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Design and Build a Virtual Reality Based Cycling Simulator Game

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Abstract— At the present time, there is a lot of digitalization being carried out. The current busy work also often makes people need to carry out an activity without leaving the place. One of them is exercising, in this case is cycling.

Therefore, an idea emerged to design a VR-based cycling simulator game. The purpose of this study is to find out how the interaction between cycling and VR is, and to find out the interesting points of this game and its use as a new alternative to cycling. The method used in this study was to test the "Simulator Sepeda VR" game on several users and collect data through interviews. The results of this study indicate that the "Simulator Sepeda VR" game is able to provide an interesting experience and can also be an alternative for cycling at home.

Keywords— Simulator Game, Bicycle, VR, New Experience, Alternative.

I. INTRODUCTION

With today's rampant digitalization and busy workloads, many expect to be able to carry out activities without leaving their homes. Recent advances in digital technology have driven massive changes in the sports industry, which has traditionally been labeled conservative (Smith and Stewart 1999). This in turn has ushered in a new era in which a deep appreciation of digitalization and sport has become even more relevant.[1]

One of the things that digitalization can do is cycling, due to busy work, some people will find it difficult to find free time to be able to leave the house to do cycling.

Therefore we need a facility for cycling that can be done at home and also provides an experience as if cyclists or users can feel the sensation of cycling as usual or even provide new experiences for cycling that have never been felt before.

With a combination of bicycles and Virtual Reality-based games, a cycling simulator can be created that can be played using real bicycles and Virtual Reality devices. With this, the cycling experience can be made as interesting as possible and also made more unique. Without eliminating the main and authentic thing from the sport of cycling, namely pedaling the bicycle itself.

By making this cycling simulator more unique and interesting, users will feel that there are new experiences and also new challenges for cycling. This can also make users not feel bored.

II. LITERATURE REVIEW

2.1 Arduino

Arduino is an *open-source* programmable circuit board. In other words, Arduino is a single-board computer that is easy to use. Arduino circuit boards can read inputs, such as sensors, buttons, and turn them into outputs such as activating a dynamo, turning on a light.[2]

2.2 Magnetic Sensor

A magnetic sensor is a sensor that uses a magnetic field to open and close an electric current flowing through a cable connected to a circuit.

2.3 Analog Joystick Module

The Analog Joystick Module is a module that functions to provide directions in two

directions, namely vertical and horizontal. This module utilizes the use of a variable resistor to determine the direction in the input.

2.4 Bluetooth

Bluetooth is an electromagnetic wave that serves to replace cable technology. *bluetooth* has a relatively short range of about ten meters (10 m).[3] With *Bluetooth* technology , it is possible to provide input from humans to Android devices.

2.5 Virtual Reality (VR)

Virtual Reality (VR) is getting a lot of attention these days. With the very development of computer graphics technology today. The more realistic the resulting graphics are. But in the end it was still not enough, so *Virtual Reality* (VR) was created. The initial idea of *Virtual Reality* (VR) is to create a virtual world that looks real, sounds real, and feels real and responds to players interactively.[4]

Virtual Reality incorporates 3D technology which gives the illusion of real life. *Virtual Reality* provides a simulation of the real world.[5]

2.6 Google Cardboard

Google Cardboard is a VR *handset* similar to the *Oculus Rift, HTC Vive* , but with cheap and easily available materials. *Google Cardboard* uses cardboard to turn a user's smartphone into a capable VR device. This breakthrough from *Google* can support the growth of potential VR users.[6]

Google Cardboard was chosen because of its low cost, and also supports many existing smartphone devices. Even though it's cheap, *Google Cardboard can* still provide a 360-degree visual viewing experience, like other more expensive VR tools.[7]

2.7 Human Interface Devices

Human Interface Device (HID) is a device that interacts directly, and can read *input* from the user, and can also provide *output* . HID devices can usually be connected using *Bluetooth* , a USB cable, and PS/2.[8] Examples of HID devices are keyboards, mice, and gamepads.

2.8 Simulation Game

In a journal entitled *"Genre and game studies: Toward a critical approach to video game genres"* by Thomas H. Aperley (2006). The simulation genre includes video games that simulate sports, flying, and driving, and games that simulate the dynamics of cities, towns, and small communities.[9]

2.9 First-person

The perspective used in this bicycle simulation game is the first-person perspective or what is often referred to as first-person. First-person is played as if the screen is the player's own vision.[10]

With the use of this perspective, it will provide a feeling that feels real for players to be able to feel themselves in the game world itself.

2.10 Android

Android is a platform and operating system based on the Linux kernel, Android was developed by Google and is now continued by the Open Handset Alliance (OHA).[11]

Android also provides easy access and optimal performance, and its *open-source nature* also makes it easy for developers to create or develop applications or games for *the platform android*.[12]

The development of a VR-based cycling simulation game aimed at *the Android platform* not only provides easy access for developers, but also makes it easy for the public to access, due to the widespread use of *Android.*

2.11 Unity

Unity is a *game-engine* that was first introduced in the event *Apple's Worldwide Developers Conference* in 2005, and immediately provide a significant change for the gaming industry.[13]

Unity is a tool for creating games created by *Unity Technologies* . Unity also supports multiple destination platforms some of which are *Windows, Mac OS, Linux, Android, iOS, Web Player, Playstation 4, Xbox One, and Nintendo Switch.*[14]

2.12 C# Programming Language

To realize VR-based games using Unity, the C# programming language is needed. This is because Unity itself now only supports the C# programming language. And also C# is a programming language that supports object-oriented programming (OOP). The C#

programming language also provides great performance for VR-based *game-engine applications Unity*.[15]

2.13 Waterfall Method

The research method used in this study is the Waterfall method. The Waterfall method is a sequential method from start to finish without repetition. So in this method to go to the next phase must complete the previous phase.[16]

III. RESEARCH METHODOLOGY

3.1 Source of Data

1. Primary Data Source

Primary data sources were taken from interviews with 10 friends and relatives who tried to play the simulator directly.

2. Secondary Data Source

Secondary data sources are taken and obtained from journals or other references related to the development of this game.

3.2 Data Collecting

1. User Interview

This technique is carried out by inviting 10 people to try the game and answer questions from researchers.

2. Literature Study

Data collection techniques through written information sources, for example scientific journals, papers, and online journals.

IV. RESULTS AND DISCUSSION

4.1 APPLICATION OF BICYCLE INTERACTION WITH VIRTUAL REALITY

The "VR Bike Simulator" game is a 3D game that combines real-life human activities and their interactions in the game. By using VR as one of the features in this game, it provides a playing experience like in a virtual world. And by implementing VR for this cycling simulation game, it will increase the immersive level of the game.

To implement the interaction between bicycles and VR is to use an Arduino-based device. Arduino-based devices are connected to a magnetic sensor placed on the rear wheel of the bicycle, and use an analog joystick module placed behind the bicycle handlebar.

This allows the Arduino to read each wheel rotation and handlebar rotation angle, which will later be converted into input and sent into the VR game via Bluetooth transmission.

1. **VR Googles**
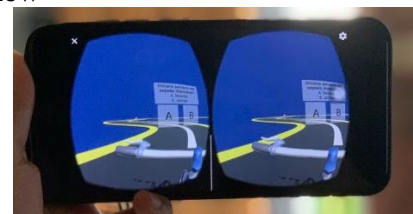

Figure 4.1 VR Goggles for Smartphone

2. **VR View**

Figure 4.2 Game view in VR format
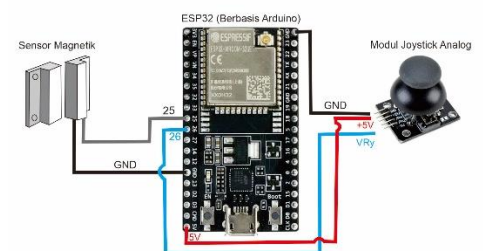
3. **ESP32 Device and Sensor Circuit**

Figure 4.3 ESP32 Device and Sensor Circuit

4. **Bicycle**

Figure 4.4 Bicycle

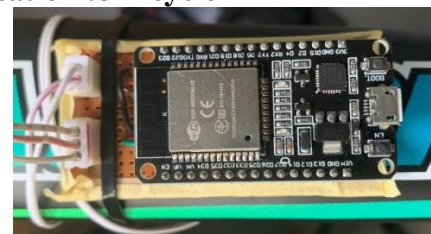5. **Application to Bicycle**

Figure 4.5 ESP32 Device

Figure 4.6 Magnetic Sensor Installed on the Bicycle

Figure 4.7 Analog Joystic Module Intalled

4.2 Realizing the Design of "VR-Based Cycling Simulator Game" with Unity Engine

To realize the design of "VR-Based Cycling Simulator Game", the use of Unity Engine is very appropriate. Because Unity Engine is a game engine that supports both 2D and 3D views. Before later being developed in the Unity Engine there are several designs that must be prepared, including:

1. **Game Design**

   "VR-Based Cycling Simulator Game" is a game that has 4 levels, namely "Trivia", "Collect Trophy", "Time Rush", and "Time Trial". Each level will present a different way of playing, and a different experience.

   The main game flow is the player moves the bike and passes the challenges in each level and continues on to another.
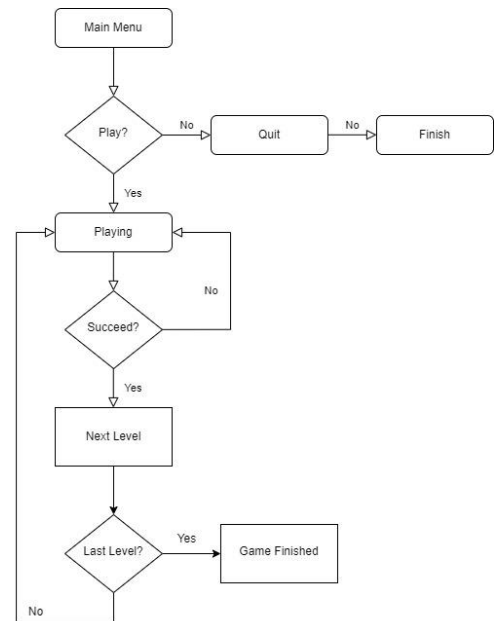

Figure 4.8 Game Flow

2. **World Design**

   Because "VR-Based Cycling Simulator Game" presents 4 different levels, the routes or roads that are displayed are also different. The following is the shape of the route or path for each level made using the "Path Tool" from Unity.
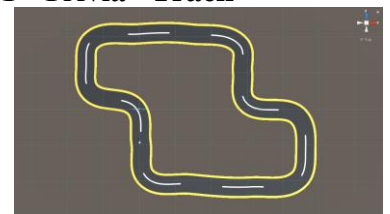
   i. **Level 1 "Trivia" Track**

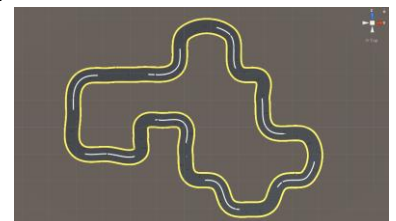**Figure 4.9 Track for Level 1**

   ii. **Level 2 "Collect Trophy" Track**

Figure 4.10 Track for Level 2

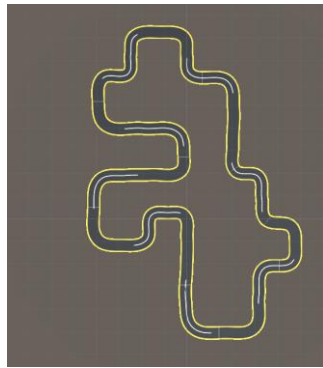   iii. **Level 3 "Time Rush" Track**

Figure 4.11 Track for Level 3
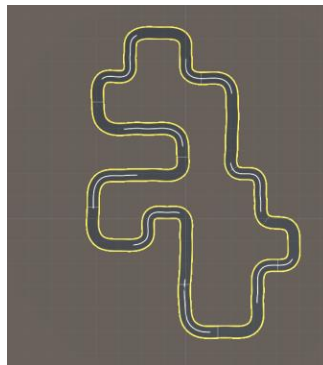
iv. **Level 4 "Time Trial" Track**

Figure 4.12 Track for Level 4

3. **Game Mechanic Implementation**

When the game design and world design are in place, it's time to implement game mechanics. There are several mechanics and features that need to be made including the *Player Controller, Bike Controller, Level Manager*, and implementation of the Google Cardboard SDK.

i. **Player Controller**

The player controller here aims to receive input from the player and convey the data in Boolean and Vector2 form to the Bike Controller.

ii. **Bike Controller**

The bike controller here is a useful mechanic for moving the bike in the game. In this game, because the character uses a bicycle, what is needed is for the bicycle to move forward and turn right or left. Therefore, the bike controller that is made will be based on the Wheel Collider component.

iii. **Level Manager**

Level manager is a collection of several scripts to regulate how each level is presented, because there are 4 (four) different levels, there will be 4 scripts that must be made, but because of the similarities between level 1 and level 2, the script can be simplified to 1 (one) script only. Finally there are only 3 scripts that must be made to set the level, which are as follows.

    a. PointManager
    b. TimeRushManager
    c. TimeTrialManager

iv. **Google Cardboard SDK Implementation**

In realizing the VR concept in this game, there must be an implementation of the Google Cardboard SDK. The most important thing in implementing the Google Cardboard SDK in Unity is adding the Google VR Android package from the package manager.

4.3 Gather user feedback when using "Virtual Reality Based Cycling Simulator Game"

To prove that the design of "Simulator Sepeda VR" can provide a new and interesting experience, testing and data collection was carried out on players. Several questions are given to players and must be answered by players.

From the overall response of users who have tried playing the "Simulator Sepeda VR", it can be concluded that the "Simulator Sepeda VR" provides a new experience and feels more challenged (PE). Users also find it easy to play and complete the "Simulator Sepeda VR" (EE) game. Users feel that the way to play and the levels in the game "Simulator Sepeda VR" can be considered interesting (HM). Due to these three things,

the user plans to continue playing the "Simulator Sepeda VR" (BI) game.

V. CONCLUSIONS

Based on the results of development and research, the following conclusions can be drawn:

1. The "Simulator Sepeda VR" game is a 3D game that combines human activities in the real world with their interactions in the game using VR technology. The use of VR in this game provides a more immersive gaming experience for users. This game also uses an Arduino-based device to read every wheel rotation and bicycle handlebar rotation angle, which is then converted into input and sent to the game via Bluetooth transmission.

2. In realizing the game "Bike Simulator VR" using Unity, the level designs were made with the aim of providing an interesting and varied experience. In developing the game "VR Bike Simulator" a library is needed that can provide VR features, namely the Google Cardboard SDK / Google VR SDK. Implementation of input from bicycle-mounted devices to read in-game to move characters in-game was also added. So that every rotating wheel will be read as a button which will increase the acceleration of the bicycle in the game, and every angle of rotation of the bicycle handlebars will be read as an "axis" which will later function to turn the bicycle in the game.

The "VR Bike Simulator" game can provide an interesting and more challenging experience as evidenced by the results of data collection for a number of users. And it is also proven that users will plan to play the game "Bike Simulator VR" in the future if they have the supporting facilities.

REFERENCES

[1] J. Hedman, F. Ter, and C. Tan, "Sports Digitalization Sports Digitalization: An Overview and A Research Agenda Completed Research Paper Platform Driven Sustainable Development View project Declarative Business Processes View project," 2017. [Online]. Available: https://www.researchgate.net/publication/321081719

[2] K. S. Kaswan, S. P. Singh, and S. Sagar, "Role Of Arduino In Real World Applications," vol. 9, no. 01, pp. 1113–1116, 2020.

[3] G. Nandi and V. Tsira, "Bluetooth Technology: Security Issues and Its Prevention Article in," *International Journal of Computer Applications in Technology*, no. October, 2014, [Online]. Available: https://www.researchgate.net/publication/268018259

[4] J.-H. Kim *et al.*, "Virtual Reality History, Applications, Technology and Future," *Digital Outcasts*, vol. 63, no. ISlE, pp. 92–98, 2013, doi: http://dx.doi.org/10.1016/B978-0-12-404705-1.00006-6.

[5] M. Okechukwu and F. Udoka, "Understanding Virtual Reality Technology: Advances and Applications," *Advances in Computer Science and Engineering*, no. June 2015, 2011, doi: 10.5772/15529.

[6] S. Schlögl, M. E. R. Bergmann, V. Eder, M. Achleitner, and P. Evangelatos, "Google Cardboard in Social Science Research – Exploring low-cost virtual reality and its potential," *Proceedings of the Forschungsforum der Österreichischen Fachhochschulen*, no. July, pp. 814–818, 2017.

[7] S. H. (Mark) Lee, K. Sergueeva, M. Catangui, and M. Kandaurova, "Assessing Google Cardboard virtual reality as a content delivery system in business classrooms," *Journal of Education for Business*, vol. 92, no. 4,

pp. 153–160, 2017, doi: 10.1080/08832323.2017.1308308.

[8] A. Maurya, "Programmable USB Human Interface Device," no. March, pp. 1–4, 2019.

[9] T. H. Apperley, "Genre and game studies: Toward a critical approach to video game genres," *Simul Gaming*, vol. 37, no. 1, pp. 6–23, 2006, doi: 10.1177/1046878105282278.

[10] A. Denisova, *First Person vs. Third Person Perspective in Digital Games: Do Player Preferences Affect Immersion?* 2015. doi: 10.1145/2702123.2702256.

[11] Prabhu. and Visalakshi. S, "Android Operating System: A Review," *International Journal of Trend in Research and Development*, vol. 2, no. 5, pp. 260–264, 2018, doi: 10.13140/RG.2.2.20829.72169.

[12] H. Döring and Y. Wei, "A study on the performance of a gyromonotron," *Int J Infrared Millimeter Waves*, vol. 2, no. 3, pp. 437–452, 1981, doi: 10.1007/BF01007412.

[13] A. Andrade, "Game engines: a survey," *EAI Endorsed Transactions on Game-Based Learning*, vol. 2, no. 6, p. 150615, 2015, doi: 10.4108/eai.5-11-2015.150615.

[14] P. P. Patil and R. Alvares, "Cross-platform Application Development using Unity Game Engine," *International Journal of Advance Research in Computer Science and Management Studies*, vol. 3, no. 4, pp. 1–9, 2015.

[15] X. Li, D. Liu, and X. Zhang, "A System Integrated with C# Programing and Real-Time 3D Observation for Learning Virtual Reality Technology," *Open J Soc Sci*, vol. 07, no. 03, pp. 127–135, 2019, doi: 10.4236/jss.2019.73009.

[16] G. Wiro Sasmito, "Penerapan Metode Waterfall Pada Desain Sistem Informasi Geografis Industri Kabupaten Tegal," *Jurnal Informatika:Jurnal Pengembangan IT (JPIT)*, vol. 2, no. 1, pp. 6–12, 2017.

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