



Creating Enhanced User Experience Through Persona and Interactive Design: A Case of Designing a Motion Sensing Game

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Abstract. Motion sensing games are operated with body movements that are captured dynamically by somatosensory devices so that more authentic experiences can be gained for users compared with the traditional operations with keyboards or joysticks. The motion sensing game design involving interactive design, user cognition, information layout of product, interface, influences nearly every important aspect of user experience. To our knowledge, the main problems exist in the motion sensing game design are as follows: (1) motion sensing games, as new type of video games, lack guiding theories and methods for reference. (2) To enhance user experiences for players, it is necessary to increase the research on user perception of user behaviors in early stages of the design. Therefore, inefficiency of game design arises due to lack of effective research methods. In addition, (3) it takes a very long time to develop the project and it also costs a lot. Only by determine users' needs in early stages can these problems be resolved. Inspired by current user research methods within human-computer interaction, product design, and architecture, this paper argue that a persona that is created as a design tool can be used in the process of motion sensing game design. This paper ground the persona method through a design project, Ball Game, based on Kinect. This approach opens new avenues for the analysis and practice of user-centered interaction design of motion sensing games and improves the game experience significantly.

Keywords: Persona · Motion sensing game · Interactive design

1 Introduction

Today, motion sensing game, a new type of video game based on somatosensory technology which is one of the most exciting technological achievements in the twenty-first century, has become an attractive form of entertainment. Motion sensing games are operated with body movements that are captured dynamically by somatosensory devices so that more authentic user experiences can be gained compared with the traditional operations with keyboards or joysticks. Studies identified that motion sensing games use images, sounds and videos images to create dynamic and visual interactions also have strengths in improving cognitive function, visual performance

skills, hand-eye coordination. Bodies can be used to convey or represent ideas, qualities, forms and other meaningful aspects of the design situation.

Utilization of somatosensory technology, such as dynamic capture, human body photography, face recognition and optical and inertial motion measurement, can make amazing game experiences come true [18]. User actions in the ever-changing environment can be understood through the technology. The combination of somatosensory technology, virtual reality and augmented reality technology will bring tremendous changes to the application of motion sensing games and it will lead to a significantly increased interest in the development of motion sensing games. A team started to use Xbox Kinect and found that the game have its benefits not only on physical but also on emotional functions. Somatosensory video games had its unique characteristics which include immediately feedback, competition, challenges, close to grandchild and fun, to attract older adults to keep involved. With the development of somatosensory technology, the motion sensing game will become one of the most important trends of game developments in the future.

The motion sensing game design involving interactive design, user cognition, information layout of product, interface, is complex and influences nearly every important aspect of user experience [6, 16]. To our knowledge, the main problems exist in the motion sensing game design are as follows: (1) motion sensing games as new type of video games lack guiding theories and methods for reference, on the other hand, (2) to enhance user experiences for players, it is necessary to increase the research on user perception of user behaviors in the early stage of the design. Therefore, inefficiency of game design arises because of lack of effective research methods. In addition, (3) it takes very a long time to develop and it also costs a lot to develop the project. Only when the user's needs are determined in the early stage can the product be able to solve these problems. The design strategy of 'actions before product' has an emphasis on understanding and exploring physical actions prior to designing "interface mechanisms that afford such actions". Now there are many traditional ways to understand user needs, such as direct inquiry, observation, etc. However, these methods are not easy to cover all user needs, and cannot reflect users' subconscious behaviors in the process of motion sensing game design. In HCI, usability and UX are considered similar but different terms regarding user satisfaction. It is understood that the system's functional characteristics are vital, but the user motivation to keep using the product is critical as well.

2 Related Work

Alan Cooper (1998) proposed the concept of persona in his book *The Inmates Are Running The Asylum*. Later on, the methods are widely used in researching user needs. Based on the data obtained from user interviews and questionnaires, designers build user models, which includes user behavior models and cognitive models. The user cognitive model mainly includes the users' brain activity process and the external conditions in the process of each character operation. Specifically, user operation model is established to describe the action intention in the operation through the perception of external conditions so that users can solve problems they encounter in the operation.

User research can put the users' expectations for product functions, designs and appearance requirements into the product development process through the users' work environment, product use habits and other research, so as to help enterprises improve product design or explore a new product concept in the early stage of product development. However, in the HCI research field, there is some polemic regarding reliability, validity, and sensitivity of these instruments [15].

3 Persona and Interactive Design

3.1 Understanding Persona

Personas are the outline of real characteristics of product target groups and the comprehensive prototype of real users [1]. User goals, behaviors and viewpoints of product are abstracted and synthesized into a set of description of typical product to help designers understand user needs.

3.2 Attributes of Persona

Attributes of persona: goals (what the user wants to do), behavior (how the user does it) and perspective (how the user views the experience and views themselves). The interaction between people and products can be regarded as a dialogue [2]. The conversation starts when the user plays the motion sensing game, for example, users achieve their goals in the process of game operation according to their own cognition. The motion sensing game also can give information to help users quickly achieve the goal of game content, and reasonably response to the users' request [3].

Before designers design motion sensing games, they must be clear about some facts:

- (1) The user goals are different from ours.
- (2) The user concerns are different from ours.
- (3) Users different considerably from each other.

Designers will be more capable of designing usable products after mastering accurate persona and corresponding role scene. At the time of creating persona, it's necessary to ensure that: (1) persona can represent real users to whom designers pay close attention; (2) property and description regarding personas shall be accurate and complete [19].

3.3 Interactive Design

In the past, interaction design was done by programmers, who were good at coding rather than interacting with end users [8]. Therefore, although many software functions are relatively complete, the interaction design is very rough, tedious and difficult to learn and to use [17]. To make software easy to learn, interaction design is separated from programmer's work into a separate discipline, namely human-computer interaction

design [4]. In the design of interactive products, approaches are emerging which incorporate movement qualities into product form and interaction [5].

The goal of interaction design is to make the product easy for users to use. The realization of any product function is accomplished through the interaction between human and machine. Therefore, the human factor should be reflected as the core of the design [12].

The principles of interaction design are as follows:

- (1) There are clear error prompts. After misoperation, the system provides targeted tips.
- (2) Let the user control the interface. “Next step”, “complete”, facing different levels to provide a variety of options, to provide different levels of users with a variety of possibilities.
- (3) Both mouse and keyboard are allowed. The same function can be used with mouse and keyboard at the same time. Offer multiple possibilities.
- (4) Allow work interruption. For example, when you write a new text message on your mobile phone, you can still find the new text message you just wrote after receiving the text message or phone call.
- (5) Use the language of users, not the language of the technology.
- (6) Provide quick feedback. Give the user psychological hint, avoid the user anxious.
- (7) Navigation function. Always move from one feature to another.

Essentially, persona is created to represent users with different goals by creating typical users to satisfy user groups with similar goals and needs. Since the persona was proposed, many designers have applied it to product design projects [20, 21]. In this paper, this method has been applied to the design of motion games, and the practice has proved that it can greatly improve the efficiency and quality of the design of motion games.

When creating personas, it is ensured that personas represent the real users, attributes and descriptions of personas should be accurate and complete. Next, let’s take a look at the specific ways to create personas.

3.4 Methods for Creating Personas

To find the most accurate model for creating personas, designers will test multiple models at once using statistical analysis. The steps for quantitative persona are as follows:

- Step 1: Qualitative research
- Step 2: Forming a hypothesis about subdivision options
- Step 3: Collecting data of subdivision options through quantitative research
- Step 4: Segmenting users based on statistical clustering analysis
- Step 5: Creating a persona for each subgroup

After analyzing the subgroups, designers should add the names, photos and stories of the characters, telling them to become real and credible characters to make the characters lively. This method needs to be completed by statistical analysis of “questionnaire”. The steps of this methods are as follows:

Step 1: Select user attributes. Gather the goals, behaviors, and opinions of the target users together and classify them according to the priority of primary and secondary attributes.

Step 2: Select the number of subgroups. That is, the number of characters to choose. Generally speaking, each game has 3 to 6 subgroups. Identify segmentation options by analyzing user attributes and the number of personas using the analysis method.

Step 3: Evaluate segmentation options. This process validates and evaluates our resulting segmentation options.

Step 4: Describe subgroups. Put the subdivided groups into two-dimensional table for description. Now designers need to round out our personas by adding names, photos, personal information, industry information, additional information, personas priorities, and complete usage scenarios [22].

There is no such a person as a realistic user, and designers should try our best to enrich and visualize our target user in design decision process. Therefore, it is so necessary to continue to use and update personas that designers need to constantly improve, demonstrate and explain it to each member of the development.

4 Design Experiments: Design Development for a Motion Sensing Game

Inspired by current user research methods within human-computer interaction, product design, and architecture [10, 13], this paper argue that a central persona that is created as a design tool can be used in the process of motion sensing game design. Rather than relying on the imagination of the designer excessively, the approach this paper advocates can be considered as a solution.

Therefore, this paper explores how interactive design and persona can be used to create enhanced user experiences in motion sensing game design. Persona is an abstract user characteristics obtained from user survey, and many key factors of personas are taken into consideration during the creation of this thesis including user study, storytelling, and interactive design principles to enhance their understanding of motion sensing games for users [11].

This project starts with a research on teenagers. This plan employed a questionnaire design in a serious game and recruited N users to participate in our research. A survey was conducted among students in middle and primary schools, and then analyzed the data to describe user's every action, creating a persona for designers to understand user behaviors, finally, grounding the persona through a design project, Ball Game.

4.1 Creating Personas

It is necessary to select the appropriate approach to determine user behaviors, motivation and goals when creating a user segmentation model [14]. Interviewing real users is one of the methods to obtain basic user information, but if investigators want to get more rigorous user data, they need to go to the environment where users use products, and to care about the feelings and expectations of users [7].

In the presented work, this project elaborate our own questionnaire items including more specific questions, one primary school and one middle school in Guangzhou are taken as the sample in the investigation. Distributing questionnaires on the scene and network survey are adopted. 82 questionnaires are taken back of which 11 questionnaires are with data defects and deemed as invalid questionnaires, so there are 71 effective questionnaires in total. The questionnaire is divided into three parts, including basic information on respondents, cognition regarding game objective and game type willingness.

Basic information on samples is as follows (see Table 1):

Table 1. Sample basic information.

Basic information		Number of people	Percentage
Gender	Male	37	52.1%
	Female	34	47.9%
Age	Below 9 years old	6	8.5%
	10–11 years old	15	21.1%
	12–13 years old	34	47.9%
	Above 13 years old	16	22.5%
Average time length of playing games every day	Less than 30 min	35	49.3%
	30 min–1 h	21	29.6%
	1–2 h	8	11.3%
	Over 2 h	7	9.9%

In addition, based on the investigation, more than 88.7% informants agree that playing games can relax and above 78.9% informants have gained some understanding about motion sensing game.

To inspect whether data index is influenced by one factor, we often use variance analysis model for inspection. Fundamental principle of variance analysis is to divide data into a group(s) as per a level(s) of Factor A. In case that sample average level at a level(s) is free from significant difference, it’s deemed that Factor A has no prominent influence on data; in case that sample average level at a level(s) is with significant difference, it’s deemed that Factor A has a significant To inspect whether data index is influenced by one factor, this paper use variance analysis model for inspection. Fundamental principle of variance analysis is to divide data into a group(s) as per a level(s) of Factor A. In case that sample average level at a level(s) is free from significant difference, it’s deemed that Factor A has no prominent influence on data; in case that sample average level at a level(s) is with significant difference, it’s deemed that Factor A has a significant influence on data.

Establishment of variance analysis model:

$$SS_T = SS_A + SS_E \tag{1}$$

SST refers to total sum of squares of deviations, reflecting overall variance volatility of data. SSA refers to sum of squares of deviations of Factor A, reflecting the influence of factor A on test index. SSE refers to error sum of squares, reflecting the influence of experiment error on test index.

$$SS_T = \sum_{i=1}^a \sum_{j=1}^b (X_{ij} - \bar{X})^2 \tag{2}$$

$$SS_A = \sum_{j=1}^b \sum_{i=1}^a (\bar{X}_i - \bar{X})^2 \tag{3}$$

$$SS_E = \sum_{i=1}^a \sum_{j=1}^b (X_{ij} - \bar{X}_i)^2 \tag{4}$$

Establishment of test statistics:

$$F = \frac{SS_A/df_A}{SS_E/df_E} = \frac{MS_A}{MS_E} \sim F(a - 1, ab - 1) \tag{5}$$

Null hypothesis is refused and factor A is deemed to have an appreciable impact on data at that time:

$$F > F_{\alpha}(a - 1, ab - 1)$$

Related data of investigation and statistics is brought into variance analysis model (1), (2), (3), (4) and (5) and the following results are obtained:

Table 2. Variance analysis on the time length of people with different sexes playing games

Variance sources	df	MSE	F value	P value
SSA	1	0.08999	0.352239	0.55
SSE	69	0.25548		

Table 2 shows P value 0.55 > 0.05 and no significant difference occurs to time length of player with different sexes playing games.

Table 3. Variance analysis on time length of people at different ages playing games

Variance sources	df	MSE	F value	P value
SSA	3	0.78	3.376623	0.023
SSE	67	0.231		

Table 3 shows that P value $0.023 < 0.05$, significant difference happens to time length of player at different ages playing games and with the increase in age, progressive tendency occurs to time length of playing games.

Table 4. The time teenagers play games

Time length of playing games	Sample size	Percentage	Class mid-value	Mean value
Less than 30 min	35	49.3%	15 min	44.15 min
30 min–1 h	21	29.6%	45 min	
1–2 h	8	11.3%	90 min	
Over 2 h	7	9.9%	135 min	

Table 4 shows that only 21.1% teenagers play games for more than 1 h and the mean value of player playing games is 44.15 min.

Table 5. Analysis on target expectation when users play motion sensing game

Target expectation	Sample size	Percentage
The game is relatively exciting	27	38.0%
Operation is simple and easy to learn	25	35.2%
Exercise	35	49.3%
Game surface is exquisite	17	23.9%
Only want to experience it	15	21.1%
Interacting with people can be realized	18	25.4%

Table 5 shows top three target expectations when users play motion sensing game are (1) getting the “exciting” game experience in the process of playing games, (2) easy operation and studied, and (3) doing exercise.

User segmentation model is created based on segmentation option data collected by the above quantitative research and statistical analysis. And then designers add names, photos, ages and hobbies to them so as to make them more realistic and reliable as well as vivid and it’s necessary to crystallize roles and avoid wrong description as far as possible as well as realize particularity and accuracy. Inaccurate description will cause the designer has less understanding about users and even result in wrong judgment concerning design direction. As for motion sensing game, some stories with content are needed which are like stories in the film and television program or novel. However, users of motion sensing game can have more direct experience and players are personally can play the role in the story.

4.2 Requirement Description of Personnas

According to research analysis on target users, motion sensing game to be designed in this paper shall be able to meet the following requirements of users:

Challenging need: “Challenging” of the game can excite users with “excitement” embodied incisively and vividly in the competitive games. With popularity of competitive games, demand of game challenge and satisfaction of challenge demand are very important for players.



“I like exciting games!
I like sports!”

Bill

- 13 years old
- Middle School Students
- Lives in Guangzhou
- 2 brothers

After school, Bill would play games with his two brothers for half an hour every day. He thought games were a good way to relax and it had better be challenging.

He knows a little about motion sensing games and VR games. If he has the opportunity, he is willing to try them. It would be even better if motion games could exercise the body while allowing for multiplayer interaction and simple gameplay.

Typical game requirements:

- Exciting game
- Sensitive game operation
- The operation is simple
- Multiplayer
- Exquisite game pictures

Fig. 1. Persona for Ball Game

Aesthetic demand: Aesthetic demand is people’s instinct. Exquisite game screen, gorgeous special effects and lifelike persona can enable players to experience beauty.

Interactive demand: Satisfying interactive demand and interaction really can be realized by research on users’ psychological need and integration of game factors. In case of game players being able to smoothly communicate with game system, excellent interactive experience will arise. Now, although there are many good multiplayer stand-alone games in the market, they fail to meet players’ interactive demand.

Sports demand: Motion sensing game shall be simple and funny and then players can have a happy time in the game freely and easily. In the process of playing games, players often win various awards. Sports is everyone’s physiological needs.

4.3 Personas Implementation

At the moment of creating persona (see Fig. 1), there shall be at least one primary persona in the user subdivision group which is the central person to be considered, thus game demand of the main character must be meet. Based on role description, the designers shall reasonably analyze main persona. For example, several main user

behaviors (including “head movement”, “upper limb movement” and “lower limb movement”, etc.) are known by user analysis [9]. Such behaviors is the constitution foundation for one persona model. Satisfaction of user behaviors demand can be realized by recognizing users’ effective body language in the motion sensing game finally.

4.4 Process Design of the *Ball Game*

This motion sensing game, *Ball Game*, is aimed at sport-loving teenagers, who are energetic, loving challenges. Through the analysis of these users, the personas are established, and then the tasks the personas are trying to complete and the feedback of interaction errors are mainly considered in the game design process. Otherwise, users will get lost in the navigation of the game if the reason for the error and the solution are not considered. Therefore, this method can be applied to improve interaction efficiency.

In accordance with main persona established, main users’ psychological need and behavior are analyzed. On this basis, the author designs the process of motion sensing game. Based on the method applied for the above persona, one motion sensing game simulating the movement of heading the ball is designed in this paper. In short, motion sensing game design is to conceive game structure and process (see Fig. 2). The design is characterized by emphatically highlighting learnability and repetitive challenge of the motion sensing game-motion sensing football game. For example, the player can get satisfaction of winning by playing the game in several rounds in the link of goaling by heading the ball. In the meanwhile, somatosensory interaction design model established on the basis of persona is used to evaluate problems and solutions from different perspectives, reduces error message prompt furthest and can improve interactive efficiency and solve key problem of interaction model.

4.5 Display of the *Ball Game* Design Example

At the moment of designing the interface of the team member implementing corner kick, the blue is used as background and team members’ shirt is red, as a result, team members can be clearly emerged. Characteristics are marked near each team member with highlighting for suggestion, more attention will be attracted from users. Mar-shalling sequence of team members is set to “s” arrangement which saves interface space (see Fig. 3).

Figure 4 shows the interface of virtual footballer serving a ball which is filled with a very big digit. Such design can facilitate the footballer heading the ball to pay attention to the time and creates nervous game atmosphere.

The scene in Fig. 5 involves character expression of the athlete in the game in the virtual scene. In case of the player in the real scenario moving, the athlete in the virtual scene will also move. Such man-machine interaction is more intuitive and natural. In the virtual scene, each athlete is with one aureole aimed at beauty as well as marking and differentiation.

Figure 6 involves the physical interaction scene where the player is going to head the ball when the ball comes from a distance. Six footballers in the virtual scene correspond to six players in the game. The player goaling by heading the ball is the

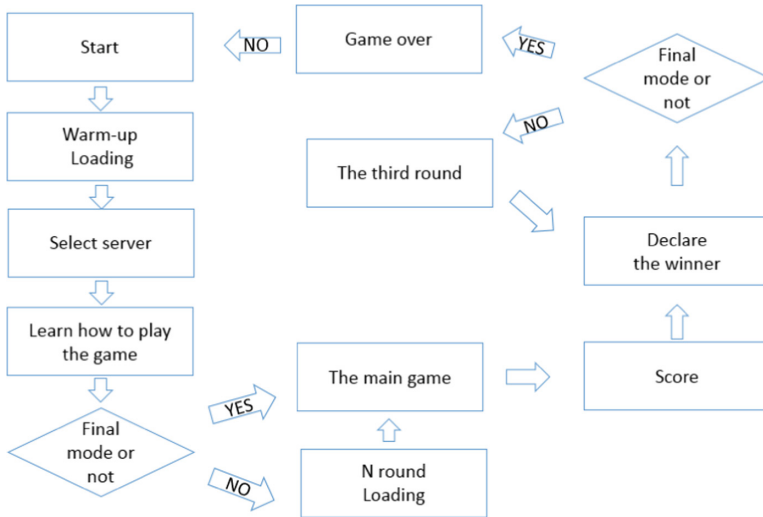


Fig. 2. Interactive flow of the *Ball Game*

winner who can win the game by only judging the best time for heading other than learning other aspects. The game can mobilize the players’ enthusiasm and satisfy their mood of aspiring to succeed.

Applying persona to the design of motion sensing games is considered to be an



Fig. 3. Select server (Color figure online)



Fig. 4. Message for kickoff

effec-

tive way and can greatly improve the quality of motion sensing game design. This paper ground the persona method through a design project, *Ball Game*, based on Kinect and played by teenagers. This approach opens new avenues for the analysis and practice of user-centered interaction design of motion sensing games. The user-centered interaction game design based on personas focuses on the tasks users are trying to accomplish, the feedback of user interaction errors, and what functions the motion sensing game provides, improving the game experience significantly. The results showed users can clarify their ideas based on the interface of motion sensing game.



Fig. 5. Attempt stage

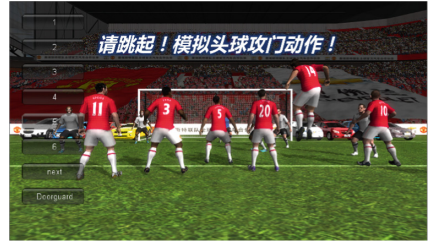


Fig. 6. Start the game

5 Discussion and Conclusion

This paper introduces a typical virtual user, persona, to help designers understand game players better. Persona contributes to understanding users better for motion sensing game designers. Additionally, the method of persona reduces the time of game development and the risk of development of motion sensing games relying on designer's intuition or manager's imagination. Finally, users of the game get enhanced user experience. However, survey on more samples should further inquire on the potentially critical relation between the information available of the interactive design of motion sensing games and user behaviors. In addition, further adjustments and additional test iterations are warranted to validate its use as a reliable usability evaluation.

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