Innovative IOT based gesture recognition and health care monitoring system for elderly and physically challenged people

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Abstract: *In Today's world many people are suffering from Physical disabilities and most of the physically disabled patients are dependent on care takers. A physical disability is a limitation on a person's physical functioning, mobility or stamina. In extreme cases, the patient may be speech impaired which makes it difficult for the person to communicate with others and to express the needs. Providing solution to these inabilities is the prime motive of this work. The physically disabled persons require special assistance from care takers or other persons to lead their normal life and even at home it is not convenient for them to control the home appliances according to their wish. Apart from this, it is also difficult to continuously monitor the health of the patient. The aim of the work is to design and implement the device multi sensor- gesture-gestured based home automation system and develop MEMS based wheel chair control which is useful to physically disabled person, with the hand movement or the hand gesture recognition using MEMS technology the person can control the action of wheel chair. We have also added patient health monitoring system to continuously monitor the patients health and alert the guardian of the patient in case of emergency.*

Keywords : Gesture, MEMS accelerometer sensor, Heart rate detection, H-bridge.

1. INTRODUCTION

This work is for controlling a wheel chair by using MEMS ACCELEROMETER SENSOR (Micro Electro-Mechanical Systems*)* technology. MEMS ACCELEROMETER SENSOR is a Micro Electro Mechanical Sensor which is a highly sensitive sensor and capable of detecting the tilt. This sensor finds the tilt and makes use of the accelerometer to change the direction of the wheel chair depending on tilt. For example if the tilt is to the right side then the wheel chair moves in right direction or if the tilt is to the left side then the wheel chair moves in left direction. Wheel chair movement can be controlled in Forward, Reverse, Left and Right direction. Automation is the most frequently spelled term in the field of electronics. The hunger for automation brought many revolutions in the existing technologies. Few among them are fire sensor, temperature and heart beat sensor. This device is portable and this system operation is entirely driven by wireless technology. User can wear it to the wrist like a watch and can operate it by tilting the MEMS Accelerometer sensor. This work makes use of a micro controller, which is programmed, with the help of embedded C instructions. This microcontroller is capable of communicating with all the mentioned blocks. The MEMS ACCELEROMETER SENSOR based sensor detects the tilt and provides the information to the microcontroller (on board computer) and the controller judges whether the instruction is right movement or left movement instruction and controls the direction respectively. The sensor senses the data and sends the same to the conductor. The controller is interfaced with two dc motors to control the direction of the wheel chair.

2. BLOCK DIAGRAM

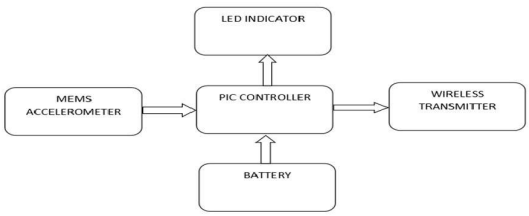

Fig 1: Block of transmitter unit on patient hand or head

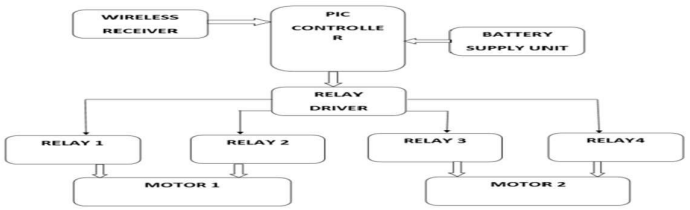

Fig 2: Block of receiver unit on wheelchair

I. Block Diagram with Working

The transmitter and receiver sections are placed at a distance of at least 20 meters. In order to show the working of wireless communication between transmitter and receiver, 4 Relays at receiver side are controlled by 4 IR SENSOR at transmitter section. The HT12E encoder IC converts the 4-bit data from the 4 data pins that are connected to sensor into serial data. This serial data is sent to RF transmitter. The RF transmitter transmits this serial data using radio signals. At the receiver side, the RF receiver receives the serial data. This serial data is sent to HT12D decoder IC which converts into 4 bit parallel data. The 4 data pins of decoder are connected to relays. According to the sensor, the home appliances can be turned ON or OFF. The 9V and 12V DC power supply is connected with transmitter and receiver respectively. It's a hardware which supplies the required voltage to the device. It's usually takes the input as AC and gives DC output to the device as required. Here we have used12 volt Lead Acid Battery which is 9Ah battery and provide supply for 9 hours The voltage regulator is used to control the voltage in the electrical equipment's. It is also used as current limiting device. The combination of a heat sink and fan (HSF) is referred to as an active heat sink. It absorb the extra heat in the circuit which helps to overcome the over heat problem.A crystal oscillator is an electronic oscillator circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a very precise frequency. An accelerometer is used to measure acceleration by gravity and changes the angle of direction with respect to the earth. The accelerometer further controls the speed and device direction while moving. The accelerometer is interfaced with three analog inputs of PIC CONTROLLER. An Accelerometer is an electromechanical device that measures acceleration forces. These forces may be static, like the constant force of gravity pulling at your feet, or they could be dynamic caused by moving or vibrating the accelerometer. It is a kind of sensor which record acceleration and gives an analog data while moving in X,Y, Z direction or may be X,Y direction only depending on the type of the sensor. PIN NO SYMBOL FUNCTION 1 Z Records analog data for Z direction 2 Y Records analog data for Y direction 3 X Records analog data for X direction 4 GND Connected to ground for biasing 5 VCC +3.3 volt is applied. In most of the applications the encoder is used to detect RF signals. In the present design the encoder is used for remote control accessing. The 12-bit digital data is converted to serial data which is used to enable RF transmitter on the transmitter board. The 12-bit data is partitioned into 8-bit address and 4-bit data. The address bits can be used to select multiple receiver devices at receiver end. HT12E is a remote control encoder paired with HT12D utilizing CMOS technology. It encodes data and address pins into serial coded waveform suitable for RF or IR modulation. HT12E has a maximum of 12 bits of tri-state address pins providing up to 312 address codes; thereby, drastically reducing any code collision and unauthorized code scanning possibilities. The pin description is shown below. It has 4 input while 1 output pin. The address pins can also be utilized as data pins. The decoder is used to control remote operations. It converts serial input data into parallel data. The Block diagram of receiver section and respective components involved at receiver side. DECODER IC (HT12D) HT12D is a remote control decoder paired with HT12E utilizing CMOS Technology. It has 12 bits of tri-state address pins providing a maximum of 312 address codes; thereby, drastically reducing any code collision and unauthorized code scanning possibilities. The input data is decoded when no error or are found. It has 1 input while 4 output pins. The address pins can also be utilized as data pins. DC motor converts electrical signals into mechanical energy. Its operation is based on the principle that when a

current carrying conductor is placed in a magnetic field, the conductor experiences a mechanical force. DC motors have a revolving armature winding but non-revolving armature magnetic field and a stationary field winding or permanent magnet. Different connections of the field and armature winding provide different speed/torque regulation features. The speed of a DC motor can be controlled by changing the voltage applied to the armature or by changing the field current. A geared DC Motor has a gear assembly devoted to the motor. The speed of motor is counted in terms of rotations of the shaft per minute and is termed as RPM .The gear assembly helps in increasing the torque and dropping the speed. Using the correct arrangement of gears in a gear motor, its speed can be reduced to any required figure. This concept of reducing the speed with the help of gears and increasing the torque is known as gear reduction. Reducing the speed put out by the motor while increasing the quantity of applied torque is a important feature of the reduction gear trains found in a gear motor. The decrease in speed is inversely relative to the increase in torque. This association means that, in this sort of device. Radio frequency (RF) is a rate of oscillation in the range of about 3KHz to 300 GHz, which corresponds to the frequency of radio waves, and the alternating currents which carry radio signals. Although radio frequency is a rate of oscillation, the term "radiofrequency" or its abbreviation "RF" is also used as a synonym for radio – i.e. to describe the use of wireless communication, as opposed to communication via electric wires The RF module is working on the frequency of 433 MHz and has a range of 50-80 meters. The RF module, as the name suggests, operates at Radio Frequency. The corresponding frequency range varies between 30 kHz & 300 GHz. In this RF system, the digital data is represented as variations in the amplitude of carrier wave. This kind of modulation is known as Amplitude Shift Keying (ASK). Transmission through RF is better than IR (infrared) because of many reasons. Firstly, signals through RF can travel through larger distances making it suitable for long range applications. Also, while IR mostly operates in line-of-sight mode, RF signals can travel even when there is an obstruction between transmitter & receiver. Next, RF transmission is more strong and reliable than IR transmission. It uses a specific frequency unlike IR signals which are affected by other IR emitting sources. Above listed qualities makes RF, a better substitute for wireless communication.

3. BLOCK DIAGRAM OF PATIENT HEALTH MONITORING SYSTEM

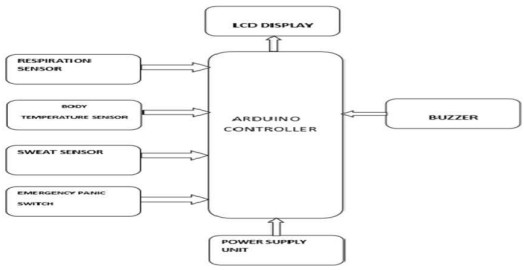

Fig 3: Block Diagram of Patient Health Monitoring System

Here the parameters of patient are measured continuously (temp and heartbeat)and displayed on LCD Module. This work provides a solution for enhancing the reliability and flexibility by improving the performance and power management of the patient monitoring system. In the current proposed system the patient health is continuously monitored and the acquired data is analyzed at a centralized PIC microcontroller. If a particular patient's health parameter falls below the threshold message is sent to the preconfigured mobile number using standard GSM module interface to the PIC microcontroller(28 pin). Patient health parameter are sent to doctors mobile on the request. This work presents the methodology for monitoring patient remotely by using GSM network & Micro controller. Patient monitoring systems consist of equipment, devices and supply

that measure, display human physiological characteristics, including temperature, heat activity and various bodily substances, pulse rate other health related criteria. It provides continues monitoring of patient's health including processing module and receiving psychological data from the patient. this unit may be inserted in a bedside display unit to display the psychological data from the patient.

Wheel Chair Circuit System Diagram

Working of Circuit

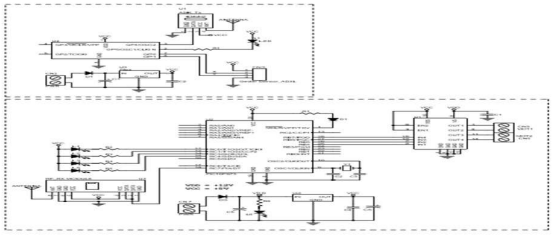

Fig 4: Working of Circuit

This system operated with taking head movement as input signal to control the motion of wheel chair in any direction. A MEMS sensor or accelerometer is used to track the movements. A cap is placed on the head and the sensor is connected to it. The variations produced by the sensor according to head movement are trapped and fed as input to the microcontroller. The microcontroller takes decision based on the inputs provided and controls the wheel chair. The decisions made by microcontroller are:

If the head tilts in forward direction, the wheel chair moves in forward direction.

1) If the head tilts in backward direction, the wheel chair moves in backward direction.
2) If the head tilts left, the wheel chair moves left.
3) If the head tilts right, the wheel chair moves right.

In this proposed system, we have used a microcontroller based system having various sensors to continuously taking the measurement of the patient's heart beat, body temperature etc. and displaying the same on the LCD continuously. In this system the information about patient's health is provided within every prescribed interval of time to the Doctor. This system takes care of patient's health 24x7 whereas this facility is not available in the conventional system.

Wireless Remote Patient Monitoring system
Working of Circuit

Heart rate measurement the soundness of the cardiovascular system. This work demonstrates a technique to measure the heart rate by sensing the change in blood volume in a finger artery while the heart is pumping the blood. It consists of an infrared LED that transmits an IR signal through the fingertip of the subject, a part of which is reflected by the blood cells. The reflected signal is detected by a photodiode sensor. The changing blood volume with heartbeat results in a train of pulses at the output of the photo diode, the magnitude of which is too small to be detected directly by a microcontroller. Therefore, a two-stage high gain, active low pass filter is designed using two Operational Amplifiers (Op-amps) to filter and amplify the signal to appropriate voltage level so that the pulses can be counted by a microcontroller. The heart rate is displayed on a16x2LCD display. The microcontroller used in this project is PIC16Fxxx PICMCU).

4. PROCEDURAL STEPS FOR COMPILATION, SIMULATION AND DUMPING

Compilation and simulation steps:

For PIC microcontroller, PIC C compiler is used for compilation. The compilation steps are as follows :

1. Open PIC C compiler.
2. You will be prompted to choose a name for the new project, so create a separate folder where all the files of your project will be stored, choose a name and click save.
3. Click Project**,** New, and something the box named 'Text1' is where your code should be written later.
4. Now you have to click 'File, Save as' and choose a file name for your source code ending with the letter '.c'. You can name as ' project. c' for example and click save. Then you have to add this file to your project work.
5. You can then start to write the source code in the window titled 'project.c' then before testing your source code; you have to compile your source code, and correct eventual syntax errors.
6. By clicking on compile option .hex file is generated automatically.
7. This is how we compile a program for checking errors and hence the compiled program is saved in the file where we initiated the program.
8. After compilation, next step is simulation. Here first circuit is designed in Express PCB using Proteus 7 software and then simulation takes place followed by dumping. The simulation steps are as follows:
9. Open Proteus 7 and click on IS1S6.
10. Now it displays PCB where circuit is designed using microcontroller. To design circuit components are required. So click on component option.
11. Now click on letter ’p’, then under that select PIC16F877A ,other components related to the project and click OK. The PIC 16F877A will be called your “Target device*”,* which is the final destination of your source code.

5. DUMPING STEPS

The steps involved in dumping the program edited in proteus 7 to microcontroller are as shown below:

1. Initially before connecting the program dumper to the microcontroller kit the window is appeared as shown below.

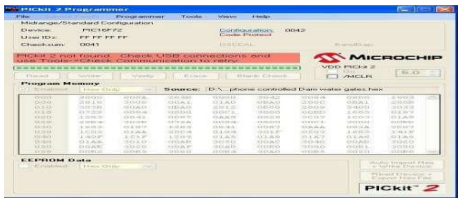

Fig: Picture of program dumper window

2. Select Tools option and click on Check Communication for establishing a connection as shown in below window.

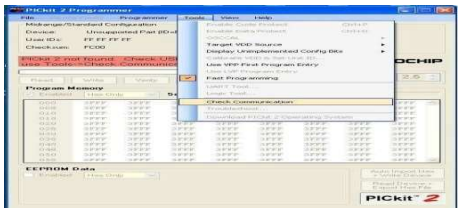

Fig: Picture of checking communications before dumping program into microcontroller

3. After connecting the dumper properly to the microcontroller kit the window is appeared as shown below.

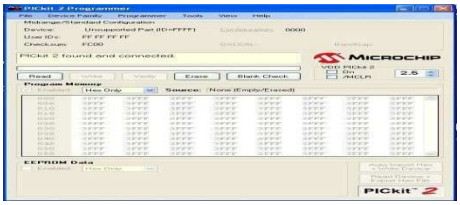

Fig: Picture after connecting the dumper to microcontroller

4. Again by selecting the Tools option and clicking on Check Communication the microcontroller gets recognized by the dumper and hence the window is as shown.

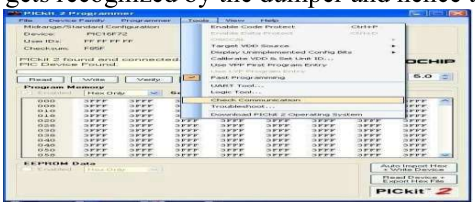

Fig : Picture of dumper recognition to microcontroller

5. Import the program which is '.hex' file from the saved location by selecting File option and Clicking on "Import Hex".

Fig : Picture of program importing into the microcontroller

6. After clicking on 'Import Hex' option we need to browse the location of our program and click the 'prog.hex' and click on 'open' for dumping the program into the microcontroller.

7. After the successful dumping of program the window is as shown below.

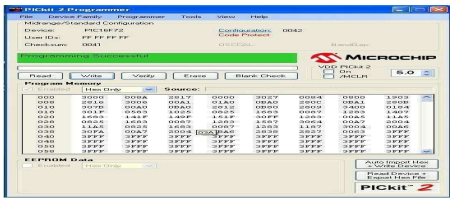

Fig: Picture after program dumped into the microcontroller

Advantages

Wireless controlling of wheel chair using MEMS accelerometer sensor.

1. Fast response..
2. Efficient and low cost design..
3. Low power consumption..
4. Alerts on phone.

Disadvantages

Limited distance.

Application

1. The user can wear this device to any movable part and with the simple gestures the person can request the event the basic needs like water, food or medicine through wheel chair operated wirelessly using MEMS (Micro Electro-Mechanical Systems*)* technology.
2. User can also control the electrical devices like light, fan etc with the help of gestures.

Result

The project "Hand Gestures operated Smart Wheel chair" was designed such that the wheel chair can be operated using MEMS accelerometer sensor wirelessly using RF technology.

Conclusion

Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC's with the help of growing technology, the work has been successfully implemented. Thus the work has been successfully designed and tested.

Future Scope

This work "Hand Gestures operated Smart Wheel chair" is mainly intended to operate Wheel chair using MEMS accelerometer sensor. The micro controller is programmed in such a way that the wheel chair can be operated. By connecting voice module we can get the prerecorded voices for requests of the user using voice module. The user can wear this device to any movable part and with the simple gestures the person can request even the basic needs like water, food or medicine through MEMS (Micro Electro-Mechanical Systems*)* technology. User can also control the electrical devices like light; fan etc with the help of gestures.

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