

4.2 Game User Interface Design

An interface has many pieces; for instance, menus, text, buttons and icons. What is more, the interface is the part of the game that allows the user to interact with the game. Interaction is what makes a video game different from a movie. When playing a video game, the user can make choices and respond to events. "An interface is the connection between the user and the game, and a well-designed interface makes the video game experience more fun." (Fox 2005)

Interface design is a creative, exciting, and challenging subject. However, it is necessary to point out that, too often, video game interfaces are an afterthought. The reason is too many project managers assume the most important part of a software development project is the programming, and then the interface can come later. As the result, insufficient time is assigned for interface design which may leads to a poor quality interface. (Fox 2005)

All this considered, the visual quality of a game is very important. A poor interface can ruin the entire video game experience. One of the negative example is the user is confused and cannot comprehend how to navigate the menu or if he/she cannot find the information while playing the game. The more the user tries to search for information in order to play, the less enjoyable the game becomes. On the contrary, if the game has a great interface, it can enhance the playing experience. A good-looking interface with a lot of well-designed features can actually be fun to use and even seem like a game itself. But more importantly, great game interface design can boost game sales. (Fox 2005)

Overall, the purpose of this sub-chapter is to introduce the game interface design principles, goals and methods of presenting an interface. There is a huge amount of information to learn about interface design. As the result, this sub-chapter will, however, cover all only the basics you need to know in order to design your own game interface.

4.2.1 The Game Interface Design Goals

A good way to for a Game Designer to make decisions about features of a game is to have goals. If he understands these goals, it will be much easier for him to make decisions about the interface. It is not always easy to define the overall game goals, but if the Game Designer takes the time to create concise goals for the entire game and clearly understands these, many decisions will be easier to make. In fact, goal oriented design produces great results. (Fox 2005)

In many cases, the Designer may be wondering, “What kind of goals do I need to set when designing an interface?” Thus, making the coolest interface ever may be the first thing that comes to mind. This goal sounds great, but it probably should not be the first priority. As much as everyone wants a cool interface, there may be other things that are more important. If making a kids’ game; for example, it might be more important that the menu is easy for a six-year old to use than that it

looks cool. More importantly, prioritization is the key to using these goals to guide the design. (Fox 2005)

In addition, below is a list of possible goals that a Designer may have. These goals may not match perfectly with every case, but it is important to understand the goals of the company, and to align these with the user's requirements. This list is by no means a complete list of goals that could ever be used for every Game Design case. In fact, it is a very brief list which meant to simulate thought about the real goals of the Game Designer. (Fox 2005):

- Promote an existing license or famous personality.
- Capitalize on an existing license or famous personality.
- Meet a particular schedule.
- Reach a particular audience.
- Create something completely unique.
- Outdo a competing game.
- Capitalize on the success of a competing game.
- Continue a successful series.
- Sell another product (other than the game itself).
- Promote a moral issue.
- Create an educational experience.
- Pass the approval process of the console manufacture.
- Please the marketing department.
- Tell a story

Promoting and **capitalizing** an existing license or famous personality are the first goal for the Game Designer. It is important to have a good first impression from the users. The second goal is **meeting a particular schedule**. A game interface design should be treated equally as the other phases in the game development process. Therefore, a sufficient time should be scheduled for the design in order to create a well-made interface that can guarantee meeting the player's expectation. A further goal is **reaching a particular audience**. A targeted group of customer should be decided first, before starting to create an interface. For instance, different styles of interface will be made based on the information whether the game is for young audiences, or for more mature audiences. Consequently, if the target audiences are students or teachers, **creating an**

education experience should be considered as one of the priority goals. The fourth possible goal is **pass the approval process of the console manufacture –** a game can be developed for playing in many platforms**.**

Furthermore, for a game manufacture to success in the market, it is essential for the Game Designer to **create something completely unique**. There is a variety of possible ways to achieve this goal. The Designer can **outdo a competing game** in features and effects; **capitalize on the success of a competing game, continue a successful series** or even **promote a moral issue**. But more importantly, the game should **tell a story.** For example, the strategy game "Total War Shogun 2" promotes the Japan's warfare in the 16th century.

The final goals in this list are the Game Designer needs to **please the marketing department** and **sell another product** (e.g. a game is based on a movie or a novel)**.** More innovative ideas can possibly be acquired by the collaboration between different departments. In this case, since the marketing people work closely to the customers, they understand clearly the customer's desires. Additionally, a game may be used in a promotion campaign to boost sale of another product, that is different than game.

What is more, it is essential to mentioned that every Designer should avoid the temptation to set one large goal that is actually several goals in one. This is often the easy way out, since it is more difficult to articulate specific goals than it is to generalize. But in comparison, a goal like "Make a cool game" is not nearly as clear as "Add three new and creative features that are not found in competing racing games." The point is to define useful goals that will provide direction during development. As the result, understanding the motive behind the goal is very important. (Fox 2005)

4.2.2 Basic Design Principles

Every best Interface Designer knows and understands clearly the design principles. In fact, nothing will improve the design skills better than an understanding of basic design principles. Many Interface Designers learn these principles in college or a specialized art school but they forget them later, since it is easy to go out and find a job in the industry, start working on real games, and just gets sort of rusty on design basics (Fox 2005). Ignoring or forgetting basic design princi-

ples will adversely affect the design ability. Once the Designer has learned basic design principles, it is important to keep using them to evaluate and improve the interfaces. In this subchapter, a number of design principles will be introduced. They are in a form of combination between the design knowledge and the study of Human Computer Interaction.

Understand the users and support their goals. Mitchell Kapor wrote a Software Design Manifesto back in 1991: "If a user interface is designed 'after the fact' it is like designing an automobile dashboard after the engine, chassis, and all other components and functions are specified." If these interfaces are designed after the fact, it is almost impossible for them to be able to meet all the user's goals. In other words, the Designer need to first understand the users (their needs and objectives) in order to create an interface that allows them to effectively access the system's functionality. (Adrian Jones, date of retrieval 2.3.2012)

Get back to basics – using color. Color can be a very powerful design tool. One of the abilities of color is to set a mood; color can express emotion and set an atmosphere. For instance, a design that uses a lot of neutral gray and de-saturated colors can bring the sad feeling. Moreover, one of the major challenges when working with color is finding a set of colors that work well together – creating color harmony. Harmonious colors or complementary colors can include colors that are similar to one another like a range of blue colors can look good together. (Fox 2005)

Make the interface easy to learn and enjoyable to use. This is an important rule that helps the user maintain a sense of spatial orientation and sanity. It is essential to consider how the user will interface with the product before creating it. Additionally, a bonus point for a good interface is creating an interface that is enjoyable to use. The Designer can add a variety of effect like 3D transformation and adding light/shadow, instead of using only plain text and picture, into the design. (Adrian Jones, date of retrieval 2.3.2012)

Organize the visual. A good rule when creating an interface is to space elements evenly and align them well. It is necessary to paying attention to spacing and alignment results in visual organization. If the elements in the design are scattered and the spacing between them is not consistent, the design will appear unorganized. This is displeasing to the user because most people are attracted to organization. Moreover, if the design calls for objects that are not aligned, then make sure that these elements are not positioned only slightly off-alignment with other objects, in other word, move them far enough out of alignment that there is no doubt that it was intentional. It

can be very disconcerting to the user if objects look like they should be aligned but they are not. Many designs can be improved by simply fixing the spacing between objects. (Fox 2005)

Use Unity and Variation. When creating an interface design, one of the biggest challenges is striking a balance between unity and variation. If the design is composed of a group of unrelated elements, then there is no unity. If all of the elements in the design are a different shape or color, then the composition will appear to be thrown together and it will lack the cohesiveness found in a good design. On the other hand, if all of the colors and shapes in the design are exactly the same, then this design will not be very visually interesting. A little variation is required to make a design pleasing to the eye. The best approach is to start with unity. Everything should feel like it fits together (an application of the Gestalt laws of Perceptual). (Fox 2005)

Be a problem free. The quickest way to inhibit enjoyment is to create frustration over simple interface and navigation issues. Although testing is never the most fun part of the process, it is vitally important. In a competitive marketplace, if the game's interface has noticeable bugs it risks losing the users no matter how good the content is. Interface problems can be more than just software bugs, however, as a poorly designed interface is still a major issue. A good way to test an interface is by watching people use this interface a real-world scenario, then arise with some possible questions: Are they able to navigate around and achieve their objectives with relative ease? Is the interface intuitive to both experienced and less experienced game players? (Adrian Jones, date of retrieval 2.3.2012)

Develop for Console or PC. There are some big differences exist between video game development for consoles and development for PC games. Each platform has its benefits and drawbacks. One of the biggest and most apparent differences between the PC and a console is that they use different input devices. A mouse is very different from a controller. The entire game can change if it is on a console instead of a PC. Understanding these differences can help an Interface Designer create a better interface for either platform. (Fox 2005)

4.2.3 Methods of Presenting a Game User Interface

All the Game User Interfaces are made of two main elements: text and icon. Therefore, these two elements, in another word, are the two ways of presenting a Game User Interface:

The first element is **Text**. It is a powerful tool that is often overlooked or at least underestimate by Designer working on game interfaces. The style of text can also set mood of the game as well as color. Each font has a personality. A font that is handwritten and "scratched up-looking" might be a great choice for an extreme sport game, while a smooth and flowing script font might be great for a horse riding game targeted at young female players. It is also possible to make a great interface design using only text. Font choice, size, placement, color, and type effects can greatly improve the design of an interface. (Fox 2005)

Nonetheless, in reality, no one likes to read a lot of text when playing a video game. For this reason, text should only be used when it is absolutely necessary. If the information is so important that text must be put in the interface, then it needs to be easy to read. If text is hard to read because it is too small or is not clear enough, the user is likely to ignore it and move on. Additionally, in many cases, it has been proved that text can be used in the background merely as a design element. And the purpose of this background text is to set a mood. (Fox 2005)

Furthermore, fonts or text styles are an essential element in design text. Fonts can easily be made by using software to manipulate the font design. Most game engines require that an artist create all the fonts. Some advanced engines have tools that can take a standard font and convert it to game format. Even in these cases, it is good to understand how a font works because it is often helpful to edit the font directly. The most common format for a game font is white text placed in a grid. Fonts can also be a great place to put all kinds of images; numbers, dashes, symbols, and icons can all be put into a font file. These icons and images can be used in the game just like a font. A common example of using icons in a font is when creating a console game and small images of the controller buttons are placed in the font (e.g. the Xbox 360 icon). (Fox 2005)

The second element is **Icon.** Beside text, it is another important method of communication in an interface. Nevertheless, displaying information graphically is always more interesting than displaying a lot of text. For instance, if an amount of money must be shown, consider using gold coins instead of a number amount. If the amount of energy character has left must be displayed, consider using a fill-bar. So, icons can be used for almost everything in the interface. Although they usually take a lot more time to create than would a paragraph of straight text, they make the game a whole lot more fun to play. (Fox 2005)

What is more, great icons can accommodate the game to the user without text. Text can used to reinforce an icon, but the better the icons are, the less text will be needed. The key to creating a great icon is choosing the right image to represent the functionality. For example, for a button that allows the player to attack an enemy, a crossed sword icon may be a great solution. Many standard icons, or icons that always mean the same thing, are used in video games. Players already know what these icons mean and can get up to speed more quickly if these standard icons appear in the game. For instance, many game have a save feature, and a common icon for the save feature is a floppy disk. Consequently, it is important to take advantage of player's past experiences by using images that they are familiar with. However, in order to have a better impression from the players, these icons should be customized to fit the look of the game. Moreover, for non-game standard icons; for instance, a symbol used in a bathroom door, a stop icon in music player software, or even a minus and plus sign, these icons can also be used in designing a game icon, since most people can recognize their meaning. (Fox 2005)

4.3 HCI Evaluation Techniques

"Evaluation is concerned with gathering data about the usability of a design or product by a specified group of users for a particular activity within a specified environment or work context." (Preece, J. et al. 1999, 602)

Evaluation can be divided into 2 types: an informal evaluation which only requires a quick feedback of the users, and an evaluation that are much more rigorously planned and controlled (e.g. use laboratory experimentation or large scale surveys). However, regardless of the type evaluation being done, it is important to consider the four aspects: the characteristics of the user who is chosen to participate in the evaluation (e.g. age, gender and experience), the types of activities that the user will do, the environment of the study and the stage of the game that is evaluated (whether it is a demo version or a completed version). (Dix, A. et al. 2004)

Furthermore, the evaluation methods that are used in game serve three main goals. First of all, it is used to access the functionalities, in the extent of accessibility, that is are provided by the game. Second of all, these methods are used to record the user's reaction and experience when playing the game. And lastly, they are used to identify any specific problem with the game. (Dix, A. et al. 2004)

So, without evaluation the games reaching consumer would be premature; they would reflect the intentions of the design team but there would be no study of the actual relationship between design and use (Preece, J. et al. 1999, 605). As the result, it may lead to the failure of games in the market. For that, there are many evaluation methods can be used in game, however, only the Heuristic Evaluation technique is chosen to present in the next sub-chapter (4.3.1). For the reason, Heuristic Evaluation is one of the most powerful techniques that currently used in the computer game and video game industry; it focuses on evaluating the usability of game interface (Pinelle, D. et al. 2008).

4.3.1 Heuristic evaluation for Games

Most of video games require constant interaction, so Game Designers must pay attention to usability issues; for example, the degree to which a player is able to learn, control and understand a game. Having failure to design usable game interfaces can interfere with the larger goal of creating a compelling experience for the users, and can have a negative effect on the overall quality and success of a game. Additionally, Game Designers need a method for identifying usability problems both in early designs and in more mature prototypes. However, there are few formal methods for evaluating the usability of game interfaces (Pinelle, D. et al. 2008). In this sub-chapter, I will introduce a set of Heuristics which can be used to carry out usability inspection of video games.

But first, there is a necessity to understand to word “Heuristic”. It is a set of usability principles that is used by the evaluators to explore an interface (Nielson & Mack 1994). And unlike many common usability inspection techniques which are not appropriate for games since they either rely on formal specifications of task sequence or are oriented around user interface concepts used in desktop applications. Conversely, the Heuristic Evaluation does not make any assumptions about task structure, and it is flexible enough to be adapted to specialized domains. (Pinelle, D. et al. 2008)

What more is the Heuristic Evaluation has the potential to improve the Game Design process. Unlike play-testing (one of the most common ways to uncover design problems using playable prototype of a game), it does not require user participation. Instead, Heuristic Evaluation relies on

skills of evaluator who inspects the user interface and identifies usability problems. In addition, it is in-expensive and can be carried out in a short amount of time. As the result, Heuristic Evaluation gives the evaluators significant freedom in how they conduct the evaluation, and it also helps the Game Designers find important classes of problems that are not always found with user testing. (Pinelle, D. et al. 2008)

One of the first set of Heuristics was developed by Nielsen which is primarily used for desktop applications. It refers to common user interface concepts such as dialogs, undo and redo, and error prevention (Nielson & Mack 1994). However, many of these ideas have limited application in the game context, for the reason, it does not address several important usability issues. An example is the necessity of providing intuitive control mappings when displaying the game world. Similar to the Nielsen case, Federoff (2002) and Desurvire et al. (2004) also compiled a list of Game Heuristics that concentrates on four areas: game interface, game mechanics, story and playability. Some of the usability issues were mention in both the cases, but they were not described in detail. For instance, Federoff's Heuristics include: "for PC, consider hiding the main interface" and "the interface should be as non-intrusive as possible", while Desurvire's Heuristics include: "players do not need to use a manual to play game" and "provide immediate feedback for user action".

Among all, the most appropriated Heuristics, which can be used for the Game Usability inspection, are probably from Pinelle and his associates (2008). What make these Heuristics be different from previous mentioned Heuristics are they consider on the detail of usability. Pinelle and his associate believed that a set of Heuristics that focuses on Game Usability can help improve the video game process. As the result, they created a set of Heuristics to serve as a set of design principle, and to implement the usability inspections at the same time (table 2). (Pinelle, D. et al. 2008)

TABLE 2. Game Heuristics (source from Pinelle, D et al. 2008)

HEURISTICS	DESCRIPTION
Provide consistent responses to the user's action	Games should respond to users' actions in a predictable manner. Basic mechanics, such as hit detection, game physics, character movement,

	and enemy behavior, should all be appropriate for the situation that the user is facing. Games should also provide consistent input mappings so that users' actions always lead to the expected outcome.
Allow users to customize video and audio settings, difficulty and game speed	The video and audio settings, and the difficulty and game speed levels seen in games are not appropriate for all users. Therefore, the system should allow people to customize a range of settings so that the game accommodates their individual needs.
Provide predictable and reasonable behavior for computer controlled units	In many games, the computer helps the user control the movement of their character, of a small group of teammates, or of a large number of units. Computer controlled units should behave in a predictable fashion, and users should not be forced to issue extra commands to correct faulty artificial intelligence. The game should control units so that path-finding and other behaviors are reasonable for in-game situations.
Provide unobstructed views that are appropriate for the user's current actions	Most games provide users with a visual representation (i.e. a "view") of the virtual location that the user is currently occupying. The game should provide views that allow the user to have a clear, unobstructed view of the area, and of all visual information that is tied to the location. Views should also be designed so that they are appropriate for the activity that the user is carrying out in the game. For example, in a 3D game different camera angles may be needed for jumping sequences, for fighting sequences, and for small and large rooms.
Allow users to skip non-playable and	Many games include lengthy audio and video se-

frequently repeated content	quences, or other types of non-interactive content. Games should allow users to skip non-playable content so that it does not interfere with gameplay.
Provide intuitive and customizable input mappings	Most games require rapid responses from the user, so input mapping must be designed so that users can issue commands quickly and accurately. Mappings should be easy to learn and should be intuitive to use, leveraging spatial relationships (the up button is above the down button, etc.) and other natural pairings. They should also adopt input conventions that are common in other similar games (e.g. many first-person shooters and real-time strategy games use similar input schemes). Games should allow users to remap the input settings, should support standard input devices (e.g. mouse, keyboard, gamepad), and should provide shortcuts for expert players.
Provide controls that are easy to manage, and that have an appropriate level of sensitivity and responsiveness	Many games allow users to control avatars such as characters or vehicles. Controls for avatars should be designed so that they are easy for the user to manage, i.e. they are not too sensitive or unresponsive. When controls are based on real world interactions, such as steering a car or using a control stick in an airplane, the game should respond to input in a way that mirrors the real world. Further, games should respond to controls in a timeframe that is suitable for gameplay requirements.
Provide users with information on game status	Users make decisions based on their knowledge of the current status of the game. Examples of common types of information that users need to track include the current status of their character (such as their health, armor status, and location in

	the game world), objectives, teammates, and enemies. Users should be provided with enough information to allow them to make proper decisions while playing the game.
Provide instructions, training, and help	Many games are complex and have steep learning curves, making it challenging for users to gain mastery of game fundamentals. Users should have access to complete documentation on the game, including how to interpret visual representations and how to interact with game elements. When appropriate, users should be provided with interactive training to coach them through the basics. Further, default or recommended choices should be provided when users have to make decisions in complex games, and additional help should be accessible within the application.
Provide visual representations that are easy to interpret and that minimize the need for micromanagement	Visual representations, such as radar views, maps, icons, and avatars, are frequently used to convey information about the current status of the game. Visual representations should be designed so that they are easy to interpret, so that they minimize clutter and occlusion, and so that users can differentiate important elements from irrelevant elements. Further, representations should be designed to minimize the need for micromanagement, where users are forced to interactively search through the representation to find needed elements.

These Heuristics were developed by analyzing PC game review from a popular gaming website, and the review set covered 108 different games divided by 18 for each of 6 major game genres (e.g. action, strategy, simulation, etc.). In the conclusion, Pinelle and his associates believed that the Heuristics that they presented have provided a new way to adapt usability inspection for

games, and allow Game Designers to evaluate both mockups and functional prototypes. Moreover, the Heuristics allow "the Game Designers to evaluate Game Usability by applying design principles that are based on design trends seen in recent games, and that are generalized across major genres found in commercial games." (Pinelle, D. et al. 2008)

4.3.2 Evaluate Usability issues from a case study

In this sub-chapter, I will use the Heuristics from Pinelelle and his associates (2008) to evaluate the usability of the role-playing game (a third person view game) -- "Final Fantasy XIII". The game belongs to the Final Fantasy series developed by Square Enix, and it was released on March 9th 2010. The evaluation process is presented in form of a table (table 3) with the Heuristic's list as well as my comments related to each issue.

TABLE 3. Usability Evaluation of Final Fantasy XIII

HEURISTICS	EVALUATION
Provide consistent responses to the user's action	Character's movement responses consistently to the player's action.
Allow users to customize video and audio settings, difficulty and game speed	Final Fantasy allows the player to set the levels of difficulty (from easy to hard) for the game. The player is also allowed to freely customize the video and sound settings before starting the game and during the gameplay.
Provide predictable and reasonable behavior for computer controlled units	The game has a few problems with the computer controlled teammates. They are frequently fallen behind by the player's character which causing the troubles to engage the enemies and to explore maps
Provide unobstructed views that are appropriate for the user's current actions	The game's views are built with two different modes: third-person and first-person view. The third-person camera is used for most of the gameplay, while traveling or during the battles. However, the player can also have the ability to switch to

	the first-person view in some actions that require an accurate aiming.
Allow users to skip non-playable and frequently repeated content	The game includes many cut-scenes during playing, and they can be skipped by the player's choice.
Provide intuitive and customizable input mappings	The attack and defense strategies, called paradigm, can easily be set by the player, and then be labeled automatically by the game (e.g. combat clinic, diversity and perpetual magic). In the battle, the player can switch between each paradigm quickly by choosing their names.
Provide controls that are easy to manage, and that have an appropriate level of sensitivity and responsiveness	The player only needs to control a single character at a time, when traveling. During the battle, the player can let the game choose a default set of actions on his/her behalf, some late-game battles benefit from a bit of skill micromanagement on top of the usual paradigm (or strategy) fiddling. There will be smart and more difficult challenges waiting for the player once he/she overcomes the ease of the early hours.
Provide users with information on game status	The information about the player's character (e.g. level, experience, attack and defense points, and status) can be easily access through the game menu.
Provide instructions, training, and help	The game provides a sufficient amount of instruction and help during the first few hours of gameplay. The player also has an option to skip these assistances. Some additional information; for example, the data of monsters that the player has fought or location that the player has travelled through, can be found during the gameplay by accessing the game's menu

Provide visual representations that are easy to interpret and that minimize the need for micromanagement	During the gameplay, the player is provided with radar view and map which can be accessed by a short-cut button or accessing the game's menu. Objectives and treasure location icons are displayed in the game's map.

To sum up, "Final Fantasy XIII" had some glitches with the artificial intelligence which are one of the most common errors found in games. However, the game has successfully provided the players with an "easy to use and learn" interface, among its stunning beauty game world, dynamic battles and fantastic story. Nearly every battle and every leg of the journey moves fluidly made these errors seem minor. Thus, it almost goes without saying that "Final Fantasy XIII" is a fruitful product of the RPG genre in the past few years.

5 SUMMARY AND CONCLUSION

The purposes of this Thesis were to gather and summarize information from different publications about the Human Computer Interaction (HCI) and Game Design, then show how the HCI has been applied in the Game Design. Therefore, I started by exploring the many aspects of the Human Computer Interaction research and practices, which included the knowledge from different fields, the three concerned components in HCI (the human, the computer and the interaction), and the set of design steps and design's principles for creating a usable interface of different software related products. And according to Alan Dix and his associates (2004), "the ideal designer of an interactive system would have expertise in a range of topics, since it is not possible to design effective interactive system from one discipline in isolation".

In the Game Design chapter, I presented important information about games. Firstly, talking about the anthropology of games has revealed an interesting fact that there is explicit links between the digital game (e.g. video and computer games) and the analog game (e.g. paper and board games) – the technologies and purposes of games. The purposes of game form into a set of game genres, then the technologies help to bring those ideas into life. Secondly, a list of principles for Game Design which were developed by Roger E. Pedersen (2003) and Bob Bates (2004) were brought together. They serve for the one common goal – to create a better and more usable interface. And lastly but not least important was the set of skills that can be useful for every Game Designer. It is essential to point out that, by no mean, this list is neither completed or that can be applied for every scenario. Instead, these principles will serve as guidelines for every Game Designer, and they can be changed accordingly depended on the situation.

What more is according to on the sub-chapter 3.4 (The Game Designer), it is clear to say that there is no fixed set route to becoming a Game Designer, and this is not an entry level role. Every Game Development process requires high level of complexity, which includes teams of programmers, artists, project managers, writer, musicians and also some other roles. Among these roles, the Game Designer is at the central of Game Development process. Therefore, a qualified Game Designer needs to have a reasonably high level of industry experience and knowledge. For example, the Game Designer usually is asked to provide their employers with some portfolios of

work (e.g. completed game projects or written Game Design documents and proposal). Furthermore, many Game Designers may come from various backgrounds in the Game Industry. Whatever knowledge they had will give them direct experience and different viewpoints of the game development process. It also is important to note that a common route into the role is via a developer or publisher Quality Assurance (QA) department working as a Game Tester. This offers a good grounding in the development process, access to software and tools, and an insight into the different job roles.

Lastly, chapter 4 was a discussion about the role of the Human Computer Interaction (HCI) which contributes in the Game Design process. At the beginning, some issues had been pointed out for there is a necessity to increase the use of HCI in the Game Design processes. One of the matters was about the HCI technologies which contributed to the interaction in games, and the other was about using HCI to solve the negative effect of computer and videos games have in the modern society. In addition, the game interface design process was also introduced as one of the applications of HCI in Game Interface Development; the HCI human factors are the major element to decide the design's goals for the Designer. Furthermore, a set of design principles and the method of presenting a game interface are the results of integrating the knowledge of the three HCI's foundations. More importantly, among other applications such as the interaction styles and the design principles, the HCI's evaluation techniques have probably contributed the most in the Game Development processes. Heuristic Evaluation is a modified version of HCI's evaluation techniques to use specially for games. It is efficient, effective when is used to inspect the usability of an interface, and can also be applied in early developing phases.

6 DISCUSSION

The Thesis took approximately 5 months in total to complete, although the original goal was only 4 months. Among all the chapters had been written, the chapter 4 (Applying Human Computer Interaction) was the hardest and required the longest time to complete. This was mostly due to choosing which the best and most appropriate materials are available, and how to put them together in a logical and organizational way for presenting.

In my second year of study, I had chance to participate in some Graphical Design courses such as User Interface Design, Graphical Design and Desktop Publishing. Additionally, for my work practice period, I spent time on a web-based simulation project for a local software company. During these academic and practical experiences, I had come in contact with some interesting issues. For instance, what is the best way to design interfaces that can both deliver the designer's intents, and help the user easily achieve his or her goal. In order to resolve the issue, I chose to study the Human Computer Interaction, and have developed interest in this subject. As for this Thesis's topic, which is studying the relationship between HCI and the Game Design process, I found it fascinating because unlike other software related products, the idea of bringing the knowledge of HCI into Game Development is still new, and it is an on-going process. Therefore, there are plenty of room for the development and improvement in this area.

What I have learnt by doing this Thesis is, first of all, Human Computer Interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use. The subject has its own unique characteristics in the Computer Science field -- it studies both human and computer systems behaviors, and the interaction between them. Therefore, it can be applicable in a variety of areas such as Web Design, System Design and Game Design. Secondly, in order to create a game which can be easily learned, effectively played and enjoyed at the same time, the Game Designers should not only use their own intuitions and experiences but also it is important to build a relationship between design and use. This has been of a reason that there has been upward trend in using different inspection techniques to decide the level of usable of every game interface, and of all, Heuristic Evaluation is the most compatible to be used in Game Development.

Furthermore, I would like to say both of the strength and the weakness of this Thesis are converged at one point. There is a weak link between the Human Computer Interaction and the Game Design, since some of the materials mentioned in chapter 4 are for the HCI in general software products; they are not specifically to be used in games. However, they also help to point out that we need to have more researches on this matter.

To sum up, I would like to make the Human Computer Interaction as a focus for my future career. I aim to work as a user interface design specialist in the software industry, and by writing this Thesis is a starting point to my goal. Therefore, for those who are interested in the HCI topic or the Game Design, I hope that after you finish reading this Thesis, you can have a better understanding about these subjects.

REFERENCE

Apperley, T. 2006. Genres and Game Studies: Toward a Critical Approach to Video Game Genres. Retrieved 15.2.2012, from Academia.edu http://monuni.academia.edu/ThomasApperley/Papers/358573/Genre_and_Game_Studies_Toward_a_Critical_Approach_to_Video_Game_Genres

Baecker, R.M., Buxton, W.A.S. 1987. Readings in Human Computer Interaction: A multidisciplinary approach: 40.

Barlow, M. 2011. Game Led HCI Improvements. In M. Cruz-Cunha, Business, Technological, and Social Dimensions of Computer Games: Multidisciplinary Developments.

Bates, B. 2004. Game Design, Second Edition. Boston: Course Technology.

Bekker, M. B. 2003. KidReporter: a user requirements gathering technique for designing with children. In Interacting with Computers: 187-202.

Bushman, B. A. 2002. Violent Video Games and HostileExpectations: A Test of the General Aggression Model. Personality and Social Psychology Bulletin.

Card, S. K., Moran, T. P., & Newell, A. 1983. The Psychology of Human Computer Interaction. Hillsdale, NJ: Lawrence Associates.

Csikszentmihaly, M. 1990. Flow: The Psychology of Optical Experience. New York: Harper Perennial.

Davis, M., Hawley, P., McMullan, B., Spilka, G. 1997. Design as catalyst for learning. In Association for Supervision and Curriculum Development: 3-12. Alexandria, VA.

Denning, P. J. 1988. Report on the ACM Task Force on the Core of Computer Science. New York: ACM Press.

Desurvire, H., Caplan, M., Tosh, J.A. 2004. Using Heuristics to Evaluate the Playability of Games.

Dix, A., Finlay, J., Abowd, G., Beale, R. 2004. Human Computer Interaction. Harlow: Pearson Education Limited.

Dyck, J, Pinelle, D., Brown, B., Gutwin, C. (n.d.). Learning from Games: HCI Design Innovations in Entertainment Software.

Federoff, M. 2002. Heuristics and usability guidelines for the creation and evaluation of fun in video games. Indiana.

Fogg, B. 2003. Persuasive Technology: Using Computers to Change What We Think and Do. San Francisco: Morgan Kaufmann.

Fox, B. 2005. Game Interface Design. Thomson Course Technology PTR.

Game Software Industry Report in AlienBrain product catalog 2001. NxN software.

Gentile, D. A., Lynch, P. J., Linder, J.R., Walsh, D.A. 2004. The effects of violent video game habits on adolescent hostility, aggressive behaviour, and school performance. Journal of Adolescence: 5-22.

Hewett, Baecker, Card, Carey, Gasen, Mantei, Perlman, Strong and Verplank 2009. ACM SIGCHI Curricula for Human-Computer Interaction.

Höysniemi, J., Hämäläinen, P., Turkki, L. 2003. Using peer tutoring in evaluating the usability of a physically interactive computer game with children. In Interacting with Computers: 203-225.

Jackson, N. 2011. Infographic: Video Game Industry Statistics. The Atlantic.

Jones, A. 2011. 5 Principles of User-Centered Interface Design. Retrieved 2.3.2012, from Design Festival
http://designfestival.com/5-principles-of-user-centered-interface-design/

Jouhtimaki, J. 2006. Design and Develop a game for Learning. Tampere, Finland.

Kapor, M. 1991. A Software Design Manifesto. Retrieved 2.3.2012, from Dr.Dobb's The world of software development
http://drdobbs.com/184408473

Kimbell, R. 1997. Design as a Catalyst for Learning. Alexandria, VA: Association for Supervision and Curriculum Development.

Lyon, J. 1970. New Horizons in Linguistics. Harmonds-worth: Penguin.

Nanni, P. 2004. Human Computer Interaction: Principles of Interface Design.

Nielsen, J., Mack, R.L. 1994. Usability Inspection Methods. New York: John Wiley & Sons.

Norman, D. 1988. The Psychology of Everyday Things. NewYork: Basic Books.

Norman, D. 1992. Turn Signals are the Facial Expressions of Automobiles. Reading, MA: Addision-Wesley.

Oborne, D. 1985. Computer at Work: A Behavioural Approach. Chichester: John Wiley.

Ogden, S., Falstein, N. 2005. Game Design - Theory & Practice, Second Edition. Plano: Wordware Publishing, Inc.

Paap, K.R., Roske-Hofstrand, R.J. 1988. Design of menus. In Handbook of Human Computer Interaction

Pedersen, R. 2003. Game Design Foundations. Plano: Wordware Publishing, Inc.

Pinelle, D., Wong, N., Stach, T. 2008. Heuristic Evaluation for Games: Usability Principles for Video Game Design.

Preece, J., Rogers, Y., Sharp, H., Benyon, D., Holland, S., Carey, T. 1999. Human Computer Interaction. Harlow: Addison Wesley.

Prensky, M. 2001. Fun, Play and Games: What Makes Games Engaging. In Digital Game - Based Learing. McGraw-Hill.

Price, S., Rogers, Y., Scaife, M., Stanton, D., Neale, H. 2003. Using 'tangibles' to promote novel forms of playful learning. In Interaction with Computers: 169-185.

RocResearch. 2004. Video Game Industry. RocResearch ltd.

Rouse, R. 2005. Game Design Theory and Practice, Second Edition. Plano: Wordware Publishing, Inc.

Scheirer, J., Fernandez, R., Klein, J., Picard, R.W. 2002. Frustrating the user on purpose: a step toward building an affective computer. In Interacting with Computers: 93-118.

Schell, J. 2008. Art Game Design. Burlington: Morgan Kaufmann.

Setzer, V.W, Duckett, G.E. 2000. The risks to children using electronic games. Retrieved December 22, 2011, from http://www.ime.usp.br/~vwsetzer/video-g-risks.html

Shneiderman, B. 1983. Direct manipulation: a step beyond programming languages. In IEEE Computer: 57-59.

Singh, G., Kapoor, A., Singh, A., Sidhu, J. (n.d.). Report on SCAD & HMI. India.

The NPD Group, Inc. Retrieved 15.11.2011 http://www.npd.com

Tuck, M. 2010. Gestalt Principles Applied in Design. Retrieved 9.2.2012, from Six Revisions: http://sixrevisions.com/web_design/gestalt-principles-applied-in-design/

Visual Perception. (n.d.). Retrieved 21.12.2011, from CkBooksOnline
http://ckbooks.com/computers/human-computer-interaction/visual-perception/

Watzman, S., Re, M. 2009. Visual Design Principles for Usable Interfaces: Everything is Designed: Why we should think before doing. In A. J. Sears, Human Computer Interaction: Design Issues, Solutions, and Applications: 1-25. Boca Raton: CRC Press.

Wikipedia Contributors. Video game genres. Retrieved 15.2.2012, from Wikipedia, The Free Encyclopedia
http://en.wikipedia.org/wiki/Video_game_genres#cite_note-Apperley-0

Wikipedia Contributors. Game. Retrieved 10.2.2012, from Wikipedia, The Free Encyclopedia http://en.wikipedia.org/wiki/Game

Williams, D., Skoric, M. 2005. Internet Fantasy Violence: A Test of Aggression in an Online Game. In Communication Monographs: 217-233.

Zaphiris, P., Ang, C.S. (n.d.). HCI Issues in Computer Games. Centre for HCI design.

Zhou, Z., Cheok, A. D., Yang, X., Qiu, Yan. 2004. An experimental study on the role of 3D sound in augmented reality environment. Interacting with Computers 16(6).