ISSN No.: 2455-6130
Volume 2, Issue 2, 2017, pp. 15-20

website: www.ijoetr.com

International Journal of Emerging Trends in Research

Accelerometer Based Wireless Air Mouse Control Using Hand Gesture

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Abstract

With the day to day advancements in technology, the interaction between the human and the digital world is diminishing. Lot of improvement has taken place in the mobile technology from button keypads to touch screens. However the current PCs still need a pad to operate its mouse and are wired most of the time. The idea is to develop a wireless mouse which works on the hand gestures of the user without the need of a pad making an effortless interaction between the human and the computer. The implementation is done using a sensor named accelerometer to sense the hand gestures. Accelerometer is a motion sensor which sense changes in motion in any of the three axes. In here the accelerometer will be at the users side, attached to the hand to sense the movement and gives the output to a micro-controller to process it. Necessary modifications are done by the microcontroller to these values and are transmitted through a RF module to the PC. At the receiving end a mouse control program which contains functions to control the mouse reads these values and performs the necessary action

Keywords: Accelerometer; Air Mouse; Human Computer interaction and RF.

1. Introduction

The advancement of technology in the field of sensors made it possible to design a humanoid for any application [1]. Efforts are being made to reduce the gap between a human and a machine. Infra red sensors, ultrasonic sensors, accelerome-ters, gyrometers, gas sensors etc. can be used by the machine to sense the surroundings and make decision like a human would [2]. An accelerometer can be used to sense motion, more particularly acceleration in a given direction [3]. This property of accelerometer can be exploited in the field of Human Computer interface by using it as a mouse. The sensor would sense the motion of hand and the mouse pointer will move [4].

The accelerometer senses the change in motion, in our case the tilt of the hand. The change in the acceleration values of the accelerometer are transmitted to the PC, where in the software applications take control and moves the mouse cursor.

Looking for the hardware requirements, Arduino, the name now synonymous with microcontroller and sensors seemed the suitable platform [5]. Its main advantage is being easily programmable and

has massive online support [6]. To control the mouse pointer, java class called as java. robot is used, which consists of functions that take control over the mouse and keyboard [7]. 'Processing' programming language [8] is used to read the values from the serial port and implement the java class. To make the mouse wireless, RF Modules CC2500 [9] from Texas instruments were used as they are cheap compared to other modules like Bluetooth and Zigbee. The paper is organized as follows: Section 2 discusses the architecture of the system with subsections of each block. Section 3 discusses results and concludes in Section 4.

2. System Architecture

The proposed system architecture uses accelerometer as a sensor to detect the motion. Accelerometer is interfaced to a microcontoller, Arduino in this case. The microcontroller does the necessary processing on the sensor data and transmits it through a wireless transmitter module. The wireless receiver receives the data and feeds it to the computer through one of the interfaces. The application running on the PC analyzes the received values and perform the necessary action on the mouse pointer.

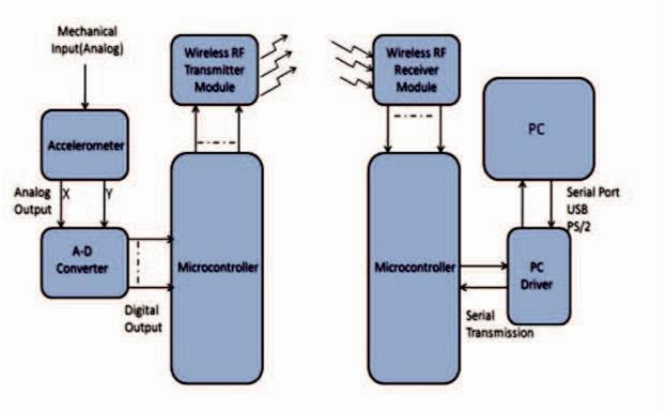

Figure 1: Block Diagram of the proposed System

The following subsections studies each block in detail :

2.1 Accelerometer

An accelerometer is a micro electromechanical sensor (MEMS) that measures acceleration. It is also helpful in detecting tilt or orientation with respect to the earth of a device it is attached to [10]. This application uses its property to detect the tilt of the hand to move the mouse pointer.

MMA7260 3-axial Accelerometer from free scale is used. This accelerometer is a thin, low power 3-axial accelerometerwhich gives an analog voltage output. The voltage output is directly proportional to the accelerometer. When the accelerometer is kept stationary and rotated, the three values along each of the three axis X, Y and Z gives the tilt along each of the axis.

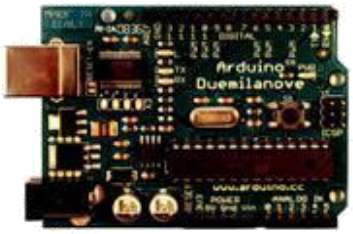

Figure 2: Arduino Duemilanove

2.2 Arduino Microcontroller

Arduino is an open source hardware and software platform for making interactive projects that can sense and control the physical world [11]. Arduino Duemilanove board which uses ATmega328 microcontroller board with 14 digital I/O pins and 6 analog inputs is used. The board is as shown in figure 2 Arduino can be programmed through its IDE software that is built on Java. The IDE is based on software library called Wiring".

The analog output of the accelerometer sensor is given to three analog inputs of the Arduino board. The inbuilt ADC of the board converts the values to digital and sends the data to the Wireless module through Serial UART port.

2.3 Wireless Transceiver Module

Texas Instruments' CC2500 2.4GHz RF Transceiver mod-ule for the wireless transmission and reception of the data is used. CC2500 works very efficiently for a short range transmission.

CC2500 operates on TTL logic levels whereas the PC takes in RS232 logic levels. MAX232 IC is used to convert TTL logic to RS232 logic.

Logic	TTL	RS232
low(0)	0V	+3 to +25V
high(1)	3.3 or 5 V	-3 to -25V

2.4 Computer Application and Algorithm

The computer receives the data serially through its RS232 interface. 'Processing' programming language to make a soft-ware application to move the mouse pointer based on the values received is used [8].

Processing invokes the Java robot class to enable mouse functions. Java.awt.Robot class belongs to java.awt package which is used to take control of the mouse and keyboard.

The function Robot.mouseMove is used to move the mouse cursor.

Data: Input digital sensor values for X, Y and Z axes
Result: Direction of Mouse Cursor Start:Set Threshold Intervals for
direction Centre
North
East
South
West
North
East
North

West
South
East
South
West;
While Values are received do
read X; read Y; read Z;
if X and Y lies in interval of direction then
Generate direction identifier value ID; else
check for other directions; end
transmit ID to the TX pin end

Algorithm 1: Algorithm at the Transmitter

Data: Direction Identifier ID Result: Move the cursor Invoke java.awt.robot class; while Values are received do
read ID;
Generate coordinates for received direction;
Give coordinates to the function robot.mouseMove()
;
end

Algorithm 2: Algorithm at the Receiver

3. Results Analysis

The accelerometer values received at the computer were analysed in Processing by plotting the received samples. The X-axis values are shown in figures 3 and 4 for different tilts of accelerometer. These values were then fed to algorithm at the receiver discussed above which invokes the JAVA Robot Class to perform the necessary move. The system is shown in figure 5.

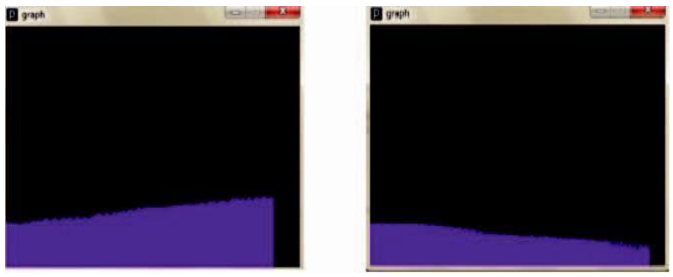

Figure 3: X-Axis readings at: a) rest position b) random position

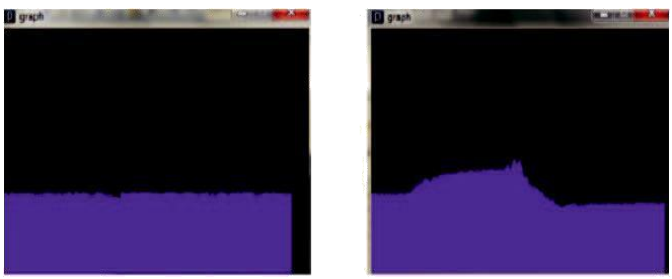

Figure 4: X-Axis readings at a) right tilt b) left tilt

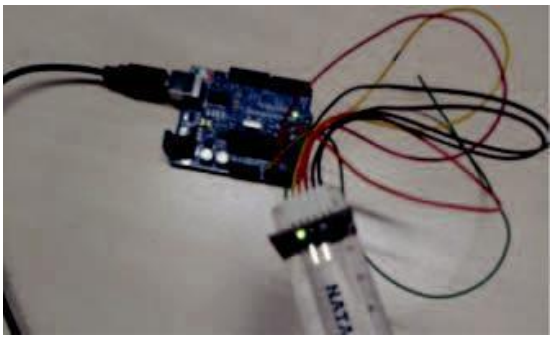

Figure 5: System setup with accelerometer connected to Arduino board

4. Conclusion

Accelerometer based Wireless Mouse using Arduino Board is presented in this paper. Accelerometer is used as a motion sensor with two axes of the accelerometer that is the X-axis and Y-axis, which forms a plane of motion, are used to sense the tilt in the specific direction and the mouse cursor is moved accordingly. Change of acceleration or a tilt in the direction of Z-axis, is used for click and release of the cursor of mouse. The aim of the project was to design an Air mouse which do not require a mouse pad and works on the hand gestures and is designed successfully. In the proposed system, the cursor is made to move based on the tilt of the accelerometer, not exactly the position. This is a tilt based approach. The position based approach can be tried in the future, where in the mouse cursor just follows the movement of the finger.

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