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Appliances Control in Virtual Reality using Leap Motion Somatosensory (LMSS) Controlled Switches

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Abstract:
This involves the controlling of electrical appliances by virtual reality through Leap Motion Somatosensory (LMSS) module. The LMSS module accepts the gestures as inputs and produces the output of controlling various electrical appliances. Gesture recognition refers to recognizing the motion of the human parts like limbs, face etc. This work uses Unity 3D for the recognition and processing of gestures and LMSS based algorithm for detection of objects. At first the image is captured by the LMSS Module and it is processed by Unity 3D, if the preloaded gesture is matched with the existing gesture the data will be sent to the microcontroller, then the home appliances are controlled. The hardware module consists of LMSS Module, PIC microcontroller, electrical appliances, power supply and ZIGBEE module. This hardware module is communicated with simulation software using a USB to serial converter bus which comes along with driver software.

Keywords: Leap motion, somatosensory appliances, switch, PIC, virtual reality

I. INTRODUCTION

Automation is the essential need for the present world. Day by day the gap between machines and human is being reduced. Nowadays hand gesture-based home automation is getting more importance. Human-computer interaction is mainly based on the pointing or typewriter-style devices. This kind of interaction can limit the natural ways of manipulation using the hands [1], which may result in a complication of simple tasks. One of the over complicated control examples is rotating a three-dimensional object. Using a computer mouse, a user needs to grab the object and rotate it using the mouse, which can only operate in a two-dimensional space.

The rotation operation represented by the mouse's movement is unintuitive for humans and users need a few attempts to understand how it works. In the real world, however, the rotation task is natural thus it is simple how to move hands to rotate the object in a desired way. By two-dimensional method, human action was recognized [1]. In this normal angular representation was used to describe a pose which was found to be less reliable and also the system performance was low. To overcome those problems, we proposed a new system.

The interfacing between Man and machine is the beginning of a new era.This technology of virtual reality [2] helping to improve the complexity. To improve the accuracy and speed the leap motion sensor is used. In this proposed method, human action recognition is done by using 3D skeletal joints. This proposed approach is based on calculating all the possible angles and distances between each joint. Here, the pose is described by tailored angular representation of the skeleton joints which is found to be highly reliable and also offers a better performance.

II. METHODOLOGY

a. Virtual reality

Virtual reality is an artificial environment that is created with software and presented to the user in such a way that the user suspends belief and accepts it as a real environment. On a computer, virtual reality is primarily experienced through two of the five senses: sight and sound. The simplest form of virtual reality [2] is a 3-Dimage that can be explored interactively at a personal computer, usually by manipulating keys or the mouse so that the content of the image moves in some direction or zooms in or out. More sophisticated efforts involve such approaches as wrap-around display screens, actual rooms augmented with wearable computers, and devices that let you feel the display images. Virtual reality can be divided into: (1) the simulation of a real environment for training and education. (2) The development of an imagined environment for a game or interactive story. The Virtual Reality Modelling Language (VRML) [3] allows the creator to specify images and the rules for their display and interaction using textual language statements. Here, the hand gestures are recognized and converted to real time output for switching on and off of electrical appliances wherein the preloaded images(gestures) are compared with the ones being sensed by the LMSS module [4][6] used here and real output is obtained.

b. Leap Motion

Leap Motion somatosensory sensor is composed by 2 cameras to detect the distance and posture of the human fingers of hands. The detecting range of the Leap Motion somatosensory sensor is between 25 and 600 mm [5]. The coordinate system is the traditional X-Y-Z system. The unit of sensing position is millimeter. The signal of Leap

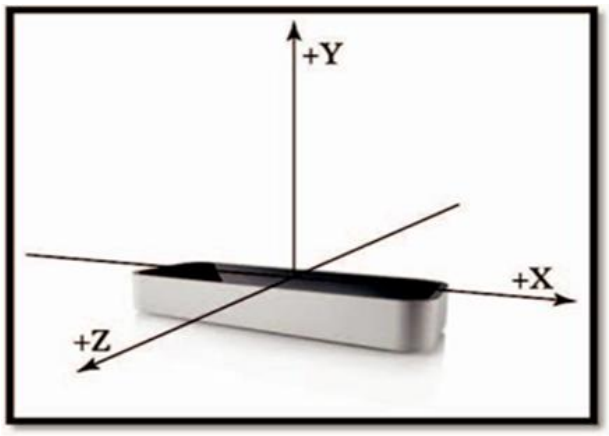

Figure.1. Leap Motion controller

Motion somatosensory sensor was acquisitioned by the programming of professional computer language "PROCESSING" which has promoted software literacy. There are many parts in the computer program.1) Constants and variables settings; 2) Include libraries; 3) USB port and font settings; 4) Plot; and 5) Detection. The heart of the device consists of two cameras and three infrared LEDs. These track infrared light with a wavelength of 850 nanometers [5], which is outside the visible light spectrum. Cameras with wide angle lens provide 8 cubic feet of interaction space. LED light intensity is ultimately limited by the maximum current that can be drawn over the USB connection. At this point, the device's USB controller reads the sensor data into its own local memory and performs any necessary resolution adjustments. This data is then streamed via USB to the Leap Motion tracking software.

c. PIC16F series MICROCONTROLLER:

Analog, Core Independent Peripherals and communication peripherals which is used for a wide range of general purpose and low-power applications. Additionally, this family includes up to 56 KB of Flash memory, along with a 10-bit ADC with Computation (ADC^2) for automated signal analysis to reduce the complexity of the application. The Microcontroller produces the output signal for the corresponding appliance according to the gesture-match between the input and the preloaded one. The microcontroller is connected to a driving circuit that controls the appliances. The microcontroller controls the switches by the gesture match of the input and the predefined ones.

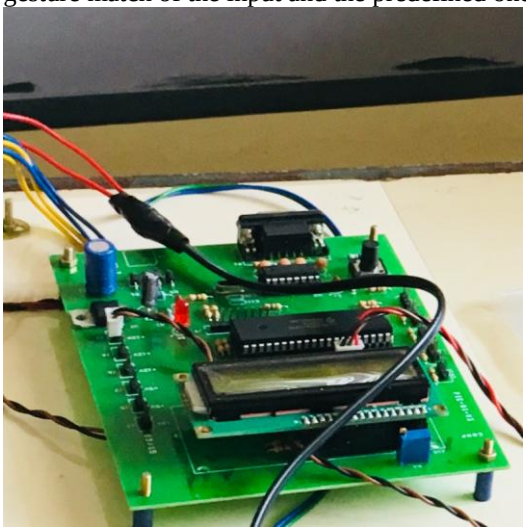

Figure. 2. PIC16F series microcontroller

d. Software

i. MP LAB

MPLAB X IDE is a software program that runs on a PC (Windows, Mac OS and LINUX) to develop applications for Microchip microcontrollers and digital signal controllers. It is called an Integrated Development Environment (IDE), because it provides a single integrated "environment" to develop code for embedded microcontrollers. MPLAB X Integrated Development Environment brings many changes to the PIC microcontroller development tool chain. Unlike previous versions of the MPLAB IDE which were developed completely in-house, MPLAB X IDE is based on the open source NetBeans IDE from Oracle. Taking this path has allowed us to add many frequently requested features very quickly and easily, while also providing us with a much more extensible architecture to bring you even more new features in the future. Here MPLAB is used for programming the PIC controller.

ii. Unity 3D: Unity is a multipurpose game engine that supports 2D and 3D graphics and drag -and- drop functionality usingC#. Two other programming languages were supported: Boo, which was deprecated with the release of Unity 5and JavaScript which started its deprecation process in August 2017 after the release of Unity 2017.1. The engine targets the following graphics APIs: Direct3D on Windows and Xbox One; OpenGL on Linux, mac OS, and Windows; OpenGL ES on Android and iOS; Web GL on the web; and proprietary APIs on the video game consoles. Additionally, Unity supports the low-level APIs Metal on iOS and mac OS and on Android, Linux, and Windows, as well as Direct3D 12 on Windows and Xbox One.

iii. Proteus 8

The micro-controller simulation in Proteus works by applying either a hex file or a debug file to the microcontroller part on the schematic. It is then co-simulated along with any analog and digital electronics connected to it. This enables its use in a broad spectrum of project prototyping in areas such as motor control, temperature control and user interface design. It also finds use in the general hobbyist community and, since no hardware is required, is convenient to use as a training or teaching tool.

III. WORKING

By two-dimensional method, human action was recognized. In this, normal angular representation was used to describe a pose which was found to be less reliable and also the system performance was low. To overcome those problems, we proposed a new system. The interfacing between Man and machine is the beginning of a new era and this technology of virtual reality helping to improve the complexity. To improve the accuracy and speed the leap motion sensor is used. In this proposed method, human action recognition is done by using 3D skeletal joints. This proposed approach is based on calculating all the possible angles and distances between each joint. Here, the pose is described by tailored angular representation of the skeleton joints which is found to be highly reliable and also offers a better performance. Thereby, to observe the physically challenged people in areas where they could not be fit in due to their physical inability and to provide an effective experience to the gamer through physical actions rather than mere pressing,

touching or toggling of buttons/switches and provide non-touch VR switches that avoids the possibility of infections which cause from the hands' touches of the switches in some places such as hospitals, surgery operating room centers of elders' health care.

Figure.3. Working of LMSS Module

The LMSS Module is connected to a PC where the gestures are preloaded, which in turn is connected to a microcontroller. The Microcontroller produces the output signal for the corresponding appliance according to the gesture-match between the input and the preloaded one. The microcontroller is connected to a driving circuit that controls the appliances. The driver circuit gets activated if the preloaded gesture and the input gesture matches, thereby switching on and off the appliances. Gestures inputs from the camera are sensed by the Leap Motion Somatosensory Module. The processing of the 3D image is done using UNITY3D, and the gestures are compared with the predefined ones on the PC. The microcontroller controls the switches by the gesture match of the input and the predefined ones. As the gestured are matched, they produce an output signal for the specified electrical appliance.

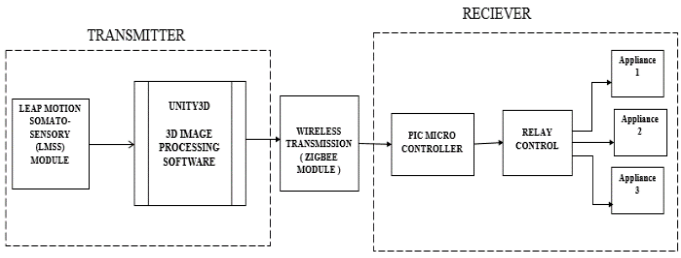

Figure.4. Block diagram

IV. RESULT

The implementation of the bulbs control in virtual reality by using leap motion somatosensory controlled switches in Fig. 5. A light bulb and an electrical fan were controlled by the leap motion somatosensory controlled switches. The relay module was served as electrical controlled switches which received the signal from PIC16F Microcontroller that received the instructions were controlled by using leap motion somatosensory module. The electrical fan was employed to prove that this system can control other AC electrical devices, if the users need to increase the operations of the AC electrical devices.

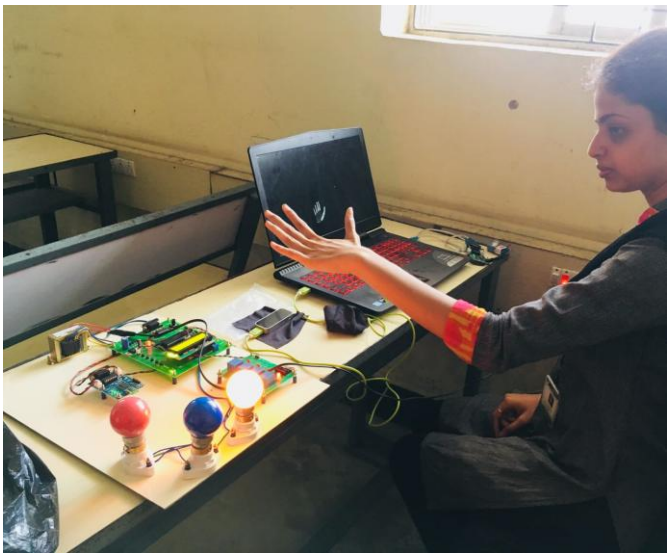

Figure.5. Real Time Output

V. CONCLUSION

Thereby, to observe the physically challenged people in areas where they could not be fit in due to their physical inability and to provide an effective experience to the gamer through physical actions rather than mere pressing, touching or toggling of buttons/switches and provide non-touch VR switches that avoids the possibility of infections which cause from the hands touches of the switches in some places such as hospitals, surgery operating room, and centers of elders' health care. To absorb physically challenged people in areas where they could not be fit in due to their physical inability. To provide an effective experience to the gamer through physical actions rather than mere pressing, touching or toggling of buttons/switches.

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