

# **Virtual Reality Environment for Teaching and Training of Industrial Operations (Assembly of Mechanical Components)**

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## **SUMMARY**

This project arises as an affordable medium that allows a college or technical course requiring the use of a machine to be advantage for students since it will allow the interaction of each of them with the machine, this is that each student working with a virtual machine and thus can have a complete perspective of the machine many times is not achieved when many students working on the same machine. Characteristics of virtual reality devices that exist in the market were evaluated for this and at the end it decided to work with glasses virtual reality, a Smartphone and the Leap Motion Controller that together represent a solution according to the raised end.

In this respect over the years it has developed virtual reality as a means that allows to simulate activities, carried out in the real world, in a virtual environment. The above examples are modules simulating the interior of a car where everything inside is virtual however the user using module undergoes a dive and into the virtual world can handle the car, another example is the virtual reality of tourism modules that allow you to enter a virtual environment that simulates, for example a Zoo and be able to walk and see animals that are at the Zoo. For this work the concept mentioned is used to be able to simulate the interaction of a person with a machine to remove some of its parts.

## **INTRODUCTION**

Courses for industrial machine in the ideal cases of maintenance using actual machinery on which taught students the necessary maintenance procedures, using real machinery represents a benefit to learning that would be much more significant if the student had the possibility, once knowing the procedures, practice them on real machinery in a personalized way; the practice represents learning experience which is one of the best ways of learning, according to research.

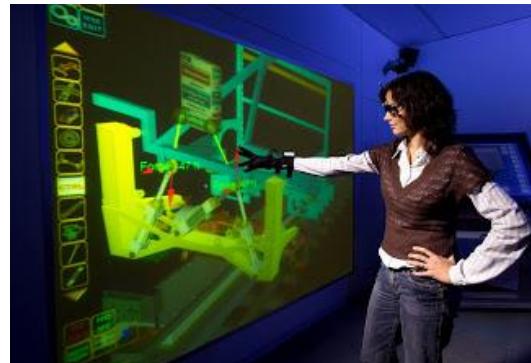


Fig.1 Virtual Reality.

To get that mentioned personalized learning requires that each student in a class has a module so that it use the same which in economic terms is much less a purchased a real machine to each student.

This paper will show the development of a virtual environment for mechanical parts handling, will be raised the General and specific objectives of the project, describe the solution to the problem, the implementation and the results obtained.

Finally, the findings of the project were made, bibliographic sources consulted during the research and the realization of the project will be presented.

## PRESENTATION OF THE PROBLEM

### General problem

The high cost that represents purchase sufficient quantities of industrial machinery for technical students of maintenance to have a highly customized training and practice.

### Engineering problem

What kind of engineering and technological principle or system should use in order to enable that technical training centres offer a practical and personalized education students and that this not translates into inaccessible amounts of money for the Center and its students?



Fig.2 Students driving machinery

Among the limitations of the project, is that you can not manipulate objects that are much larger than the virtual hand that will be used in handling. Limited additional is required of one computer per student, since its content is projected to virtual reality glasses.

## OBJETIVE

### GENERAL OBJETIVE

- Develop a virtual reality module through which to appreciate a virtual environment that allows the manipulation of virtual objects, for their subsequent implementation in Assembly and disassembly of mechanical components.

### SPECIFIC OBJETIVES

- Create a virtual environment that simulates a laboratory practices.
- Model a machine with its different parts, the machine must be in the virtual environment.
- Manipulate virtual objects, objects should move according to the movement of the hands.

## DESCRIPTION OF THE SOLUTION

To start, as mentioned, to make this project has decided to use the Leap Motion Controller whose function and operation is explained below:

### THE LEAP MOTION CONTROLLER

The controller is a device that allows you to be tracked to the hands of the user. It has a USB connection and is usually put on a desk for use in virtual reality also can be virtual reality Viewer pointed in the direction of the vision of the user.

The device can be used with Windows, MAC and Linux. The latest version of software is only for Windows. The device is made for PC and then it is as moving as it is a PC.

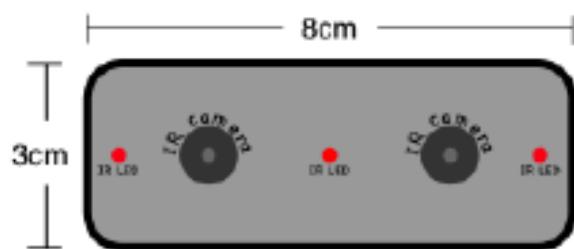


Fig.3 Leap Motion Controller

It has three infrared leds and two cameras which illuminate the space close to the cameras with infrared lights and is capable of capturing the hands and fingers of the user.

It uses some kind of tracking algorithm and is capable of estimating the position and orientation of the hands and fingers. The maximum infrared illumination is limited by the maximum current which is obtained with the USB connection. The illumination of the environment may interfere with the quality of monitoring.

Follow-up accuracy is quite good, the deviation is less than a millimeter, although the accuracy decreases at greater distances. Sometimes the hand position makes the camera look not fingers, but the algorithm can be estimated based on typical hand gestures.

The solution that arises has the steps that are shown graphically below:

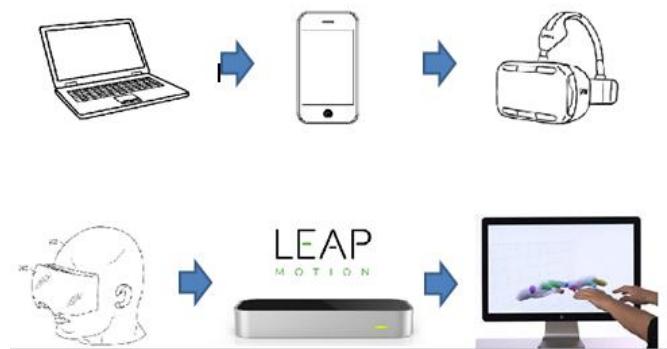


Fig.4 Pictorial diagram of the proposed solution.

## Operation

The general operation of the module will be as follows:

- Develops virtual environment desired, also the machine that you want to manipulate all this on a PC that should have installed the software necessary.
- To make the flexible project Solid Works software will be used for drawing the machine to manipulate, then this will be exported towards the environment.
- Once you have the environment together with the machine, all that content will be projected from the PC to a Smartphone screen.
- The Smartphone is placed in the glasses of virtual reality to have the feeling of immersion in the environment.

- Using the Leap Motion manipulate the components of the machine that is in the virtual environment created.

## Devices and components used

For the development and implementation of the project must be with the following devices and components:

- A computer, where it develops all the part that will be appreciated in the virtual environment. The environment will be held in Unity 3D, and manipulation can be achieved using the Leap Motion SDK; both software must be installed on the PC.
- A Smartphone, where the content will be screened in PC screen - with the Unity Remote app (for android).
- A display of virtual reality — virtual reality glasses.
- A Leap Motion, necessary for the handling of the machine.

## Limitations of the solution

At the end by the proposed solution can do the following:

- View of 360 ° within a virtual environment.
- Manipulate virtual objects within the virtual reality environment.

Can not do what follows:

- Manipulating objects whose size is much larger than that obtained with the Leap Motion virtual hand.
- Manipulate forms effective objects with irregular shapes.
- To use the module of virtual reality that develops, is necessary to have a computer or a laptop available. The second allows the module to be portable.

## Methodology of design and implementation

### Description

- As a first step is to create a virtual environment in UNITY 3D that simulates a laboratory environment.
- Then he is drawn an industrial machinery that will be the model to manipulate in SolidWorks.
- The model made in Solidworks is imported from 3DS MAX, for then since this last move the model to UNITY 3D.
- The whole having in UNITY 3D is projected through the Unity Remote app and a mobile phone to a Smartphone cable.
- When the environment is projected on a Smartphone, it is positioned within virtual reality goggles and thus begins the immersion in the virtual environment made.
- The next step is to use the Leap Motion as a means to manipulate virtual objects within the virtual environment, the Leap Motion connects to a Pc by means of a cable with USB terminal.
- Finally integrates everything and you can interact with the model of machinery in the virtual environment.

### Block diagram

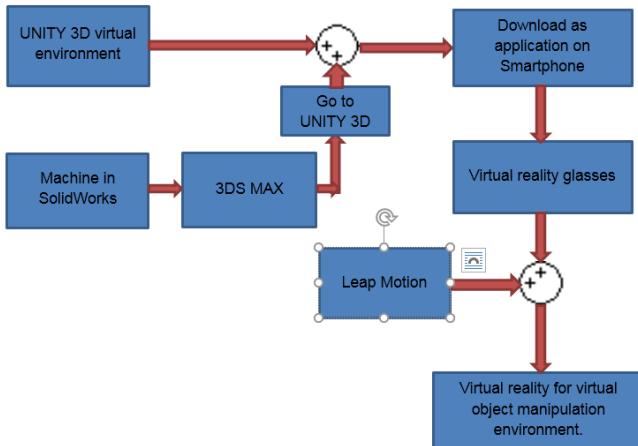


Fig.5 Diagram blocks with the troubleshooting steps.

### Using the methodology of design

Using the Unity 3D and the 3DS Studio Max is designed environment that simulates a laboratory and also machine that is manipulated, was obtained as follows:



Fig.6 Environment and machine to manipulate

Once has been shown and because that use Unity Remote app does not represent the biggest problem, is to solve the problem of how to get a virtual model of hands with Leap Motion which represents the most difficult challenge. This downloadable file Leap Motion Core Asset Orion is used, tests in a different environment and is obtained as follows:



Fig.7 A virtual hand model.

Once you get a model representing hands reales from the user in a virtual environment we proceed to solve how those hands to interact with virtual objects in the environment. This is achieved by using a module which has the Leap Motion Core Asset Orion, which is known as Interaction Engine and has to be imported to the Unity.

## RESULTS

- As a first result of the tests with the Leap Motion and the Unity was obtained that Leap Motion is able to follow up with great accuracy into the hands of the user when they are extended.

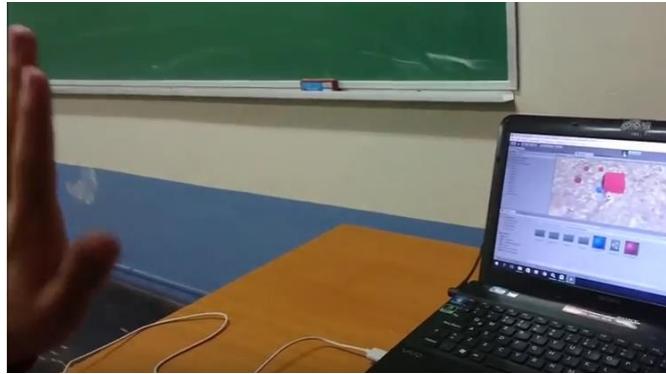


Fig.8 Tracking hands with Leap Motion

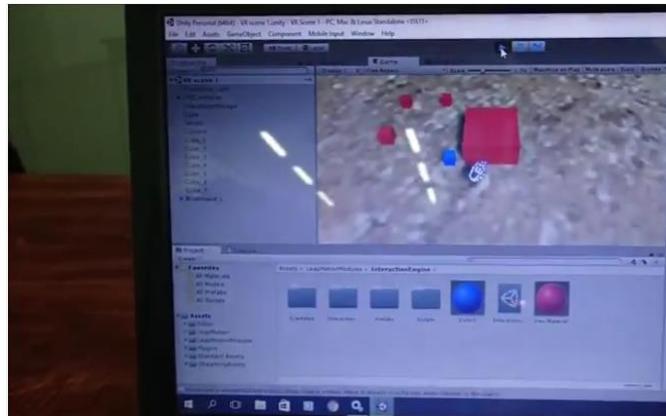


Fig.9 Hand model obtained

- However, the effectiveness of monitoring lapses when wielding is the hand. To move your fingers and see that follow-up to the Leap Motion, was obtained that it was done better follow-up to the index finger.

- In the case of handling this is possible when the objects with which it will interact are interaction objects, this means that they are objects to which you have specified them certain physical properties such as rigid body and gravity properties, in addition to these objects must be added them the material property of interaction that which means that they can be supported by the virtual hand and also that move with the virtual hand once held.

- Initially interacted with such way cubical and spherical objects objects turned out to be objects which achieves a better interaction with respect to other geometric shapes. Then shown interaction with cubic objects, the purpose of this example is to put the blue cube on top of the Red block.

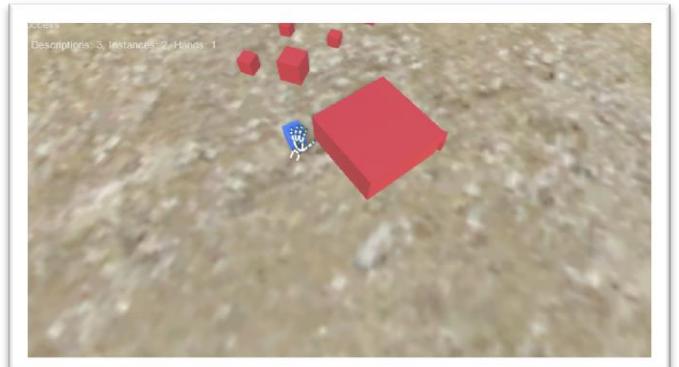


Fig.10 Positioning the hand to grab the bucket.



Fig.11 Held to the cube and moves towards the parallelepiped.

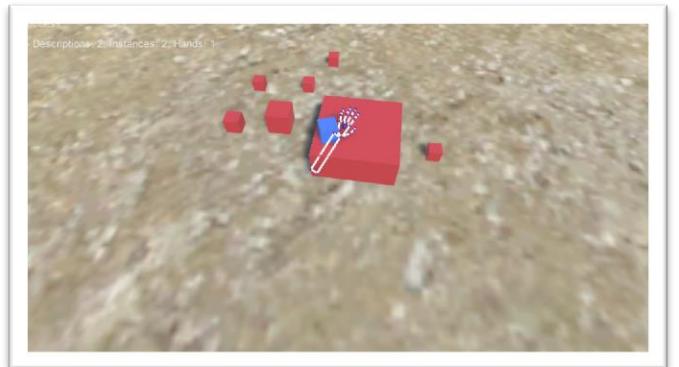


Fig.12 Cube is finally positioned on top of the parallelepiped.

With the results shown so far is obtained as the final result the integration of environment and handling properties:

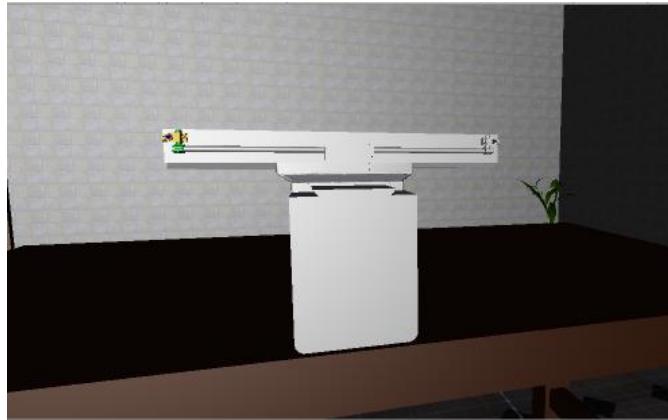


Fig.13 Environment with ready for handling modifications.

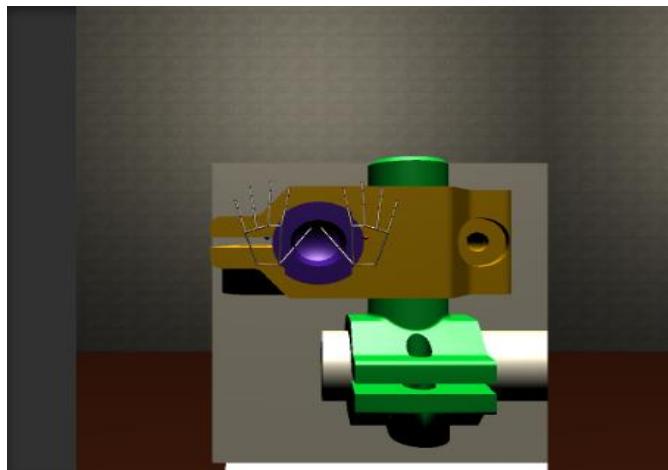


Fig.14 Manos posicionadas para manipular las piezas de la máquina.

## CONCLUSIONS

- Starting from the tests and configurations made to the virtual objects is concluded to seize an object is not suitable to make a fist with your hand gesture, since sometimes loses control of the object, but only a gesture of bowing hand, but to form a fist.

- If scaled the relation of size hand - field of view (camera) similar to the relation of size real hand - field of vision of the eye, you get a greater sense of immersion to manipulate objects.

- The outside of the virtual hand is more effective than the Palm of the hand for throwing objects with force.

- The Leap Motion SDK gives you the option of generating a model of virtual hands with our arms, however when you move the virtual hand movement of the arm does not seem natural. So for the immersion experience is the best is convenient to use a free-arm model.

- The Assembly and des Assembly of machinery is one of the applications that have great potential to be developed that can even be done while using a CAD software (which are already widely used) and then export what has been done to the virtual environment that you are performing, which is a characteristic of great flexibility.

- The Leap Motion Controller is a device that is in constant development, if monitoring is improved that it performs on the hands of a user, this device will open the doors to a large number of applications in the world of virtual reality.

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