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Sense of Touch in Virtual Reality for CAD viewer

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ABSTRACT
Achieving fine visualisation of designs inside CAD applications stays a task for designers with modern-day methods of CAD visualisation requiring both a excessive degree of technical capability, or pricey hardware and software.The recent re-emergence of consumer Virtual Reality(VR) has lowered the barrier for everyday developers wanting to visualise their designs in 3D form. This paper presents the CAD viewer which employs the Oculus Rift/VR Goggles/VR goggles (Head Mount Display) and Leap Motion Controller to provide a low cost method enabling users to use their hands to analyse a mechanic model to handle and examine individual components in realistic 3D. Qualitative observations of consumer interactions with the CAD/OBJ viewer show that customers have been capable of intuitively control the CAD version the usage of physical hand movements with handiest much less education.
Keywords: Virtual Reality, Leap motion, VR goggles, Gesture Recognition, Hand gestures, Unity 3D, 3D object, Finger Tip sense, Human – Computer Interaction, Head-Mounted Display, Game Engine, CAD viewer.

I. INTRODUCTION

Human – computer interaction is an multidisciplinary field in which computer developer, engineers and design professionals play important roles. Virtual reality (VR) is a computer simulated surrounding that can simulate the physical world in places in the real world. The aim of VR system is to involve the participant or others within a computer generated interact with the virtual environment. Human interaction with VR is making pc based structures simpler to use and greater powerful for people consciousness on manage motion in VR.Therefore, HCI(Human-Computer interaction) in VR consists of 3 parts such as the user, the computer and the way to work together.Virtual Reality for Computer Aided Design (CAD) and visualisation has been a famous topic in recent years [1-5]. Differing levels of VR immersion are discussed by [2], vary from technology inclusive of second screens for little to no immersion, projection walls for moderate immersion, and Head-Mounted Displays for full immersion. Virtual Reality allows users to view and navigate 3D virtual environments in ways not possible with conventional 2D displays. Combination of VR and CAD makes it is possible for users to viewtheir designed model in front of them in authentic 3D in a similar fashion to viewing the physical realistic artefact. Through the integration of hand tracking technology developer can interact with the model using physical hand movements and gestures. Recently, the Oculus Rift/VR Goggles has achieved popularity as a consumer-grade virtual reality headset. The Rift/VR Goggles contains a bunch of sensors to ensure accurate head tracking of the orientation of the users head at all times [2]. The Rift/VR Goggles provides high screen resolution stereoscopic images with 100° field of view . While application of the Rift/VR Goggles is as diverse as from teleportation to historical reconstruction, to the best of the authors' knowledge, it has not yet been used for CAD. The achievement of these studies, combined with the developers' own experience with the Oculus Rift/VR Goggles, have contributed to the decision to use the Oculus Rift/VR Goggles in the development of the CAD viewer introduced in this paper.

II. SYSTEM DESCRIPTION

1. System Architecture

The following fig 1.1 shows the system architecture of interaction of hand gestures and VR headset with CAD viewer.

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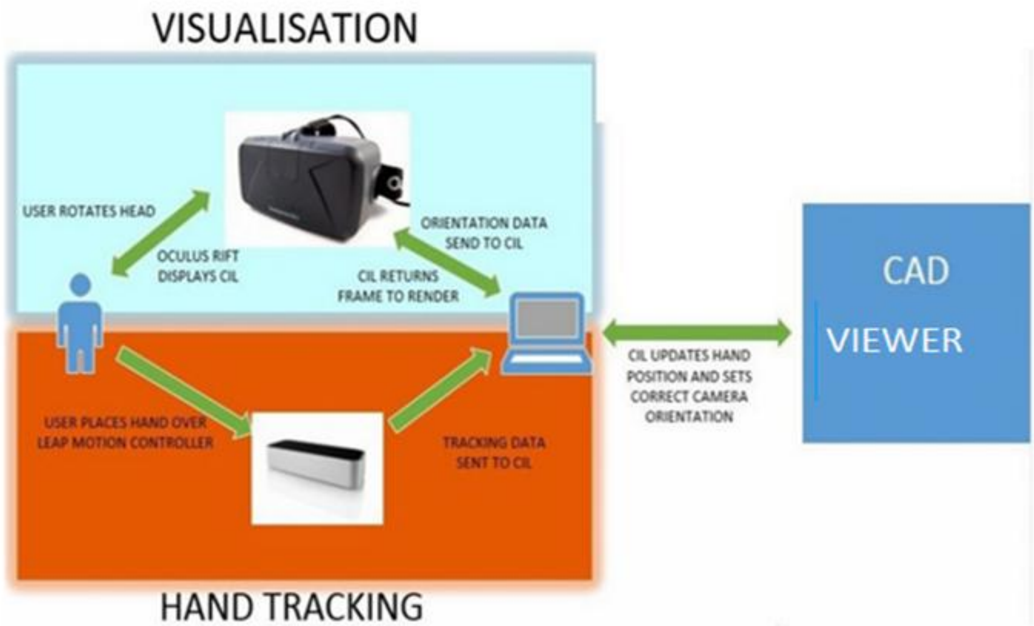
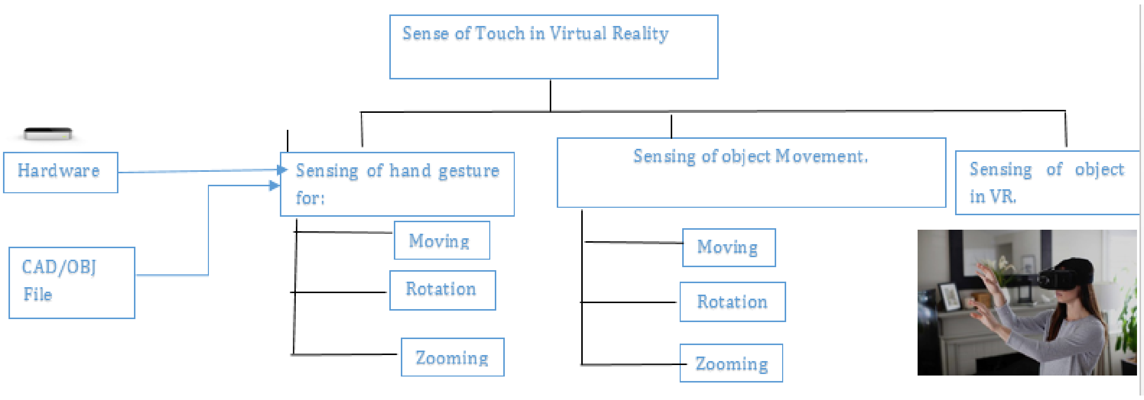


Fig 1.1 System Architecture

According system architecture we require features for system like minimum 4GB RAM,2GB Graphics card(Gaming Hardware).

2. Module Details

The following fig.2.1 explains working module of proposed system.



III. D HAND LOCALIZATION

The estimation of 3D hand position in VR will assist and furnished by means of jump motion's SDK in Unity3D. For more command and apply the SDK function, we can edit the script directly. In the Fig. 3.1, we set the position of user and user's hand follow the position in VR. expect that function of the user's avatar denoted by way of$A(x_A, y_A, z_A)$ and the user's hand denoted by $H(x_H, y_H, z_H$that have N as palm ordinary. We use hand role for detecting hand as follows:

$$isHandEnable = \begin{cases} true & ,H(x_H, y_H, z_H) \\ false & ,H(x_H, y_H, z_H) \end{cases}$$

Before tracking hand for control avatar we constantly discover hand first after that we will check hand gesture. If isHandEnable = false user's avatar will not move and standby else if isHandEnable = true. When we detect hand position and palm normal we also have an angle of 2 vectors for check gesture. In this movement we considered only horizontal axis consist of x-axis and z-axis. Thus, the angles utilize for movement control are the angle of the user's hand and the angle of AN . We define these angles by horizontal value as follows:

$$\theta_H = tan^{-1}\frac{|\overline{N}_z|}{|\overline{N}_x|},\ \theta_A = tan^{-1}\frac{|\overline{AN}_z|}{|\overline{AN}_x|}$$

These angles is use of check moving forward, backward, move left or move right. When

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system detect the user's hand, palm normal are also find out in local coordination relative with hand position. The of this vector will have an impact on to user movement. we cancheck player move forward by the direction of this vector by THETA$_H$ as follows:

$$isForward = \begin{cases} true & ,0 \le \theta_H < \pi \\ false & ,\pi \le \theta_H < 2\pi \end{cases}$$

If $_H$ value is moreover 0 to , it mean that users are pushing the hand ahead and avatar will move forward.

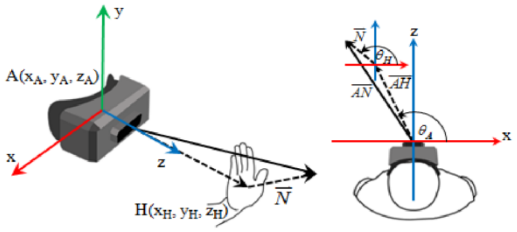

Fig. 3.1 D hand localization and palm normal related with user's avatar

Otherwise, if $_H$ value is moreover to twousers are flipping their hands and avatar will circulate or move backward. Moreover, if $_A$ value is in the quadrant 1 or 4 this mean person pass the hand to the right and avatar will move a side step to right hand side. Conversely, the user will pass the hand to the left and avatar will move a side step to left hand side as follows:

$$isHandEnable = \begin{cases} true & ,H(x_H, y_H, z_H) \neq null \\ false & ,H(x_H, y_H, z_H) = null \end{cases}$$

Assume that the distance of push and pull their hand that we assumed with respect to Z axis is front range or distance of Z between hand and the person. another distance is the lateral variety we bear in mind by X axis of the hand relative to user's front view line or Z axis. Front range and sidewise range value are considered as follow:

$$front = |\overline{AN}| \sin\theta_A = |\overline{AN}_z|$$

$$lateral = |\overline{AN}| \cos\theta_A = |\overline{AN}_x|$$

These distances are calculated with movement speed. The front value will compute with velocity of move forward and backward, while lateral value will calculate with velocity of pass left and right.

We have a function for fist detecting namely pinchStrench(). The return value of pinchStrench() function is always from zero to 1. If we found out that pinchStrench() value more than 0.5 we claim that user are fisting as follows:

$$isFist = \begin{cases} true & ,pinchStrench() \ge 0.5 \\ false & ,pinchStrecnh() < 0.5 \end{cases}$$

When user shows fisting the avatar will stop moving forward or backward, but still able to move evade left or right. If users want to forestall they have got to hold their fist in the middle of the screen. We will see that when the player move forward, move backward and finish moving are still allow moving left or right at the same time. While moving forward, move backward & end moving command are separated, unable to work together. These imply to the logical command relate to all parameters as follows:

$$moveForward \equiv isHandEnable \wedge isForward \wedge \neg isFist$$

$$moveBackward \equiv isHandEnable \wedge \neg isForward \wedge \neg isFist$$

$$moveLeft \equiv isHandEnable \wedge \neg isRight$$

$$moveRight \equiv isHandEnable \wedge isRight$$

[2]

IV. TABLE OF EXPERIMENTAL EVOLUTION

The following fig 4.1 shows tabular representation of Evolution of time (in sec) used in experiment.

	Scene1		Scene2	
	Gamepad	Gesture	Gamepad	Gesture
Min	51.10	37.11	113.14	87.75
Max	76.39	70.54	131.06	118.65
Average	57.31	47.21	120.49	100.58
STDEV	7.95	9.54	5.78	10.41

Fig 4.1 Table of Evolution of time used in experiment.

V. CONCLUSION

Our proposed system discussed the development and qualitative evaluation of an interactive VR environment developed for the purpose of giving users a simple and natural method for visualizing a CAD model.

Future work could be directly applied to education particularly in fields where maintenance and assembly of large and/or expensive objects is required. This method of object manipulation can also influence fields such as data visualization and medical imaging.

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