

Virtual Reality Application for Cycling

^IPoonam Golhar, ^{II}Tanvi Kulkarni, ^{III}Deepak Khedkar, ^{IV}Nikita Pathak

Dept. of Computer Engg., Pune Vidyarthi Griha's College of Engineering and Technology, Pune, India.

Abstract

Virtual Reality is a revolutionary concept for experiencing the virtual world which do not have any physical existence using Head Mounted Display device. It is the factor to feel the environment with our own customization. VR is completely safe and can give mesmerizing experience to the user. Virtual Reality has a wide scope starting from small object to the entire world which depends on the creativity of the environment designer. It can be used in many fields like medical practices, health care, driving simulation, experiencing any tourist place sitting at one spot, gaming, etc. In this paper, the product is meant for people who want to maintain their fitness experiencing different environment of their own choice. Nowadays, cycling in gym has become too generic, also in stationary cycle along with just paddling the intended product will provide them a thrilling environment in which they will exercise more frequently and help them to maintain their health. VR provides completely new level of human-computer interaction.

Keywords

Virtual Cycling, Virtual Reality, Human-Computer Interaction, Virtual Environment, Simulation, Dynamic generator.

I. Introduction

In recent years, development of Virtual Reality (VR) system has created major impact on Human-Computer interaction system. The applications of virtual reality exhibits medical applications[1], education[2], sports[3], military affairs, aerospace, real estate development, industrial simulation,[4] etc.

1. Virtual Reality

Virtual reality is centre of attraction from its birth. It is continuously developed and improved to increase its usage in various fields. Virtual reality is a computer-simulated, multi-dimensional environment that simulates physical presence in real world with virtual world by mapping physical world parameters with virtual world parameters[1]. User gets completely involved in the virtual environment such that he cannot differentiate between real and virtual world. This complete involvement of user is referred as immersion. VR mainly provide users with ability to:

1. immerse in the virtual world,
2. navigate through the virtual environment,
3. observe or manipulate the 3D objects.[1]

With computer technology at the core, parameters like visuals, touch, audio, etc. can be simulated in virtual environment. Similar to any human-computer interaction system, VR also need user input and sensor feedback. For the user input Position/Orientation tracking, Eye tracking, Full body motion tracking are mainly focused and types of feedback could be Visual feedback, Haptic feedback, Sound feedback, Olfactory feedback[5]. Virtual environment consists of 3D objects with which user can interact using standard input output devices such as keyboard, mouse, touch screens, etc. or by special human-computer interface like head mounted display. One such type of device is Oculus-rift by Google, which overcome the problem of motion sickness and dizziness in other VR headsets[6].

The virtual reality can be divided into three levels non-immersive VR, (sensory-immersive) semi-immersive VR and (Neural-direct) fully immersive VR. Non-immersive VR is specifically experienced on the traditional desktop without any advanced hardware whereas semi-immersive VR needs advanced hardware devices like Head Mounted Display (HMD). Fully immersive VR is one in which direct connections of human brain are referred. The virtual cycling is the one which falls into level two i.e. semi-immersive VR as it needs HMD as an advanced hardware device for interaction.

II. Related Work

In order to introduce a new technology in exercising field, some amount of work has been done so far. Virtual reality can be used successfully in the sports for competitive sports, sports rehabilitation, physical education[3]. One of the application that has used VR for cycling is the VRACK system. In the development of VRACK system 15 sensors has been used. This number is large enough to increases the complexities in communication[8].

A turning control device for a virtual stationary bike with a video monitor and a computer program for simulation is used. The program is driven by a flywheel of the bike which is only used to show images of a rider on the bike on the road[9]. Another example is of the Widerun. It is the bike trainer for indoor cycling in VR world. It provides with a completely immersive system that can be directly connected to VR headsets[10].

III. Overview of Virtual Cycling System

1. Problem Definition

Today as technology is emerging vastly, most of the human race is unaware of the fact that how virtual reality can be useful in almost everything. It can be useful in medical practices, gaming, education, etc. In contrary, this technology is not yet seen here in many places. Virtual reality can provide easier and interesting approach for various applications. In real world, humans can interact with the objects around them but a virtual reality is an artificial environment that is created using programming and presented to the user in such a way that the user suspends his belief and accepts it as real world. The simplest form of virtual reality is a 3D image that can be explored interactively at a personal computer usually by manipulating keys.

Generally when person does exercise he faces lots of difficulties at first. So in this application, the user will be given virtual environment for physical fitness where the user can experience himself exercising in virtual world with exact reflection of his actions performed in real world. Basically it is interaction between real and virtual worlds.

The user can experience accurate real world physical parameters produced as output in virtual world by accessing them as input in real world using different sensors. These sensors are basically attached to an exercise bicycle where it measures every action performed by user and simulate it in the virtual world and provides user with better visual experience by fully immersing in the virtual

world. It is seen from above description that sensors plays major role for giving user a virtual world experience.

2. Components

Fig. 1 depicts the continuous loop of basic communication in virtual cycling system corresponding to the human-computer interaction. User performs certain actions using exercise bike which act as input to the computing device via Arduino board. Exercise bike is equipped with sensors for measuring physical parameters like speed, turn angle of bike, heart rate of user, etc.

Computing device, i.e., a smartphone with Android OS receives actions performed by user as an input and process the real-time information and renders the output as virtual environment to the output device. This process simulates the human behaviour to the virtual world.

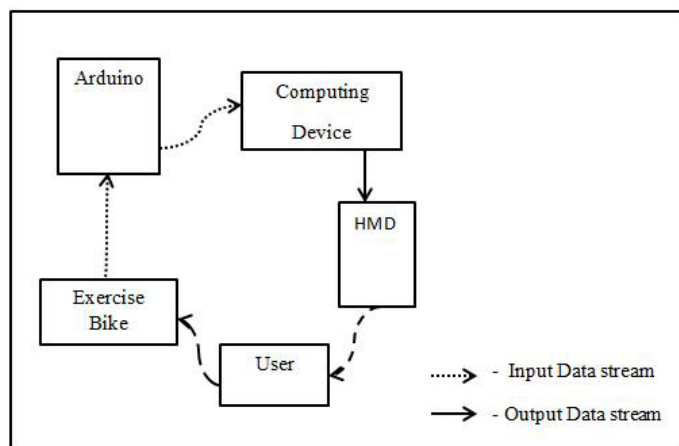


Fig. 1: Components of Virtual Cycling System

3. Architecture

The computer with mouse, keyboard and desktop is not compatible for multi-dimensional virtual environment. The major challenge with virtual reality system is to replace traditional computer system with new system that has to manage most of the interfaces. For any VR system two main components are needed – sensors and effectors. Sensors provide control over the virtual world by providing input and effectors are feedback providers to the user. Here, effector is Head Mounted Display(HMD).

Any fully functional immersive VR system consists of three basic elements that are:

- Virtual environment
- Computer environment
- VR interfaces

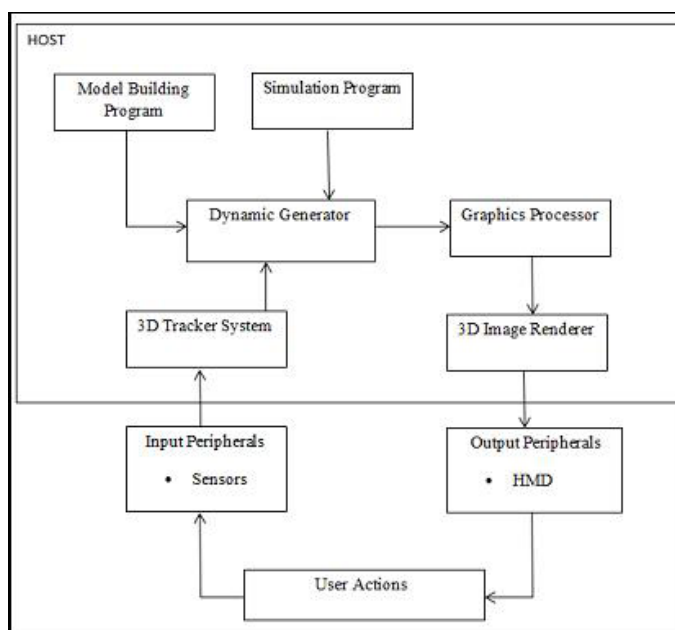


Fig. 2: Virtual Cycling Architecture

Virtual environment provides users with real-time interactivity and make them feel as a part of that environment by means of virtual presentation of the information provided by the user itself[7].

Computer environment is a computing device which receives data through its I/O channels and simulates it with virtual environment. VR interfaces include the hardware used in the system for motion sensing, haptic, etc. As the above figure depicts virtual cycling system consists of host, input peripherals and output peripherals. The actions performed by the user are perceived by sensors and provided as input to the 3D tracker system via Arduino. Virtual environment is actually a set of 3D models created by model building program. Model building program and input is given to the dynamic generator which reflects the input in virtual environment with the help of simulation program. Dynamic generator uses input peripherals for tracking. Then the graphics processor comes into the picture which takes whole responsibility of simulated virtual environment. With the help of 3D image renderer, simulated virtual environment is rendered on the output peripheral device, Head Mounted Display(HMD). This is the abstract view of virtual cycling. Host can be laptop, personal computer or Head Mounted Display.

4. Conclusion

In this paper, we propose a virtual reality system in which the user will be having immersive experience for exercising in 3-dimensional world. As the virtual Reality is growing rapidly, there might be many applications for exercising but we are developing this system with minimum sensors. Nowadays indoor cycling is one of the best type of exercise, traditional cycling system is preferred by many health conscious users but virtual cycling adds features that makes cycling more appealing and interactive to the people. This application can be used by physical trainers in gyms or in homes to observe and improve the exercise pattern. Thus, the main intention of the project is to develop a user-friendly application for the fitness maniacs to exercise along with 3D experience and to introduce virtual reality application in cycling.

Acknowledgement

We thank Prof. M.S.Pokale for her support, help and guidance without which this work would not be completed.

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