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Implementation and Design User Interface Layout Use Leap Motion Controller With Hand Gesture Recognition

Implementation and Design User Interface Layout Use Leap Motion Controller With Hand Gesture Recognition

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Abstract. Human Computer Interaction is the study how to design, evaluate, and implement computer systems interactive, the systems can make a dialogue with human. This research was designed and implementation leap motion used hand movements into digital models, which can be used to replace the function of the mouse or keyboard and can provide an alternative in the utilization of hand movements as interactions that the naturally between human and computers and allowing users to input gesture commands into an application in place of a mouse or keyboard. Human gesture recognition as technique interaction for deliver interpretation more natural and for communicating with computers. The aim of this research to find usability leap motion, how effectiveness of the Leap Motion controller for hand gesture recognition for solve important problems in human use of mouse or keyboard. Testing and implementation from this reseach focused are tracking, detection, dynamic, and statis gesture recognation. The result 6 gesture recognation double outward swipe, tap, swipe, clap,circular and fly control tap accuracy of gesture interrpretation data has obtained 87.62%. The uses the data for recognation model has obtain very good and testing with Leap Motion visualizer hand gesture recognation are often sensitive to poor resolution.

1. Introduction

Technology leap motion or hand motion tracking is now widely used, namely by means of the capture to hand movements that can replace the function of the mouse or keyboard functionality, technological of leap motion can help user with a means of controlling any instruction that will be ordered the computer device used only by giving the movement of the hands or fingers in the air. Virtual Technology is also to be developed with the aim of helping the user in the process of interaction with the Computer used, for that many development that utilize technology with virtual media as a means of interacting, communication and information, one of which is a leap that could control every motion movement of the fingers and hands from the users so that it can replace the mouse and keyboard functionality that is currently used as a medium of interaction input to computer. The problem arises when this is currently many developed 3D application models, but the limitations the use of gesture in applications that exits, to the process of with a human machine interaction to happen naturally through hand movements currently have limitations such as only for virtual based applications. At this time the use of the mouse and keyboard are often used as one of the tools interactions with the computer, but also the limitations of the device used when applications are made in the form of virtual currently started developing rapidly as a means communication, information and interaction between human and machine is still minimal use. The purpose of this research is as the user with the machine in the process as the user with the

machine in the process of interaction that can be done naturally without utilizing tools like the mouse and keyboard. The process is done in the form of gesture recognition with a process that occur by using the movement the hands and fingers through the air, so the gesture brings can be adjusted with space and shapes with unlimited movement. Natural User Interface is communication between human and machine in the purpose of this to add value to human interaction with machine naturally occurring with the use of the hand movements, gestures and other movement with grabs, gesture and body language which can then be responded quickly by machine.

2. Literature Review

A. Human Computer Interaction

Is the concept of human and computer interaction is one of the interaction that occurs between people with the system or with device so communication between humans with machines to achieve a particular goal. Human Computer Interaction is defined as the scientific discipline that deals with the design, evaluation, and implementation of interactive computer system for use by humans and the study of phenomena in the environment. Human Computer Interaction is a computer science attention to continue that only use keyboard and mouse only, and so many researches to make human interaction computers with gesture spontaneous body movement that usually verbal communication and body parts that are commonly used are the hands, fingers.

B. User Interface

Is Interface between man and computer which a component of the operating system that are in touch directly with the user. User interface can design focuses what users might need to do and ensuring that the interface has element that are easy to access, understand, and the use to facilitate those action. The user interface input, allowing the users to manipulate a system and output is the system to show the effect of the manipulation of the user. System interface design has a discipline known as User Centered Design (UCD). It is a design philosophy that places the user at the center of the system development process. System interface design is a complex and challenging job. One complaint from the end user when interacting with interface computer that is when the system is no longer able to meet the needs of system use. This makes the interface evaluation involving human participation becomes very important [1]. The user interface should be easy to use (ease of use), playfulness and usefulness, for that practitioners should develop information systems targeted at system attributes, associated with the reception quality since initialization to use, so that customer satisfaction is achieved [2].

Things to look for in the design of the user interface are:

a. User Friendly has a nice interface, easy to operate, easy to learn and users are comfortable with the look designed.
b. Have high quality, admired by users, circulating outside and often imitated.

The importance of good interface design because of:

a. Reduce Cost to Write Program
   In program a graphical user interface on average 70% writing programs related to interface.
b. Easy to publish Product
   An early appearance of the product is visible from the side view of user interface.
c. Improve the usability of computer for the human.

Models humans interact with Computers and development process of interaction:

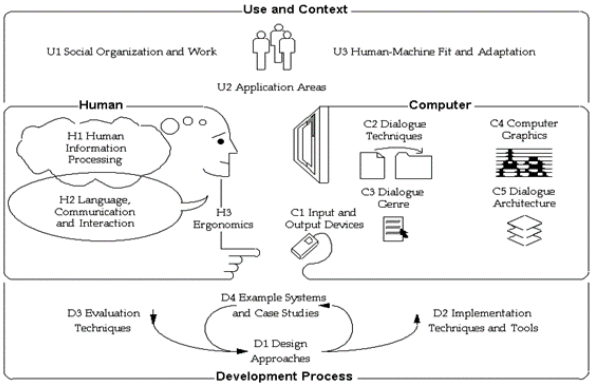

Figure 1. Aspects interaction, source: Dix, Alan, et.al, Human Computer Interaction.

From the figure 1, aspects of interaction are: use and context of computers (Social organization network, application area, Human-machine fit and adaptation), Human Characteristic (Human Information Processing, Language, Communication and Interaction, Ergonomics), Computer system and interface architecture (Input and Output Devices, Dialogue technique, Dialogue genre, Computer Graphics, Dialogue Architecture).Development Process (Design approaches ,implementation techniques and Tools, Evaluation Techniques).

C. Natural User Interface

Natural User interfaces show great promise to define new and potentially large niches of interactive computing. The promise of Natural Computing Interfaces (touch and gesture) stems from at least two sources -- the prospect of touch and gestural computing becoming as ubiquitous as currently dominant paradigms (e.g. GUI.) and technical breakthroughs. However, this new field of research and commercial development faces significant challenges (Steven C. Ph.D., Dennis Wixon, Ph.D, Ann Morrison, Giulio Jacucci, Ph.D., 2010).

D. Gesture Recognition

Gesture Recognition is an interface that can recognize the motion and movement an interaction that can be understood by the computers and gesture recognition can also be used to interact with the computer and tracking how to read human body movements that can be processed by a computers as trigger to do the next process that was made in advance capable of reading and translate the movement made by humans become a command that can be read and processed by computer. Human Computer Interaction through the use gesture can be one of the ways to improve the comfort in the process of interaction between humans with machines, especially when interaction models that is served base by 3D, in the gesture recognition a model must be understanding gesture hand movement with tap gesture, swipe gesture and others gesture.

Gesture interaction can be into with two groups are:

a. Gesture interaction model based on the pattern of the gesture with capture picture and recognize the gesture of identification on the pattern the hand detection with hand gesture. The hand was captured by the Leap Motion Controller in accordance with the pattern of hand movements.
b. Gesture Recognition can be seen as a way for computers to begin to understand the language of the human body so the rich build bridges between machine and humans. Gesture can original from any gesture with hands, gesture recognition can be seen as a way for computer to begun understanding the language of the human body rich build bridges between machines and human than Graphic User Interface which still restrict the majority of input to keyboard and mouse.

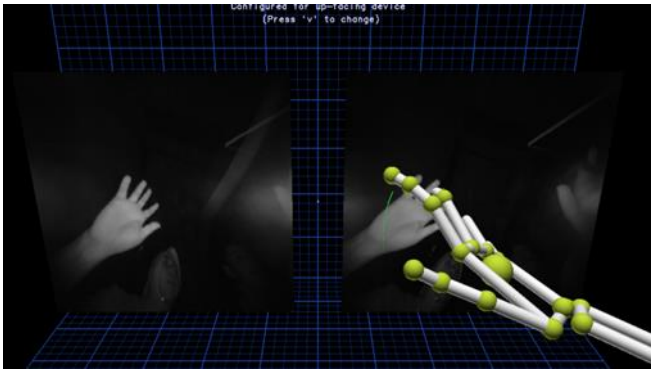

Figure 2. Gesture Hand Understand the language of human body

E. Leap Motion and Gesture Controller

The Leap Motion Controller is a modern device and technology products can sense naturally move and style with point, grab, wave, reach. The Product its Very small but a very fantastic idea, it's just a swipe hand of movement fingers and you can variety of activities in operating a computer with the Product

Figure 3. The Leap Motion Controller
http://www.google.com

Figure 4. The Leap Motion Controller
http://www.google.com

In the Leap Motion Controller have Three Infrared LED and Two IR Camera

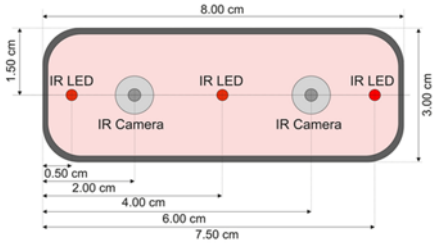

Figure 5. http://www.mdpi.com/1424-8220/13/5/6380/htm

F. Leap Motion Exploration

Leap Motion can addition to replacing the functions of the mouse, leap motion can turn out to be a function of the keyboard with the emitting that represent letters and numbers on my keyboard. Application that have been support the "Leap Enable" can be access the service Motion for Leap Motion SDK provides two type of API to get data leap Motion are:

a. Native Interface
b. Web socket Interface

Native interface is a library dynamic and that can be used to created new applications and have featured "Leap Enabled". Web Socket interface is a library can create a web application that supports the "Leap Enabled". Native Application interface provided loaded library leap motion and tracking data in application, the library connects with using programming language C++, C#, Java or Python. In the feature Native interface receive data from the motion controller via BUS Leap USB and then process the information. Application Leap Motion apart from the service and allows computer user to configure the installation Leap Motion by Control Panel. Application Leap Enabled received data tracking result.

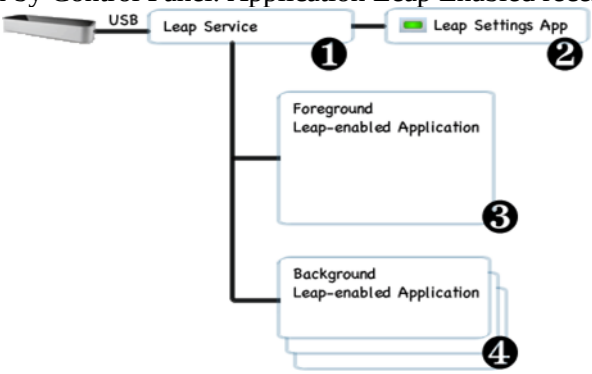

Figure 6. Architecture Native Interface http://users.itk.ppke.hu

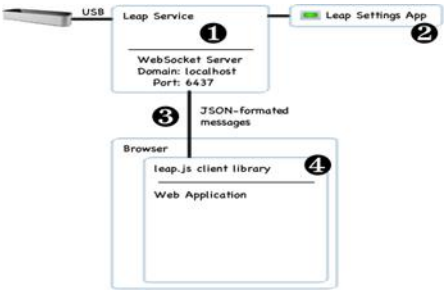

Figure 7. Architecture Native Interface http://users.itk.ppke.hu

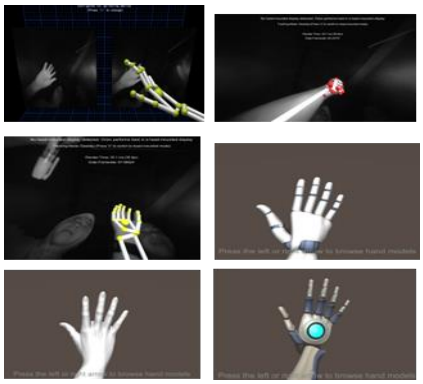

Figure 8. The Leap Motion Exploration and Sample Capture for Movement Hands and Hands Model

3. Related Work

The Leap Motion Controller hand movement and gesture recognition in the research provides an informative representation of hands, utilize tracking data through the API of Leap Motion Controller to recognize hand movement and hand gestures. The Experiment shows that our method based on hand gesture accurately when no occlusion happens [3].

Gesture Recognition is the process of recognizing human gestures via mathematical algorithms. Effective gesture recognition without wearing any device on the arm is achieved depth cameras like leap motion. Gesture Recognition devices be it a depth camera or a normal camera generate tracking data about the hands in the field of view [4].

The Leap Motion Controller is a new device for hand gesture-controlled user interfaces with declared sub millimeter accuracy. However, up to this point its capabilities in real environments have not been analyzed. In this research present a first study of Leap Motion Controller, the main focus of attention is on the evaluation of the accuracy and repeatability. For an appropriate evaluation a position accuracy of 0.2 mm [5].

This research present an early exploration of the suit ability of the Leap Motion Controller for Australian Sign Language recognition. Testing showed that the controller is able to provide accurate tracking of hands and fingers and to track movement. This detection loses accuracy when the hand moves into a position that obstructs the controller's ability to view, such as when the hand rotates and is perpendicular to the controller [6].

4. Implementation Leap Motion Controller and Design Interface Application

The process of implementation of the Leap Motion Controller on design application introduce the architecture stage of several buildings (Monas, BNI, BI, MPR/DPR buildings)

A. Methodology for design and implementation Leap Motion Controller.

Step by step for design use MDLC (Multimedia Development Life Cycle): Concept, Design, Material Collecting, Assembly, Testing and Distribution. In Figure 9 MDLC Methodology

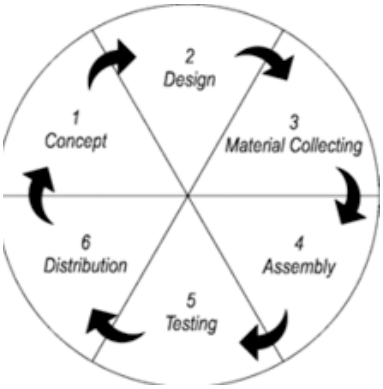

Figure 9. Multimedia Development Life Cycle

From the figure 7, step by step on MDLC Methodology are:

1. Concept Inside stage this there is some steps that need a note, among others: 1. Determine the aim application made
2. Design on stage this made specification application in a manner detailed in a design application. where manufacture adjusted based on: Design Flow Diagram (Flowchart). The designs are made too adjusted with the theme in question for example design BNI building, BI, Monad, MPR and DPR
3. Material Collecting (collection material), adjusted with building What is used on the theme this for example building Monas, BNI, BI, MPR and DPR
4. Stage assembly (manufacture) is stage Where all object or multimedia material made. Making application based on the flowchart. All object or material made and combined to be one application intact

5. Testing is stage testing existing applications and adjusted with the object being tested
6. Inside Distribution stage this, the application has been finished in test and stated well corresponding with aim manufacture, will distribute corresponding with results expected

B. Flowchart design application and Integrated Leap Motion Controller.

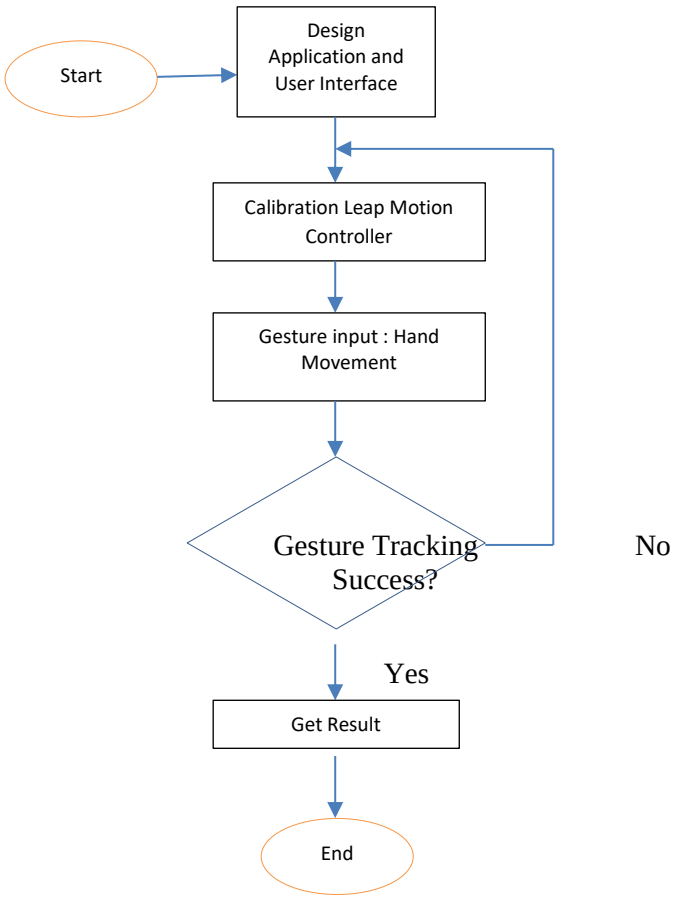

Figure 10. Flowchart design application and Integrated Leap Motion Controller.

The flowchart explains step by step design application and user interface before tracking hand movement, the computer and Leap Motion Controller must integrate in to USB port and then calibration Leap Motion controller (service, Device, Calibration, Tracking, Bandwidth, Lighting, Smudge Status. The next Step gesture and tracking hand movement, if a success capture the result and calculate accuracy hand movement and finish, if no return to back calibration about the Leap Motion Controller.

C. Design Interface

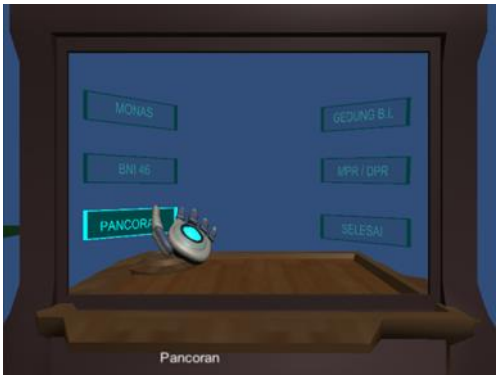

Figure 11. Design Application with Gesture Hand Movement and Integrated Leap Motion Controller

Figure 9 explain design application with stage architecture and design object with 3D Unity. The design interface can implemented about the gesture hand movement with hand models like robot. The figure 8 explain breakdown feature if choice menu (stage architecture Monas, BI, BNI, MPR/DPR and finish). The hand models respond quickly if hand movement if choice the menu.

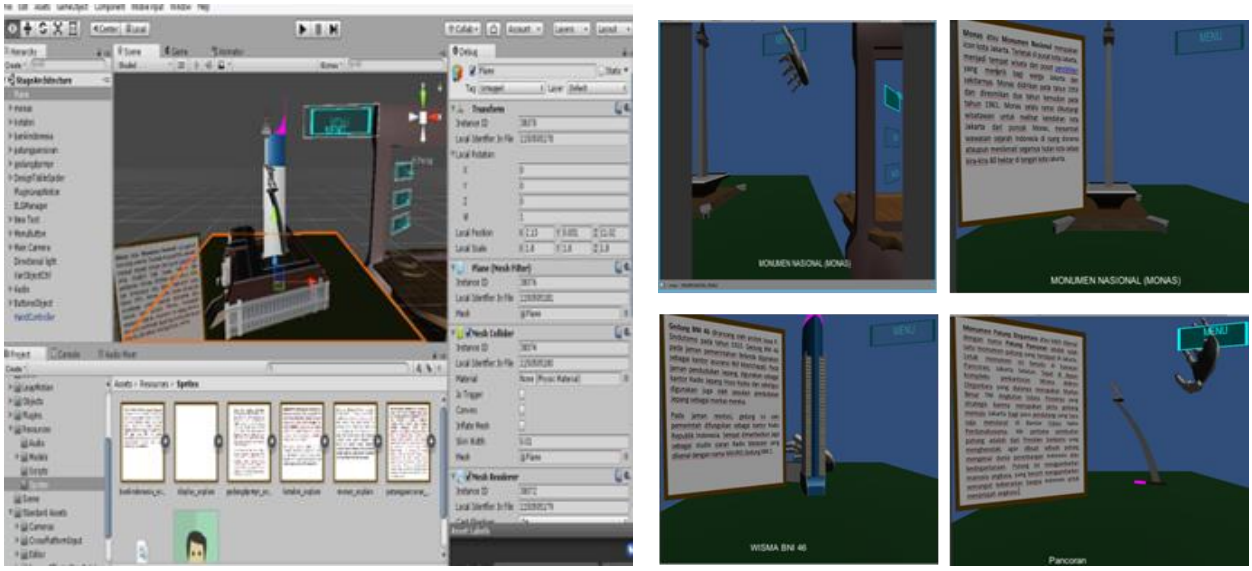

Figure 12. Feature and Explanation the feature or menu in Design interface Stage Architecture. The Figure 10 explain about breakdown feature if select the menu.

D. Code Program C# From Design Interface Stage Architecture

```
using   Unity Engine;
using System. Collections;
using LM Widgets;
public class Button To Monas : Button Toggle Base
{

public ButtonDemoGraphics onGraphics;
  public ButtonDemoGraphics offGraphics;
  public ButtonDemoGraphics midGraphics;
  public Button Demo Graphics bot Graphics;

public   Color  Mid Graphics On Color =

  new Color(0.0f, 0.5f, 0.5f, 1.0f);

  public  Color Bot Graphics On Color =

  new  Color(0.0f, 1.0f, 1.0f, 1.0f);
  public Color Mid Graphics Off Color =

  new Color(0.0f, 0.5f, 0.5f, 0.1f);
  public Color Bot Graphics Off Color =

 new Color(0.0f, 0.25f, 0.25f, 1.0f);
  private Transform camera;
  private Transform hand;
  public float buttonstate = 0;
  public  float movementSpeed = 30;
  public override void ButtonTurnsOn()
  {
```

```
if (ButtonDemo Graphics. button Enabled == true)

      {
         Button Demo Graphics. Button Enabled = false;

              TurnsOnGraphics ();
          StartCoroutine (MyCoroutine ());
       }
      print (Button Demo Graphics. button Enabled);

  }
  public override void ButtonTurnsOff()
  {
   //TurnsOffGraphics();
  }
  private void TurnsOnGraphics()
  {


on Graphics Set Active (true);
    off Graphics. Set Active (false);
    mid Graphics. Set Color (Mid Graphics On Color);
    bot Graphics. Set Color (Bot Graphics On Color);
    Game Object. Find ("beep1").Get Component<Audio Source> ().Play();
  }
  private void Turns Off Graphics()
  {
```

```
on Graphics. Set Active (false);
    off Graphics. Set Active (true);
    mid Graphics. Set Color (Mid Graphics Off  Color);
    bot Graphics. Set Color (Bot Graphics Off Color);
    button state = 0;
  }

private void Update Graphics()
  {
    Vector3 position= transform. Local Position;
    position. z = Math f .Min(position. z,

m_ local Trigger Distance);
    on Graphics. transform. Local Position

= position;
    off Graphics. transform. Local Position

= position;
    Vector3 bot _ position = position;
    bot_position.z = Mathf.Max

(bot_ position. z, m_ local Trigger

Distance - m_ local Cushion Thickness);
   bot Graphics. transform. Local Position

= bot _ position;
    Vector3 mid _position = position;
    mid _ position .z =

(position. z + bot _ position. z) / 2.0f;
    mid Graphics .transform. local Position

= mid _ position;
  }
  protected override void Start()
  {
    camera = Game Object .Find With Tag

("Main Camera").Get Component<Transform>();
    hand = Game Object. Find With Tag("Player").

Get Component<Transform>();
    base. Start();
        Turns Off  Graphics();
  }
  private void Late Update ()
  {


  private void Update Graphics()
  {
    Vector3 position= transform. Local Position;
```

```
    position. z = Math f .Min(position. z, m_ local Trigger Distance);
    on Graphics. transform. Local Position = position;
    off Graphics. transform. Local Position = position;
    Vector3 bot _ position = position;
    bot_ position. z = Math f. Max

(bot_position.z, m_localTriggerDistance - m_localCushionThickne
ss);
   bot Graphics. transform. Local Position = bot _ position;
    Vector3 mid _position = position;
    mid _ position .z = (position. z + bot _ position. z) / 2.0f;
    mid Graphics .transform. local Position = mid _ position;
  }
protected override void Start()
  {
    camera = GameObject.FindWithTag("MainCamera")

.Get Component<Transform>();
    hand = Game Object. Find With Tag("Player").

Get Component<Transform>();
    base. Start();
        Turns Off Graphics();
  }
  private void Late Update ()
  {
    if (button state == 1) {

Object. stage = 1 ;
          object. stage = "monas";
           object. Name
stage = "MONUMEN NASIONAL (MONAS)";

          if (camera. Position .x > 0) {
             camera. transform. Translate (Vector3.right

                        *movement Speed *Time. delta Time);
                              hand. transform. Translate

 (Vector3.right * movement Speed * Time .delta Time);
 render. sprite name = Object. stage+" _explain";
             Object. Go(1);
          }else{
             button state = 0;
             Button Demo Graphics. button Enabled = true;
          }
       }
  }
protected override void Fixed Update()
  {
    base. Fixed Update();
    Update Graphics();
  }



    IE numerator My Co routine()
    {
       yield return new Wait For Seconds(1);
       button state = 1;
       yield return new Wait For Seconds(2);
       Turns Off Graphics();
    }
}
```

E. Testing and Implementation Leap Motion For Gesture Recognition

1. Testing for Dynamic Hand Gesture Recognition after final stage to get and find out the ideal value of each variable parameters that are determined by the data type float in stage with Multimedia Development Life Cycle. In the implementation with different version alpha, beta and last version for key tap, double outward swipe, tap, swipe, clap, circular and fly control have a good respond.
2. Testing from Interaction Leap Motion Box

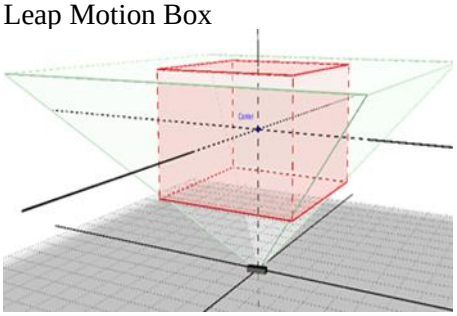

Figure 13. Leap Motion Interaction Box. http://www. Leap Motion Development

Figure 11 is a Leap Motion Interaction Box and the testing can make with the other corner (15^o, 45^o and 60^o). Range of Leap motion doing tracking data is about $150^{o,}$ the testing with 10 iteration from the 3 corner and see the recommended corner for tracking hand movement.

a. Accuracy for 15^o

Table 1. The average accuracy for the hand movement gesture

Gestures	**Known**	**Unknown**
Key tap	8	2
Double Outward Swipe	9	1
Tap	8	2
Swipe	9	1
Clap	9	1
Circular	8	2
Fly Control	7	3

From the table 1, the average accuracy for the hand movement gesture is:
Key Tap: For Know: 80%, Double Outward Swipe: 90, Swipe: 90%, Tap : 80%, Clap: 90%, Circular : 80% and Fly Control : 70%, so the average hand movement for corner 15^o is : 82.86%.

b. Accuracy for 45^o

Table 2. Accuracy With **45^o**

Gestures	**Known**	**Unknown**
Key tap	10	0
Double Outward Swipe	9	1
Tap	9	1
Swipe	9	1
Clap	10	0
Circular	8	2
Fly Control	10	0

From the table 2, the average accuracy for the hand movement gesture is:

Key Tap: For Know: 100%, Double Outward Swipe: 90%, Tap : 90%, Swipe : 90%, Clap: 100%, Circular : 80% and Fly Control : 100%, so the average hand movement for corner 15^o is : 92.86%.

c. Accuracy for 60^o

Table 3. accuracy with **60^o**

Gestures	**Known**	**Unknown**
Key tap	7	3
Double Outward Swipe	10	0
Tap	8	2
Swipe	9	1
Clap	9	1
Circular	9	1
Fly Control	9	1

From the table 1, the average accuracy for the hand movement gesture is:

Key Tap: For Know: 70%, Double Outward: 100%, Tap: 80%, Swipe: 90%, Clap: 90%, Circular: 90% and Fly Control: 90%, so the average hand movement for corner 60^o is: 87.15%. From the three simulation with the different corner the average is: 87.62%.

Conclusion

1. Human Computer Interaction is the concept of human and computer interaction is one of the interactions that occurs between people with the system or with device so communication between humans with machines to achieve a particular goal.
2. The user interface input, allowing the users to manipulate a system and output is the system to show the effect of the manipulation of the user. System interface design has a discipline known as User Centered Design (UCD). It is a design philosophy that places the user at the center of the system development process.
3. Natural User interfaces show great promise to define new and potentially large niches of interactive computing.
4. Gesture Recognition is an interface that can recognize the motion and movement an interaction that can be understood by the computers and gesture recognition can also be used to interact with the computer and tracking how to read human body movements.
5. From the three simulation with the different corner the average is: 87.62%.

References

[1] A. Chan, T. Halevi, and N. Memon, "Leap Motion Controller for Authentication via Hand Geometry and Gestures," no. figure 1.
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