History and Alternative Game Input Methods

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Abstract–This paper reviews the history of input methods used for video games, in particular previous attempts at introducing alternative input methods and how successful they have been. It also aims to answer the questions: 'What are players' perceptions of alternative input methods? and 'Can playing a game with an alternative input method increase players' immersion and entertainment?' We created a simple two-player game Project Zion, which can be played with any one of a number of different input devices, both traditional and alternative, e.g. mouse, keyboard, Xbox 360 controller, Wii Remote, dance mat, Phantom Omni haptic device, SpacePilot Pro, and webcam. We then enlisted participants to play the game in pairs with one of the selection of input methods (each player in the pair can use a different input method to their opponent) and then asked them to fill in a questionnaire about their previous game playing experience, opinions on games that make use of alternative input methods.

The project comes to the conclusion that alternative input methods can increase the immersion and fun players perceive, provided that the input method used fits the game mechanics. Players express negative feelings when playing a game with an input method that does not suit the game mechanics, feeling that it is merely a gimmick. The result also shows that players' perceptions of alternative input methods are tied to their previous experiences with that input method.

Keywords-input devices, alternative input, video games, user interface, game input

I. INTRODUCTION

The traditional keyboard and mouse combination as the primary input devices, now mainly for video games on PC platform, predates the growing popularity of game input devices like Xbox 360, Wii Remote, and recently released controller free interface--Microsoft Kinect. This paper use a two-player game prototype Project Zion to demonstrates how games can leverage alternative input devices that enhance the overall player experience. Through a player survey, we aim to find out how participants feel about a variety of input methods for a specific game, whether they think that different input methods give them an advantage playing the game, or make them feel more immersed in the play experience.

The Project Zion is simple in nature, and can be played with either a keyboard, a mouse, a Microsoft Xbox 360 Gamepad, a Nintendo Wii Remote, a dance-mat, a web-cam or a Phantom Omni haptic device. It is a two-player game, with players able to use any input method regardless of which method their opposition is using.

The rest of this paper is organized as following: firstly we review the history and future of input methods used for video games with a focus on how successful previous attempts at introducing 'alternative' input methods for games have been; then the design of the game, which can be controlled by many different input methods, is described; and the data collected as a result of participants playing the game is analyzed and discussed. Finally it will touch on some ideas for further directions and present the conclusions that have been drawn from the data.

A. Input devices of video games

This section will look at the history and future of input methods used in games, from the first graphical computer game to the future input methods currently in development and attempt to find a trend in the evolution of game input. The history section goes from the first graphical computer game to the present day, highlighting game input methods of note for one reason or another, the future section covers input methods that are in development and some details are known about them, but have not been released to the general public.

B. History of Game Input

The first graphical computer game was Noughts And Crosses (a.k.a. OXO), programmed by A.S. Douglas in 1952, for one of the earliest computers ever built, the EDSAC for his PhD dissertation on Human-Computer interaction. The game used a mechanical telephone dialer for an input device (Winter 2010a).

The first home video game system, the Magnavox Odyssey (a.k.a. 'the Brown Box') was designed to play many different games, which required it to have a more general input device. This duel-dial system allowed the player to control a number of 2D games. The Odyssey also allowed players to use overlays and attach a light-gun input device to the system to play a number of shooting games. However, the technology was not very advanced, and the player could fool the game into thinking they had performed a good shot on screen by shooting at a light bulb (Winter 2010b).

The first commercially sold coin-operated video-game machine was the Galaxy-Game machine, produced in 1971, used a joystick and buttons for the input device, in a layout that later be copied for most arcade machines for years to come.

Gran Trak 10, produced by Atari was the first arcade game to feature realistic car controls, the system used a steering wheel, four position gear shift leaver and pedals for acceleration and breaking, this revolutionary new controls quickly won many fans, and paved the way for other racing games that have similar controls. (GameSpy, 2003. Gran Trak 10 and Sprint 2)

1977 saw the introduction of an arcade machine called Triple Hunt. This was the first arcade machine to use a positional gun input mechanism, which involved fixing the gun to what is essentially a joystick and using that position to work out where on screen the player was shooting (Game Innovation Database. Tipple Hunt, 1977).

The first games console to make use of a microphone as an input device was the Nintendo Famicon, released in 1983; this system used two gamepad's with the microphone replacing the 'select' and 'start' buttons on the second controller. (Gamepad at AllExperts. Gamepad)

In 1989, Nintendo released the PowerGlove which was a glove that the player would wear and combined with three input sensors attached to the players' television, it translates the movement of the players hand and fingers into input that could be used to play existing Nintendo games. Nintendo also produced two games specifically for use with the PowerGlove, 'Super Glove Ball' and 'Bad Street Bawler'. The PowerGlove has been criticised for being inaccurate and difficult to use (Mellotts VR Page 2009) and no more games were produces specifically for it (ABC.net.au 2008).

The Super Nintendo Entertainment System (SNES), released by Nintendo in 1990 had the first gamepads to feature 'shoulder' buttons (Honniball 2008) which are buttons positioned on the top of the gamepad, where a players index fingers would usually rest, this placement proved popular and became common-place in future controllers.

In 1995 Namco released the NeGCon, an innovative control pad for the Sony Playstation, it allowed players to twist the game-pad as an input method, it was also the first game input device to feature analogue, pressure sensitive buttons. This made it exceptionally good for playing racing games, and a number of popular racing titles at the time supported it (Byte Cellar, 2007).

Another first for Nintendo came in 1996, when they released the Nintendo 64 games console. The gamepad for the Nintendo 64 made use of an analogue-stick, a smaller version of the joystick that had been prevalent in arcade systems for some time that could be controlled by the players thumb. Again this innovation became standard in future gamepads. (Press Start. Nintendo 64)

The Game.com was the first games console using a touch screen and stylus for input, released by Tiger Electronics in 1997. It didn't sell well, however, as the low sensor resolution lead to a lack of precision that is required for games (Snow 2007).

In 2003, Sony released the EyeToy, a camera input device on PS2. The camera, which was the result of work done by Richard Marks and Phil Harrison (Kim 2008), allowed players to use their body as the input, and allowed developers to create an entirely new gaming experience. The EyeToy was initially sold in a bundle that included a collection of 12 mini-games called EyeToy: Play, which contained such games as Kung Foo, where players swat ninjas and Wishi Washi, which requires players to wash windows against the clock (The New York Times, 2003. Smile, Gamers: You're in the Picture). A number of games have been released to specifically use the EyeToy, along with others that can use the EyeToy optionally, to enhance the gaming experience (EyeToy.com. The Big List). The EyeToy was initially a success, with Sony reporting that it sold 400,000 units of the EyeToy and EyeToy: Play bundle in its first two months on sale (Gaming Age, 2004. Sony Announces PlayStation 2 Holiday Sales Results), and in 2008 Sony reported that over 10.5 million EyeToy cameras had been sold (Kim 2008). Also, in 2007 Sony released PlayStation Eye for the PlayStation 3 (EyePet was a game specifically developed for they PlayStation Eye). It is the successor to the EyeToy for the PlayStation 2. Since then, it fell off the radar because of Microsoft Kinect (previously known as the Natal Project), which does full body motion tracking.

In late 2006, Nintendo released they're seventh-generation games console, the Wii and with it the Wii Remote, (a.k.a. the Wiimote). This controller was a revolution for game input, allowing games to capture a range of different motions the player made whilst holding the controller. Up to four Wii Remotes can connect to a single console via a Bluetooth connection, and uses this connection to send button presses and other data to the console. Wii Remotes make use of a sensor bar, which is usually placed on or near the television the Wii is plugged into, the sensor bar comprises a number of LEDs, a camera mounted on the front of the Wii Remote tracks these LEDs, allowing it to detect where on the screen it is pointing (Marriott 2006). Wii Remotes also make use of a three-axis linear accelerometer that is used to detect the relative motion of the control along three axis. Along with these innovations, the Wii Remote also includes, a speaker for audio-feedback, a rumble-pack that causes the control to vibrate at different intensities, 7 digital buttons, a d-pad style input for 8-way directional input and a pressure-sensitive 'trigger' button. At the back of the Wii Remote, there is a plug that allows the connection of a number of additional controls, such as the 'Nunchuck' that provides another two buttons and an analogue-stick (WiiBrew. Wiimote). The commercial advances and performance of the various controllers has been compared in Klochek & MacKenzie (2006) and Isokoski & Martin (2007).

The Wii has been fantastically successful, becoming the fastest selling gaming console in UK history, selling over six million units in the three years since its UK release (Telegraph, 2009. Nintendo Wii sales pass six million). The technology behind the Wii, including the Wii Remote has lead to a massive homebrew movement, with many un-official applications developed (WiiBrew. List of homebrew applications).

During the E3 conference in July 2007, Nintendo revealed a new input device called the 'Balance Board'. (Consol Watcher, 2007. Stay Fit with Nintendo Balance Board) The Balance Board is a device that the player stands on and contains sensors to detect the weight and balance of the player, allowing them to control games by shifting their weight, it is capable of sensing the distribution of weight on both the x (left and right) and z (forward and backward) axis (IGN, 2008. GDC 2008: Sawano on Wii Fit).

In July 2008, Nintendo announced the 'Wii Motion Plus'. This device attaches to the end of the Wii Remote and improves the motion tracking. (Kotaku, 2008. Nintendo Introduces Wii Motion Plus) The Wii Motion Plus uses a very precise multi-axis gyroscope, which when combined with the existing hardware, allows the Wii Motion Plus to determine 1:1 motion. (Kotaku, 2008. How, Exactly, Does The Wii's MotionPlus Work) Currently seventeen games have either been released, or announced that make use of the MotionPlus (How About A Wii, 2009. Wii MotionPlus Compatible Games).

In September 2010, Sony released a new motion-based controller for the PS3—PlayStation Move, which is designed to work with the PlayStation Eye camera in conjunction with the light emitting orb atop the controller to calculate the player's position in three-dimensional space. As the orb can change colour, multiple controllers can be tracked simultaneously (PlayStation Move Motion Controller 2010). Around the same time, Microsoft Kinect (2010) launched a new era in human-computer interaction and gaming experience, by using a natural user interface of controller-free full body motion capture, gestures, facial recognition, and spoken commands. Kinect competes with the Wii Remote with Wii MotionPlus and PlayStation Move with PlayStation Eye motion control systems. The strategies for developing full body motion game interfaces has been explored in Norton et al. (2010).

Another trend of game input is voice input and speech recognition. In late 2008, Ubisoft released a game called 'Tom Clancy's EndWar'. The game was a Real Time Strategy (RTS) game which typically requires a large number on inputs to allow players to access the full range of commands available. EndWar overcomes this limitation by the use of a speech-recognition facility, which translates voice commands into orders for the in-game units. This allowed the game to be released on console platforms, instead of being limited to just the PC platform (Joe 2008).

C. Future of Game Input

As early as 2007, Austrian company Guger Tecnologies showed that is possible to control a game with the power of your brain alone, producing a version of the classic arcade game 'Pong' that a player controls by using their $5,000 brain-computer interface. The system works by monitoring the fluctuations of the electrical voltage of the brain, and turning that into input that is recognised by the game. Already available for hospitals and research institutes, it claims to have a 99-100% level of accuracy for trained subjects (Ricker 2007). Recently, EEG-based technology has become more popular in brain-computer interfaces in serious games (Wang et al. 2010) since new headsets that meet player demand for wear-ability, price, portability and ease-of-use are coming to the market, e.g. Emotiv EPOC (Emotiv 2010).

In early 2010, it became public knowledge that Microsoft Research had filed a patent for a muscle-computer interface that consists of neither buttons nor cameras; instead Electromyography (EMG) sensors are connected to the players arm, these sensors read the muscle movement that occurs when the player moves their fingers, this input method can detect very complex gestures, and is accurate enough to detect modified versions of gestures that would occur when the player is holding something at the same time. Microsoft is developing a wireless version of the EMG sensor module that could be placed at numerous locations all over a player's body (Saponas et al. 2009).

D. Summary

Originally game input was a very simple affair; input devices were designed to play one game and one game only. But with the release of gaming systems able to play multiple games, the need raised for input systems that suited many games. This gave rise to the era of the gamepad, which has evolved along with the games and the hardware that plays them, growing from simple input methods with a few buttons, to the gamepads used in current generation games consoles (Sony Playstation 3, Microsoft Xbox 360 and Nintendo Wii) which are capable of and well suited to play a wide variety of different game styles.

Game input methods are always striving to be more intuitive and accurate. Future game input seems to be veering away from the gamepad, using gestures and tracking systems to make the players bodies the input method (evident by the success of the Nintendo Wii Remote and subsequent news that Microsoft and Sony's release of their own motion-based game input methods), there's even some prototype input methods that directly link to the players brain using thought to control the game.

II. Project Zion

We created a simple, two-player game that can be played with either a keyboard, a mouse, an Xbox 360 game-pad, a Wii Remote, a dance-mat, a Phantom Omni, a webcam or a SpacePilot Pro. Players are able to choose any input method they like to control the game, so it is possible to have different input methods competing in the same game (keyboard vs. webcam for example). The players are then asked to answer a questionnaire on how they found the experience, and how it relates to playing games with standard input methods.

A. The Game

Due to the varied nature of the different input methods that can be used, the game itself must be simple. It should also be kept simple so that people who don't play games often will not find it too challenging. The game should also be fun and short, so the participants' opinion of the input method isn't affected by not enjoying the game.

The game (referred to as 'Project Zion') sees the player controlling a ship flying along a track, the aim is to be the first of the two players to reach the finish line. To add a challenge to the game, blocks (asteroids) appear at random positions, travelling along the track towards the player. The player must attempt to dodge these blocks; failure to dodge a cube will result in the players' ship stopping for a short duration, allowing the opposing player to get ahead. Figure 1 shows a screenshot of the game play where the aircraft in the top screen is controlled by a player and the one in the bottom screen controller by the other. The controls are very simple: The ship can be moved up and down, left and right, up to the limits of the track (the player is unable to move off or under the track and only move a certain distance above it.) The player can also increase or decrease the speed from a minimum speed value (that has the ship moving slowly) to the maximum speed of the ship (which makes the ship move a-lot faster, but also makes the blocks harder to dodge).

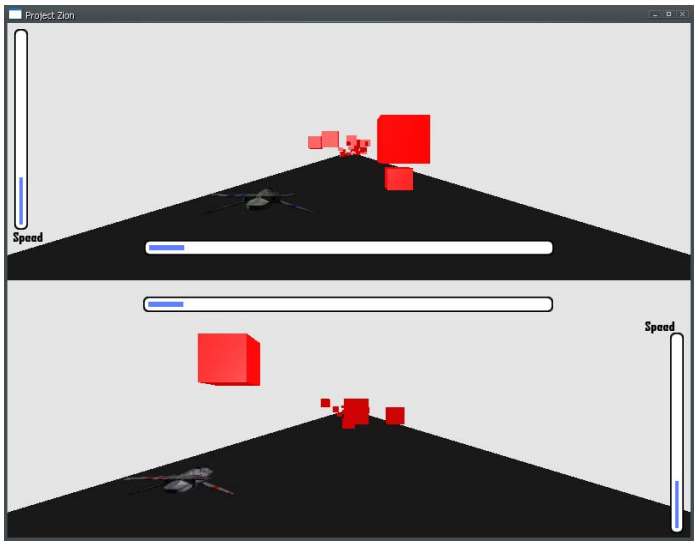

Figure 1 - 'Project Zion' game play

The game is built using the OGRE graphics engine (OGRE 2009), as creating a rendering system is beyond the scope of this project.

B. Input methods

All input codes are kept in a separate InputManager class, which deals with detecting and assigning controls, and offer

an interface for the game code to query the input data using a player index. To accommodate the variety in the input methods and to keep all inputs equal, the game uses an input system that provides a standard interface for all types of controls, and contains specialised implementations for the different input methods.

The interface contains the following methods:

- Initialise – This method is called when attempting to create the device, and should contain all the code required to set-up the specific input method, returning true if set-up was successful and false otherwise, after this method is called, the specialised input code must be in a state to poll for input.
- IsConnected – This method will return true if the device is connected, and false if it is not, it is used to detect controllers being unplugged or otherwise removed mid-game.
- Poll – This is the method that actually queries the hardware for user input, and translates that into a standard format.
- GetName – This returns the name of the device, and is used on the controller select screen.

In addition to the above functions, the abstract controller interface also defines a struct called 'ControllerState' which defines both the current state of the device, and the state from the last frame (used to detect button presses/releases), the struct consists of a three-dimensional vector representing movement, x for left and right, y for up and down, and z for increase or decrease in speed. (All values capped to a range of -1 to 1) and two Boolean values to indicate if button 'a' or 'b' is currently pressed or not (true if the button is pressed).

After the poll method for the specialised controller sub-class is called, it is expected that the m_CurrentState ControllerState value contains the correct values from the hardware at that particular frame.

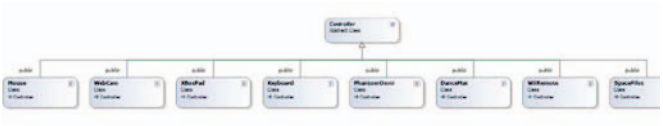

Figure 2 - UML Diagram of the abstract Controller interface and the specialised implementation classes for the different input methods

Keyboard

The keyboard implementation is straightforward. It uses DInput (The DirectX input library) to acquire the keyboard and capture the physical key presses. There are a number of unofficial conventions that have been established through years of games that have been made to use the keyboard as their input method, for example using W, S, A and D keys instead of Up, Down, Left and Right for games that require both a keyboard and a mouse, however as Project Zion uses the keyboard as an input method in its own right, using the Up, Down, Left and Right keys are the convention. A and Z were chosen for acceleration and deceleration respectively, as the keys are close together, and far away from the movement keys, leading to the player adopting a more comfortable position.

Figure 3 - Showing the mapping of the keyboard buttons

Mouse

Like the keyboard, the mouse input code relies on the DInput libraries to query the hardware, the x and y position of the cursor is captured each frame (0, 0 being in the centre of the screen) these co-ordinates are then capped and normalised, to produce output values between-1 and 1. There are many different types of mouse which have a varying number of buttons, from simple mice with two to much more complex ones with nine or more, in order to accommodate all possible hardware configurations, the code only make use of two mouse buttons (left and right), which are both 'A' and 'B' and forwards and backwards, this is possible due to the fact that the A and B buttons are only used in the menu, so pressing them has no effect in the game.

Figure 4 - Showing the mapping of the mouse buttons

Xbox 360 Gamepad

The Xbox 360 Gamepad control implementation makes use of the XInput libraries, which are a set of libraries provided by Microsoft especially for 360 gamepads. A 360 gamepad has a lot of possible button mappings, but there is somewhat of a convention among games of a similar type to Project Zion for using the right-trigger for accelerate and the left trigger for decelerate, so we have kept with this to avoid possible confusion. The left thumb-stick is used for movement in nearly all games that use the 360 Gamepad, breaking this convention would cause confusion amongst players who have used this input method before, so we have adopted it for our implementation. The 'A' and 'B' buttons are obvious, as the 360 Gamepad actually has buttons labeled as such.

Figure 5 - Showing the mapping of the Xbox 360 gamepad

Wii Remote

The Wii Remote implementation is different to the other input methods described previously, as it requires the use of the sensor-bar, which uses 8 infer-red LED's to allow the Wii Remote to discover which direction it's currently pointing in. To accomplish this, we have made use of the 'WiiYourself!' library (WiiYourself 2007) which provides easy functions for setting up and capturing input from the Wii Remote.

Since the Wii Remote provides a singular 'trigger' input, it seemed natural to use that as the acceleration input (as, due to its positioning, holding it down for long periods of time is not uncomfortable). We made the 'A' Button on the Wii Remote the decelerate button, as the natural method of holding a Wii Remote sees the users thumb hovering over this button. The 'A' button also maps to the 'A' input for Project Zion, as it is labelled such. Since the 'B' input in Project Zion is used as a 'cancel' mechanism (It allows the player to change his choice of input method on the control select screen) the home button on the Wii Remote has been used, as players that have played games on the Wii before are used to using that button to cancel/go back.

Figure 6 - Showing the mapping of the Wii Remote

Phantom Omni

The Phantom Omni is one of the more uncommon input methods that the game can be played with, unfortunately our framework doesn't allow for the game to make use of its haptic force-feedback mechanism. Therefore the Phantom Omni can be regarded as a 3D mouse. It makes sense to map up, down, left, right, accelerate and decelerate to the position of the 'cursor'. Like a normal mouse, the Phantom Omni provides two buttons, which are mapped to A and B respectively. To be able to query the Phantom Omni, we used the 'HD' and 'HDU' libraries provided by the manufacturer, SenseAble.

Figure 7. The mapping of the Phantom Omni

Dance Mat

The dance mat implementation is an example of adapting an input method made for one type of game, dance games, to another type of game, Project Zion. The dance mat provides ten digital buttons, Up, Down, Left, Right, Circle, Square, Cross, Triangle, Select and Start, which are modelled after the controls from Sonys' consoles (Playstation1, 2 and 3) as some of the most popular dace games were released for these consoles.

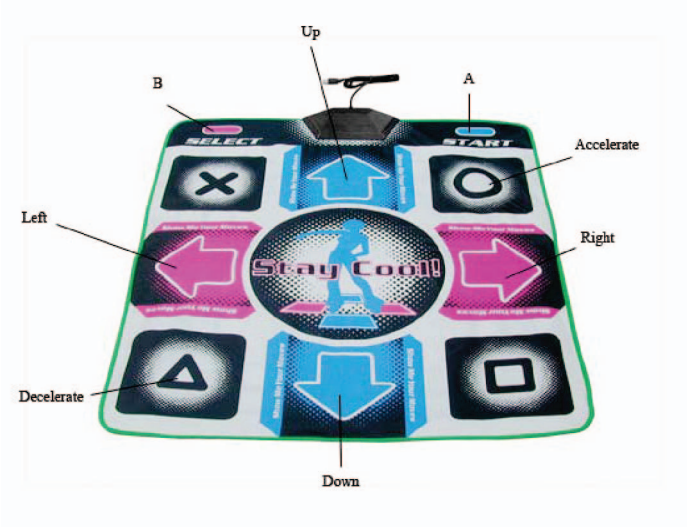

Figure 8. The mapping of the dance mat control

Again the DInput libraries are used to query the hardware for button presses, as dace mats are one of the many input methods supported by that framework. The Up, Down, Left and Right buttons were obvious choices for moving the ship up, down, left and right. The accelerate and decelerate buttons are placed at opposite sides of the mat, as they will usually not be pushed at the same time; it also correlates with the idea that the functions of these buttons are opposites.

Webcam

The webcam is probably the most unusual of all the input methods that can be used with Project Zion, as it is not traditionally thought of as a game input device. In order to use it as such, Project Zion makes use of the OpenCV libraries (OpenCV Wiki, 2009) these provide an interface for tracking the users face through the webcam, retrieving the x and y co-ordinates of the best face currently in-front of the webcam. The best face is the largest face-like image in the cameras frame according to the haarcascade algorithm being used.

The OpenCV libraries also provide extent information about the face, which allows mapping acceleration and deceleration to the proximity of the face to the camera. The implementation uses hard-coded values for the maximum and minimum values for the X, Y and Z axis, which were found through trial and error, whilst this is acceptable for this project, where the game will be set-up by the researcher, in general it would be better to add an extra configuration step for each player that has selected to use the webcam.

Since the webcam has no button interfaces, A and B are mapped to the keyboard buttons 'Space' and 'Right-Control' respectively, although not ideal, this solution is suitable as the assumption that Project Zion is always played on a device with a keyboard is realistic, and since the A and B buttons are not used in standard game-play, a player using the webcam will not interfere with a player using the keyboard.

SpacePilot Pro

The SpacePilot Pro is a 3D mouse, like the Phantom Omni, the x, y, and z inputs were linked to the cursor position. To increase the z (and thus the velocity of the vehicle) players need to press the control stick down, moving it towards the screen increased the y and to the left and right altered the x. Unlike the Phantom Omni, the SpacePilot Pro did not require the use of any special libraries to integrate, as DInput was able to detect this input method and allow the various inputs to be mapped to the games as needed.

C. Survey

A questionnaire was given to participants after they have played the game. The questionnaire has three sections. Section 1 consists solely tick-box, factual, questions, and establishes some background about the participant and their experience with games. Information gathered from section one include: the participants' gender, age-range, how often a week they play video-games, what types of games they play and what

hardware they use to play the games they do. The answers to these questions will help us to categorise participants by their gender, age and experience with games, allowing us to pick out trends in the following answers.

Figure 9. SpacePilot Pro

Section 2 contains tick-box questions, but features more subjective questions, focusing on the participants experience playing Project Zion. It establishes which game input they used, if they won or lost the game and if they have played a game using that input method before. It also provides a number of statements, and ask the participant to state how much they agree or disagree with them. The statements focus on: How easy the game was to play with the input they chose, how well they felt the input method was suited to the game, how intuitive they felt the controls were, if the game was fun to play with the input method chosen, if they would choose to use the same input for other games, both of a similar style and those of a different style to Project Zion, if they felt the input method gave them an advantage over the other player and if they felt that the input method used increased the immersion they felt playing the game.

Section 3 consists of open-ended, subjective questions, and focuses on the participant's feelings towards alternative input methods and their use in games. It asks for their general opinion on games that make use of alternative input methods, if they feel that these alternative input methods have an advantage over their traditional counter-parts and finally asks if they thought Project Zion could have implemented the input method they had chosen in a better manner.

D. Data Analysis

We make use of both qualitative and quantitative data analysis to achieve our aims. Sections one and two of the questionnaire provide quantitative data that can be analysed to find out how participants felt using the various input methods to play a simple game, and if this relates to previous experiences with games or the specific input method. It also provides data to suggest trends involving age or gender and how the participants felt playing Project Zion. Section 3 of the questionnaire provides qualitative data which are used to determine how participants feel about different input methods and their use in games.

Project Zion takes a long time to set-up, as all the various input methods have to be connected and tested before participants can play. Project Zion also requires a large number of power-outlets as several of the input methods require additional power. Due to these difficulties, we setup the game in the computer labs and open days at the University of Derby and invite people to participate. Participants are given a consent form and are provided with debriefing information. Due to the time it takes to setup and the time it takes for participants to play-through the game, the number of participants that can be processed is limited.

This also limits how much the data can be generalised to the entire population, as the pool of potential participants mainly includes university students, however because universities draw a diverse range of people and we also have some parents of potential students who attended the open days participating the project, the results are still relevant to the general population.

III. FINDINGS AND ANALYSIS

27 subjects participated the survey and play the game in pairs. We paired the players at random to ensure there was no bias as to which two input methods were being used to play the game. The participants were first presented with a consent form following a debriefing session when we explained to them the game and how it is played. We made a point to all participants that if they did not wish to be filmed playing the game, they could tick the box to opt-out from this but still participate in the study.

Participants were then asked to tick any of the input methods they would like to use, after we have explained what each input method involved. Once participants had completed their game with chosen input devices, we asked them to fill in the questionnaire. Figure 10 shows a game play session of Xbox 360 controller vs. Phantom Omni.

The participants in the study spanned a large age range, however most participants were in the 18 – 25 range. Of the 27 participants, 22 were male and 5 female.

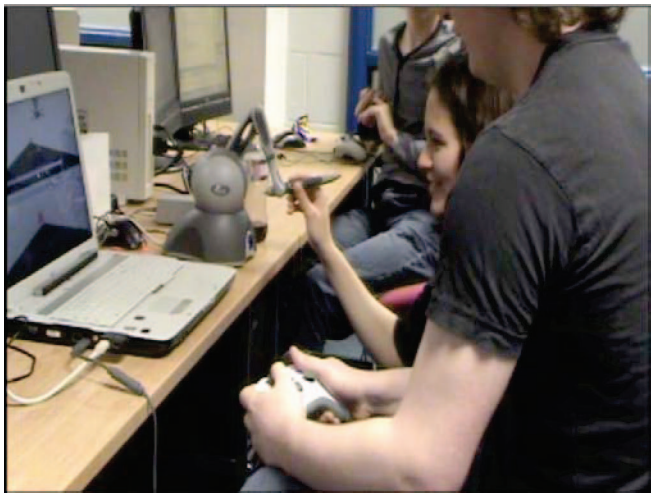

Figure 10. A game play session of Project Zion

Question 3 asked participants to state how often they played video games per week. The study attracted participants with a large variation in the number of hours per week they spend playing video games, especially interesting is that the 'less than 3 hours' range (the lowest) is the joint most selected option. No participants selected the '16 – 20 hours' range and three selected the highest range, stating that they played games over 20 hours a week.

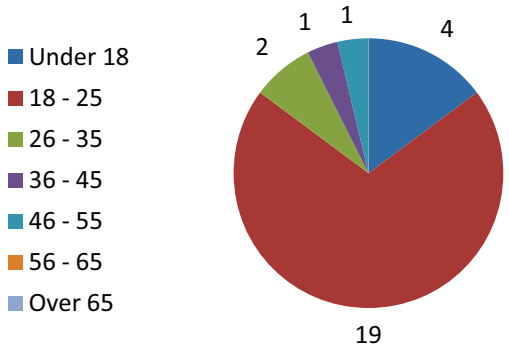

Figure 11. Number of participants for each age range

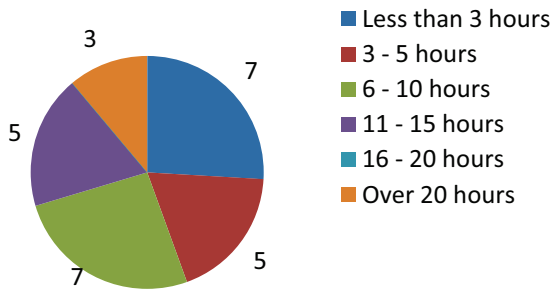

Figure 12. How often participants in the study play video games per week

The fourth question asked participants to specify which genres of games they play. By far the most popular genre is First-Person-Shooter, with 23 out of the 27 participants playing games that fit into that genre, driving games are the next most popular, with 19 participants. Both casual and puzzle games were played by 16 participants, fitting the industry trend of the increasing popularity of these genres.

The final question asked participants what platform they use to play games. The most popular choice was PC and Mac, with 23 participants stating they used those systems to play games; the least popular was the Sony PSP/ PSP Go, a portable game systems produced by Sony, with only 6 participant stating they used that system. The most popular of the dedicated gaming platforms (systems built primarily for gaming) is the Microsoft Xbox 360, with 15 participants stating they played games on this console. Of the 6 participants that stated 'Other', several use emulators, whilst it can be argued that emulators still need to be run on one of the systems listed above. Another participant that stated 'Other', gave a list of games consoles from previous generations (meaning that they have subsequently been replaced by newer consoled from the same company) which consisted of the Sony Playstation 2, Sony Playstation 1 and the Nintendo 64 (N64).

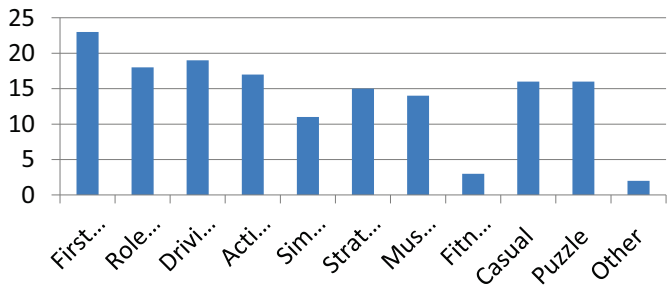

Figure 13. Number of participants that play each genre of game

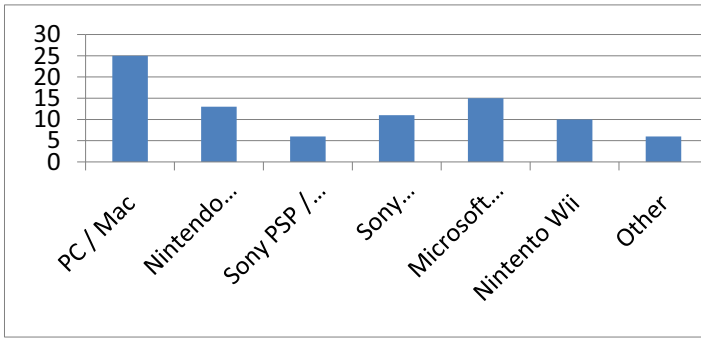

Figure 14. Number of participants that played on each platform

Which input method the participants used

Section two of the questionnaire asked participants about their experience playing Project Zion, starting with ascertaining which input method they used to play the game. The Wii Remote, Phantom Omni and Xbox 360 Gamepad were the most used input methods and the keyboard and mouse the least used.

Did the participants win their games

Figure 16 shows if the player won their games using the selected input method. Going on percentages of games won, the keyboard is the most successful input, however the low number of games played with this input method means that this finding may not be reliable. Of the two most played inputs (Xbox 360 Gamepad and Wii Remote), the Xbox 360 gamepad is the clear winner in terms of the number of games won. However, again going on the percentage of wins and losses the slightly less-used SpacePilot Pro won more games (67%) than the Xbox 360 Gamepad (64%).

Have the participants used the input method they used to play Project Zion previously

Question three in section two asked the participant if they had played a game with the input method they had just used before playing Project Zion. None of the participants that used either the Phantom Omni or SpacePilot Pro input methods had used them to play a game before, this is not surprising, as these input methods are unusual in all fields and even more so in games. The Xbox 360 Gamepad, Dance Mat, Keyboard and Mouse were the input methods that had been used before by more participants. Interestingly, the Wii Remote had been used to play games by nearly half the participants that used it to play Project Zion.

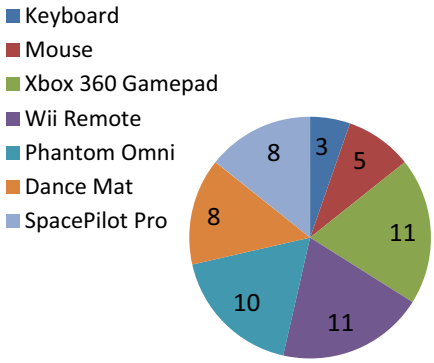

Figure 15. Number of participants that used each input method to play Project Zion

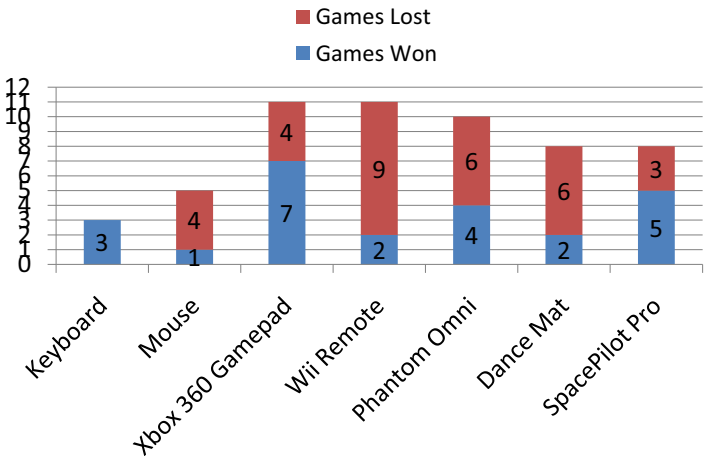

Figure 16. Number of participants that won/lost with each input method

Twenty-four games were played by participants who used an input method they had used before for playing a game. Thirteen games were won and eleven lost, which suggests that prior knowledge of an input method does not give the player a significant advantage when playing a new game.

Thirty three games were played by participants using an input method they had not used before. Out of these thirteen were won and twenty were lost, this suggests that there may be a slight disadvantage for not knowing the input method prior to using it to play a new game.

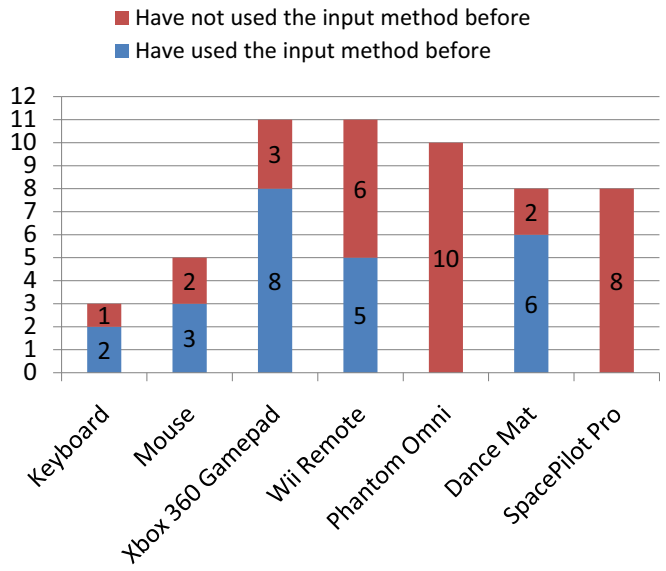

Figure 17. Number of participants that had, and had not played a game previously with the input method they used to play Project Zion

Figure 18. Number of participants that won or lost their game using an input method they had used for a previous game

Easy to use

The next question in section two asked participants to state how much they felt the input methods they used fitted certain properties, using a Likert scale with 1 meaning 'does not fit' and 5 meaning 'fits perfectly'.

The Keyboard, Mouse, 360 Gamepad and SpacePilot Pro were rated to be the easiest to use, with the majority of participants rating the ease of use as 4 or 5. The Wii Remote and the Dance Mat are rated least easy to use, with the majority of participants rating the ease of use 1 or 2. The Phantom Omni seemed to split the participants, the most common response being an ease-of-use of 3, and nearly equal numbers of participants rating it 1 or 2 and 4 and 5. The Keyboard, 360 Gamepad and SpacePilot pro are also among the more successful input methods, with more participants using these input methods to win their games. However, only one participant used the Mouse, which scored well in ease-of-use, and won his game, the other four games that were played with the mouse resulted in a loss for the participant using it.

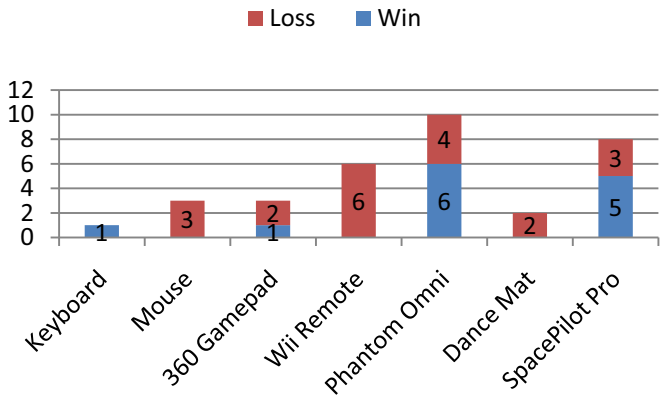

Figure 19. Number of participants that won or lost their game using an input method they had not used for a previous game

Suit the game

Again the Keyboard, 360 Gamepad and SpacePilot Pro scored highly. Participants rated the Dance Mat the least suitable for Project Zion and the Wii Remote also scored low, again the Phantom Omni split the opinion of the participants that used it to play their games. The input methods that were rated the highest (Keyboard, 360 Gamepad and SpacePilot Pro) were also the input methods that were used to win the games.

Intuitive

Here again, keyboard, 360 Gamepad and SpacePilot Pro were rated well by participants, but interestingly, the Phantom Omni was also rated well, having scored split participants opinions in the 'ease-of-use' and 'suited the game' questions. The good rating of the 360 Gamepad is not surprising as the control scheme has been well established in numerous racing style games. Likewise both Phantom Omni and SpacePilot Pro performed well as there is an obvious way to map x, y and z inputs to 3D mice.

The Mouse was rated the least intuitive input method, this may be due to the fact that, because of the limited number of buttons, the left and right click were mapped to both z increase and decrease, and a and b (which are only used on the menus). Also people who are familiar with using a mouse to interface with a computer, where moving the mouse moves the cursor in a set ratio may have been confused by an input system that steers a ship towards the cursor position at a set speed. However, this motion is disputed by the fact that the participants who rated the intuitivism of the Dance Mat input highly had used a Dace Mat to play other games previously suggesting that being presented with an input method that is known but implemented in an un-familiar way does not necessarily make it unintuitive.

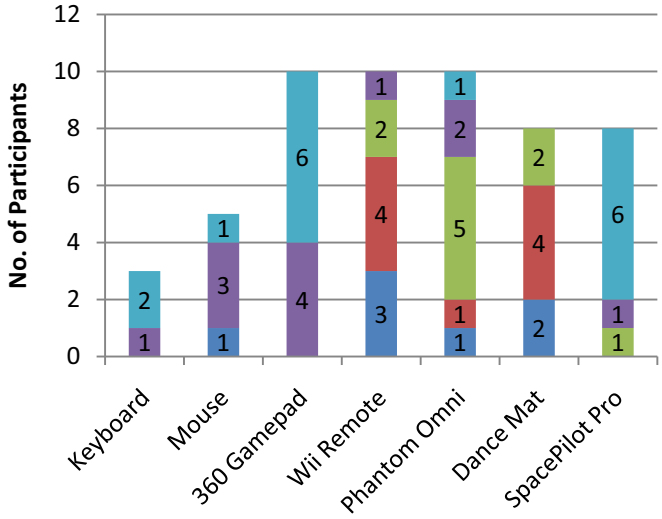

Figure 20. How much participants felt the input methods they used ‘easy to use’

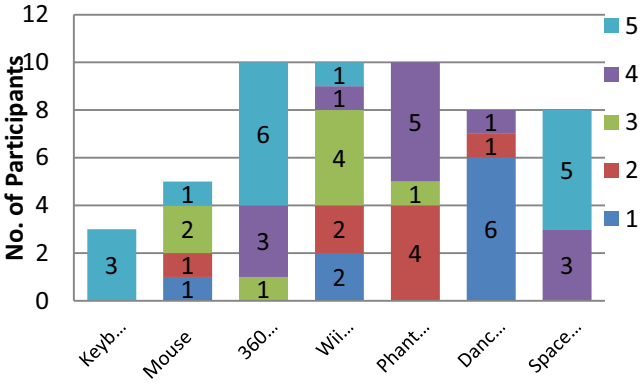

Figure 21. How much participants felt the input methods they used ‘suited the game’

Made the game play most fun

Both of SpacePilot Pro and Phantom Omni scored well in this question. Both of these devices had also never been used to play a game by any participant prior to playing Project Zion, so it is possible that part of the sense of fun came from interacting with a new and unusual input method.

Most likely to use for playing similar games

The Keyboard scored very well in this question, despite scoring low in the ‘made the game most fun’ question, however the keyboard was also judged very suitable for Project Zion. Other input methods that scored highly in both the ‘suitable’ question and this question are the 360 Gamepad and SpacePilot Pro.

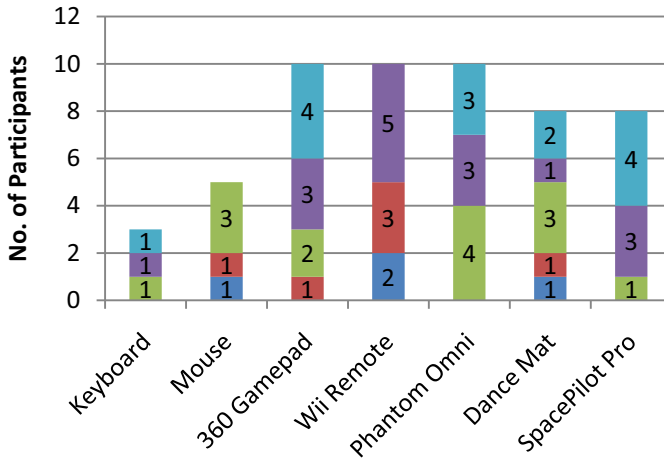

Figure 22. How much participants felt the input methods they used 'intuitive'

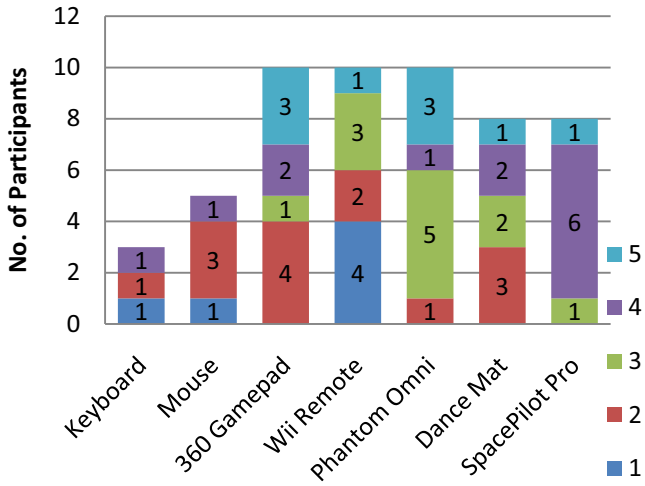

Figure 23 - How much participants felt the input methods they used 'made the game most fun'

This suggests that players who judge an input method to be suitable for a game will be more likely to use that input method in other, similar games, even if that input method was not judged to be as fun as others.

Most likely to use for playing other types of games

The SpacePilot Pro, having rated highly in the 'most fun', 'intuitive', 'easy-to-use' and 'suited-the-game' questions, seems to have persuaded some participants that it may be a good fit for other games of a different style to Project Zion. It is unsurprising that the Microsoft 360 Gamepad generated such strong positive responses, as it has been purposefully designed for use with a wide variety of games. Similarly the Keyboard and Mouse are both common input methods used in a variety of games.

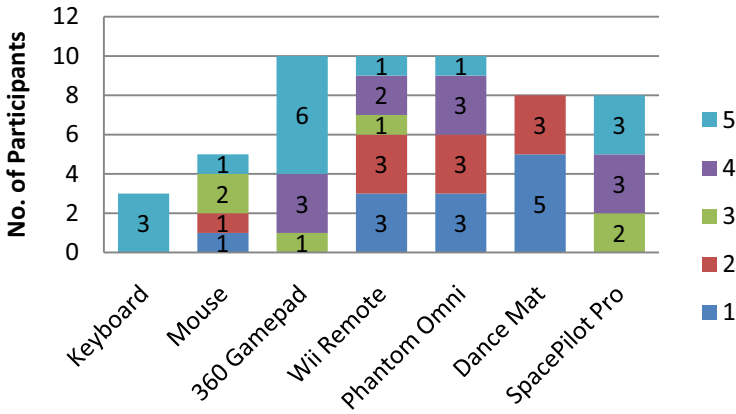

Figure 24. How much participants felt the input methods they used 'most likely to use to play similar games'

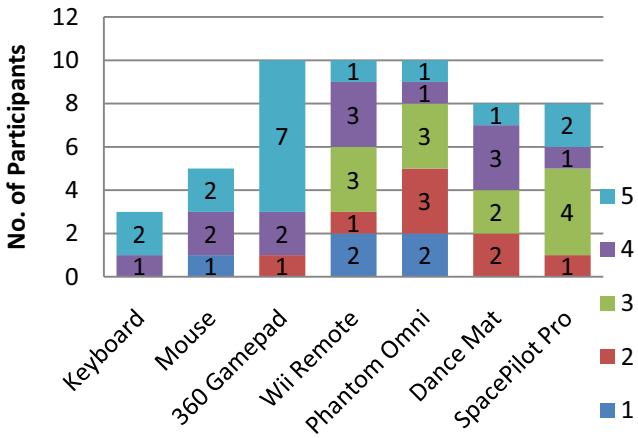

Figure 25. How much participants felt the input methods they used 'most likely to use to play other types of games'

Increased immersion

Both SpacePilot Pro and Phantom Omni again rated well in this question, suggesting that there is scope to research further the use of 3D mice in games, particularly games that wish to offer a high degree of immersion. Both of the input methods used in current-generation consoles (360 Gamepad and the Wii Remote) were judged mediocre for increasing immersion, even though one of them, the Wii Remote, makes use of motion control that is meant to increase the feeling of immersion.

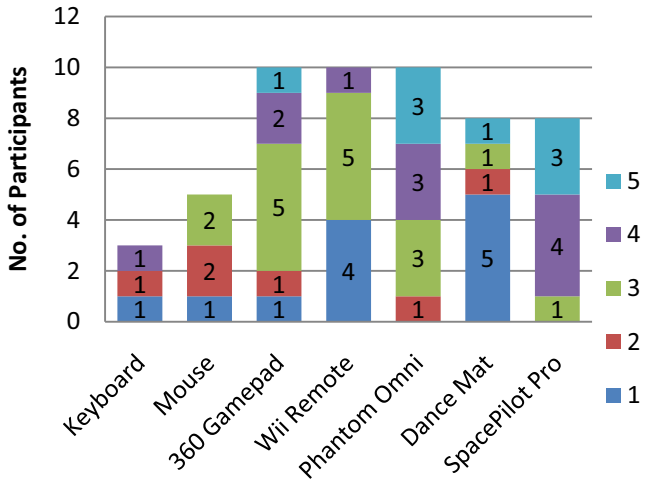

Figure 26 - How much participants felt the input methods they used fit the property 'Increased immersion'

Advantage or disadvantage participants felt they had playing Project Zion with a certain input method

The results from this question correlate fairly closely to that of the 'most likely to use to play similar games' and 'most likely to use to play different types of games' questions suggesting a link between how much of an advantage players feel like they have and the likelihood that they will use that input method again.

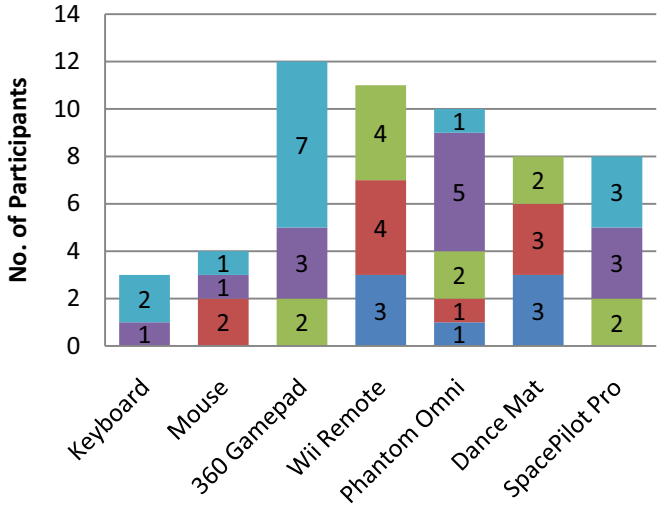

Figure 27 - How much of an advantage or disadvantage participants felt they had using certain input methods

However the lack of correlation between answers to this question and the 'increased immersion' one suggest that input methods that make a player feel more immersed do not necessarily make them feel like they have an advantage.

Opinions of games with alternative input methods (e.g. not traditional Keyboard, Mouse or Gamepad)

Only two held purely negative opinions of games with alternative input methods, both of which thought they were 'gimmicky'. Participant 8 expanded on this by stating that they felt they added "no/very little useful functionality over traditional controls". Participant 7 stated that games with alternative input methods are "something different, and make the player think more about the game". This suggests that alternative input methods can be used to distinguish a game from its competitors. The other participants thought that alternative input methods can be a positive thing provided the input method fits the game play. Most participants stated that their opinion is based on the game or on how the well the input method suits the game play.

Do you feel that 'alternative' input methods have an advantage over traditional ones?

Three of the participants felt that alternative input methods hold no advantage over traditional ones, with participant 3 stating that they felt this was because "people are used to traditional methods", participant 23 stated that 'alternative input methods have increased difficulty levels' and thus are at a disadvantage to traditional input methods. The other participants agreed that alternative input methods can have an advantage over traditional ones, as long as they are used in the right game. Participant 2 stated "If the game is made with the specific new input device in mind when designed, I think it works better". Other participants elaborated on their answers with specific examples: "Dance mat with a rhythm/music game" (participant 6). Participant 6 also expanded on what advantages they may have: "I feel that they can have certain immersive advantages" and participant 2 gave the example that "aiming with a Wii Remote for example, is easier than having to hold down a button on a joypad/keyboard". Participant 9 stated similar feelings "driving games using a steering wheel will be easier to play than someone playing with a gamepad."

These results suggest that for certain games, if the input method suits the game, and the game has been designed for the input method, players can perceive an advantage with alternative input methods.

Do you feel that the input method you used could have been implemented better? If so how?

Of the two participants who thought the input method could have been implemented better, one of them was using the Wii Remote, and commented that the game did not pick up the movement easily, adding that the game would be easier to control if the movement was slightly smoother. The other participant was using the webcam, and felt that the input method needed to be more responsive. The webcam was subsequently removed from the experiment as the environment in an open day made it almost impossible to use.

IV. Discussion

Analysing the data provided by the participants in the study has revealed a number of conclusions.

Players usually find input methods they are familiar with easier

This is an unsurprising conclusion. All but the most intuitive input methods will involve some sort of learning curve that a player will have to progress along. However it could be that this learning curve affects players' opinion of some of the alternative input methods that differ greatly to the input methods they are used to.

Intuitive, suitable, input methods can increase how fun players find a game

It also suggests that unintuitive or unsuitable input methods are a barrier to players finding games fun. This could explain why people perceive alternative input methods as 'gimmicky' and are weary of games that make use of different methods of game input. Especially players who remember previous, failed, attempts at trying to introduce a new input method.

Certain input methods can be used to play multiple types of game

The common game input methods, in particular game-pads and joysticks, are specifically designed to accommodate many different types of game play. But this research suggests that players are willing to try playing different types of game with alternative input methods too.

Players can see the advantage in certain alternative input methods

Most of the participants stated that, with the right input and the right game, they feel that alternative input methods can have an advantage over the more traditional ones. These advantages can include the control being easier, more intuitive, or making the game more immersive.

Most input methods do not increase a player's feeling of immersions when playing Project Zion

Coupled with the previous point, this would suggest that most of the input methods that can be used to play Project Zion are 'right' enough for them to increase the players feeling of immersion. It may be that Project Zion, being a very simple game, may not be able to engage players to the point where they feel immersed, no matter what input method they use, or it could be that there is an input method that would make Project Zion feel more immersive, but it's not one of the available ones.

Alternative input methods can be used to make a game 'stand out' from its competitors

This data suggests that the right alternative input method can make a game stand out from its competitors in the minds of potential players, and would possibly influence their choice to purchase a game. The right input method can possibly improve a game.

Input methods that are considered only slightly unsuitable can put players off using that input method for a similar game

The result suggests that a game that uses an input method that is perceived by players as unsuitable would put players off using that input method in similar games. This may go some way to explain the negative feelings people have towards alternative input methods, as many games have tried, and failed to implement alternative input successfully in the past.

V. Further Research

The data gathered has presented a number of possible questions that could benefit from further research, which are outlined below with a short explanation of why the data could support the propositions.

Are players more likely to purchase a game that makes use of an alternative input method?

Our data suggests that players may perceive games that make use of an alternative input methods in a more positive manner than games that make use of traditional input methods, it would be interesting to see which of two very similar games, one that made use of a traditional input method, and one that made use of an alternative input method, sold more units in a certain period of time. Then ascertain why the customers bought the versions they did, and whether it depends on their past perceptions of alternative input methods.

Can multiple input methods be combined to make a more immersive game?

The data collected suggests that players can see immersive advantages in using an alternative input method, but it would be interesting to see if this feeling is increased or decreased by creating an input system that makes use of multiple alternative input methods simultaneously, for example a first person shooter game that requires the players to move the character using their feet and a dance mat, but aim the characters weapon with a Wii Remote.

Does the complexity of the game effect the feelings players have about using an alternative input method to play them?

Project Zion is a very simple game, and was deliberately made to be so simple as to not put participants who do not play games as often at a disadvantage, however, now there exists some results generated from a simple game, it would be good to repeat the test using a more complex game, to see what effects that has on the results, and if that helps players to feel more immersed, or see greater advantages in using alternative input methods.

Which input methods suit which sorts of game?

Our data shows that even players who did not think the input method they used was suitable or beneficial to playing Project Zion would consider using the same input method to play different types of game. Obviously dance mats suit dancing games, and steering-wheels suit driving games, but it would be interesting to find out how many different styles of games these alternative input methods can suit well, are they as all encompassing as the traditional input methods they compete against? Or are they more specialised, being superior than standard input methods for the certain type of game they were designed for, but inferior to standard input methods in different styles of game?

Integrating more input methods

Whilst Project Zion makes use of a few input methods, one of the main input methods missing is voice input, requiring the player to say commands that the game will interpret and move the ship accordingly. The addition of this input would mean that Project Zion covered all the main types of input (although not all the different implementations of those types, obviously).

The webcam implementation could be improved in a couple of ways, one approach would be to make use of gestures that the player would perform to control the ship, instead of actually moving their face, the other improvement would be to use a different facial recognition library. The Face API from Seeing Machines (Seeing Machines, Face API) is capable of detecting the rotation of a head from a webcam image. It would be interesting to see if using the rotation of the players head or hand gestures would make a more natural, immersive or fun experience.

VI. Conclusions

What are players' perceptions of alternative input methods? Are they still seen as gimmicky?

Some players, certainly, do perceive alternative methods as a gimmick that adds nothing to the gaming experience, but the data we have collected suggests that most players do see an advantage, as long as the input method fits the game play. For example most players can see the benefit of alternative input methods for music or rhythm games, or, for example, a steering wheel input method for driving games. However players are quick to point out the flaws of using an input method 'purely for the sake of it' with our data suggesting that it detracts from the gaming experience and encourages players to develop negative opinions of both the game and the input method, even going so far as to effect how players perceive similar games that use the same input method.

Our data also suggests that players can see advantages to alternative input methods, if it fits the game, and that the potential advantages could be to make the game more fun, immersive or interesting, suggesting that it is worth-while for games developers to investigate all types of input method for their game, as-long as they have the recourses needed to make an input solution that enhances the game.

Since players opinions of alternative input methods are so closely related to past experience, we propose that the success of the Nintendo Wii game console, that uses a motion-sensing controller for control many of its games, and has been a great success for Nintendo since its release, could be responsible for the majority of players positive perceptions of alternative input methods and that this trend of growing positive opinion will only increase as the two other main games console manufacturers, Sony and Microsoft, release their own alternative input methods for their existing consoles (Move for the Playstation 3 and Kinect for the Microsoft 360 respectively).

Do players have more fun, or feel more immersed when playing a game with an alternative input method?

The research indicates that players can feel more immersed or have more fun, when playing a game with an alternative input method, depending on how well the player perceives the input method to fit the game play. How well a player perceives a particular input method fits a certain game may well depend on how familiar the player is with that input

method. For example, most players perceive that the Microsoft 360 gamepad could be used successfully in many different types of game, so either that input method is suitable for a large number of games (which is possible as it is the result of gamepad design that has evolved over many iterations specifically to play numerous types of games) or players mix feelings of familiarity with an input method and how well suited an input method is for a game, suggesting that players who are acquainted with an alternative input method could see it being suitable for a larger range of games.

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