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Research paper



Data Capture of Exergames using Kinect Sensor for Gameplay Analysis

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Abstract

This project aims to examine Exergames and its data capturing ability. The project tackles on how Exergames' tools are utilized and emphasize Kinect as the best Exergames tools to capture data. The research team developed a prototype application that can collect user information and display the result of their game play. All test conducted are using personal computer and the Kinect sensor. The results should be able to validate that Exergames can gather data and post development can convert those data into useful information for use in specific fields or for use to cater specific users. The result should prove that Kinect-based Exergames can capture useful data and the data can be utilized to maximize Exergames' potential as a new data capture technology alongside other data capture technologies.

Keywords: *Data Capture;, Kinect; Exergames.*

1. Introduction

Exergames is a virtual reality based game, which involves physical exercise or require gross motor activity. It is a wellness methodology that creates physical and/or mental exertion through the promotion of interactive entertainment technologies. The term Exergames is short for "Exercise Games", which has become a trend since the 1980's, and skyrocketed during the mid-90's to the 20th Century. Several studies on the impact of Exergames have been conducted which effectively can improve quality of life, rehabilitation and motivation [1-10]. A pool of that study does not only focus on the development of Exergames as a gaming tool, but it also widens the scope to an extent of healthcare interventions, learning tools, data capturing, fitness purposes in fitness clubs, used in commercial environments, and so much more. These developments lead to custom exercise games being made. These then lead to many Exergames consoles being produced.

2. Custom Made Exergames: A Trend for Data Capturing

Data capture is a method of attaining data to be converted into useful information. Its importance is emphasized and has been the basis of many researches and has been the key to improving many systems. Certain research shows a staggering effect of data capture and the impact of its effective analysis towards businesses and finances in marketing when the massive amount of data captured are transformed into marketing strategies, improving product and service quality, and the main key to maintaining a competitive edge amongst business giants [11].

Computer games are an insight into a world of entertainment although it is states that computer games can diminish the creativity of players, other researchers have found that such statement is only limited to the normal game play experiences such as repetitive game play or short timed game play [12]. Exergames has been around for 25 years and has helped increased gaming experience for many players. The reliability and practicality of custom made Exergames are also recognized.

2.1. Comparing Exergames Tools

There are many Exergaming tools to date. The most popular are the Nintendo Wii, PlayStation Move, and Microsoft Kinect. Each tools or controller have their own characteristics and functions. In this section, author will discuss the different tools and prove that Kinect is the best tool to capture data automatically.

2.2. Nintendo Wii

Nintendo Wii remote controller is a handheld device that utilizes PlayStation Eye camera to track its position, enabling users to be tracked using motion detection through six axis sensors with addition of the Wii Motion Plus console. The axis of detection is on x-axis and y-axis through the infrared sensor, making it capable of detecting three-dimensional data using its three-dimensional gyro features to obtain information of acceleration and rotational angular of the controller. The device receives audio and vibration feedback when the user communicates with the sensor using the devices buttons. The device has wireless functions that must be tethered to the Wii remote and has secondary controller.

The device focuses more to the pathway of the controller's movement, specifically the users' hand gesture and movements. Some

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outstanding game have been developed for Wii however some of the games are quite lackluster [13].

2.3. PlayStation Move

PlayStation Move is a motion sensing gaming controller that was built for the PlayStation 3 gaming console. The device uses six axis sensors that has a built in XYZ-axes detection camera. [14] explains the device uses Move Eye that will detect the users' movement when users move the Motion Controller. The Move Eye's sphere will change color when it receives feedback and vibrations from the Motion Controller.

This device can capture both visual and acoustic data of the user by using its three-dimensional gyro sensors, three-dimensional acceleration and geomagnetic sensor. Equipped with high resolution for visual data capture, the device can receive and analyze three-dimensional information of acceleration, position and rotational angular of the controller. These functions are similar to the Wii, but it has a better hand recognition as the construction is three-dimensional, and the device has additional high robustness and high spatial resolution.

2.4. Microsoft Kinect

The Xbox Kinect Sensor is a controller free sensor that can track the users' body movement. In general, the sensor has a camera with similar capabilities of the PlayStation Move. However it has more flexibility in terms of area of monitoring, and more data can be captured as it can sense the users' whole body movement and physical activity.

Windows Developer Centre explains Kinect tools are divided into the Software Development Kit (SDK), Windows Hardware, and Kinect Tools and Resources. The current version of SDK is SDK 2.0, which allows users to create applications and experiences that support gesture and voice recognition through the usage of programming languages such as C++, C#, Visual Basic, or any other Windows Store projection. Some samples are also provided in the SDK with access to the full source code, Kinect Studio, and resources to aid beginning programmers and developers in application development. Table 1 provide comparison between these Exergames tools:

Table 1: Comparison of Exergames Tools

Tools Attributes	PlayStation Move	Nintendo Wii	Microsoft Kinect
Motion detection	6 axis sensor built-in	6 axis sensor	Controller free, sensor detects body movements
Buttons	Yes	Yes	No
Feedback	Yes	Yes	Yes
Built in batteries	Yes	No	No
Camera	Yes	No	Yes
Augmented reality	Yes	No	Yes
Image capture	Yes	No	Yes
Microphone	Yes	No	Yes
Resolution	Blue ray powered HD with support up to 1080	480p	HD with support up to 1080

Based on table 1, Microsoft Kinect have been chosen as tools for this research because of two main criteria. One of the criteria is that Microsoft Kinect is controller free or hands free. Therefore, it is suitable and easy to use. Another criterion is Microsoft Kinect does not depend on any battery. Kinect has the capability for doing interactive augmented reality [15]. Kinect has also the capability to recognize object [16]. Kinect sensor can be place on top of the television screen. Since Kinect v2 is an improvised version of Kinect v1 in terms of body tracking where v2 able to track up to 25 joints per person (up to six person) compared to v1 which can only track 20 joints per person and maximum of 2 person only. With higher depth sensing fidelity, Kinect v2 have an improved ability to see smaller objects and improves stability of body tracking. The color camera provided by Kinect v2 allows Full HD 1080p to be captured thus improving input and ensures data reliability and accuracy. Kinect v2 also possess a new active infrared (IR) capability that allows the sensor to see in the dark.

3. Data Capture, Analysis and Organization in Kinect Application

Kinect tools and applications have the capacity and capability to extract and capture data for analysis and organization. Visual data captured by the Xbox Kinect Sensor are in the form of two-dimensional and three-dimensional data. The Kinect can sense the depth, capture active infrared (IR) vision, and has 1080 pixels of colour camera that also has additional capabilities of tracking user's body movement in a wider field of view. The enhanced fidelity feature of the depth camera can track a maximum six skeletal user structures and 20 body joints as well as 1000 points meshed up for better face sculpting and facial recognition.

As for acoustic data, the microphone array can detect the user's voice and store it using the Audio capture feature of the Kinect sensor. The Microsoft Windows SDK will recognize the user's voice and save it as a part of the recorded video in the Microsoft Studio.

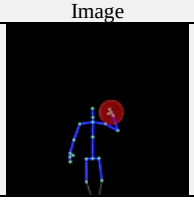
However, the audio capture feature can be disabled at any given time at the studio's timeline. A study done by [17] proves that the acoustic data can be captured simultaneously and separated later in the Microsoft Studio and just as the visual data, the audio data can be looped and saved as a new recorded video. All data capture must be in the field of view of the sensor, which places the optimal placement of the Kinect between 2 to 6 meters. The Kinect has a sensing range of 10 meters but can change under a variety of environmental conditions.

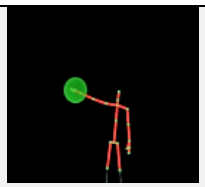
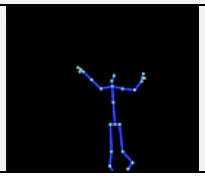
4. Analysis and Findings

After receiving the pre-test survey, the demonstration team gives an explanation based on all the criteria in the survey and do a Kinect sensor demonstration. The demonstration is done by showing the skeletal input display of the application and further explaining how the users' actual body was captured and processed into the skeletal display. Users were then guided to use the prototype application. After completing the game play, they fill out the post-test survey.

In this project, all the data is analyzed via data saved game play data collected and also user ID query via the DataCap application. Through the results, the image of the captured kinect skeletal display is obtained and the most popular task chosen by the user was determined. Below are some samples of the data captured in DataCap.

Table 2: Gameplay Results

PlayerID	Task	Image
3132003581	Wave Right Hand	

3132004321	Wave Left Hand		
4144010601	Jump Up Quick		

Based on the results, it has been derived that the most popular task users select to do is jumping up quick and waving their right hand. Based on the user rating, the research team found a significant difference pre-test and post-test. The results are as shown in Figure 4.1. The bar chart shows that after explanation, application demonstration and also game play, users find that Kinect-based Exergames can be used as a method to capture data. Therefore, all of the users are satisfied with the system performance after the game play, demonstration and explanation in comparison to before it.

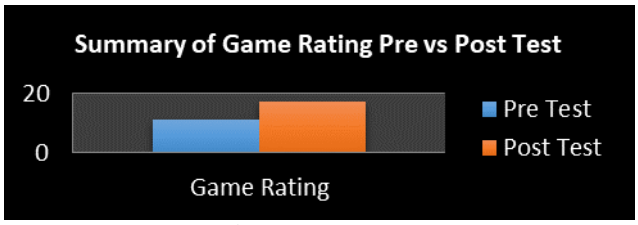


Fig. 1: Summary of Game Rating Pre-Test versus Post-Test

Data that have been captured can be used in various industries including retail. Virtual Fitting Rooms is an example on how Kinect is used in retail industry. By acting as supporting tools, Kinect is able to assist customer in trying out clothes and matching accessories thus creates a new experience for online shoppers. This minimizes return due to unfit clothes and help in boosting sales [18]. Data from Kinect also can be used in manufacturing industries. Inspection is one of the processes in electronic industry. Most companies try to create the smallest chip from time to time due to the demand of consumer. In order to carry out inspection of these chips, clean room is normally used to avoid any type of contamination. Using certain software and Kinect, clean operator can operate from outside of the clean room and use their hands to control the inspection modules [19]. In healthcare industries, Kinect have been widely used. Example of Kinect usage in healthcare includes Telementoring. By utilizing Kinect and Microsoft Azure, it can saves lives especially in rural areas and able to replace or supplement existing telemedicine which can take up to 25,000 dollars [20]. In healthcare, Kinect is also use as tools to encourage elderly to increase physical activities [21].

5. Conclusion

Kinect-based Exergames have been widely used for 25 years. More research can still be done in order to better understand Exergames' actual potential in helping all other fields such as education, security, animation, and so many more. The system and application only need to be sorted to allow users receive each input and make use of the saved data.

In conclusion, this project proves that Kinect is the best tools to capture data in Exergames in compared to other Exergames tools such as Nintendo Wii and PlayStation Move. This project also validates that a Kinect prototype can be made to collect input from the kinect sensor by detecting the users' body movement, capturing it into a skeletal display on the Kinect screen view. This project also proves that Kinect-based Exergames can be used as a data capture method.

For future researches, the application can be further updated so that the Kinect can sense the users' movement, capture the data to be displayed as a skeletal of the user, hence record their movement, and store into the database through the movement of the user. This means that for future researches, author hopes that the data can later be captured automatically by the kinect sensor instead of from the computer keyboard input.

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