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Hand Action Recognition Using Accelerometer

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ABSTRACT:- The phenomena of a Hand Action Recognition is a known concept which is based on Accelerometer and its execution in the field of gaming controller. By using this concept, an intention to build up an active device, which is also like to call a "Virtual Mouse".To use an accelerometer, is the main functional aspect of this particular project, which is used to sense the hand action movement done on which the accelerometer is placed. The movement of the palm will be resulting as the cursor movements. The signals will be transmitted between a user and the computer screen by using the mouse that have deigned, where the movement of the system by means the desired instructions would be given via the hands of the user and this instructions would be recognized subsequently by the system and this instructions would be executed accordingly. The entire basis of this prototype is operating as a mouse and it is an interfacing system which is used in our daily life but ease of use in context of the user and keeping the convenience, it is simply the total new paradigm.

KEYWORDS:- Accelerometer, Mouse, Palm, Cursor.

I. INTRODUCTION

A Wireless Accelerometer based Mouse designing can help in many ways for tilt based games, screen navigation by using the user's fingertip. In modern electronics era, Human Interfacing Device is a key area. In modern day computers to play 3-D games, gesture recognition can be well introduced. Virtual Reality is not far away from our doorsteps. An accelerometer is a simple inertial navigation sensor, which can be utilized in getting Static or Dynamic profile of acceleration of the movement to rotate 3-D object or to move cursor of mouse or Gyroscope. To convert acceleration profile of accelerometer into distance, a technique on same principle has to be proposed with double integration. Accuracy might be an important issue as errors keeps on adding in double integration but it would not create problems with robust signal processing. The movement will be the only limitation which will cause a little acceleration, which puts upper limit on sensitivity of sensor. To separate out the Dynamic & Static response of accelerometer is the measure challenge in this technique, to differentiate between Rotational & Static movements. On similar basis tilt based movement can be mapped onto cursor movement of mouse. This introduces entirely different technology in navigation compared to earlier Ball mouse with optocoupler or latest optical image processing based mouse. For smooth navigation, we added BLUETOOTH module. Simple low cost, low power inertial sensor based mouse with wireless capability will provide ease of use. It can also be converted to be useful in 3-D gaming application. It can be well used in Gesture Recognition with additional gyroscope with complete 6–Degrees of freedom.

II. BACKGROUND

In today's computer-centric world, you spend copious amounts of time with a mouse in your hand. A high quality mouse will be comfortable, help ease strain from constant clicking, come with software for macros and other automation, and provide pinpoint accuracy and speedy response. The peripheral competition between Logitech, Microsoft and other big brands is as fierce as ever, and more and more companies are releasing mice for gaming and other specific uses every day.

Because the majority of computer users stick with whatever mouse that comes boxed with their computer or slapped on their desk by an IT department, many don't realize how much better a quality mouse is until they've tried it out. Spending a lot of money on such a basic peripheral may seem entirely irrational, especially when just about every computer includes one free. If you're looking into buying a new mouse, the best place to start is with friends and family

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who have already made the switch to a decent mouse, and compare it with your own. After a few hours, you should notice improved comfort, increased accuracy and response, and the ability to use the mouse on almost any surface. More advanced mice will also allow you to program their extra buttons or even change resolution on the fly depending on the software you're using.

Nintendo Wii Remote uses simple 3-D mouse principle. A main feature of the Wii Remote is its motion sensing capability, which allows the user to interact with and manipulate items on screen via movement and pointing through the use of accelerometer and optical sensor technology. Apple I-PHONE gained lot of attention with its interactive keyless accelerometer based navigation. Market has lot of play station remotes including inertial sensors for playing 3-D games. Gyration has just released theirGyromouse with simple 3-axis gyroscope as inertial sensor based on magnetic properties to sense amount of degree of rotation along any of 3-axes.Simple orientation application also gives help in GPS based navigation system.

Cordless or wireless mice transmit data via infrared radiation (see IrDA) or radio (including Bluetooth). The receiver is connected to the computer through a serial or USB port, or can be built in (as is sometimes the case with Bluetooth). Modern non-Bluetooth wireless mice use USB receivers. Some of these can be stored inside the mouse for safe transport while not in use, while other, newer mice use newer "nano" receivers, designed to be small enough to remain plugged into a laptop during transport, while still being large enough to easily remove.

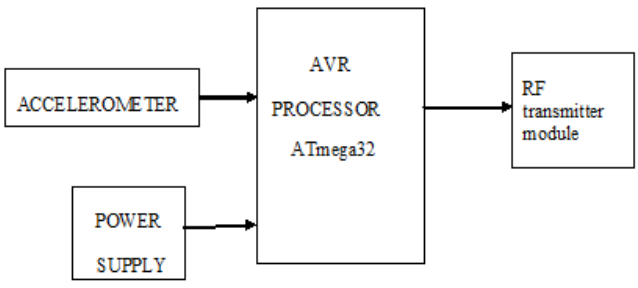
III. PROPOSED SYSTEM

The proposed work of the project is to design a wireless accelerometer based mouse. The idea came out there to find an alternative to mouse pad & clumsy movement based optical mouse. Accelerometer based mouse would help in many ways for screen navigation, tilt based games etc. With its small size QFN package it can even be easily inserted in mobile to interface with Bluetooth or can occupy user's fingertip to navigate.

The project is an accelerometer based tilt mouse, with 2 buttons and an auto-scroll ability. The mouse communicates to a computer via the PS/2 protocol, or an optional RS232 to USB converter can be purchased and the mouse can be connected through a USB port. Furthermore, the reason behind this project is two fold. One, it is just plain cool. This is proof that the method of control tom cruise had over his computers in the movie minority report is not science fiction nor far off in the future. The second reason behind this project is the possible health benefits it provides to the user of any computer. The most prevalent injury associated with using a keyboard and mouse is carpal tunnel syndrome. This is caused by resting your wrist on a hard surface as you type or move your mouse. This pinches the nerves that pass into your palm, specifically the median nerve. This causes severe pain and tingling, which can usually only be cured by surgery (with an "in-air" mouse, there is no need to rest your wrist on a hard surface. But if you do decide to rest your wrist on a hard surface while you control the mouse, the ergonomics of the mouse forces you to rest on the side of your wrist (i.e. the palm makes a perpendicular angle with the surface). We believe this does not cause pressure on the carpal tunnel nerves.

IV. SYSTEM OVERVIEW

i) Transmitter:



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ii) Receiver:

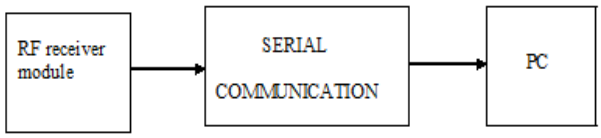

Figure 1: Block diagram of Wireless Mouse

The proposed system contains following main blocks:

- Accelerometer
- AVR Microprocessor
- RF trans-receiver module
- PC & Serial port.

1) Accelerometer (ADXL335):

The accelerometer (ADXL335) is a low power, thin, small, with signal conditioned voltage outputs, completes 3-axis accelerometer. The acceleration measurement with a minimum full-scale range of ±3 *g* is done by product. The static acceleration of gravityis measured in tilt-sensing applications, also dynamic acceleration from motion, shock, or vibration will be resulted. The user selects The bandwidth of the accelerometer is selected by the user at the XOUT, YOUT, and ZOUT pins, using the CX, CY, and CZ capacitors. With a range of 0.5 Hz to 1600 Hz for the X and Y axes, the bandwidths can be selected to suit the application, and also a range of 0.5 Hz to 550 Hz for the Z axis. Accelerometer sensor can measure static (earth gravity) or dynamic acceleration in all three axis. Many applications can be developed using this sensor, as well as application of the sensor is in various fields. Accelerometer sensor measures A level of acceleration can be measured by the accelerometer, where it is mounted. This enable us to measure acceleration of object like robot or car, or vibration produced by machines, or tilt of a platform with respected to earth axis. Sensor provides 0G output which detect linear free fall ands the ensitivity can be adjusted in two ranges for different applications. Acceleration is a vector force which has direction and measured in meters per second. By monitoring the three axis acceleration, one can measure the level of tilt of any platform.

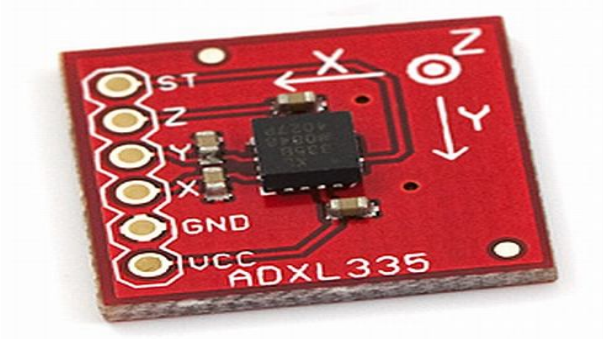

Figure 2: Accelerometer ADXL335

An accelerometer has many features such as 3-axis sensing, small, low profile package. It has an low power feature which has typically 350 µA current. It has an Single-supply operation: 1.8 V to 3.6 V. Here, a BW adjustment with a single capacitor per axis has to be done. The analog output for each axis will be obtained and it is Highly Sensitivity (800mV/g @ 1.5g).

2) RF Trans-Receiver Module:

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The RF trans-receiver module (CC2500) is a low-cost, 2.4 GHz transceiver designed for very low-power wireless applications. The circuit is intended for the 2400-2483.5 MHz ISM (Industrial, Scientific and Medical) and SRD (Short Range Device) frequency band. This RF transceiver is integrated with a baseband modem, which is highly configurable. This modem has a configurable data rate up to 500 kBaud and supports to the various modulation formats.

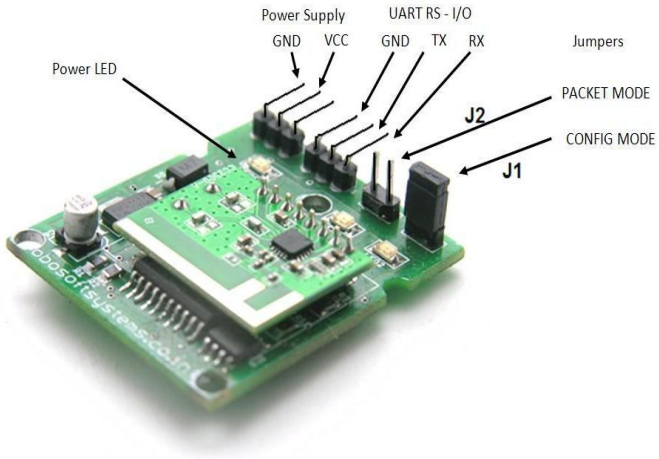

Figure 3: RF Trans-Receiver Module

A RF trans-receiver module (CC2500) provides extensive hardware support for data buffering, clear channel assessment, packet handling, burst transmission link, wake-on-radio, and quality indication. A 64-byte transmit/receive FIFOs of CC2500 and main operating parameters can be controlled via an SPI interface. In a typical system, the CC2500 will be used together with a microcontroller and a few additional passive components.

The RF trans-receiver has a frequency range of 2400-2483.5 MHz ISM/SRD band systems. It has a high sensitivity (–104 dBm at 2.4 kBaud, 1% packet error rate). A Low current (Power) consumption is the main feature of RF trans-receiver typically as 13.3 mA in RX. It also has programmable output power up to +1 dBm. This trans-receiver module supports for programmable data rate from 1.2 to 500k Band, OOK, 2-FSK, GFSK, and MSK. This module enables you to wireless transmit & receive serial data. It is an replacement for wired serial connections allowing transparent two way communication. In this, an Automatic Frequency Compensation (AFC) can be used to align the frequency synthesizer to the received centre frequency. The RF trans-receiver module can simply used for serial port replacement to establish connection between MCU and PC for data transfer.

3) AVR Microcontroller:

The Atmel®AVR®AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The Atmel®AVR®ATmega32 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega32 achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers.

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Figure 4: AVR ATmega32 Microcontroller

The ATmega32 provides the following features: 1024 bytes EEPROM, 2Kbyte SRAM, 32 general purpose I/O lines, On-chip Debugging support and programming, three flexible Timer/Counters with compare modes, 32 general purpose working registers, a JTAG interface for Boundaryscan, Internal and External Interrupts, an 8-channel, 10-bit ADC with optional differential input stage with programmable gain (TQFP package only), 32Kbytes of In-System Programmable Flash Program memory with Read-While-Write capabilities, a serial programmable USART, , Two-wire interface, A/D Converter, SRAM, Timer/Counters, SPI port, a byte oriented Two-wire Serial Interface, a programmable Watchdog Timer with Internal Oscillator, an SPI serial port, and six software selectable power saving modes. The Idle mode stops the CPU while allowing the USART and interrupt system to continue functioning.

4) Power Supply:

The basic step in the designing of any system is to design the power supply required for that system. The steps involved in the designing of the power supply are as follows,

1) Determine the total current that the system sinks from the supply.
2) Determine the voltage rating required for the different components.

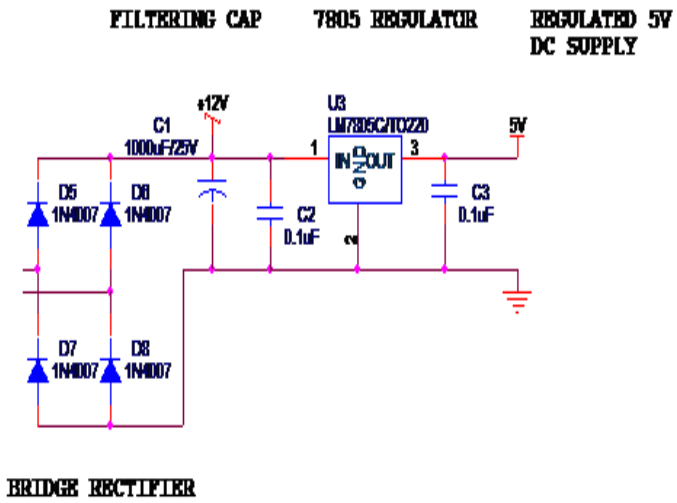

Figure 5: Power Supply design

The bridge rectifier and capacitor i/p filter produce an unregulated DC voltage which is applied at I/P of 7805.As the minimum dropout voltage is 2v for IC 7805, the voltage applied at the input terminal should be at least 7 volts.C1 (1000 µf / 65v) is filter capacitor and C2 and C3 (0.1 pf) is to be connected across the regulator to improve the transient response of regulator. Assuming the drop out voltage to be 2 volts, the minimum DV voltage across the capacitor C1 should be equal to 7volts (at least).

Power supply design of the project :

The average voltage at the output of a bridge rectifier capacitor filter combination is given by $V_{in(DC)} = V_m - I_{dc} / 4 f C1$

Where, $V_m = \sqrt{2} V_s$ and V_s = rms secondary voltage. Assuming Idc to be equal to max load current, say 100mA.

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C = 1000 Gf / 65v, f=50hHz
19 = Vm – 0.1 / 4*50*1000*10¯6
19= Vm – 0.1 / 0.2
Vm=19.5 volts

Hence the RMS secondary Voltage

Vrms = vm / √2
= 19.5 / √2=19.5 / 1.4421=13.5 volts

So we can select a 15v secondary Voltage. In our system most of the components used require 5 V as operating voltage such as micro controller, MAX 232, MCT2E etc. The total current, which our circuit sinks from the power supply, is not more than 100 mA. We have used Regulator IC 7805 that gives output voltage of 5V.The minimum input voltage required for the 7805 is near about 7 v. Therefore we have used the transformer with the voltage rating 230v-10v and current rating 500 mA. The output of the transformer is 12 V AC. This Ac voltage is converted into 12 V DC by Bridge rectifier circuit.

V. SIMULATION ALGORITHM

Transmitter Side:
1. Initialise port direction
2. Initialise ADC, Serial Port
3. Read acceleromter output
4. Send output to bluetooth through serial port
5. Go to step 3.

Receiver Side:
1. Initialise port direction
2. Initialise serial port
3. Read 2 axis data from serial port
4. Convert the data for mouse output
5. Send the data to pc

VB Side:
1. Start VB
2. Start wireless mouse program
3. Check the motion of mouse. The cursor should move as the acceleromer positions are changed.

VI. APPLICATIONS & ADVANTAGES

1. It can be widely used in 3-D games.
2. Accelerometer based mouse would help in many ways for screen navigation.
3. It can also be used for a person having motion disability.
4. It can also be used by teachers in schools and colleges.
5. It can be well used in Gesture Recognition with additional gyroscope.
1. Auto-scroll ability.
2. Provides Health benefits to the user of any computer.
3. The most prevalent injury associated with using a keyboard and mouse is carpal tunnel syndrome.
4. Simple low cost, low power inertial sensor based mouse with wireless capability**.**

VII. CONCLUSION & FUTURE SCOPE

The wireless accelerometer based mouse is designed to make our day today operations on the PC more convenient and time saving. This introduces entirely different technology in navigation compared to earlier Ball mouse with optocoupler or latest optical image processing based mouse.

Simple low cost, low power inertial sensor based mouse with wireless capability will provide ease of use.It can be converted to be useful in 3-d gaming application. It also provides health benefits by preventing a problem of carpel

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tunnel syndrome caused due to the use of keyboard and mouse. The above project can be developed in future to move the cursor using the movement of eyes. The EEG waves (brain waves) can also be used for cursor movement.

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