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Gesture Based Human-Machine Interface

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ABSTRACT

Computers have been a very integral part of people's lives for a long time. In recent times, computers have become technologically well advanced being able operate at high speeds and capable of performing a wide range of functions. In spite of all these developments, the input technologies being employed in computers have various usage constraints that have been posing as a major hurdle for users against the ever evolving technology. The conventional mouse restricts movement and additionally require a cable to work. Furthermore, excessive usage of this mouse have being extremely strain inducing on the users. Hence a necessity for an efficient substitute for the conventional means arises. One such substitute is gesture, which is a natural form of communication. They are a very effective form of communication and are comparatively more spontaneous. Gestures don't restrict movement nor do they require any specific structure to work on. The proposed system employs gesture movements to be programmed for performing various mouse operations such as clicking and dragging. In addition, the system includes gestures to effectively function as a remote keyboard wherein specific gestures and movements can be assigned to each key.

Keywords: Computers, Gestures, Mouse, Keyboard, wireless.

I. INTRODUCTION

to Computers were primarily invented to serve as a means of performing complex calculations in a much simpler and quicker manner. Since then computers have evolved to become machines that operate at high speeds and capable of handling enormous amounts of data in an efficient manner. Ever since the beginning, humans have communicated with computers and its various units with the help of input devices. These devices allowed users to provide data and other instructions which were then processed by the central operating unit(CPU) in order for the computer to produce the desired output. In older times, computers were only built to take "punch cards" as input. The users had to indulge in a tedious job of punching each and every instruction, and then feed this information into the computer. Since then computers have come a long way and have evolved to an extent where they are now capable of accepting input data using a variety of easy- to-use devices. Nowadays the most common input devices are the keyboard and mouse. Evolution of such technologies with regards to the input devices have helped people

communicate with computers in a much better way. In spite of all these developments, many input devices have various usage constraints that have been posing as a major hurdle for users against the ever evolving technology. Many people have experienced excessive strain from repeated usage of input devices such as mouse and keyboard. This has also led numerous people to experience conditions such as Carpal Tunnel Syndrome, which occurs due to pressure on the median nerve that runs along the arm and wrist. This condition results in numbness, tingling, or weakness in the hand. Hence people have been leaning towards adopting other efficient substitutes for the conventional input devices. One such substitute is gesture, which is a natural form of communication.

Gestures have long been used as a means of communication between different people. They have proven to be a very effective form of communication and is comparatively more spontaneous. Gestures don't restrict movement nor do they require any specific structure or environment to work on. In recent years, gesture- controlled user interaction with computers has become more widespread. Unlike traditional devices like the optical mouse, gestures do not restrict user activity by forcing users to move their hand to the location of a command. They also do not require any additional devices, the command and even the parameters can be defined with the help of simple hand movements. Users are also capable of executing multiple input device functions using just their hand to implement various gestures that can be assigned to different tasks. In contrast to the conventional optical mouse and keyboard that only accept tap or click inputs, numerous gestures such as taps, swipes, touch and other hand motions can be utilized as a form of providing input to computers. Gestures also do not require any form of physical contact to operate the systems. Hence they can also be used at much safer distances in places like industries and other workplace environment.

II. LITERATURE REVIEW

Gesture control is widely studied across the entire globe. In 2008, mouse controlled by head movements and mouth open/close had been built to help people with disabled limbs [1]. This used a head sensor to monitor the mouse co-ordinates [2].

Another model proposed the usage of most commonly used Accelerometer and Gyroscope to monitor the motions of human hands. Gesture Based Keyboards are also proposed where SVM algorithm which is a Machine Learning Algorithm is used to detect the keystrokes.

Some methods proposed the use of MEMS IMU (Inertial Measurement Unit) where it is proposed wearing the keyboard as a ring. Mouse Gesture can also be implemented using Kinect[4] sensor which is introduced by Microsoft for the Gaming enterprises.

III. SYSTEM OVERVIEW

Our entire system consists of two main parts the transmitter part which transmits the users motion to the machine or system wirelessly via Bluetooth and the machine side software part which uses python programming language along with some libraries to detect the user motion from the transmitter part and move the mouse cursor to the desired locations and write as the user wave their hand in air.

IV. METHODOLOGY

The Whole system is divide into two divisions which is shown in the block diagram below

1. Transmitter Unit
2. Receiver Unit

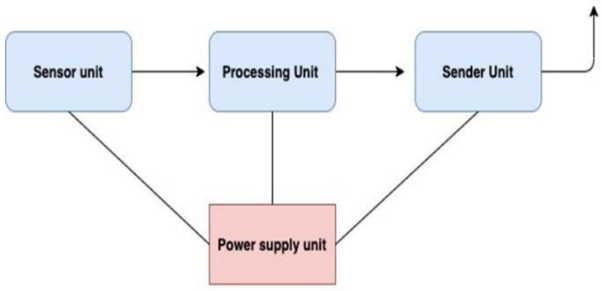

Figure 1 Transmitter Unit

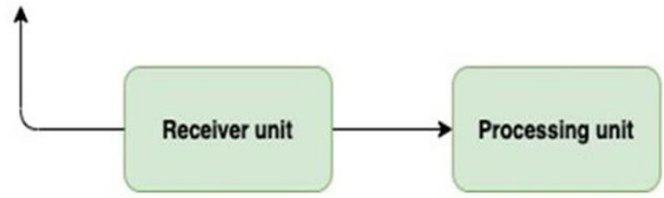

Figure 2 Receiver Unit

The transmitter Unit consist of from figure 1

- Power Supply
- Accelerometer and Gyro
- Bluetooth HC-06
- Arduino Pro micro

As shown in the block diagram the entire project is divided into transmitter unit which consist of the Arduino Pro micro which orchestrates the accelerometer and gyroscope which is the MPU6050 module and the Bluetooth module which is the HC-06 module. These hardware components on the whole monitors the human hand motions and gestures and converts them into co-ordinates in three dimensional space time and then these co-ordinates are wirelessly transferred to the machine or system.
The Receiving parts consist of from figure 2:

- A python script
- Receiver Bluetooth which is inbuilt in machine

A script in python programming language keeps running on the machine end which looks for these co-ordinates. The python makes use of these co-ordinates and moves the cursor and also allows the user to write.

a. Arduino Pro micro

The Arduino Pro micro is a microcontroller board based on ATmega32U4 developed by Ada fruit. It has 20 digital i/o pins, a 16 MHz crystal oscillator, a micro USB connection, an ICSP header and a reset button. It contain everything that a microcontroller has and can also be easily placed in a breadboard due to its size complexity.

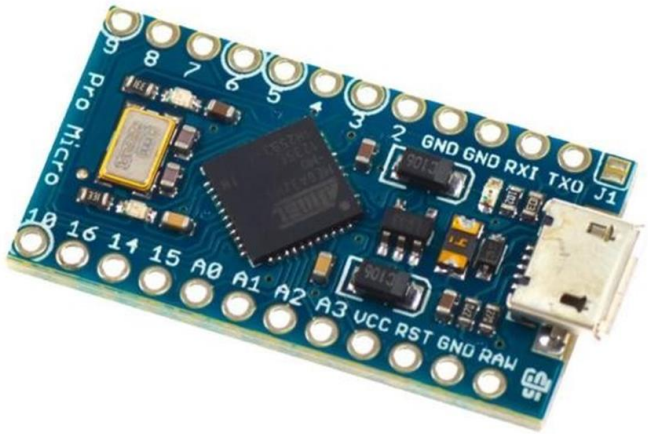

Figure 3 Arduino Pro micro

b. Accelerometer (MPU6050)

Figure 4 Accelerometer

The MPU6050 has an embedded 3- axis MEMS gyroscope, a 3-axis MEMSaccelerometer [6]. It is very useful for some motion detecting. This small

moduleintegrate the logiclevel converter circuitmakes it compatible with

3.3V-5V voltagelevel)togetherwiththeMPU6050sensor, youcanintegrateittoyourprojectconvenient.Th eMPU-6050cancommunicateusingI2CProtocol.Digit alMotion Processor ortheDMPisanembedded processor thatcanreducethecomputational load from the host processor, like an Arduino, by acquiring and processing data from Accelerometer, Gyroscope and an external Magnetometer.

Features

- I2Cinterface
- Compatiblewith3.3V-5.0V

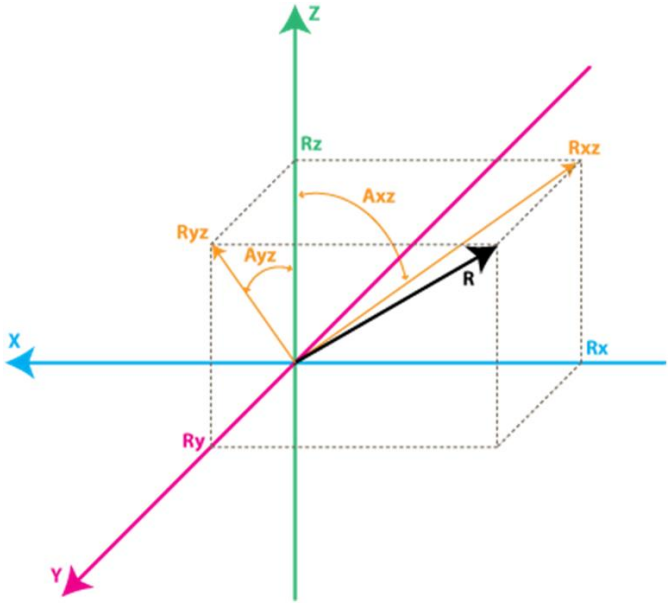

Figure 5 Accelerometer co-ordinates

c. Bluetooth Module – HC-06

HM-06 is a Bluetooth module designed for establishing short range wireless data communication between two microcontrollers or systems. The module works on Bluetooth 2.0 communication protocol and it can only act as a slave device. This is cheapest method for wireless data transmission and more flexible compared to other methods and it even can transmit files at speed up to 2.1Mb/s.

HC-06 uses frequency hopping spread spectrum technique (FHSS) to avoid interference with other devices and to have full duplex transmission. The device works on the frequency range from 2.402 GHz to 2.480GHz.

The Project also supports mouse click both left and right. There are three dedicated buttons at the forefinger, middle finger and the ring finger for mouse click and gesture write. There is also a switch mounted on to toggle between the mouse and keyboard mode. Whenever the user wanted to move cursor he can switch to mouse mode and if the user decides to write he can switch to keyboard mode.

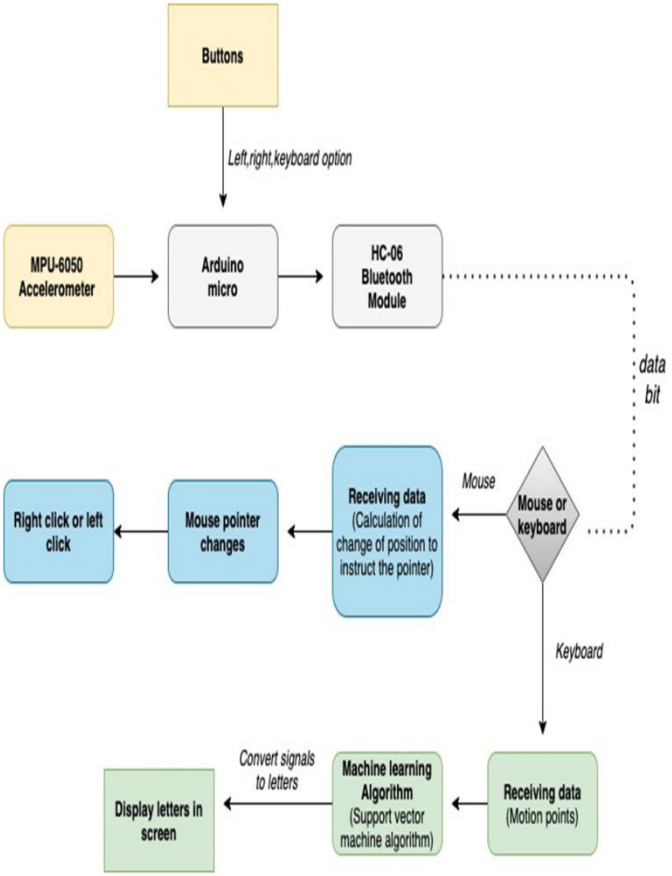

Figure 6 Architecture

The Accelerometer measures the user's motion as he makes gestures. The accelerometer sensor takes value in three dimensional space with x, y, z coordinates and in regular interval of time. These three dimensional coordinates are the transferred to the machine via HC-06 Bluetooth module. The Arduino Pro micro is the lead orchestrator which controls both the accelerometer and Bluetooth module.

The Arduino is used to toggle between mouse mode and keyboard mode and also decides whether the user decides to write or to move. The communication between the arduino and the python language is made by an inbuilt library called pySerial.

pySerial is a library built in python programming language which is used to make communication between python and any micro controller and serial ports. Normally Rasberry pi is required for these kind of machine learning, but the availability of libraries like pySerial helps us to avoid the use of Rasberry pi and reduc the overall cost. The python scripts keeps running on the machine. It get the three dimensional coordinates from the transmitter unit. The coordinates are then formatted to a style which the python understands. The values are also scaled for proper moving of the cursor.

If the user decides to write, he has to press the button mounted on the ring finger and then wave in air. This tells the scripts that the user in trying to write and not move the cursor.

V. RESULTS

The the proposed project was built and the gestures worked as excepted. The accelerometer successfully transferred coordinates to the machine via Bluetooth and the python script also detected the gesture and acted accordingly.

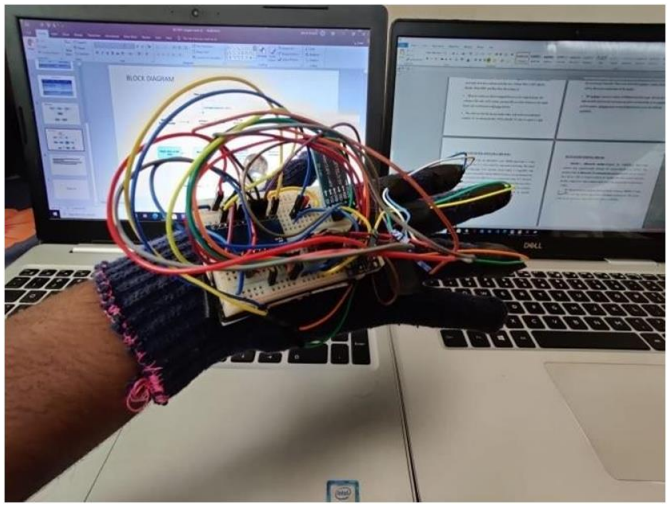

Figure 7 Transmitter Unit

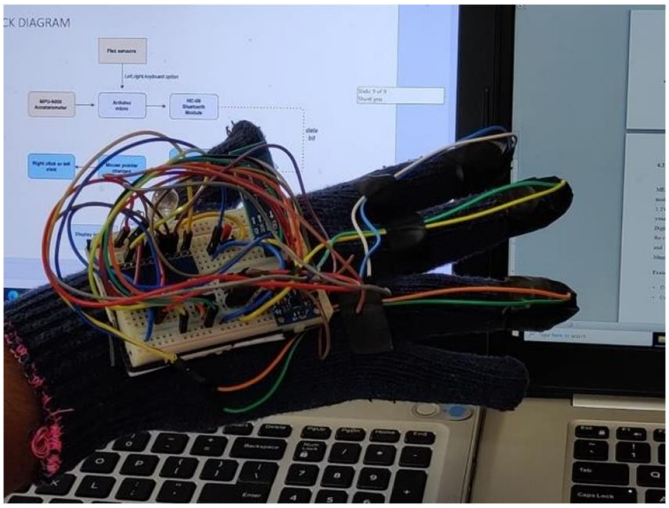

Figure 8 Transmitter Unit

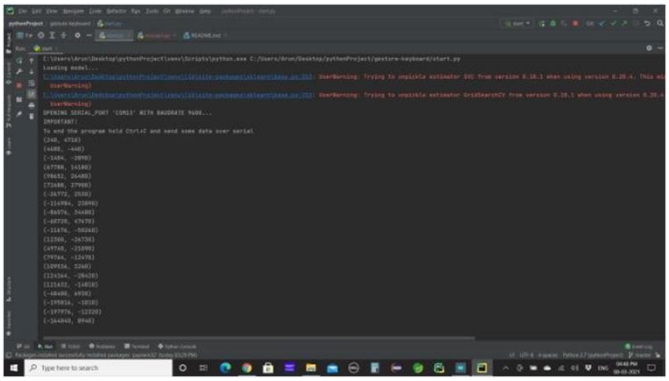

Figure 9 Receiver Unit with receiving coordinates

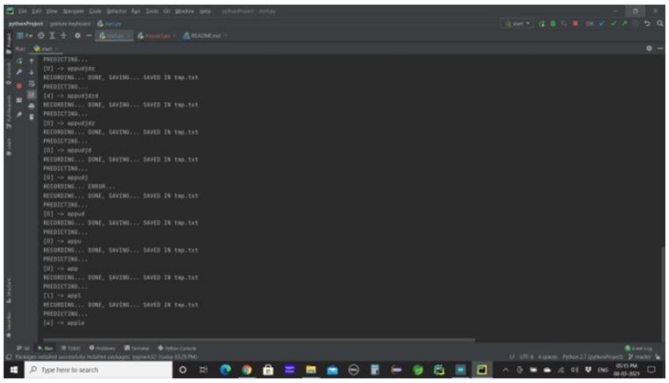

Figure 10 Machine detecting the Letters

VI. CONCLUSION

Thus the proposed method is built with an intention of changing the way we traditionally use our mouse and keyboard and the way we interact with the machine. This project also seems to be useful in industries where humans has to operate machine from a safe distance and even in Nuclear power plants where keeping a distance from the nuclear reactor is absolutely essential

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