HMOS: Head Control Mouse Person with Disability

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Abstract: This paper presents an idea to build a human machine interface for disable persons. The purposed idea is very economical and useful for those disable persons who cannot use their hands to control computers.The main focus is to control the mouse through their head movements by using head-tilt sensor and air blow sensor. The system uses dual axis accelerometer based tilt sensor for detecting the movement of the head which is mounted on the headset and clicking of the mouse is activated by the 2 air blow sensor which are placed near the mouth to detect the left and right click of the mouse from the effect of the air blow in to the sensors. Since the device relies only on the user's head and air blow, so it can be used easily without requiring too much energy neither in the head movement nor in the air blow for clicking. This system encourage the disable person to start their independent professional life.

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INTRODUCTION

Owing to the lack of appropriate input devices, people with disabilities often encounter several obstacles when using computers. Currently, keyboard and mouse are the most common input devices. Due to the increasing popularity of the Microsoft Windows interface, i.e., Windows 98 and NT, computer mouse has become even added important. Therefore, it is necessary to invent a simple mouse system for people with disabilities to operate their computers.To develop a human machine interface emulating function of a mouse for disabled or paralyzed persons. In our proposed method there are two units one is transmitter unit which is placed on the user's headand second one is receiver unit which can be laptop or computer.The transmitter unit consists of the head-tilt sensor and an air blow/humidity sensor. The head tilt sensoruse an accelerometer ADXL 335 to detect the movement of the head. When the head of the user is tilted up/down or left/right, the reading from the accelerometer is subtracted from the value of a pre-defined reference point. The difference of the calculated reading determines the level of head tilt. Clicking operation is performed by an air flow/humidity sensor. It detects the air blow direction according to which left and right clicks of the mouse is activated. The output of both the sensors are given to the ADC inputs of the microcontroller. After the signals are interpreted by the microcontroller, mouse instructions are sent to the computers. The processed digital information is transmitted to the PC through the USB port using a USB to TTL module. As we all know that computer is now become necessity for everyone, so this system provides the human machine interface alternative for

Disable persons to use computer or laptop in easy way. From last many years, various Artificial Limbs and services are offered worldwide to people who have permanent or long term impairment. Artificial hands and legs have been proven to be quite effective and satisfactory for a limited number of Activities.The failure of these artificial limbs in enabling the amputees to successfully handle a computer is evident since one can exercise a limited control on the mechanical limbs attached. Moreover, many amputees have a job and work in offices wherein they have to use a computer. Hence device should be thought of which would allow easy and smooth control over computer. Thus every growing need of the computer is paralleled by ever increasing ways to work with them.

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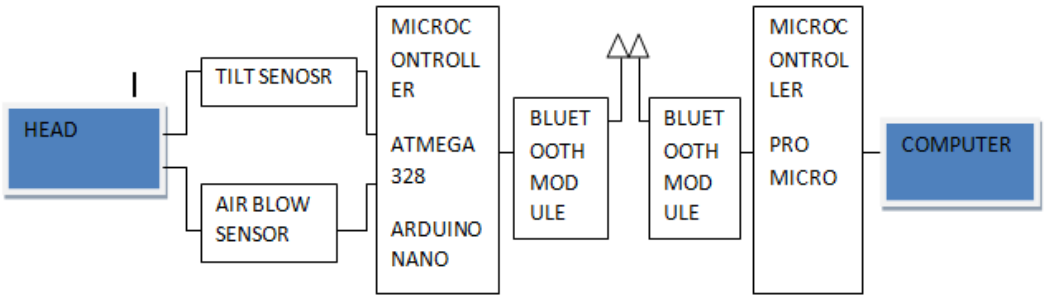

FIGURE 1 Block Diagram

The rest of this paper consist components used in this project in Section 2. Section 3 consist of Methodology having Tilt sensor for cursor moments up, down, left, right, upper-left, upper-right, lower-left, lower-right and Air blow sensor for clicking and software for programing for above function is Arduino IDE and language is embedded C. Comparison in Section 4, Result in Section 5, Conclusion in Section 6 and finally Future Work in Section 7.

COMPONENTS

This project consists of following components: -

- Microcontroller(Arduino Nano ATMEGA 328)
- Tilt sensor
- Air blow sensor
- Bluetooth module (HC05)
- Microcontroller(Arduino PROMICRO ATMEGA 32u4)
- Arduino IDE(language embedded C)

Microcontroller(Arduino Nano ATMEGA 328)

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328 (Arduino Nano 3.0) or ATmega168 (Arduino Nano 2.x). It has more or less the same functionality of the Arduino Duemilanove; but in a different package. It lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one. The Nano was designed and is being produced by Gravitech.

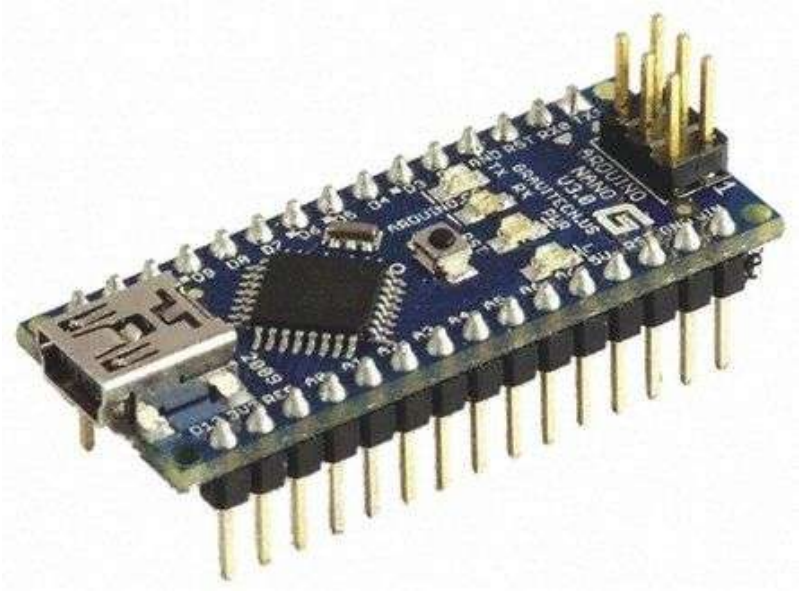

Figure 2 Microcontroller (Arduino Nano ATMEGA328)

Arduino Nano is a surface mount breadboard embedded version with integrated USB. It is a smallest, complete, and breadboard friendly. It has everything that Diecimila/Duemilanove has (electrically) with more Analog input pins and On Board +5V AREF jumper. Physically, it is missing power jack. The Nano is automatically sense and switch to the higher potential source of power, there is no need for the power select jumper.

Arduino Nano ATMEGA 328Components

It consists of following components

- Analog pin
- Digital pin
- Power pin
- power led
- Test led 13
- Reset button
- Tx/Rx led
- ICSP header
- USB jack
- SMD Crystal (16MHZ)

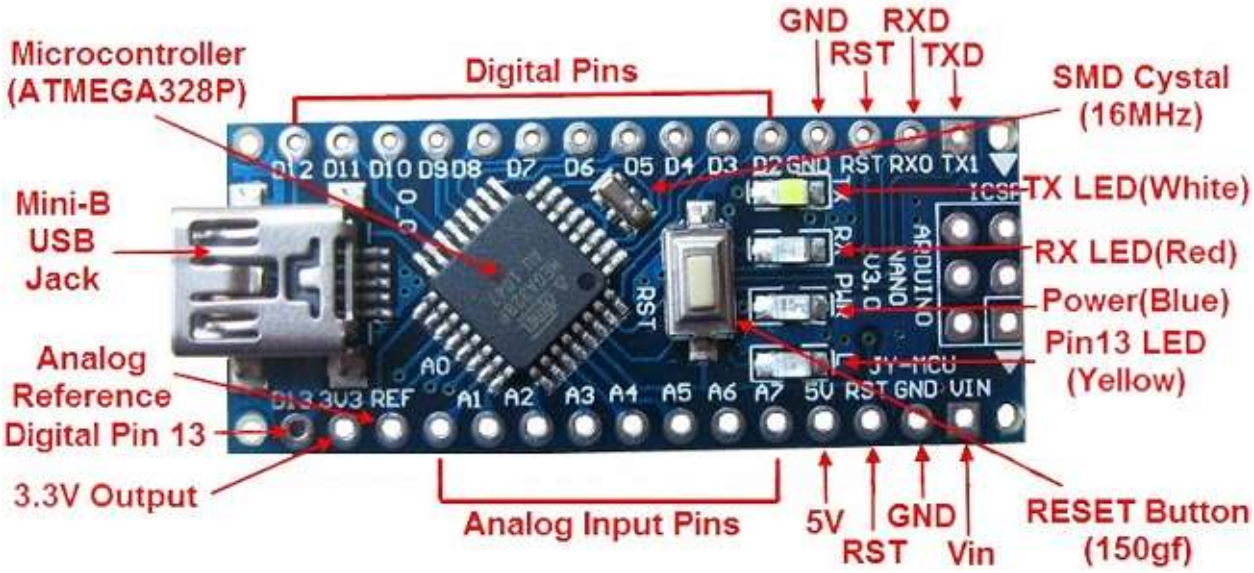

Figure 3 Arduino NANO (ATMEGA 328) Components

METHODOLOGY

This section consists of all the procedures involved while the making of this project. Firstly, we connect Tilt sensor (ADXL335) and Air blow sensor to the microcontroller (ATMEGA 328)and then its connect to Bluetooth module for transmitter side and the receiver side also have one Bluetooth module that is connected to Microcontroller(Arduino pro micro ATmega 32u4) and this microcontroller connect to the computer. Arduino IDE(language embedded C) software is used for programing all the function of the project using embedded C.

TILT SENSOR

The ADXL335 is a complete 3 axis accelerometer which is very thin, small and signal conditioning voltage output. The minimum fall range of accelerometer is +-3g. Its bandwidth range of X and Y axis is 0.5 to 1600 Hz and 0.5 to 500 Hz for the Z axis. The output signals of the accelerometer are analog voltages that are proportional to acceleration. The accelerometer can measure the both static and dynamic acceleration resulting from motion shock and vibration. The accelerometer is having polysilicon surface-micro machined structure. In accelerometer deflection is measured using a differential capacitor that consists of independent fixed plates and plates are attached to the moving mass. The defection is measure by the deflection of the moving mass and unbalancing

of the differential capacitor which results in the sensor output and then for determining the magnitude and direction phase – sensitive demodulation technique is used. The demodulator output is amplified and brought off-chip through a 32-kohm resistor then the signal bandwidth of the device is set by adding a capacitor. This filtering helps in increasing resolution and in preventing aliasing. The sensor uses a single structure for sensing the X, Y and Z axes. So that three axe's sense directions that are highly orthogonal and have little cross-axis sensitivity. In performance,there is no quantization error or no monotonic behaviour and temperature hysteresis is very low(typically less than 3mg)

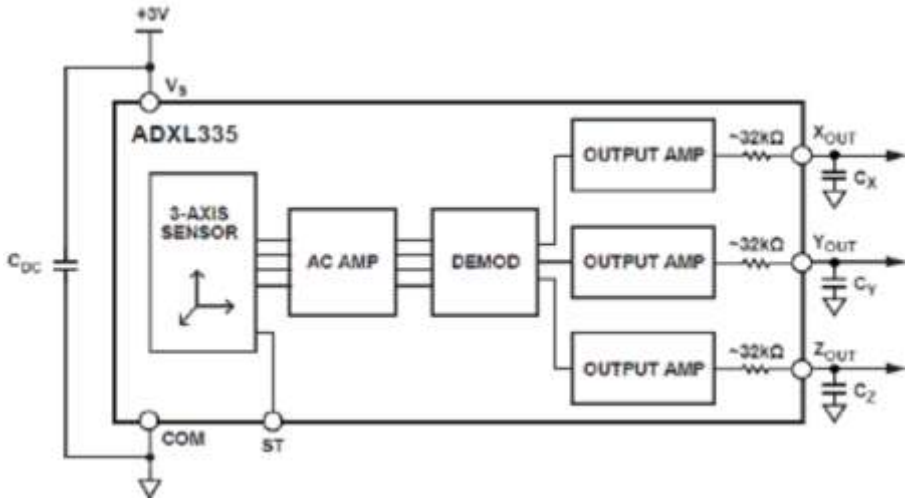

FIGURE 4 Functional Block Diagram of ADXL335 Accelerometer

AIR BLOW SENSOR

The sensor that we used for the purpose of the mouse click is the air blow sensor. This sensor is attached with the headset. So whenever the person will make the movement of his head according to the movement of the mouse, the person will blow the air for the clicking purpose. Here we have used DC motors as generators. Whenever you blow on the motor, an Analog signal voltage is produced which can be captured be the ADC of microcontroller and used to trigger an event that is left or right in this case The motor generators that we have used a device used to convert electrical power to another form. Motor generator sets are used to convert frequency, voltage or phase of power. A motor generator consists of an electric motor mechanically coupled to an electric generator. The motor runs on the electric input current while the generator creates the electrical output current. Motor generators can be used for various conversions including AC to DC and vice versa, DC at one voltage to DC at another voltage ,AC at one frequency to AC at another harmonically- related frequency and so on. Motor generators today have been replaced by semiconductor devices for some purposes. The term motor generator can be used to describe a single power transducer that can be used as either an electric motor or a generator, converting between electric power and mechanical power. In principle, any electric generator can also serve as an electric motor, or vice versa.

So, whenever the person has to click, he just Need to blow so that the Analog signals are detected and the event is triggered.

BLUETOOTH TO SERIAL PORT MODULE HC05

The device used for transparent wireless serial connection setup in this project is the HC05 Bluetooth Serial Port Protocol Module. Serial Port Bluetooth Module is fully qualified Bluetooth V2.0+EDR(Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technologyand with Adaptive Frequency Hopping Feature. It has the footprint as small as 12.7mmx27mm

Hardware Features

- Typical -80dBm sensitivity.
- Up to +4dBm RF transmits power.
- Low Power 1.8V Operation,3.3 to 5V I/O
- UART Interface with programmable baud rate
- With integrated antenna

- With edge connector
- Slave default baud rate :9600,Data bits :8,Stop bit:1,Parity:No Parity
- PIO9 and PIO8 can be connected to red and blue led separately. When master and slave are paired,red and blue led blinks 1time/2s in interval, while disconnected only blue led blinks 2times/s.
- Auto-connect to the last device on power as default
- Auto-reconnect in 30 min when disconnected as a result of beyond the range of connection.

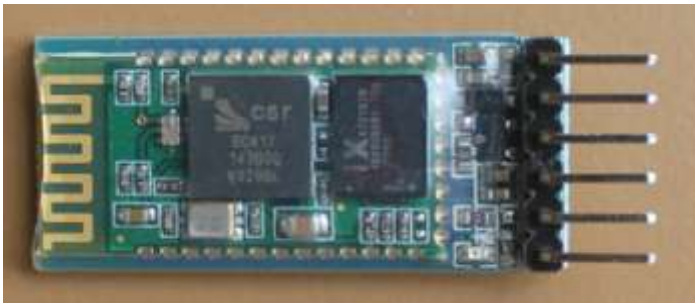

FIGURE 6 Pin Diagram of HCO5 Bluetooth Module

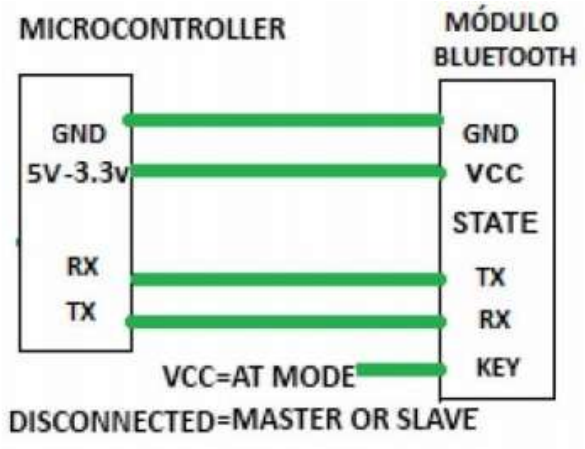

FIGURE 7 Connection of Microcontroller to Bluetooth Module

MICROCONTROLLER (Arduino pro MICRO ATMEGA 32u4)

The Arduino Micro is a microcontroller board based on the ATmega32u4 (datasheet), developed in conjunction with ADafruit. It has 20 digital input/output pins (of which 7 can be used as PWM outputs and 12 as Analog inputs), a 16 MHz crystal oscillator, a micro USB connection, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a micro USB cable to get started. It has a form factor that enables it to be easily placed on a breadboard. The Micro is similar to the Arduino Leonardo in that the ATmega32u4 has built-in USB communication, eliminating the need for a secondary processor. This allows the Micro to appear to a connected computer as a mouse and keyboard, in addition to a virtual (CDC) serial / COM port. It also has other implications for the Behaviour of the board**.**

SUMMARY

Microcontroller ATmega32u4

Operating Voltage 5V Input

Voltage (recommended) 7-12V

Input Voltage (limits) 6-20V

Digital I/O Pins 20

PWM Channels 7

Analog Input Channels 12

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DC Current per I/O Pin 40 mA

DC Current for 3.3V Pin 50 Ma

Flash Memory 32 KB (ATmega32u4) of which 4 KB used by bootloader

SRAM 2.5 KB (ATmega32u4)

EEPROM 1 KB (ATmega32u4)

Clock Speed 16 MHz

FIGURE 8. Arduino pro MICRO ATMEGA 32u4)

Arduino IDE(language embedded C)

The Arduino IDE is a cross-platform application written in Java, and is derived from the IDE for the Processing programming language and the Wiring project. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and is also capable of compiling and uploading programs to the board with a single click. There is typically no need to edit makefiles or run programs on a command-line interface. Although building on command-line is possible if required with some third-party tools such as Ino. The Arduino IDE comes with a C/C++ library called "Wiring" (from the project of the same name), which makes many common input/output operations much easier.

- Cross-Platform program
- Open-Source
- Different instructions for different OS

FIGURE 9 A screenshot of the Arduino IDE

COMPARISON

As, there are lots ofsuch types of Head control mouse devices available in the market, it makes us all to think about the uniqueness of this device so called HMOS, which makes it different from all such existing devices.After comparing HMOS from them with

all possible features like microcontroller,cost,resource, USB jack, flash memory, voltage levels and sensors, following table is drawn On concluding from below drawn comparison table, it can be observed that used when we talk about the processor specifically, HMOS can work on ATMEGA 168 and ATMEGA 328p both while other models could work only upon ATMEGA 328p. Another important factor is the cost. As compared to other models that generally cost around 15,000 Rupees HMOS can be made available at just 8000 Rupees that is almost half of the price ofother models that makes HMOS cost effective. Another factor that comes into play is the resources, the resources needed for HMOS is less as compared to other models that makes it efficient to use. As with the present times, we often look forward to minimize the components, looking forward to another advantage of HMOS. HMOS requires a mini USB jack compared to other models that function with the regular USB jacks making it more complexand heavy. The efficient performance of a model can be seen by comparing the flash memory used by the models. HMOS has the ability to use the flash memory of 16kb or 32kb both whereas other models have the access to use only 32kb flash memory. The voltage values used by the model soften concern with their performances. HMOS uses low voltage level of around 5V and 7-9V as compared to other models that use 5V and 7-12V that are higher voltage levels to that used by HMOS. Last but not the least feature of HMOS is that it uses air-blow sensor for the purpose of the mouse click as compared to other models that used eye-blink sensor for this purpose. Using air-blow sensor reduces errors and ambiguity and increases the precision of HMOS

Table1. Comparison between HMOS and other models

Features	Other	HMOS
PROCESSOR	ATmega328P	ATmega168 ATmega328P
Cost	High	Low
Resource	More	Less
USB	Regular	Mini
FLASH(KB)	32	16/32
VOLTAGE	5 V / 7-12 V	5 V / 7-9 V
SENSOR	Eye blink	Air blow

RESULT

HMOS has made it possible for the paralyzed person to operate the computer by the use of mouse controls solely through his head and face movements. The Arduino Nano chip that we have used has inbuilt various convertors like the Analog to digital convertors that convert the incoming Analog signals into appropriate digital signals which further helps in the operation. The Bluetooth module has been used for serial Port communication that makes wireless communication between the paralyzed personand the computer. Tilt sensor and air-blow sensor have been used respectively for the purpose of the movement of mouse and clicking enabling the paralyzed person easy operation simply by his head and face. Paralyzed person just needs to wear the headset on which the sensors are mounted and they are through for operating the computer. HMOS has finally made an impossible thing possible by offering a second life to the paralyzed people.

CONCLUSION

The main advantage of this project is to eliminate the disability for the paralyzed people so that they can enjoy this world as a normal human being are enjoying. Those people can control or operate all the computer application by the mouth air blow and the interactive application are done by this sensor, and also gaming, swapping, page scrolling, etc. are also done using their head movement by placing a Tilt sensor. The complete replacement of wired communication, it finds the solution to the disabled person to operate the computer fully with the enabled mode.The HCI (Human Computer Interface) is an evolving area of research interest nowadays. This project aims to be a convenient process for helping out the disabled to operate computers. These systems can also be used in other application like robotics efforts, in process to make the device cost effective and more complex thereby reducing the size. Thus we have developed a real hand free mouse. This project will be very effective and accurate using of both Tilt sensor and Air blow sensors as a wireless mouse for future

FUTURE WORK

Human Computer Interaction is gaining mass popularity in the present days. This project provides a greater scope for improvement in the near future. Effective control in increasing of writing speed is still one of the sectors to be improved in future.

Better methods of transmission and reception channel can also be developed on further experiment. In the future this interface can be introduced into many control systems at home such as powered wheelchairs, telephones, and appliances with great potential demanded by the market.

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