International Journal of Engineering Research and Reviews ISSN 2348-697X (Online)
Vol. 6, Issue 3, pp: (22-27), Month: July - September 2018, Available at: www.researchpublish.com

HEAD MOVEMENT CONTROLLED HOME AUTOMATION FOR HANDICAPS USING MEMS TECHNOLOGY

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Abstract: **The mission statement is to design a cost-effective, scalable and portable MEMS based control system for the physically handicapped with high accuracy and programmability. The project focuses on head movement recognition via displacement in different directions. Many approaches have been made using cameras and computer vision to interpret sign language. Gesture recognition is a way for machines to begin to understand human body language, thus building a richer bridge between human and machines. Approximately 6 million people in the world face the problem of disability due to paralysis of various degrees. The proposed work is to provide a system that can be used by physically challenged people to control various devices using head movement. The system comprises of a microcontroller employing a MEMS accelerometer senses displacement signals. The direction along x- axis, y- axis, z- axis is real time detected by the software which in turn communicates to the various devices to function accordingly.**

Keywords: **Head movement recognition, Gesture recognition, MEMS accelerometer.**

I. INTRODUCTION

The purpose of developing new technologies always has been to make life easier. People suffering from paralysis have lesser muscular activity when compared to normal people. The cause of reduced muscular activity is called stroke. . According to a study initiated by the Christopher & Dana Reeve Foundation, there are nearly 1 in 50 people living with paralysis -- approximately 6 million people. That's the same number of people as the combined populations of Los Angeles, Philadelphia, and Washington, D.C. And that number is nearly 33% higher than previous estimates showed. Such people will be in need of moral and technological support to withstand the situation. This can also be used by senior citizens who suffer from various ailments such as arthritis, back pains etc. to help make their life easier. Nowadays with the increase in work schedule, people are facing hectic work hours and do not have enough time to look after the old and needy, and not everybody can afford help either.

This system can help them be independent and reduce a lot of unnecessary pain. Over the past few decades the increased level of public awareness concerning healthcare, physical activities, safety and environmental sensing has created an emerging need for smart sensor technologies and monitoring devices able to sense, classify, and provide feedback to user's health status and physical activities, as well as to evaluate environmental and safety conditions in a pervasive, accurate and reliable fashion. But the technology is not accessible to all, especially in rural areas as it may be expensive or simply out of their reach. Keeping all these factors in mind, there was a need for an inexpensive and easily accessible automotive controller which works with lesser effort compared to the conventional systems. Hence this system is designed as a portable and customizable acceleration detector in different axis which could control electrical appliances with the help of head movement.

II. METHODOLOGY AND BLOCK DIAGRAM

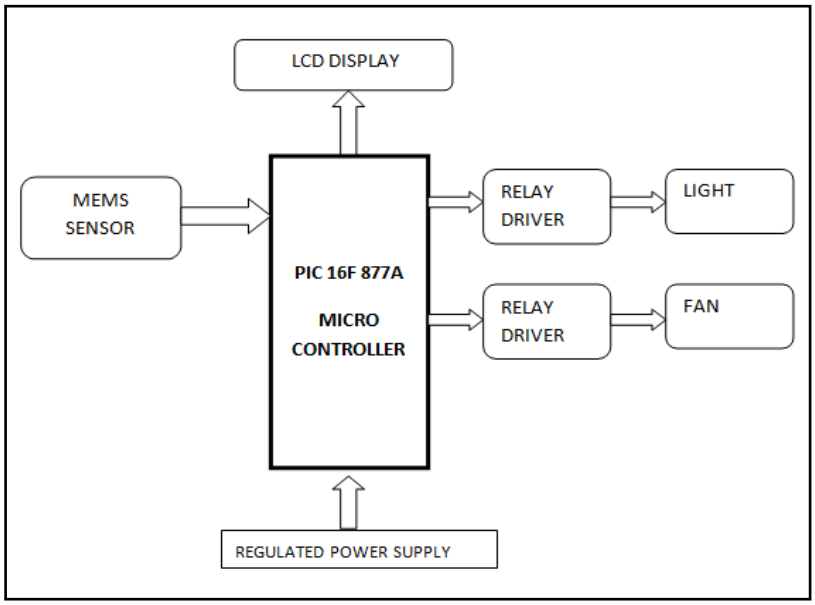

Fig.1: Block diagram

The proposed project uses Micro-Electro-Mechanical-Systems (MEMS) with high accuracy, high reliability and multiple functionalities has provided a powerful tool set for body motion sensing. The user can wear this device to head and with the simple head movement's he can control the electrical devices like light; fan etc with the help of head movements by using MEMS (Micro Electro-Mechanical Systems) technology. MEMS is a Micro Electro Mechanical Sensor which is a highly sensitive sensor and capable of detecting the tilt. This sensor finds the tilt and operates the electrical devices and announces the basic needs depending on tilt.

For example if the tilt is to the forward then the device will be "ON" for the first time then next time it will be "OFF". In the same way, if the tilt is to the left side then another device is going to be controlled. The tilt is in left side or right side direction the related need will be satisfied. This device is very helpful for paralysis and physically challenged persons. This device is portable and this system operation is entirely driven by wired technology. User can wear it to his head like a band and can operate it by tilting the MEMS sensor.

A. MEMS accelerometer sensor

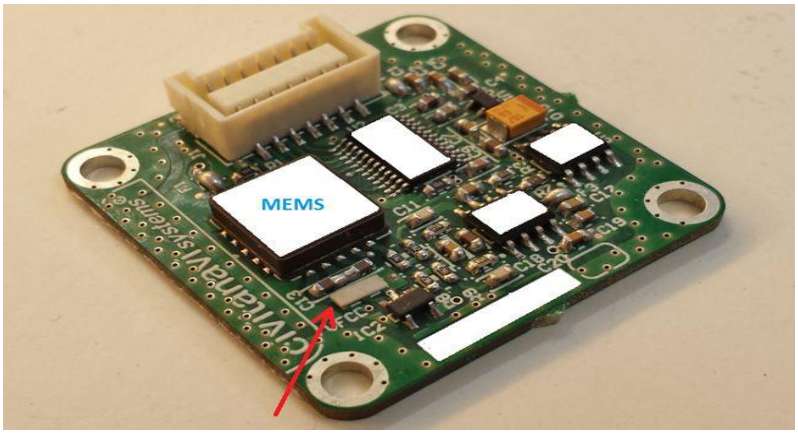

Fig.2: Accelerometer sensor

It is a tiny integrated devices or systems that combine mechanical and electrical components are created using MEMS technology. They have ability to sense, control and actuate on micro scale and generate the effects in micro scale. It is one of the most promising technologies of 21st century it consists of mechanical micro structures, micro sensors, micro actuators integrated on to the same silicon chip. Changes in the system's environment are detected by the micro sensor and corresponding electrical signal is produced, micro actuators react to this signal. In the proposed system, MEMS

sensors measure the tilt angles produced by the patients. It is a three directional accelerometer having X, Y, and Z directions. The voltage is in the range of 1.3V to 1.9V. Due to their small size, MEMS devices can be integrated into a single chip, thus, data reception, storing, interfacing, etc., can be carried out with a single chip.

B. PIC16F877A Microcontroller

Fig.3: PIC Microcontroller

The PIC16F877 Microcontroller includes 8kb of internal flash Program Memory, together with a large RAM area and an internal EEPROM. An 8-channel 10-bit A/D convertor is also included within the microcontroller, making it ideal for real-time systems and monitoring applications. All port connectors are brought out to standard headers for easy connect and disconnect. The 16F877 is one of the most popular PIC microcontrollers and it's easy to see it comes in a 40 pin and it has many internal peripherals. The 40 pins make it easier to use the peripherals as the functions are spread out over the pins. This makes it easier to decide what external devices to attach without worrying too much if there enough pins to do the job. One of the main advantages is that each pin is only shared between two or three functions so it's easier to decide what the pin function (other devices have up to 5 functions for a pin).

C. LCD Display

Fig.4: LCD Display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments another multi segment LEDs.The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. 16x2 LCD means it can display 16 characters per line and there are 2 such lines. This system makes use of16x2 LCD display which is used to display the cut off values of head movement set in the code.

D. Relay

Fig.5: Relay

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be ON or OFF so relays have two switch position and they are double throw (changeover) switches Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. The relay's switch connections are usually contains COM, NC and NO.

COM = Common, always connect to this; it is the moving part of the switch.

NC = Normally Closed, COM is connected to this when the relay coil is off.

NO = Normally Open, COM is connected to this when the relay coil is on.

Connect to COM and NO if you want the switched circuit to be on when the relay coil is on. Connect to COM and NC if you want the switched circuit to be on when the relay coil is off.

This system makes use of a Relay for switching the devices and Micro controller, which is programmed, with the help of embedded C instructions.

III. RESULTS

The change in the direction of accelerometer sensor (tilting) causes the movement of a reference capacitor inside the accelerometer and hence giving a differential voltage output across the axis pins, which acts as input the complete system. The sensory information is sent to a microcontroller in the device which has an algorithm programmed to repeat the transmission of the present axis. For example if the tilt is to the forward then the device will be "ON" for the first time then next time it will be "OFF". In the same way, if the tilt is to the left side then another device is going to be controlled. The tilt is in left side or right side direction the related need will be satisfied.

Fig.6: Experimental setup (Load 1&2 off)

Fig.7: Experimental setup (Load 1 ON)

Fig.8: Experimental setup (Load 2 OFF)

Below table shows the functions of accelerometer:

Head movement gesture (direction)	**Load operation**	**Voltage**
Right	Load 1 ON	V1<395,V2<350
Left	Load 2 ON	V1<370,V2<300
Right(again)	Load 1 OFF	V1>385
Left(again)	Load 2 OFF	V2<340

IV. CONCLUSION

This automated system is done mainly for the paralyzed people, handicapped people, especially those who are incapable of moving their limbs on their own. The extracted values from the accelerometer are processed using algorithms that take care of propagating signal to the necessary component. The reference voltages of the accelerometer remain constant. The change in the axis, changes the capacitor position inside the sensor and provides a different voltage. The received signals are processed by the microcontroller and algorithm decides the controlling of various devices. This system is the complete addition of electronic circuits, hardware designing and software knowledge. The MEMS sensor, microcontroller, relays circuits gave the required outputs. The system is successfully implemented to move the head left, right to operate the home appliances. Independent movement is achieved with the help of the system. It is designed to be characterized by low price and high reliability.

V. FUTURE ENHANCEMENT

For the future enhancement of this system, a number of additional subsystems can be incorporated. A temperature sensor can also be integrated on the receiver slide, which will automatically regulate the air-conditioning based on the temperature changes. Apart from these subsystems, the number of electronic devices to be controlled will be increased. The main enhancement of this system is that we can make a system which can be wireless. Output of the sensor can be applied to wireless transmitter circuit. So wireless operation can reduce wiring arrangements. Instead of using acceleration motion (head movement) we can use eyes retina using optical sensor. Using retina movement, one should able to control the devices. Another enhancement is that obstacle detection in the path can also be implemented. Since the system is designed and controlled by MEMS accelerometer sensor, MEMS will undoubtedly invade more and more consumer products. Size of MEMS getting smaller, frequency response and sense range are getting wider. This will be helpful for the enhancement of this system. This concept can be extended to other regions of the body like wrist movement, leg etc. Maximum use of this technology can be made by multiprocessing at a time i.e. two or more work can be done by the movement of the head.

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