# Advanced Hand Gesture Controlled Television Using Data Glove

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*Abstract:* *Human interaction with wearable computers is a challenging research issue, especially when combined with augmented reality applications. Natural interaction with various devices should be simple and at the same time intuitive for any user. This project represents the design and implementation of a novel interactive hardware which recognizes certain hand gestures and responds in a way of controlling a remote television. The hardware is made as a data glove with an accelerometer and stretch sensor attached to it. Control parameters are calculated by an accelerometer and stretch sensor mounted on the glove, which detects positions of a user's palm in a 3D space. Slow palm rotation is translated into commands for the volume control, ON/OFF, and channel switching. RF transmitter connected to the accelerometer sends the current palm and hand coordinates to the remote unit. The TV control is managed by an RF receiver and microcontroller which translates the received data to TV commands.*

*Keywords:* *Accelerometer, Stretch sensor, PIC microcontroller, IR LED, Hand gestures.*

## I. INTRODUCTION

Rapid development of technology and fast moving life accounts for the cause of more user friendly and interactive operations. Considering the above aspects, the Human-Machine interaction is getting more significant in the present scenario. Television, one of the most widely used entertainment media, has had a number of innovations in terms of the display screen. But the TV control has had only few innovations. This presents the importance of developing a user friendly and efficient control mechanism. Hand gesture control for television is a new technology that helps to interact with computer or television in a natural and intuitive manner. It can also be considered as a novel interactive hardware. Gesture recognition refers to the process of understanding and classifying meaningful movements made by a humans hands, arms, face and

sometimes head. Humans often make use of their hands to express an opinion or to initiate an action. It is understood that nonverbal means of communication are more important than verbal communication in the transmission of an intension. Gestures using body or hand are the typical nonverbal means of communication. Gestures are of great significance in designing artificially intelligent human-machine interfaces for various applications, ranging to virtual reality. Motion data gloves are frequently used input devices that interpret human hand gestures for applications such as virtual reality and human-computer interaction. The data gloves enable efficient gesture recognition at a low cost. Y Han ET. Al [1] proposed that hand gestures can be effectively captured and recognized through an inexpensive motion data glove which overcomes the obstacle of high cost. To lower costs, the glove was designed to use single-channel video instead of expensive motion sensing fibers or multi-channel video. Is composed of an inexpensive consumer glove with attached thin-bar-type optical indicators and a closed form reconstruction algorithm that can overcome the common disadvantages of single channel video approaches, i.e., occlusion and the need for inconvenient iterative reconstruction algorithms.

S. K. Kim et al [2] proposed a gesture control mechanism which is a hand-held interface system for 3D interaction with digital media contents. The system is featured with 1) tracking of the full 6 degrees-of freedom position and orientation of a hand held controller, 2)robust gesture recognition using continuous hidden Markov models based on the acceleration and position measurements, and 3) dual-mode feedback using both vibration motor and voice coil actuator. The advantages of the system through a usability experiment was also demonstrated.

## II. WORKING

The gesture recognition and control is carried out with the help of a data glove that consist of an accelerometer and a stretch sensor. The control parameters are sensed by the glove and processed by the microcontroller which then compares the value with the predefined set of values programmed in the microcontroller to produce the control frequency, which is then transmitted using an IR led. The working of the system is explained in detail in the following sections.
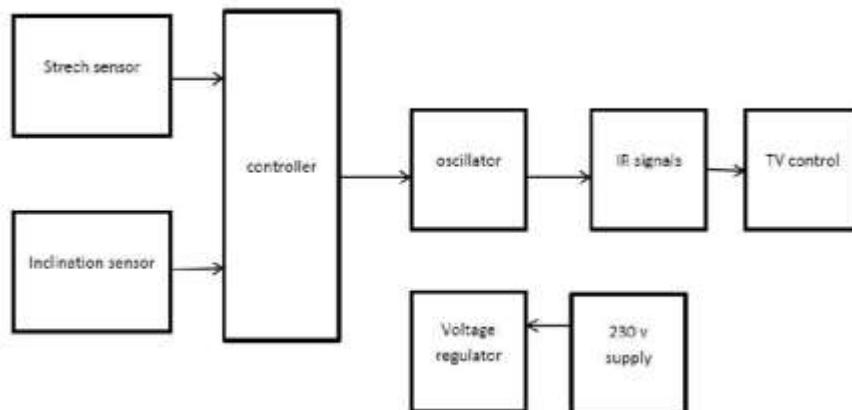


*Figure 1: block diagram*

Figure 1 shows the block diagram of the data glove. The data glove consist of two sensors, microcontroller, and oscillator and frequency transmitter. The accelerometer and stretch sensor detect the user's palm in a 3D space and produce a set of analog values corresponding to each gesture or movement of the hand. These analog values are scaled by suitable scaling factor and

converted to corresponding digital values by the ADC and fed to the microcontroller. The microcontroller compares the values with the predefined values to identify a valid gesture. Once a meaningful gesture is recognized, the oscillator produces a set of IR (Infra-Red) frequencies corresponding to the gesture and the frequencies are transmitted through the IR led. All sections of the unit are supplied from a battery through a voltage regulator.

GESTURE RECOGNITION

A set of gesture commands for volume control (volume up, volume down, mute, unmute), channel switching (channel up, channel down) and menu selection have been predefined. The data glove detects the position of the users palm in a 3D space by evaluating the values obtained from the tri axial accelerometer and the stretch sensor, which is given to the analog pin of the microcontroller after scaling with a suitable multiplication factor. The analog values for meaningful gestures have already been analyzed a stored in the micro controller. By comparing the values obtained with the predefined values for each control action, a meaningful gesture made can be recognized. The vague gestures are ignored.

FREQUENCY TRANSMISSION

Once a meaningful gesture is recognized, the microcontroller produces a set of frequencies in the IR (Infra-Red) region corresponding to the control action implied by the gesture. The set of frequencies for each valid gesture has been preprogramed in the microcontroller. These frequencies are coded from the television set on which the control system is intended to be implemented. These frequencies are emitted to the television receiver through an IR led incorporated on the glove unit.

CONTROL MECHANISM

The IR frequencies transmitted by the glove unit are captured by the receiver of the television unit. Since these frequencies are coded from the system being used, the frequencies are identified by the television set and the desired control action is carried out. Fig.2 shows a flowchart of working of the system
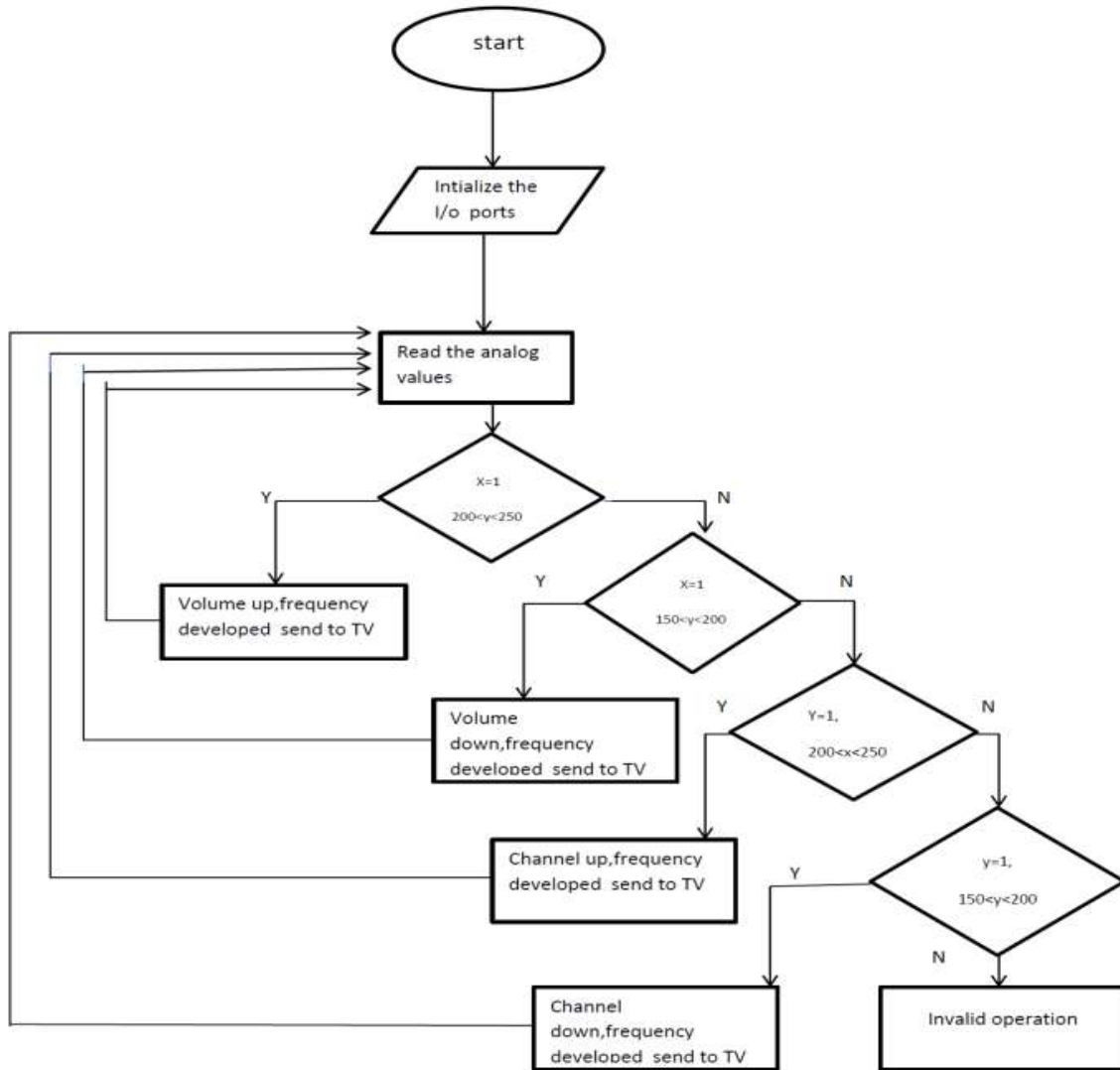
*Figure 2: Flow Chart*

PROGRAM ALGORITHM

Flow chart of the micro controller program is given in Fig. 2. The program algorithm is explained below. Step 1: Start

Step 2: Switch on the power supply

Step3a: Read the analog values from the accelerometer and stretch sensor

Step 3b: Give it to the analog pins of microcontroller

Step 4: If the x value=1 and y value is between 200 and 250, send the IR signal for volume up operation

Step 5: If the x value=1 and y value is between 150 and 200, send the IR signal for volume down operation

Step 6: If the y value=1 and x value is between 200 and 250, send the IR signal for channel up operation

Step 7: If the y value=1 and x value is between 150 and 200, send the IR signal for Channel down operation

Step 8: Go to step 3a for a new operation
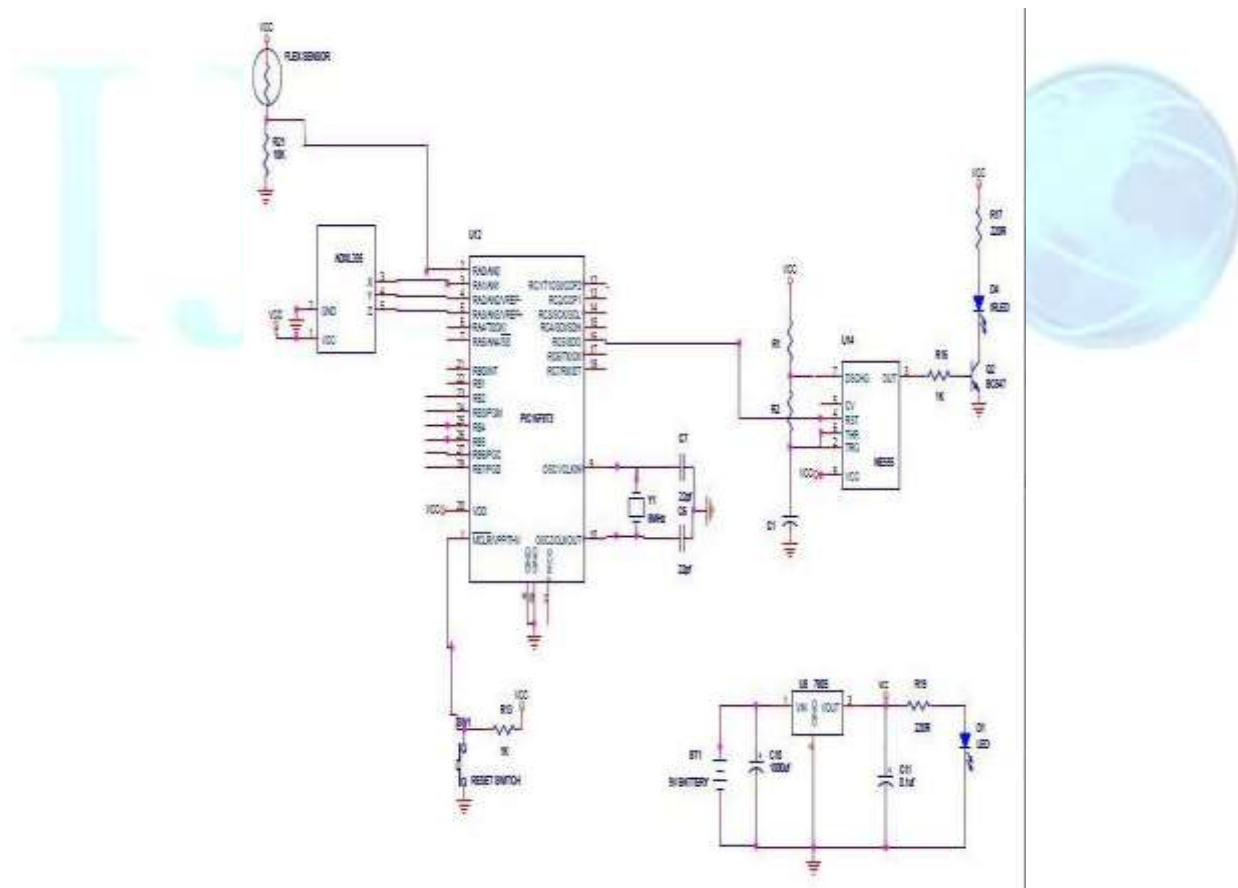
Step9: End

## III. CIRCUIT DIAGRAM



*Figure 3: Circuit Diagram*

## IV. HARDWARE

A. MICROCONTROLLER PIC 16 F873A

It is a powerful (200 nanosecond instruction execution) yet easy-to-program (only 35 single word instructions) CMOS FLASH-based 8-bit microcontroller packs Microchip's powerful PIC architecture into an 28-pin package and is upwards compatible with the PIC16C5X, PIC12CXXX and PIC16C7X devices. The PIC 16F873A features 128 bytes of EEPROM data memory, self-programming, an ICD, two com- praetors, 5 channels of 10 bit Analog to Digital convertor, the synchronous serial port can be configured as either 3-wire Serial Periphery Interface(SPI) or the 2-wire Inter Integrated Circuit (I2C) bus and a Universal Asynchronous Receiver Transmitter(USART). All these features make it ideal for more advanced level A/D applications in automotive, industry, appliances and consumer applications. It is a High Performance RISC CPU with only 35 single word instructions. All are single cycle instructions except for the program branches which are two-cycle.

B. ACCELEROMETER

ADXL335 is a small, thin, low power, complete three axis accelerometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full-scale range of +3g to -3g (g-acceleration constant). It can measure the static acceleration of gravity in tilt sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration. The user selects the bandwidth of the accelerometer using the CX; CY and CZ capacitors at the X, Y and Z output pins. Bandwidth can be selected to suite the application with a range of .5Hz to 1600Hz for the X, Y axis and a range of .5Hz to 550Hz for the Z axis. ADXL is available in a small low profile 4mm*4mm *1.45mm, 16 lead, plastic lead frame chip scale package. The ADXL335 uses a single structure for sensing the three axes. Therefore, the axes sense direction is orthogonal and has little cross-axis sensitivity. Mechanical misalignment is the principal source of cross-axis sensitivity. However, this misalignment can be calibrated out at the system level.

C. STRETCH SENSOR

The stretch sensor is a cylindrical flexible cord with electrical connectors on each end. They convert the stretch force to an analog value. The sensor produce varying resistance depending on the amount to which they are stretched. The more they are stretched, the larger the resistance is. In a 'relaxed' state, it has a resistance of about 350 ohms per inch. The variation in resistance varies the voltage output of the sensor. These find wide application in augmented reality applications.

D. IR LED

An IR LED, also known as IR transmitter, is a special purpose LED that transmits infrared rays in the range of 760 nm wavelength. These LEDs are usually made of gallium arsenide or aluminum gallium arsenide. They, along with IR receivers, are commonly used as sensors.
The appearance is same as a common LED. Since the human eye cannot see the infrared radiations, it is not possible for a person to identify whether the IR LED is working or not, unlike

a common LED. To overcome this problem, the camera on a cell phone can be used. The camera can show us the IR rays being emanated from the IR LED in a circuit.

## E. VOLTAGE REGULATOR

The 7805 is a self-contained fixed linear voltage regulator inferable circuit. It is commonly used in electronic circuits requiring a regulated power supply due to the ease of use and low cost. The 7805 voltage regulator has a 5V output voltage. The IC has three terminals and commonly found in the TO220 form factor. These devices. Support and input voltage anywhere from a few volts over the intended output voltage, up to a maximum of 35V to 40V depending on the make and typically produce 1A or 1.5A of current.

## V. SOFTWARE

### A. MIKRO C

The microcontroller executes the program loaded in its *Flash* memory. It is a so called executable code which consists of a seemingly bizarre sequence of zeros and ones. Depending on the microcontroller's architecture, this binary code is organized in 12-, 14- or 16-bit wide words. Every word is considered by the CPU as an instruction to be executed during the operation of the microcontroller. As it is much easier for us to deal with hexadecimal numeric system, the executable code is usually represented as a sequence of hexadecimal numbers called a hex code which, long time ago, used to be written by the programmer. All instructions that the microcontroller can recognize and execute are collectively known as the instruction set. For PIC microcontrollers with 14-bit wide program words, the instruction set includes 35 different instructions.

### B. PROTEUS

The Proteus Design Suite is wholly unique in offering the ability to co-simulate both high and low-level micro-controller code in the context of a mixed-mode SPICE circuit simulation. With this Virtual System Modeling facility, you can transform your product design cycle, reaping huge rewards in terms of reduced time to market and lower costs of development. Proteus Virtual System Modeling (VSM) combines mixed mode SPICE circuit simulation, animated components and microprocessor models to facilitate co-simulation of complete micro-controller based designs. For the first time ever, it is possible to develop and test such designs before a physical prototype is constructed. This is possible because you can interact with the design using on screen indicators such as LED and LCD displays and actuators such as switches and buttons.

*Figure 4: Hardware Implementation*

## VI. CONCLUSIONS

Rapid development of technology and fast moving life accounts for the need for more user friendly and interactive operations. Considering the above aspects, Human-Machine interaction is becoming more significant. Motion data gloves are frequently used input device that interpret human hand gestures for applications such as virtual reality and human-computer interaction. The data gloves enable efficient gesture recognition at a low cost. The glove consist of an accelerometer and stretch sensor. The control parameters are sensed by the glove and processed by the microcontroller which then compares the value with the predefined set of values programmed in the microcontroller to produce the control frequency. This is received by the TV unit to produce the required control action.

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