AUGMENTING THE REALITY WITH LEAP MOTION CONTROLLER

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ABSTRACT

As the technology started, evolving, new ways to interact with the digital world have been developed by the people around the world. One of such new things is Leap motion controller; however, this technology has been existed for past 3 years, but few people have known about it. Leap motion is not actually replacement for our traditional keyboard and mouse, which we have been using since 1995, but a new way to interact with the digital domain using that device. It gives precision and accuracy while tracking up to 10 fingers at a time. The Augmented Reality is also 3-4 years old technology, which is about displaying 3D models in the real world with markers on the screen instead of real world. Marker is an image, which is used display the 3D object while the camera is focused on it. Very few attempts have been made to combine these two technologies. Our goal for this research paper is to explain and demonstrate how possibly the leap motion can track all fingers in any direction and various applications where we can use it to make a more effective use of this technology.

Keywords: *leap motion, augmented reality, computer interaction, gesture recognition, controller*

INTRODUCTION

Everybody in real life wants to interact with display using hands, the way it is shown in the sci-fi high budget movies. This is almost possible in our present time with various devices and technological advancements that are available for us, which includes the Leap Motion Controller, Myo band, GloveOne (Recently released) for the devices while thinking in terms of the technology we have the Augmented Reality (AR) for augmenting 3D objects in the real world as well Virtual Reality (VR) for head mounted display – kind of wearable device that can track your head movement. Various attempts have been made to make it possible and almost it is now possible by merging some of these technologies with one another.

In this research paper we are going to explain how these technologies can help us solve real world problems by making interaction easier and the goal of the technology to reduce the trouble of learning for newcomers. Gestures are natural way for humans to interact and an everyday part in a human life while communicating with others. This paper will explain how Leap motion and Augmented Reality can work together to solve the problem of connecting to the digital world in the analog domain. Now I will start by explaining both the technologies AR and Leap Motion.

Augmented Reality (AR):

It is the art of adding content in the real world which is not actually present there at the time but can be seen through the computer generated imagery or some similar devices. Here, we have two kinds of technologies that make it possible;one is markerless while the other requires use of markers to display the objects in the virtual space.Markers are just images which can be anything including a full graphic image or the QR code. This when scanned by

the device camera, the content related to the image is displayed on the screen. The problem with the marker is that it should be always carried by that person, since without markers the content cannot be seen. Markerless AR allows seeing us the content without even having the markers thus it makes more effective than previous one.During the start of AR the content can only be displayed in the real world and there was no way to interact with the models like scaling, rotating and moving from one place to another. With the evolution of high end smartphones it became possible up to certain level to interact with such 3D content and view itin any angle.However to work with this technology we require a higher configuration for smart phones as low configuration phones don't work best with it.

Fig. an AR gameplay in progress

As seen in the above image the scanned image is showing the 3D models over the image marker. It is a parking simulator game where by selecting the cars by touch you drive them the way you want to drive. As seen above we can see the image at any angle just by rotating the view.

How it works?

- What you need: A marker image, a scanner application for the particular marker, a device that has camera.
- First you need to place the marker on someplace where it can be still.
- The scanner application should be opened on the device.
- Now scanner will scan the image and the 3D model will be displayed on the screen.
- This 3D model now can be viewed at any angle.

Leap Motion Controller:

It is a controller that tracks our fingers and based on our touches responds back or shows output to the screen. It is similar to the Kinect motion sensor which tracks full body but it only allows us to interact with screen using only hands or fingers, like the mouse but without touching the screen.It is a small USB device that allows the interaction with the screen, which should be placed facing in the upward direction with the effective range of 2 feet. The vendor claims that it can track 10 fingers at the time precisely and accurately. It has 3 IR LEDs and 2 monochromatic IR cameras that are used for tracking finger movement and position. Data rate for transfer is 300 frames/seconds for reflected content which is passed through USB cable to the display. It works in the 3 dimensions known as X, Y, Z which makes it easier hand movement in any direction. X direction is parallel to the device; Y direction is perpendicular to the device; while Z direction is of positive values toward the user. Various gestures are possible such as taps, swipes, hover, pinching, etc.

Fig. Leap Motion Controller

It is very small device which user places in front of him/her and can perform gestures over the device.

How it works?

- The 3 IR LEDs emits IR rays into the environment which when hit to solid surface and reflects back. This IR rays are out of the visible spectrum of the light and hence are invisible to the human eye.
- When you place your hand or fingers over leap motion controller the IR rayfrom 3 LEDs will hit and reflect back.
- This reflected IR rays are captured back by 2 IR cameras placed between the IR LEDs.
- The tracked rays are now processed and the data is passed through the USB cable to the output device.
- The output device will display the data based on the reflection of fingers in real space.

Observations while using Leap Motion Controller:

1. The high frequency of data transmitted over the cable because almost no lag for the device to recognize the gestures done by the hand.
2. It have little difficulty while tracking gestures when they are already performed and hand directly hovered over the controller with the gesture which makes it difficult to scan the fingers to be able to be detected.
3. The area for the leap motion scanning is large enoughfor a person to move his/her hand freely around the environment.
4. Having your hand positioned in the air for more time can cause some pain in the shoulder, so using it for large amount of time should be strictly avoided.

Why the requirement of gesture based recognition?

Even though over the years the technology is advanced over the years various ways of interactions were designed such as mouse, keyboard, joysticks, etc. people still have problems while using this devices. For e.g. while using the keyboard people still tend to find the alphabets. It happens mostly because sometimes while mind is not concentrated it can happen as well if person is new to using the keyboard then also the person has find it difficult to find the alphabets. Even if we have the mouse it is still difficult for people to point out something properly. Not everyone does that but most the times due to over sensitivity the mouse goes out of flow. Gestures are the natural way for us to interact. It might be possible using the gestures as a natural ways to interact with the displays. Performing certain gestures to write the words on the screen, pointing and then tapping in air to click something, etc. such kind of tasks can be performed and since most of the gestures are fairly known such as tapping for click, swiping for moving the screen on any direction, pinching or closing palm for grabbing object, etc.

We can also use a pointing device as our fingers but it is not as effective as fingers because we only get to use one point as the pointer to point at computer. This is effective when we

want to show or point out certain things or the screens where only one point is required. It is still little bit complex to use the tool for the controls. The tool should be pointed enough to be used as a pointing device.

The behind this is onlyonce you know where you are pointing at then it is easier for you to interact with the object, instead of finding the cursor position on the screen. Using IR rays allows the interaction even in the darkness since the camera creates grey scale imagery based on the depth map generated by the IR rays strikes the object. The frame rate which is captured over here can also give precise tracking of hand and finger movements in the air. The best way it can be used with VR which is still in development process, we can create a device that can capture the environment with its camera and the head mounted display will show the surrounding and while interacting we can use our hands to interact with people, objects, etc.

Applications for Leap Motion Controller with AR:

We have seen capabilities of both more let's see how this two can be combined together to show best of both worlds.

1. **Music applications:**Various instruments require your hands, such as piano, drums, bongo, and various other instruments. People will have difficulty to buy such instruments because they are mostly very high cost and the budget required for it can go over 20k to 100k. We simulate an application to create same effect. Simulating the effect, can reduce the cost because here we can use system generated tones for use. Later on live instruments can be purchased and used as necessary.
2. **Interactive story telling:** People always read the stories but what if we allow them to interact with the story. By allowing simple gestures to make people immerse in the stories, such as "Thirsty Crow" in which kids will help the crow to fill the jug more quickly, "Fox and The sour grapes" where kids will have fun not allowing the fox to eat grapes. It is a fun way to let people learn the stories. Stories will be literally modified and making the ones playing the god of the story.
3. **Test for hand augmentation:** A man wants to use a prosthetic hand but don't know how it will look when it is attached to his hand then the AR can be used to solve this problem. We can create the 3D hand model and then placing hand over the marker. When hand is placed over marker, the 3D model is generated over the hand. This hand will allow the handicapped person to see how this 3D hand will look when implanted to the person. This idea is not that much perfect but can be helpful for persons to see the implanted robotic hand before it is attached to the person.
4. **3D models display in museum:** Using AR we can also display the artwork in the museum which can be in 3D but not real while the real model is kept somewhere else. Using leap motion we can rotate, resize the model as per our need to see the details of the original work. However one thing here should be probably taken care of is the accuracy and exact similarity between the model and real world artwork. It can be really helpful for researchers to use the model to learn more about that it rather than studying on the real model. Since 3D models can be taken anywhere user wanted.
5. **Military usage:** 3D model of the terrain is created first and then by detail survey of this map it will become easier. Finding vulnerable points on the map can be made easier while using such 3D model. It is really risky to send out the militants in the enemy area for inspection. The 3D detailed map can also be used guess where the enemy can possibly plant mines and other traps.
6. **Educational purpose:** Using Leap Motion Controller for educating students can be great way. For e.g. showing the solar system in 3D to the students. Which can help student better understand the concept as well as figuring out how the stars circles

around themselves as well as planets orbiting around start and when touched by children they can provide more information. Teachers can also use Augmented Reality with the Leap Motion controller to make presentations more live than it was before.There are various other fields in education whereit can be used.

7. **Healthcare:** In the healthcare, we can create 3D anatomy models of human body which can be used for displaying the inner functions, previous like dissections, it can be used to understand and present the human physiology in a better format. For e.g. dissecting animals for the medical students. It is possible that experimenting on the dead animals can be difficult where cutting a wrong vein which may be important can entirely fail the experiment. It will be better if we use the 3D models of animals for this purpose, so even if some mistake is happen the student can undo the process and restart again from the previous point.
8. **Furnishing at home:** You want to buy a new piece of furniture, but you want to test it out first before buying it. You really want to buy that but don't want to waste your money if it won't look better once you bought it. We can create such 3D models to test out how this new piece of furniture looks. Using AR one can place the furniture with the use of AR as the way one wants to put anywhere in the room. If the new furniture really fits the place and works good then the person will buy it, else he will choose for other options.
9. **Games:** We can play games using AR and Leap Motion where the controller will act as our device for purpose of playing the game. We can use gestures to do simple interactions right now, but with more updates we can also assume to track more complex interactions with the games such as driving a car, or performing magic actions, which requires more time but can be done in this.
10. **CGI field:** Models with the right camera can be directly added to the screen while filming the movie or episode. The only problem with this approach is the lack of displacing the object once it is in the scene. Since it is already recorded and is the part of the screen. Otherwise if we do not have to change the object once the scene is shot then it is possibly the good use to the application of AR and people can interact with it too while it is on the screen and no need for further CGI is needed.

CONCLUSION

Tracking fingers with IR is still part of the development, and right now we can at least track 10 fingers at a time. The topic of research here is how the combination of these technologies can help reduce the human efforts for interaction with computers. This is also a possible way for trying to bridge the gap between real world and digital world where interaction with the digital world is possible on touch of fingers. Since AR allows us to view 3D models from any angle it is a really good way to show objects in the real world. The Virtual Reality (VR) is still in development and most good applications have been developed for it but then it is still mostly in use for developing games while the AR is mostly used for both purposes.

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