Gameplay Issues in the Design of 3D Gestures for Video Games.

Abstract

We describe preliminary tests that identify points to be considered in the design of 3D gestures in space as a means of interacting with video games. Previously, research on 3D gesture has largely been the domain of VR. There has been less investigation into the use of 3D gestures in video games where emotion, immediacy and immersion are more important than breadth of functionality and user task efficiency. These tests use the 3motion™ system, a wireless inertial motion tracking device and gesture SDK. This enables a range of gesture types from tight, precise movements to whole arm gestures, and from direct mapping of movement to recognition of symbolic gestures. Four game scenarios using different gesture characteristics were used to identify gameplay issues that have an impact on the design of 3D gestures.

Keywords

3D gestures, videogames, physical gaming.

ACM Classification Keywords

H5.2. User Interfaces (input devices and strategies).

Introduction

3D spatial gestures have been a part of computing interaction research since the “Put that there” interface from Bolt [1]. The seemingly natural and intuitive ease with which gestures could replace command menu structures and cumbersome or intrusive controller mechanisms was seen to empower users with increased
control over their intent. However the effective implementation of gestures is more complicated than originally thought. Issues related to human spatial motion awareness, user performance differences, cognitive/semiotic confusion and user feedback all complicate the implementation of spatial gestures in videogames.

The past five years has seen physical gaming and gestural interaction become an attractive element of videogaming scenarios. Whether players use a context specific device such as a light gun or input devices that are unique from typical games controller such as an EyeToy® or Gametrak™, new forms of interaction are playing a role in the development of innovative gaming scenarios.

We have developed a wireless inertial gesture recognition software development kit called 3motion™ [2] that allow us to easily define and implement 3D spatial gestures within gaming scenarios. By utilising this resource we aim to investigate the key aspects required to implement intuitive and enjoyable gestural gaming applications through demonstrator development and user experience trials. This information should reduce any conflict between the game designer’s intent and the user’s experience within the game.

**Review**

We define gestures in games as a means of control which requires the recognition of a pattern of behaviour or performance thresholds. An early example of this type of gesture in games is from Capcom’s 1992 game “Street Fighter II®” which used a series of digital control pad movements and button presses which, when these patterns were performed within time constraints, would make your character perform a special move such as a fireball or hurricane kick.

Lionhead Studios®’ “Black & White®” requested the player to cast spells in the form of letters or symbols by moving the mouse thus removing the need for extensive menu structures which would have slowed the pace and user’s immersion within the game. This is an example of the benefits for using gesture within a gaming scenario.

Even with this effective implementation in 2D, 3D gestures present their own problems in relation to:

- how to present 3D gesture feedback,
- user performance differences,
- what are familiar semiotics for 3D gestures.

Recent gesture interaction games have shown there are ways around a full implementation of 3D spatial curve and posture matching through recognising key thresholds in human movement and using this information to drive the gameplay.

An example of this system can be seen in the game “Samba de Amigo” or “Dance Dance Revolution” in the arcade. The Samba game used sensors to drive a rhythm-based movement game, where the player had to match movements on screen in time with the music. Inertial sensors recognised movement and orientation of the player based on threshold measurements.

The advent of the Sony EyeToy® and Gametrak™ input devices which didn’t have any kind of conventional button based input presented users and developers
with a problem of how do you control menu screens or select options in 3D with no buttons to press? Also, how do users set up and play with the device where there is nothing to hold or touch? Both of the above applications approached this problem through introductory videos and tutorials. Since gamers haven’t had previous experience with 3D interfaces, new methods of teaching users what to do needed to be developed. Nolan Bushnell’s comment that “no-one wants to read an encyclopaedia to play a game” [3] illustrates that users have to be informed clearly, concisely and reliably.

The Nintendo® DS™ “WarioWare™”, “Twisted” and “Touched” mini-game format illustrates that the use of single word phrases, simple and distinctive graphics with applicable user feedback are all required to ensure that the gameplay is intuitive and rapidly understood.

This work aims to present the implementation issues of 3D gestures and show how we have attempted to overcome them, through a series of user-tests and demonstration development cycles.

Testing rationale
During the technical development of the 3motion™ system, we exposed it to a wide range of users, both adults and children, including game developers and gamers. This allowed us to make informal observations about the ways in which people used the device in a wide range of scenarios including mobile games, interactive TV and pervasive technologies. We are now using the device in our research on the design and use of 3D gesture in video games. To inform the design of a more extensive testing regime, we implemented a suite of four test game scenarios, and carried out a pilot test with two adult subjects: one male, a heavy user of computer games; one female, with limited experience of computer games. These tests, while limited in number, nevertheless identified some important issues in the design of 3D gestures for video games which we propose to investigate in the next stage of testing. In particular, they highlighted the close connection between gesture and gameplay issues.

The characteristics and capabilities of the 3motion™ [4] system enabled us to develop a range of games (see below) with contrasting interaction scenarios using significantly different aspects of ‘gesture’: gesture directly mapped to action (e.g. Neverball) or symbolic use of gesture (e.g. Wizards); tight, controlled, precise movements (e.g. Neverball, Alarm) or broad gestures (e.g. Wizard); speed/repetition (e.g. Heli) or accuracy (e.g. Neverball). This allowed us to observe issues which are common across scenarios, or particularly significant with specific types of gesture.

Tilt
The open-source 3D game “Neverball” features a ball, controlled by tilting the ground beneath it. Each level in the game is an obstacle course where the player must guide the ball carefully towards the exit, avoiding hazards, and before the time limit expires. For our tests “Neverball”’s control system was modified to allow the tilting to be performed using the 3motion™ wireless controller. No button presses were required.

Alarm
The accelerometers of the 3motion™ controller can detect minute changes in velocity. The Alarm demonstrator uses no graphics, simply emitting a loud ringing sound should an acceleration threshold be exceeded. i.e. if the player’s hand shakes, or is unsteady. Each player was presented with the

Above is a screenshot of the Neverball Tilt game, below is a screen from the Heli game.
challenge of silently picking up the controller, lifting it over the laptop, and placing it back on the desk.

**Heli** In this 2D game, a helicopter on the left of the screen must avoid collision with rocks randomly appearing from the right. As the boulders move towards it, the helicopter can change only its height to avoid impact. The player obtains this lift by twisting and shaking the 3motion™ controller, so building the helicopter rotor-blade speed. A score, increasing over time, is also multiplied by the collection of bonus fruit objects.

The testing equipment involved a video camera, laptop with demonstration applications and the 3motion™ hardware (figure 3). The evaluators recorded comments and performance issues during the trials. Once they were comfortable with the interaction they were left to play a number of rounds with each game.

A pre-test interview gathered computer use, gaming behaviours and background. This helped to indicate performance relationships between frequent game players and novices.

Each demonstration was preceded by a brief introduction to the game. An indication as to how to move the controller was given with the application running. The user was left to play each game for a number of rounds or until satisfied. During the trials users were asked to think-aloud and describe their experiences and ideas throughout.

After each trial the participant was questioned about their immediate experiences with each scenario. This enabled us to get a focused insight to each application. At the end of the testing session, a post-test discussion allowed subjects to highlight positive and negative experiences across all applications.

**User feedback and observations**

The observations of the researchers and feedback from the subjects covered a broad range of topics; for the purposes of this paper we concentrate on issues that
have an impact on the design of gestures for games, particularly those directly related to gameplay. Our original intention was not to get bogged down in gameplay with subjects, however it became clear that it was not possible – and even undesirable – to separate the nature of gestures from aspects of gameplay, particularly in more complex applications of gesture such as “Battle of the Wizards”.

In all the scenarios, good ‘feedback’ on gestures, in the sense of a subject being able to calibrate their activity against results, was important. One subject commented in the Heli game that it wasn’t clear how much you had to shake the device to move the object. This seems to be a symptom relating to a lack of feedback in the game. Subjects preferred games with simple gestures, which allowed them to get right in and play, rather than more complex games with confusing gestures that they had to remember.

The Wizard game in particular, with its (relatively) complex 3D gesture interaction, highlighted the issues of both teaching gestures and reminding players of gestures during a game, if there is no-one present to assist them. One suggestion for the Wizard game was that in a future version, the visual representation of the spell in some way inherently describes the gesture. This type of issue emphasises the link between gesture design and gameplay.

Another observation from the Wizard game, with its symbolic gestures, was a need for coherence in the way a set of gestures is designed; although the gestures may in themselves be simple to recognise (for both machine and user) the relationships between them need to be carefully considered.

In the current implementation, the two defence spells are represented by one gesture mirrored horizontally. The attack spells are represented by another gesture mirrored vertically (both attack spells move from left to right). The spells are categorised ‘Black’ and ‘White’, each category including an attack and defence spell.

We observed that the subjects adopted the defensive spells easily, but also appeared to transfer the same reasoning to the attack spells, choosing a correct gesture but mirroring it horizontally rather than vertically for its companion spell.

Subjects also became confused about the relationship between the different attack and defence spells, particularly the relationship between the names of the spells and their gestural symbol, and also the visual representations of the spells in the scene, reflecting the interconnectedness of gesture and gameplay.

Another aspect which emerged was the possible effects of existing gaming experience on expectations of gesture. In our test, comments from the subject with a lot of experience of video games suggested that he expected more accuracy and precision in interaction, which may reflect his experience with consoles. The subject without a lot of experience of video games related the gesture interaction to other activities e.g. fencing, or scene painting.

The subject who did not regularly play computer games commented in these scenarios that gestures were much more intuitive than pressing lots of buttons, and having to remember combinations of buttons to trigger actions. She commented that the interaction was more
personal and more reactive to what you are actually doing.

A benefit of a system such as 3motion™, which was remarked on by subjects during the tests, is that the variety of gesture types it can handle could be used to provide very different types of interaction within a single game.

Conclusions
These tests, although preliminary, confirmed some of the user benefits of 3D gesture as a means of interaction, such as intuitive movements linked to actions performed, as opposed to ‘button bashing’. We found that informative tutorials, single word instructional phrases, effective semiotics and appropriate user feedback are all required to ensure that the gesture based enjoyment is intuitive and rapidly understood.

We found particularly in the Battle of the Wizards demonstration that the semiotics of the gesture set could be considerably improved through investigating their relationship with the intended gameplay.

We propose that user feedback in gesture games is closely linked to the type of gameplay being designed. For example, the Alarm game had no visual feedback to indicate where the threshold was set, only an alarm when the value was passed. This provided for a tense gameplay experience, within which users were rapidly immersed. However, Battle of the Wizards may have benefited from a form of feedback to allow gamers to more reliably match target gestures. The method of feedback is part of the definition of the game. We propose further investigations, the results of which will aid designers to effectively define the aspects of feedback to best suit their application.

Also, further research into methods to improve the menu structures based on 3D gestures within games will be performed. This work will help maintain playability and reduce excessive user memory recall within games. An assessment of training and teaching methods for 3D gestures will also be carried out, whether those are instructions for mini-games like the EyeToy® or DS™ or for full games such as the Gametrak™ or Battle of the Wizards.

The next stage will involve more rigorous testing and user feedback will include participants rating their experience against gaming-related criteria such as excitement, immersion, connection and reliability. We propose to address these emerging issues through the development of new gameplay, new gesture design and new implementations of 3D input for videogames.

References

