Virtual Reality Based Human Mouse

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Abstract— The growth in areas of Virtual Reality have seen tremendous improvements in the previous couple of decades. The prime idea behind all of the VR applications is mainly to streamline the experience of using new technological devices by providing a virtual environment to the user, giving them a sense of literally manipulating the device's data through human actions. This project undertaken aims at making use of this concept to provide with an easier working platform for the disabled in operating a computer. For a person who has lost his fingers, palm or forearm, or is born with such a condition, it is physically impossible to operate a conventional mouse. As a solution to this problem, we have developed a compact system that would essentially perform the operations of a mouse without using one. The purpose of this system is to provide mouse inputs to the system by human actions. It makes use of an IR sensor to detect eye blinks which acts as an input for the double click operation, and a tri-axis MEMS accelerometer to detect hand movements that makes cursor to move on the required computer screen. With the design of a comfortable end product, this technology can overcome the said problem.

Keywords: Arduino, 3-Axis MEMS Accelerometer, IR Sensor, Zigbee, USB to TTL Converter

I. INTRODUCTION

Today's world is the world of computers and automation. There has been a remarkable usage of computers or other such devices for all day-to-day activities. In this automated world, there would arise a need to make use of computer or other similar devices for various desired purposes. This requires a sophisticated human computer interacting environment, to make this interaction easier. Researchers have been working since ages to enhance human computer interactions, and to provide a well-equipped environment for the betterment of human life. Tremendous developments and inventions have been made and many are in the developing stages in this regard. Another significant term intently connected with automation and human computer interaction is Virtual Reality (VR). It makes us experience the impossible, without any external aid or any external environmental setup. It is a three-dimensional computer-generated environment, to get the desired work done without actually involving in it physically. The individual utilizing it becomes a part of virtual world and can manipulate given data or perform required activities. Thus, knowing the importance of computer usage in today's world, it would necessitate even the paralysed or the physically disabled to use them, especially in any home automation implementations. There are many devices that are being developed for this concern, implementing and involving different technologies. For instance, a semi – paralysed person or a person without fingers or forearm would find it extremely difficult to operate a computer with a conventional mouse. Such people can still be able to perform small movements such as a hand tilt, a head movement, eye blinks, movement of tongue etc. The basic idea is to design a device to operate any computer like device from a distance and thus perform the desired tasks by just little movements [1]. In this project we have come up with a compact model which would help such applications, the Human Mouse, a mouse like wearable device that performs cursor movements and clicks implemented by using various sensors to sense hand movements and the eye blinks respectively. It works wirelessly by using Zigbee modules for transmission and reception of information between the human and the computer device, convenient to be used by the paralysed or disabled.

II. PROPOSED SYSTEM

The proposed system objective is to device an equipment to perform computer control operations usable by the paralysed or the disabled. Here the device is designed in a wearable glove form, mounted with various hardware components for its functioning. Computer cursor movement is achieved by recognising hand movements by a tri-axis MEMS accelerometer sensor and the cursor clicks by eye blink count sensed by the IR sensor. The indication of these operations is also displayed on an LCD.

III. SYSTEM DESIGN

The system consists of Arduino as the main control unit for processing the data received and then to transmits it. Arduino is interfaced with tri-axis MEMS (Micro electrical mechanical systems) Accelerometer sensor, which acts as an input device to the system [2]. This accelerometer sensor provides analog data to Arduino for each change in the hand positions such as left, right, forward, backward or stop, based on the changes in the tilt angle. This data is processed by Arduino in turn helping in directing the mouse movements on the monitor.

The eye blink (IR sensor) module is mounted on the spectacle to sense the eye blinks and acts as another input device [3], where the number of eye blinks are counted and the according data is used to perform double clicks.

Both the tri-axis MEMS accelerometer sensor and the eye blink sensor (IR sensor) module are thus integrated with the Arduino microcontroller which processes the data received by hand movement directions and eye blinks and transmits this data to computer. These input data processed by Arduino are passed onto required system through Zigbee transmitter-receiver module. The data transmitted by the transmitter module is received at the receiver end through air interface. The received data is decoded at the receiver end and is converted from high level language to machine language by USB to TTL converter module, which is sent to desired computer system. This information is printed as an indication on output device i.e., LCD for visual display and also output can be viewed on the serial window for verification. This

received information along with the software interface gives the output of desired mouse operations.

IV. BLOCK DIAGRAM

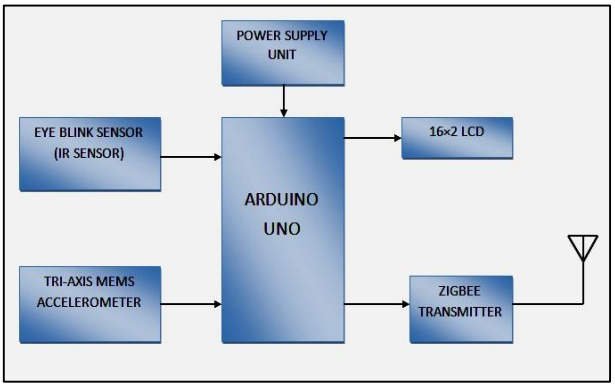

Fig. 1: Transmitter end of the system

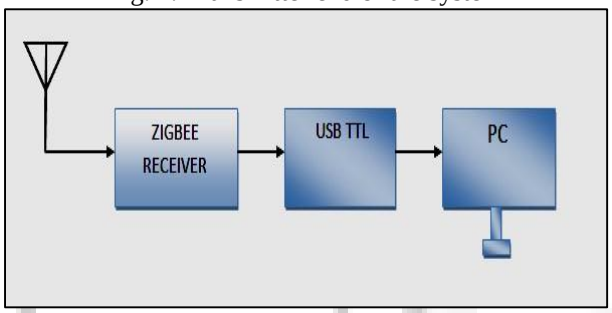

Fig. 2: Receiver end of the system

V. WORKING

The working of the system relies on two softwares – Arduino IDE [4] and MATLAB apart from the hardware components. The system essentially receives inputs from two sources – the accelerometer and the IR sensor.

The tri-axis MEMS accelerometer mounted on glove sends continuous analog values to the Arduino's processor. These values appear in three different output pins – xpin, ypin and zpin. The voltage at xpin, ypin and zpin are proportional to the static acceleration in x axis, y axis and z axis respectively. Since the movement of the mouse pointer is two dimensional, it is sufficient for us to use accelerometer output in xpin and ypin only. The analog voltage values from the accelerometer are converted to digital values for easier computations using the built-in library function in the Arduino software (The left side of the flowchart shown in Fig. 3 explains the functions performed using the Arduino IDE whereas the right side explains that of the MATLAB software). These values are compared with predefined values in order to determine the direction of change of angle of the accelerometer using the Arduino code. Based on these comparisons, an indication data is sent to the MATLAB code running on the PC serially and wirelessly using a zigbee trans-receiver pair. This i data (U, D, R, L or S) indicates whether the pointer should move up, down, right, left, or stay in the same position respectively. The same indication data is displayed on the LCD as well for verification of the operation. The IR sensor mounted on the spectacles, on the other hand, sends a digital value to the Arduino.

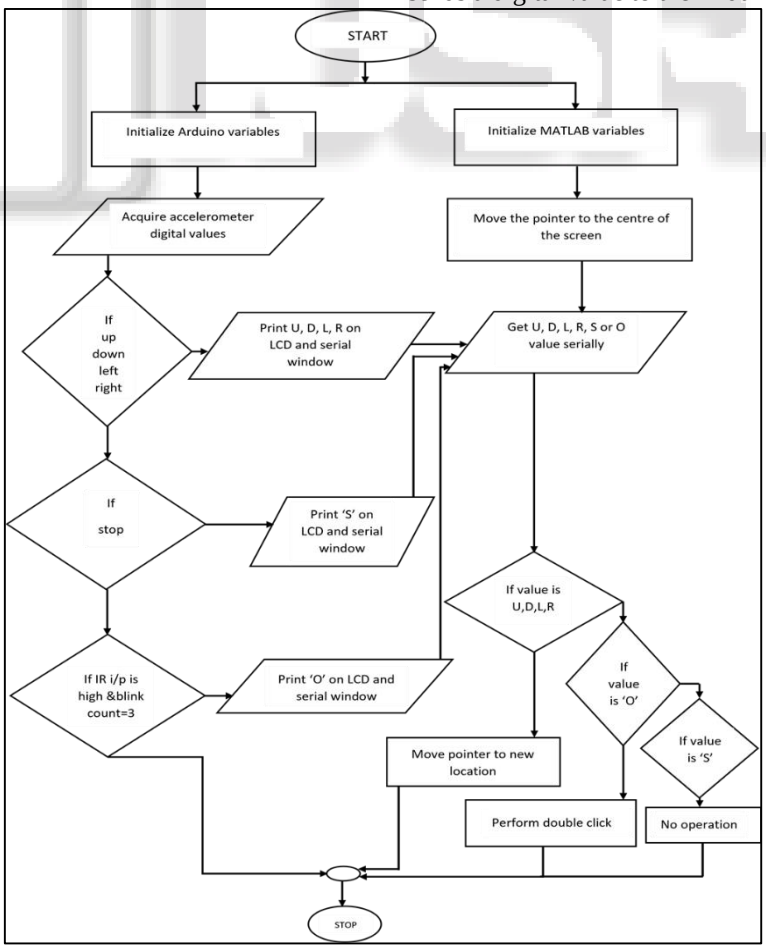

Fig. 3: Flowchart indicating the system working

Every time the user blinks his eye, the LED on the sensor lights up indicating a high value. Within the Arduino code, it is constantly monitored to find high value from the IR sensor output. Every time a high value is detected, the count value is increased. For three continuous blinks, or when count value is 3, an indication data is sent to the MATLAB code running on the PC. This data (O) indicates that the mouse must perform the 'open the folder' or in general the 'double click' operation. This is also displayed on the LCD screen.

For the hand movements and the blinks to be converted into mouse operations, it is necessary for MATLAB to be running on the PC. To do this, the screen of the PC is considered to be an x-y plane. A reference point in this plane is considered, which the centre of the screen is in this case. Based on the indication data received from the Arduino serially, the operation to be performed is decided. In case the data received is U, D, R or L, new values of x and y are computed which means a change in the position of the cursor. In case of the data being S, nothing is done. If the data is O, the double click operation is performed. All the tasks are performed in a loop to ensure that the system is continuously monitored and works in real time.

VI. Result

On successful proposed implementation and assembling of the device, the user is required to wear the glove and the spectacle. The hand tilt motions on the x-y plane i.e., forward, backward, left or right gives rise to change in the mouse pointer position on the PC screen in up, down, left or right directions respectively. Continuous three blinks by the user provokes double click operation enabling the user to open files or folders. The data regarding the operations is displayed on LCD as well.

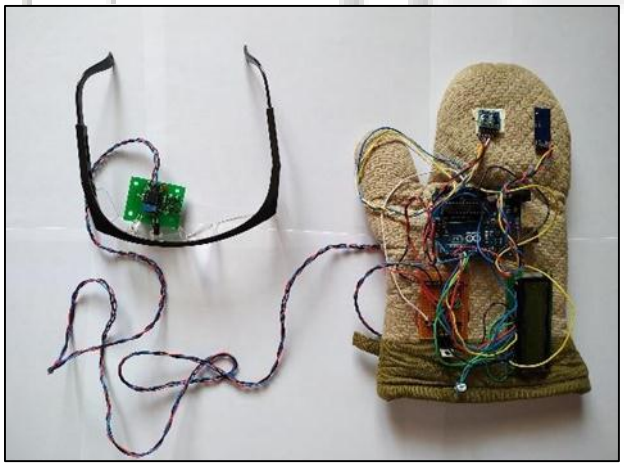

Fig. 4: Implemented system view

VII. Advantages and Limitations

A. *Advantages:*

- System functions in real time and is a user friendly application.
- The system devised is compatible for any computer.
- High degree of access to use and high accuracy.
- Can be made use by the disabled and physically challenged.
- The compact and comprehensive design, makes it ready for use by the public.

B. *Limitations:*

- Sensors must be calibrated and well functional. Slight variation in its functionality can lead to the failure of entire system.
- Limitation in range of operational area the device.
- Gloves equipped with a lot of electronics are not always comfortable.
- Wearing the eye equipment may not be always feasible

VIII. Applications

Given the pace of growth of technological usage, the system proposed would easily find applications in a number of fields [5].

- The Virtual reality gloves can be used by the stroke affected and paralyzed patients.
- Used by the physically challenged people in schools and offices.
- Can be made used in industries for risk free interaction with machines.
- Implemented in the field of education to make teaching effectively and learning fun and interesting.
- Can be adopted in modern gaming techniques.

IX. Future Scope

Although this system sufficiently manages to serve the purpose by fulfilling the basic requirements, advancements can be made for better performance and extended applications. Adoption of the voice recognition system to allow the device to take voice commands as an input and permitting user to access the computer based on voice commands would be a useful step forward. Implementation of virtual keyboard, enabling user to type onscreen and allowing the entry of text by providing a virtual environment would be a fascinating and equally useful breakthrough. Also, taking advantages of internet, application of Wi-Fi module and Internet of Things (IOT) in place of Zigbee module for data transfer, so that human computer interaction can be made from distant places as well would make the system more desirable.

X. Conclusion

In the proposed system, Virtual Reality based Human Mouse, an alternative to a conventional mouse, that can be perform with relative simplicity and high degree of usability and is combined with virtual reality environments to meet various applications is introduced. It provides us the possibility of implementing virtual mouse operations by using tri -axis MEMS accelerometer to detect hand tilts to direct the cursor movements on the monitor and an eye blink sensor to sense eye blink counts which serve as a selection mechanism. The entire system will be of substantial use for the disabled and the physically challenged, and be implemented at a low cost.

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