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Wireless Hand Motion Controlled Robotic Gripper Arm

V.V. Ramana Rao [1], B.Theja[2], K.Raju[3]

[1,2,3]Department of Electronics and Communication, St Martin's Engineering College, Hyderabad, Telangana, India-500100

Abstract

In various automated industries wireless activities are necessary specially in remote locations where its dangerous or hazards areas. In a number of the industries it's necessary to handle few jobs with very heat which isn't possible by human hand in such cases wireless operations are more efficient. This project focuses on design of hand gesture controlled robotic arm using microcontroller with the assistance of X-bee and wireless sensor networks.It consists of two parts which are interconnected by the wireless sensor communication systems. The X-bee are going to be acting because the transmitter and therefore the receiver device system. the primary part consists of gloves which were occupied by Li-ion battery, microcontroller and flex sensors. The second part consists of motor, microcontroller and robotic fingers through which the mechanical action takes place.

1.Introduction

In today's life automation plays very important role. Robotic arm is called as robot manipulator which can perform do enormous functions as human arm performs. Many industries use a robot for various functions where important part of any robot is Robotic arm or called as robot manipulator should be controlled precisely depending upon application [1]. In industry or any application robot manipulator can be used for applications like welding, trimming; picking etc. advantage of such robotic arm is it can work in hazards area, which cannot be accessed by human. Many parameters of robot are designed according to requirement [2].

Few popular systems

A. Vision-based Gesture Recognition

B. Motion Capture Sensor Recognition

C.Finger Gesture Recognition System based on Active Tracking Mechanisms

D.Accelerometer-base Gesture Recognition

2.Block Diagram

Transmitter side

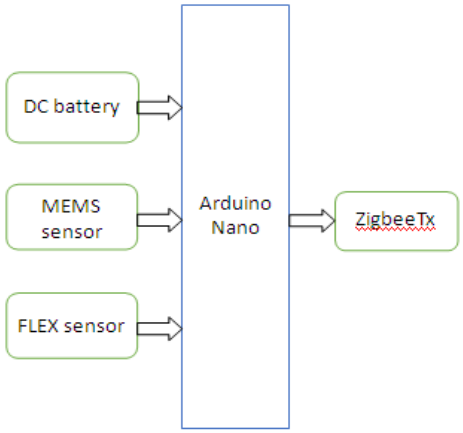

Fig 2. Transmitter module for input sensors

Receiver side

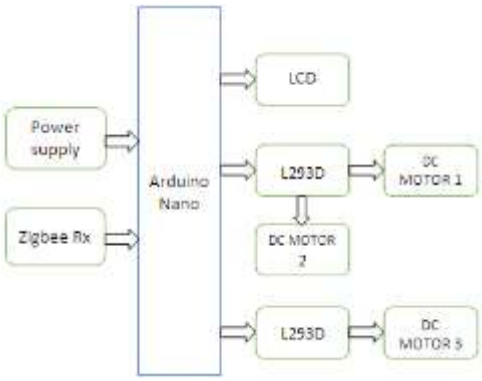

Fig 2. Receiver module for Output devices

3.Arduino Nano

This component is the brain of the whole project. This section consists of an Arduino

Fig-3: Arduino Nano

Nano chip with an ATmega328P microcontroller. This chip is the smallest of its kind and functions according to the program fed to it [3]. The program fed to this chip instructs it about how to control the whole system according to the given input. It consists of a power cable to which the power is given and input and output pins to which the input and output components are connected [4].

4. DC Battery

A battery may be a device which will store electricity. Some are rechargeable, and some are not. They store direct current (DC) electricity [5].

A battery really means two or more wet or dry cells connected serial for more voltage, or in parallel for more current, although people often call a cell A battery . AA, AAA, C, and D batteries all have 1.5 volts. The voltage of a cell depends on the chemicals used while the amount of power or current it can supply also depends on how large the cell is; a bigger cell of a given type can supply more amps, or for a extended time.

The chemical reactions that occur during a battery are exothermic reactions and, thus, produce heat. For example, if you allow your laptop on for an extended time, then touch the battery, it'll be warm or hot. However, the batteries utilized in laptops are called lithium-ion batteries and that they sometimes do have a fireplace hazard (A few years ago, dell laptops that that were powered by lithium batteries began to erupt , though this event was rare).

Fig 4: DC Battery

5.MEMS

Microelectromechanical systems (MEMS) are small integrated devices or systems that combine electrical and mechanical components [6]. Their size range from the sub micrometer (or sub micron) level to the millimeter level and there are often any number, from a couple of to millions, during a particular system. MEMS extend the fabrication techniques developed for the microcircuit industry to feature mechanical elements like beams, gears, diaphragms, and comes to devices.

Applications of MEMS

Here are some examples of MEMS technology:

i. Pressure Sensors

MEMS pressure microsensors typically have a flexible diaphragm that deforms in the presence of a

pressure difference [7]. The deformation is converted to an electrical signal appearing at the sensor output. A pressure sensor are often wont to sense absolutely the atmospheric pressure within the manifold of an engine , in order that the quantity of fuel required for every engine cylinder can be computed. In this example, piezoresistors are patterned across the sides of a neighborhood where a silicon diaphragm are going to be micromachined. The substrate is etched to create the diaphragm. The sensor die is then bonded to a glass substrate, creating a sealed vacuum cavity under the diaphragm. The die is mounted on a package, where the topside of the diaphragm is exposed to the environment.

ii. Accelerometers

Accelerometers are acceleration sensors. An mass suspended by springs is acted upon by acceleration forces that cause the mass to be deflected from its initial position. This deflection is converted to an electrical signal, which appears at the sensor output. The application of MEMS technology to accelerometers may be a relatively new development.

iii. Inertial Sensors

Inertial sensors are a type of accelerometer and are one of the principal commercial products that utilize surface micromachining [8].They are used as airbag-deployment sensors in automobiles, and as tilt or shock sensors. The application of those accelerometers to inertial measurement units (IMUs) is restricted by the necessity to manually align and assemble them into three-axis systems, and by the resulting alignment tolerances, their lack of in-chip analog-to-digital conversion circuitry, and their lower limit of sensitivity.

iv. Microengines

A three-level polysilicon micromachining process has enabled the fabrication of devices with increased degrees of complexity [9]. The process includes three movable levels of polysilicon, each separated by a sacrificial oxide layer, plus a stationary level. Operation of the tiny gears at rotational speeds greater than 300,000 rpm has been demonstrated. Microengines are often wont to drive the wheels of microcombination locks. They can even be utilized in combination with a microtransmission to drive a pop-up mirror out of a plane. This device is known as a micromirror .

v. The Future

MEMS technology has the potential to vary our daily lives the maximum amount because the computer has. However, the fabric needs of the MEMS field are at a preliminary stage. A thorough understanding of the properties of existing MEMS materials is simply as important because the development of latest MEMS materials.

6.Acceleration/Vibration/TiltSensor–3 Axis

Accelerometer sensor can measure static(earthgravity) or dynamic acceleration in all three axis.Application of the sensor is in various fields and many applications can be developed using this sensor [10].Accelerometer sensor measures level of accelerationwhere it is mounted this enable us to measureacceleration/deceleration of object like car or robot, ortilt of a platform with respected to earth axis, orvibration produced by machines. Sensor provides 0Goutput which detect linear free fall. Sensitivity can beadjusted in two ranges.Acceleration is a vector force which has direction andmeasured in meters per second. Earth producesgravitational acceleration on all objects on earth. Bymonitoring the three axis acceleration one canmeasure the level of tilt of any platform.

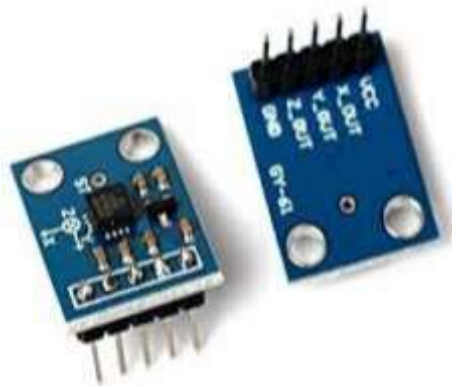

Fig 6: MEMS

7.Sensitivity Select

Selection between two sensitivities can be made by closing or opening thetwo pad contact on board. You can close the contact by soldering the twopads together. Factory supplied is open=1.5g (800mV/g) setting which ismaximum sensitivity which should be suitable for most applications.

Features

1. Simple to use
2. Analog output for each axis
3. +5V operation @1ma current
4. High Sensitivity (800mV/g @ 1.5g)

Applications

1. 3D Gaming: Tilt and Motion Sensing, Event Recorder
2. HDD MP3 Player: Freefall Detection
3. Laptop PC: Freefall Detection, Anti-Theft
4. Cell Phone: Image Stability, Text Scroll, Motion Dialing, E-Compass
5. Pedometer: Motion Sensing / PDA: Text Scroll

8.FLEX SENSOR

Flex sensors are usually available in two sizes. One is 2.2 inch and another is 4.5 inch [11]. Although the sizes are different the essential function remains an equivalent . they're also divided supported resistance. There are LOW resistance, MEDIUM resistance and HIGH resistance types. Choose the acceptable type counting on requirement.

Fig 8. Flex Sensor

How to Use FLEX SENSOR

As mentioned earlier, FLEX SENSOR is essentially a rheostat whose terminal resistance increases when the sensor is bent. So this sensor resistance increases depends on surface linearity. So it's usually wont to sense the changes in linearity.

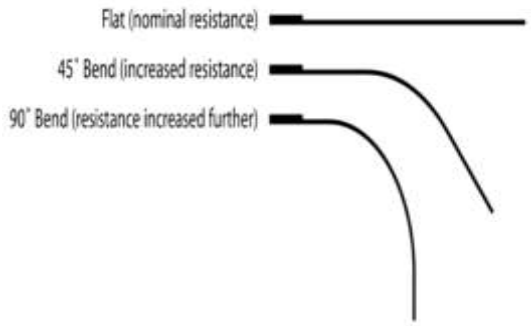

Fig G: Different bend directions

As shown above figure, when the surface of FLEX SENSOR is totally linear it'll be having its nominal resistance. When it's bent 45º angle the FLEX SENSOR resistance increases to twice as before. And when the bent is 90º the resistance could go as high as fourfold the nominal resistance. therefore the resistance across the terminals rises linearly with bent angle. So during a sense the FLEX sensor converts flex angle to RESISTANCE parameter.

9.Zigbee Technology

Fig 9. Zigbee module

Introduction to Zigbee:

Zigbee is an IEEE 802.15.4 standard for data communications with business and consumer devices [12]. it's designed around low-power consumption allowing batteries to essentially last forever. The Zigbee standard provides network, security and application support services operating on top of the IEEE 802.15.4 Medium Access Control (MAC) and Physical Layer (PHY) wireless standard. It employs a set of technologies to enable scalable, self-organizing, self-healing networks which will manage various data traffic patterns.

The current list of application profiles either published or within the works are:

- Home Automation
- Zigbee Smart Energy
- Telecommunication Applications
- Personal Home

Zigbee is one among the worldwide standards of communication protocol formulated by the relevant task force under the IEEE 802.15 working party . The fourth within the series, WPAN Low Rate/Zigbee is that the newest and provides specifications for devices that have low data rates, consume very low power and are thus characterized by long battery life.

10. DC Motors:

Electric motors are used to efficiently convert electrical energy into mechanical energy. Magnetism is the basis of their principles of operation. They use permanent magnets, electromagnets, and exploit the magnetic properties of materials in order to create these amazing machines.

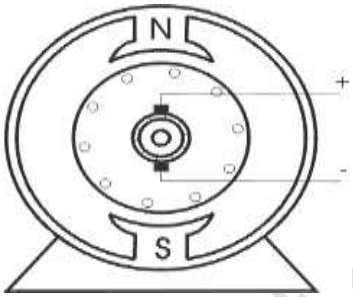

Fig 10: Internal Structure of DC motor

DC Motor has two leads.It has bidirectiona motion If we apply +ve to one lead and ground to another motor will rotate in one direction, if were verse the connection the motor will rotate inopposite direction If we keep both leads open or both lead ground it will not rotate(but some inertia will be there).If we apply +ve voltage to both leads then braking willoccurs.

Fig I: DC Motor

DC motors are fairly simple to understand. They are also simple to make and only require a battery or dc supply to make them run.

11.Liquid Crystal Display

LCD stands for **L**iquid **C**rystal **D**isplay. LCD is finding wide spread use replacing LEDs (seven segment LEDs or other multi segment LEDs) because of the following reasons:

1. The declining prices of LCDs.
2. The ability to display numbers, characters and graphics. This is in contrast to LEDs, which are limited to numbers and a few characters.
3. Incorporation of a refreshing controller into the LCD, thereby relieving the CPU of the task of refreshing the LCD. In contrast, the LED must be refreshed by the CPU to keep displaying the data.
4. Ease of programming for characters and graphics.

These components are “specialized” for being used with the microcontrollers, which means that they cannot be activated by standard IC circuits. They are used for writing different messages on a miniature LCD.

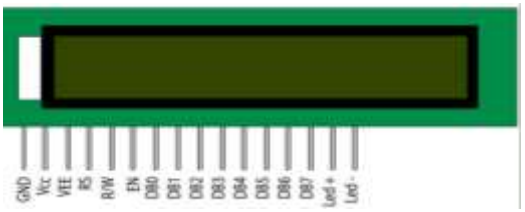

Fig 11: LCD display

A model described here is for its low price and great possibilities most frequently used in practice. It is based on the HD44780 microcontroller (*Hitachi*) and can display messages in two lines with 16 characters each. It displays all the alphabets, Greek letters, punctuation marks, mathematical symbols etc. In addition, it is possible to display symbols that user makes up on its own.

Automatic shifting message on display (shift left and right), appearance of the pointer, backlight etc. are considered as useful characteristics.

12. RESULT

Fig I: Wireless Hand Motion Controlled Robotic Gripper Arm

The robotic hand has been developed successfully as the movement of the robot can be controlled precisely. This robotic hand control method is expected to overcome the problem such as placing or picking objects that are away from the user, pick and place hazardous objects in a very fast and easy manner or augmenting our abilities to perform such tasks.

Conclusion

This projects discussed hardware and software co-design of robotic arm controller using DC motors employing microcontroller Arduino.The robotic hand has been designed to meet all of the original specifications of the project. The fingers are allowing for full motion of the hand. Observations show that the project produces the required motion of the fingers. Such type of hand gesture controlled robotic arm is mostly useful for Industrial, Medical & Military applications. This type of the hand gesture technology can be used where the humans are unable to sustain in the difficult or harsh environments. This might reduce some of the labor that is used in industry and also the life risk factor.

FUTURE SCOPE

Use of more efficient wireless communication technique and a camera on the robot unit would improve the performance of system to a great extend and can be incorporated in the future work.

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