# Space Mouse - Hand movement and gesture recognition using Leap Motion Controller

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***Abstract-*** A code based analysis of the user's performance in selection tasks using a space mouse in comparison with a standard device is presented in this paper. A new contact free gesture based human interaction with declared point to point accuracy has been used in space mouse. Systematic evaluation of this new system as not been done prior to this point. Accurate tacking of hand fingers, and the track movement was proved testing, accuracy is last when the hand moves in to a position obstructing the controller's ability to view. The space mouse uses a wide variety of ways to translate people's action into usable inputs. A prominent one is mapping the 3D space in to a 2D or 3D coordinate of a virtual space. Some apps using Space Mouse in the project. To the dynamic measurements, a unique V-shape tool, repose of two tracking objects preserving a constant space between them, was produced to replicate two human fingers. The Space Mouse represent an innovative input device for human computer interact communication based on gestures with point to point accuracy. The main focal point of concentration is on the assessment of the accuracy and iteration.

***Index Terms***- Leap Motion Controller, User Interface, Motion capture system, Accuracy measurement, Human factors, and Arm/finger gestures.

## I. INTRODUCTION

Input devices have a huge influence in the communication between humans and computer interfaces. The development of computer hardware and digital signal processing allowed for the creation of incredible sound of hardware and software synthesizers. Horizontal movement works with the device and the manipulation surface. However, electronic audio connections are common in mouse interfaces, multi-touch interfaces. In addition to standard input devices, many contactless input systems are available. Such sensors will be important for environmental cleanliness, such as medical applications or industrial applications.

***Figure 1***

- Space Mouse, a newly invented three-dimensional tactile pointing device. The sensor corresponds to the use of 3D stereo system for keyword, Especially related stereoscopic selection directly with other multidimensional standard solutions. In the Space Mouse the Leap Motion Controller Sensor, also known as the sensor, presents a new movement and spot tracking system. LMC technology design problems and models and 3D control features are predicted. The course performed in ISO standard work may not be comparable to a certain degree of difficulty and the study of LMC actions may be confused with the direction of movement. The functions of 3D mouse and sensor management tasks are evaluated and an enhanced reality enhancement is supported by the LMC. Device analysis is an attractive device such as an International Organization for Standardization (ISO).

Space Mouse works like a tangible mouse, allows for concentration of the movement of the free circulation with a high resolution and a motorized follow-up through the use of a bridge in the technological space. The portability of the Leap Motion device and the fact that this device has a large number of technical support as a usefulness of the device makes this device an attractive option for general motion control programs. The problems with calculating the device performance can be seen in the average

The main contributions in the analyses of the following: Precision and reliability (spatial scattering of measurements through time) of the controller,

- The spatial alteration of accuracy (difference of accuracy in different regions of sensory space)
- Sampling frequency and reliability. Leap Motion Controller has a wide range of applications
- It has been used for Stoke's study was part of the Smart Computer Tutoring team at the university. Another important request manually
- Many motion detection methods are discover to be presented in different environments. The ability to perceive the aslant sign in direction is considered the main advantage due to the depth of mouse's spatial dimension. The device can constantly be familiar with individual digits in a hand. The ability of the device to recognize, address and measure digit and finger point's location and movement is considered significant for accurately tracking of sign language motions. Despite the reference of a range of upto one meter in the technical specifications for the Space Mouse, During the

testing the device performs around roughly 40cm from the front and sides of the device.

A. Research problems

Project team encountered numerous technical problems during the life time of product development. Major problem that project team encountered was capture the hand and finger gesture. Later project team wrote a customizable gesture system for each and every windows application.

B. Research questions

1. How to develop the applications using space mouse?
2. How to control application using Leap Motion?
3. What specific set of gestures are the most natural, intuitive and user friendly?

C. Scope of the research

- The Space Mouse is utilizes the rapid movement and it is highly professional system. The Leap Motion sensor device is a low-cost, visual - based hand tracking system that has newly been launched on the consumer market. The depth based vision has bargain the effect of ambient conflict such as noise and illumination condition. A variety of arm and finger gestures are designed and a system accomplished of detection and categorization of gestures is developed and appreciated. A amount of static and dynamic tests are the configuration of control items and consumables. An artificial pattern repeating the human arm is used in static measurements. For dynamic measurements, the only V-shaped objects, two trace objects that had a constant space between them, were used to repeat two human toes.
- The Space Mouse is without a doubt represents the innovative introduction system is based on the parts of the communication of human components with accuracy in the acceleration meter. The main focus of concentration is on the evaluation of accuracy and repetition. By completing this survey, space-based space development can be used at the interface of the human computer.

## II. LITERATURE REVIEW

A. Evaluation of leap motor control as a new contact point device:

- Make the mouse and LMC perform clicks and performance. 3D rendering of mouse performance tests and LMC devices and the proposed LMC Assisted Enhanced Reality Interface[1]. Units as attractive units according to the International Organization for Standardization (ISO). The standard displays the problems required to calculate device performance. This is done in a variety of studies. The six mouse units with small variations in size and shape are analyzed without significant performance. Controlling a classic game and Wii remote control using the mouse are the basic conditions. Regular review of the game, 60% winning performance compared to the standard unit. The three remote devices are evaluated for use in interactive TV environments and compared to a standard mouse device with low performance compared to the initial state and the laser pointer controlled by the computer is analyzed as a device that points to an environment of collaboration. In particular, non-contact devices, such as the leap motion controller, will now also be important to avoid contamination of pathogens in medical and biological workplaces or as an interaction unit in telemedicine. As mentioned above, considering the high potential of input devices, it is necessary to compare and characterize it from the human performance perspective.
- Researchers use the concepts that the law of Fitts is undoubtedly the most popular and often used to compare human performance with input devices.
- In conjunction with the Fitts Act, any attempt to choose a goal is considered a success or failure. The selection time and error rate are used to illustrate the effectiveness of the interaction solutions.
- The Fitt's group is probably a theoretical framework that can be used to describe and compare user performance for various input devices. The area is used as a filter pattern with the cursor saved to move the button and click on it. According to the results of the current study, it was rated according to the Fitt's team.[4]

B. A leap motion web app:

This technology will bring new technologies to the computer and the company intends to improve the product for a longer period of time, making the product connect with Hewlett-Packard and Asus in future computers. These applications must be integrated into the Internet because of the websites we have access to daily. This technology brings new innovations to how we process computers, and the company plans to further improve its product over time by implementing the product on future computers through connections with Hewlett-Packard and Asus7.

Leap Motion Web Socket, a website that uses JavaScript, allows us to access websites outside Leap Motion. In addition, the Google Maps API was written in JavaScript. Because of this, you do not need extended libraries or access points to use the Google Maps API resource. In the end, the users of our application could go to other travel sites to book the latest hotel preferences.[3]

C. Hand movement and gesture recognition using leap motion controller:

- Multimedia and cultural movements that create a perceptual form of control of control perceptions. Dynamic movements are very different from static movement. Calculate the speed between the fingers and the palms. If the total cost of removal is greater than the specified amount, the hand moves.
- Otherwise, starts to recognize the static hand gestures. The studied multi-touch tables or development of DMI's innovative application, such as Mike's Waits "Hands" 8, built in the 1980's.
- In addition, many researchers have carried out a new analysis of new technologies and DMI
- The study measures the characteristics of music accuracy, such as rhythm, latency and accuracy, only

with Wii Remote, only the Wii sensor bar and existing with multi-touch multi-platform platforms.

- Others reviewed piano movements closer to the user with inertial sensors.
- The paper performs preliminary Leap Motion sensor analysis and analysis as a tool for building a DMI. List the traditional bands that your device can identify. After studying the accuracy and latency of these actions. As part of the review process, we also offer a first case study that incorporates Leap Motion on a virtual musical keyboard.[1]

D. The leap motion sensor as controller of new digital musical instruments:

- Creating new interface interfaces allows you to create new digital music instruments. The integrated interface simulates an octave from a piano and allows the user to play it in a jogging control. The method is extremely difficult at the right time, the latency of latency is a parameter.
- A DMI is an interactive artifact used for musical purposes to share the input (control of the action) from the output using mapping strategies to link. Some projects show the impact of new DMI build interfaces. Leap motion is one of the latest technological advances. DMI can cause the creation.[2]

## III. METHODOLOGY

A. Methodology overview

The Space Mouse is a new hand movement gesture capture sensor developed by Leap Motion. It is basically developed for capture hand gesture and finger position spot in interactive software applications. Up to this point, only insufficient data on the basic software's mathematical or geometrical frameworks has been available.

***Figure 2***

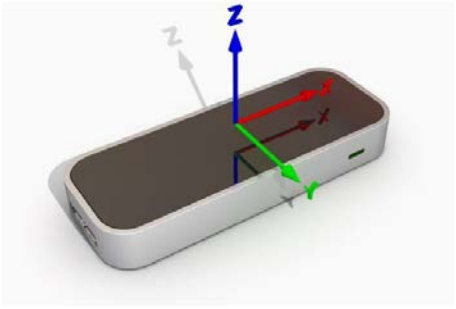


**Figure 3**

Figure 2 showing an infrared image of the Leap motion controller hardware setup. inside the hardware three infrared emitters, the device build with two IR cameras. As stated by the leap motion developer, the detector precision in position capture is about 0:01mm. previous research has shown that an precision of under 0:2mm for static setups and of 0:4mm for dynamic setups was capture in realistic scenarios.

The accuracy and reliability of the Leap motion controller were analyzed for static and dynamic scenarios using a high accuracy optical capture system as the ground truth. All measurements were captured in an environment with a slandered temperature of 22 °C and an construction intensity of approximately 500 lux, a proper legal requirement for the tracking workspace. The sampling frequency of the following reference developed system was set to 500 Hz.

B. Requirements.

In order for Space Mouse to be as efficient and accuracy as possible, we determined a list of requirements to access or control the application:

1) Implement hand gestures that are intuitive to users.
2) Provide an intuitive flow of capture movements

Software requirements,

- Net beans
- C#
- LeapC

Then, our research team moved focus on decide to get a list of requirements necessary to analyze the strengths and weaknesses of using gesture application:

1) Develop more innovative application, similar to the Space Mouse Desktop gesture application, using the Leap motion controller.
2) Achieve user learn to compare and evaluate and capture the different new gesture Desktop application technologies.

## IV. IMPLEMENTATION OF GESTURES

In order to find hand gestures that were familiar and user friendly to the user, we researched existing gestures for Windows and other platform applications. We also got resources from "leapmotion.com", This site help us to all leap motion developers, who is skillful in the zone of innovative technologies in Human Computer Interaction for suggestions of important

hand gestures. After this resources what we got, we chose to develop Space Mouse using C# and Java platforms to capture the gestures that were intuitive and natural way to access compute by the to the user provide priority to those that were already developed using the Leap Motion device. Once we gather our list of hand gestures we implemented the Windows gesture application and completed. We researched highly to find how windows application interacted with hand gestures and Leap Motion. Once we understood that, we captured each gesture to a specific function, thus creating our final gesture application.

## V. GESTURES AND PROBLEMS

The gestures use in the application are Circle Gesture, Swipe Gesture, Key Tap Gesture, and some custom gesture.

### A. Circle gesture

The Circle Gesture is the first gesture to be implemented. This gesture can be seen below in Figure 4.

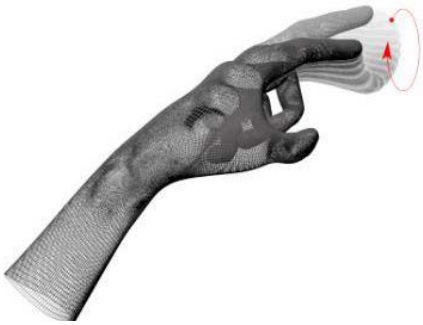

**Figure 4**

Circling clockwise with one finger is use to scroll down, and circling counterclockwise is use to scroll up in Web browser, in Video player we used Circling clockwise with one finger is use to Volume increase, and circling counterclockwise is use to volume decrease and Image viewer used Circling clockwise with one finger is use to Zoom in, and circling counterclockwise is use to Zoom out. In this project to map the circle gesture to a different action because it would be more intuitive to be used for circling an area than for zooming in and out.

### B. Swipe gesture

The Swipe Gesture, as seen in Figure 5 below, is use to next and back in Web browser, Forward and Backward in Video player and Next and Previous in Image viewer. A number of challenges while implementing this gesture. First, the Leap Motion device would often read one swipe to be multiple swipes, thus zooming in or zooming out to a much higher degree than the user have intended in the Space Mouse.

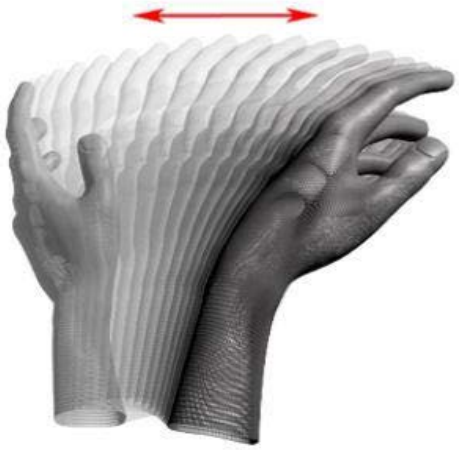

**Figure 5**

### C. Key tap gesture

The Key Tap Gesture, as seen in Figure 6 below, was first used as a ‘click’ function to allow users to select a windows application specially used in paint tools selection.

**Figure 6**

Selecting drawing tools is very important function in paint application so especially we used this gesture on paint application, in web browser also important part related with this gesture (select links and some other purpose) we used this key tap gesture and finally other application used this gesture only for clicking function.

### D. Screen tap gesture

The Screen Tap Gesture, as seen in Figure 6 below, is first use as a means to tap on a windows application. However, it is that the Key Tap Gesture would be more intuitive than using Screen Tap Gesture.

**Figure 7**

Then use Screen Tap Gesture as a click hold function. In order to click in, users would tap on the right side of the screen, and to zoom out, users would tap on the left side of the screen. That Screen Tap Gesture would not be used in all application because the gesture is not familiar and less responsive than the other gestures but we used this gesture on paint application because in paint application Screen tap gesture is very impotent for drawing images

## VI. RESULTS AND DISCUSSION

Application

Screenshots of interfaces of various Components of Space Mouse Finger Gesture System, Test plans and Test results are included to as evidence.

A. Web browser application

Every people who is using Web Browser can use these Application. These interfaces completely entertain the people with a new environment and give a new experience in efficient and user-friendly manner.

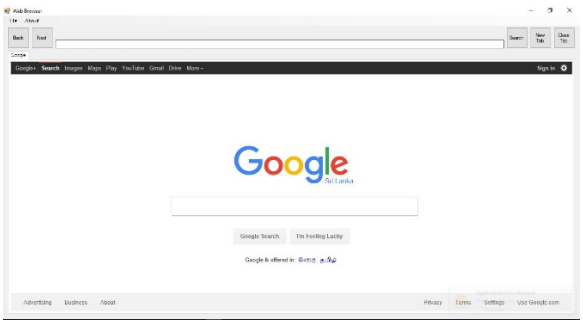


***Figure 8***

B. Paint application

Every people who is using Paint can use these Application. These interfaces completely entertain the people with a new environment and give a new experience in efficient and user-friendly manner.


***Figure 9***

C. Image viewer application

Every people who is using Image viewer can use these Application. These interfaces completely entertain the people with a new environment and give a new experience in efficient and user-friendly manner.

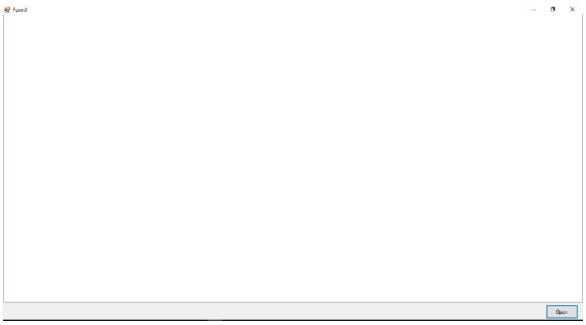

***Figure 10***

D. Video player application

Every people who is using Video player can use these Application. These interfaces completely entertain the people with a new environment and give a new experience in efficient and user-friendly manner.

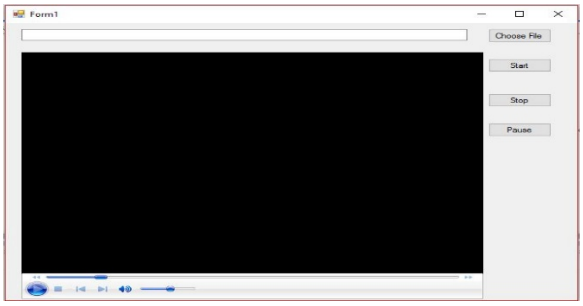


***Figure 11***

## VII. CONCLTION AND FUTURE WORKS

A. Conclтion

Based on the statistical analysis most of the youngsters are using computers daily. And there are watching videos frequently. Most of the peoples are never used 3D mouse before. Some peoples faced difficulties for handle the mouse. Most of the people are very interesting about space mouse. They haven't seen Space mouse before. So they required to test the 3D mouse before the feedback about it.

B. Limitations

Deployment of Space mouse System carries some limitation constraints which should be taken into consideration. The limitations are as follows,

- Need pure gesture capture device (LMC)

C. Recommendation

Project team have listed some user guide lines to cope up with the above discussed limitation constraints. Recommendations listed by the project team are,

- Leap motion controller.
- Connect with a USB cable.
- Also can use VR mount to improve reality.

D. Future work

Space mouse covers a very large scope with an ultimate goal of user friendly gesture control environment. Till the Goal is met numerous number of research paths will be open to researchers. This research area will stay fresh with the rise modern technologies. Project team has identified following as immediate set of future works which may interest researchers in this area.

- Integrating full gesture control system.
- Providing customize gesture application to user.
- Developing with multi-platform support.
- Expanding the system targeting entire computer world.

## ACKNOWLEDGEMENT

The project team of "SPACE MOUSE" would like to declare our honest sense of gratitude to our institution – Sri Lanka Institute of Information Technology (SLIIT). We are acutely beholden to whose help, stimulating suggestions, knowledge, experience, and courage helped us in all the times of study and analysis of the project in the pre and post research period. Also very special thanks to Mrs. Nipunika Vithana for their endless support given at times of difficulty as well as to our seniors and the lecture panel. The completion of this undertaking could not have been possible without the participation and assistance of so many people whose names may not all be enumerate

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