PROJECT REPORT ON
PICK AND PLACE ROBOTIC ARM

A project report submitted in partial fulfilment of the requirement for the award of

DIPLOMA IN
MECHANICAL ENGINEERING

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C.C.C. NASPUR,MANCHERIAL-504208,TELANGANA,2016-2018

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CERTIFICATE

This is to certify that the Project Report Entitled **"PICK AND PLACE ROBOTIC ARM"** has been carried out by 13members in the batch submitted in partial fulfillment for the award of "**DIPLOMA IN MECHANICAL ENGINEERING",** SINGARENI COLLIERIES POLYTECHNIC, affiliated to STATE BOARD OF TECHNICAL EDUCATION AND TRAINING (SBTET),TS, during course 2016-2018.

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INTERNAL GUIDE **HEAD OF THE DEPT**

PRICIPAL. **EXTERNAL EXAMINAR**

ACKNOWLEDGEMENT

WE EXPRESS OUR SINCERE THANKS TO OUR COLLEGE PRINCIPAL SIR SRI. SUDHAKARA RAO GARU &OUR HOD.SIR SRI.DHAMODAR GARU FOR THEIR KIND CO-OPERATION.

WE ARE VERY MUCH THANKFUL TO SAMPATH KUMAR GARU LECTURER

OF MECHANICAL DEPAETMENT AND GUIDE FOR HIS EXCELLENT GUIDANCE AND ENCOURAGEMENT IN EVERY STEP DURING OUR WORK ON THIS PROJECT IT WAS A PLEASANT EXPERIENCE WORKING UNDER HIS GUIDANCE,HIS CONSTANT MONITORING VALIABLE ADVICE ENSURED THECOMPLETION OF THIS PROJECT WORK.

WE EXPRESS OUR HEARTIEST THANKS TO ALL OTHER STAFF MEMBERS WHO HAVE GIVEN THEIR VALUABLE SUGGESTION FOR THE COMPLETION OF THIS PROJECT WORK.

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ABSTRACT

The pick and place robot is one of the technologies in manufacturing industry and designed to perform pick and place functions. The system is very important to eliminate human errors and to get more precise work. It can also save the cost in long term and help to solve problems and tasks that cannot be done such as on high temperature area, narrow area and very heavy load thing. This project is a basic development and modification for that type of robot where it use the peripheral interface Programmable Logic Control (PLC) as the robot brain to control all of the robot movement. The rotation of this robot is clockwise and counter clockwise. The arm will move horizontally and the gripper is to pick up and hold the object from base A and places it to base B. This robot is used to pick and place the object only in their specifications (lighter weights)

INDEX

TOPICS

CHAPTER 1: INTRODUCTION

1.1 Introduction:

The work is designed to develop a pick and place robotic arm with a soft catching gripper that is designed to avoid extra pressure on the suspected object (Like Bombs) for safety reasons. At the transmitting end using Robo-switches, commands are sent to the motors to control the movement of the ARM either to move up, down, open, close, left and right. At the receiving end three motors are interfaced to the switches where two of them are used for arm and gripper movement of the ARM. The main advantage of this robot is its soft catching arm that is designed to avoid extra pressure on the suspected object for safety reasons.

1.2 Project Overview:

The project **“Pick and place robotic ARM”** can be done using, microcontroller, dc motors, gripper, Mems, flex sensor and battery.

1.3 Thesis:

The thesis explains the implementation of “**Pick and place robotic ARM”.** The organization of the thesis is explained here with:

Chapter 1 Presents introduction to the overall thesis and the overview of the project. In the project overview a brief introduction of **Pick and place robotic ARM** and its applications are discussed.

Chapter 2 Presents the hardware description. It deals with the block diagram of the project and explains the purpose of each block. In the same chapter the explanation of microcontroller, dc motors, gripper, Mems, flex sensor and battery.

Chapter 3 Presents the advantages, disadvantages and applications of the project.

Chapter 4 Presents the results, conclusion and future scope of the project.

ROBOT DEFINITION:

“ A robot is a programmable , multifunction manipulator is to designed to move material ,parts ,tools or special devices through variable programmed motions for the performance of variety of tasks”.

CLASSIFICATION OF ROBOTS:

1. According to the type of control:

- Point to point robots
- Continues points robots
- Computer controlled robots
- Servo controlled robots

2.According to manipulation function:

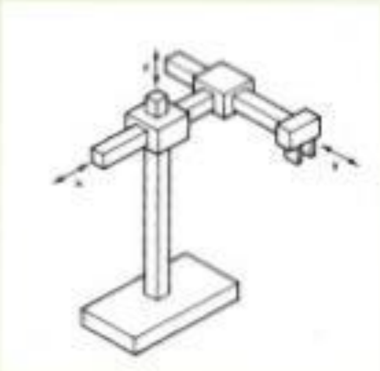
- Pick and place robots
- Sperical purpose robots
- Universal robots

3.According to the capability:

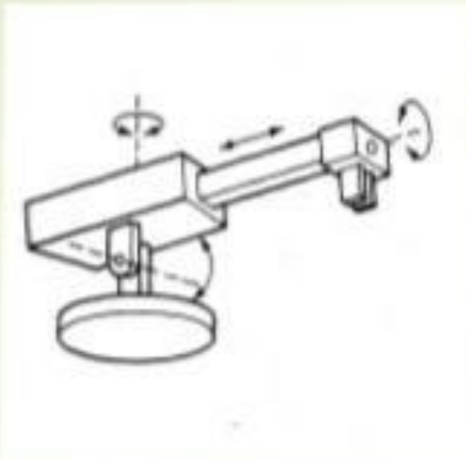
- Sequence controlled robots
- Adaptive robots
- Intelligent robots

4.According to the configuration:

- Certesian coordinate robots
- Cylindrical coordinate robots
- Articulated robots



Robots with *Cartesian Configurations* consists of links connected by linear joints (L) - ***LLL***



Polar Configuration Robot, the arm is connected to the base with a twisting (T) joint and rotatory (R) and linear (L) joints follow - ***TRL***

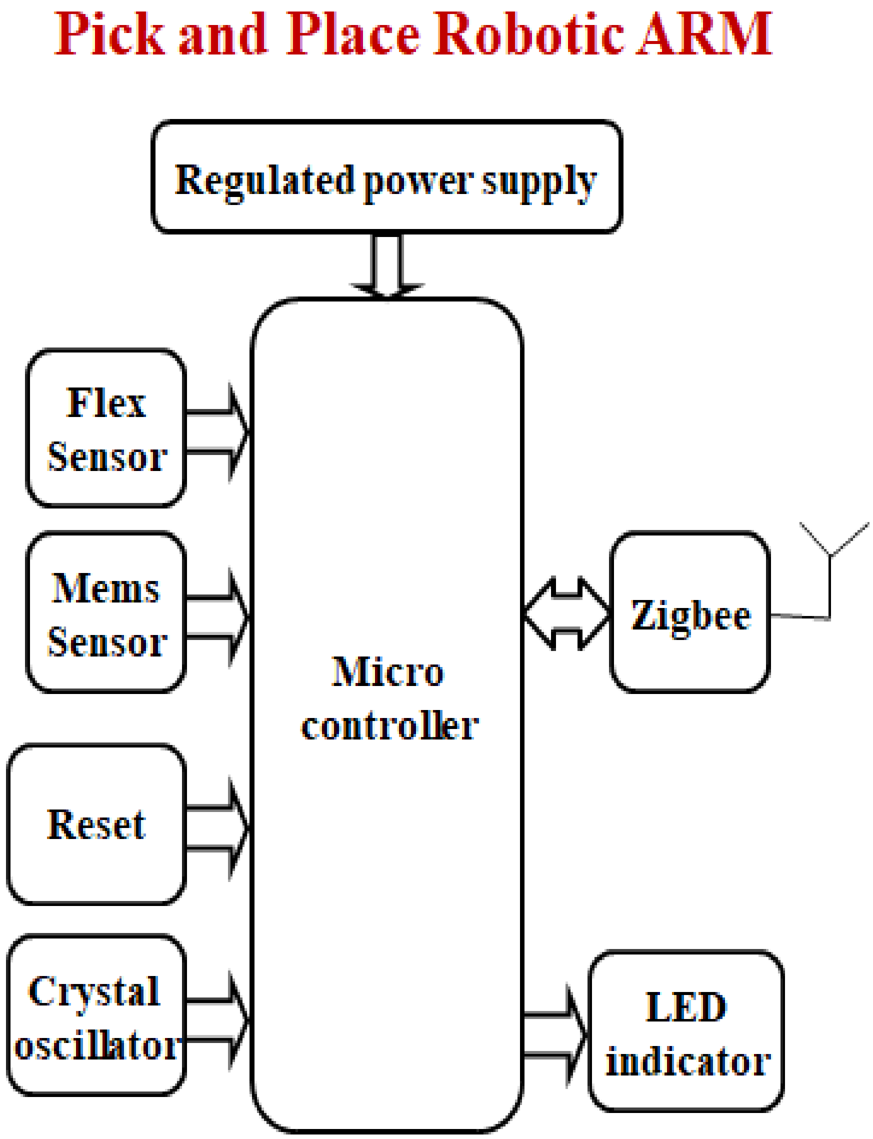
Joint Arm Configuration, the arm of the robot is connected to the base with a twisting joint. The links in the arm are connected by rotatory joints - ***TRR***

PICK AND PLACE ROBOTIC ARM

(HAND GESTURE CONTROLLED)

PARTS OF PICK AND PLACE ROBOTIC ARM:

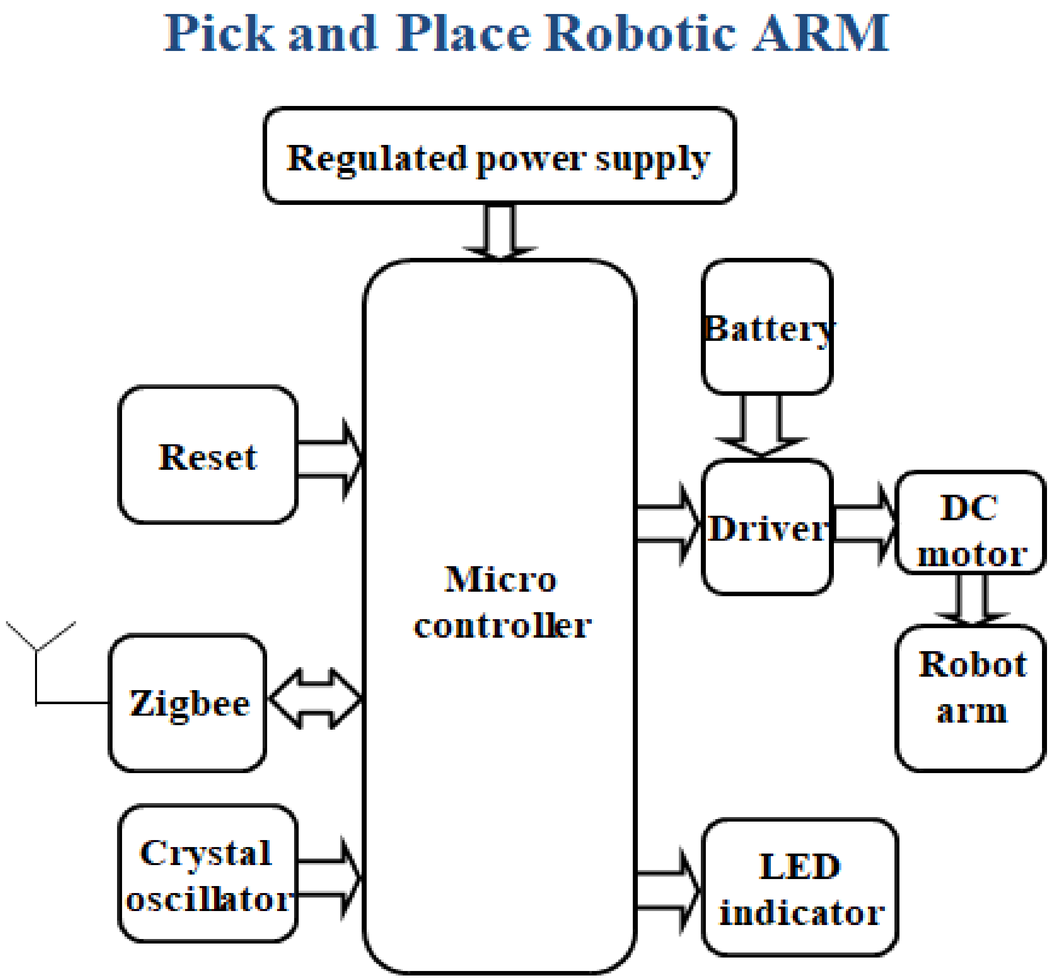
1. **Receiving section :**
   - Rps for charging batteries
   - Rechargeable batteries
   - Dc Motors
   - Motor drives
   - Micro controller
   - Zig bee
   - Led indicators
2. **Transmitting section:(on a hand glove)**
   - Micro controller
   - Flex sensor
   - Mems sensors
   - Zigbee
   - Battery



BLOCK DIAGRAM OF TRANSMITTING SECTION

The data transfer from transmitting section to receiving section with help of zigbee technology. It is a wireless technology which transfer motions with out any physical connection.

BLOCK DIAGRAM OF RECEIVING SECTION



2.1REGULATED POWER SUPPLY:

2.3.1 Block Diagram:

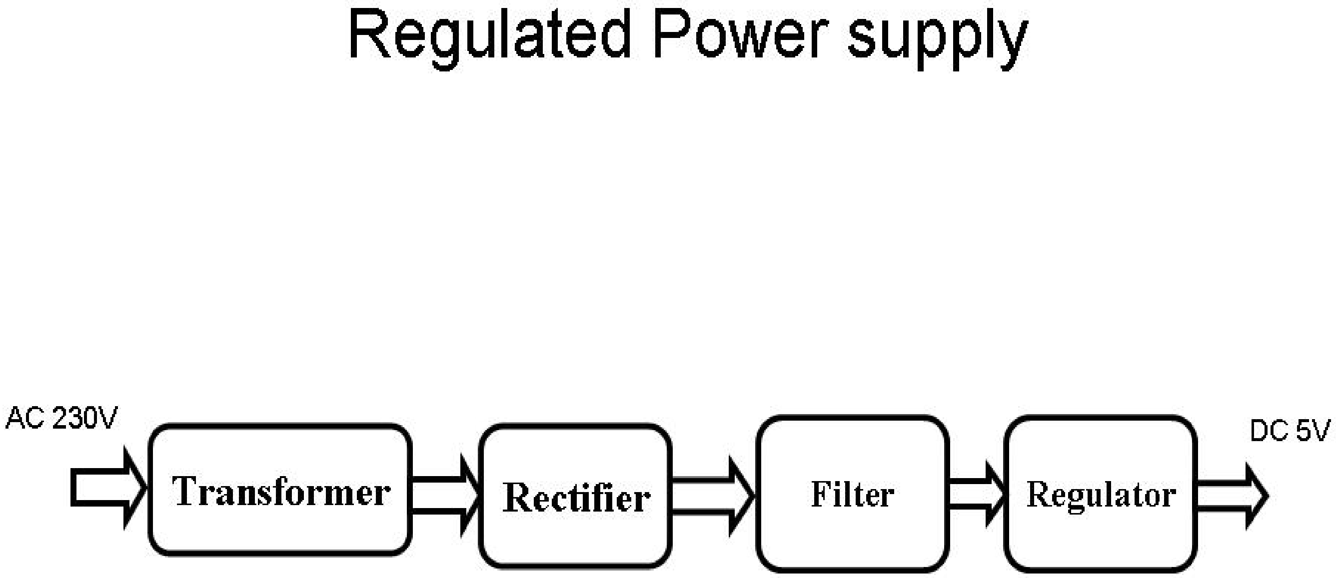


Fig 2.1.1Regulated Power Supply

The basic circuit diagram of a regulated power supply (DC O/P) with led connected as load is shown in fig: 2.3.

Regulated power supply is the conversion of. Alternating current(AC)to direct current(DC).and is used to charge the batteries of pick and place robotic arm.

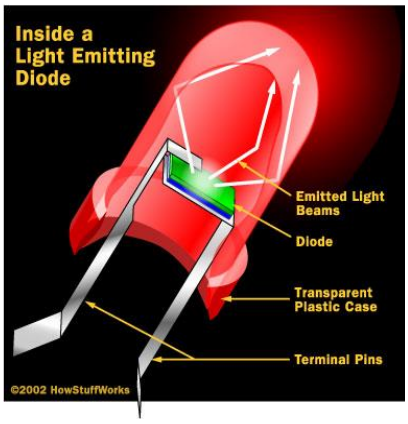


Fig 2.15: Inside a LED

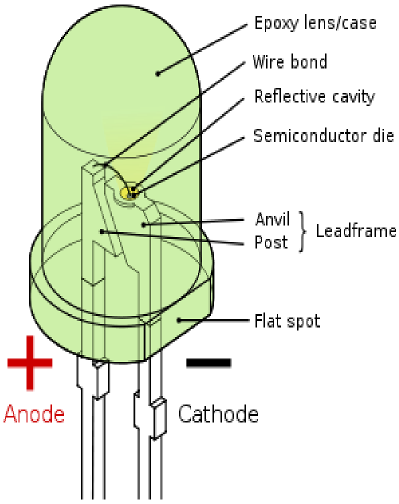


Fig 2.16: Parts of a LED

Working:

The structure of the LED light is completely different than that of the light bulb. Amazingly, the LED has a simple and strong structure. The light-emitting semiconductor material is what determines the LED's color. The LED is based on the semiconductor diode.

When a diode is forward biased (switched on), electrons are able to recombine with holes within the device, releasing energy in the form of photons. This effect is called electroluminescence and the color of the light (corresponding to the energy of the photon) is determined by the energy gap of the semiconductor. An LED is usually small in area (less than 1 mm^2), and integrated optical components are used to shape its radiation pattern and assist in reflection. LEDs present many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved robustness, smaller size, faster switching, and greater durability and reliability. However, they are relatively expensive and require more precise current and heat management than traditional light sources. Current LED products for general lighting are more expensive to buy than fluorescent lamp sources of comparable output.They also enjoy use in applications as diverse as replacements for traditional light sources in automotive lighting (particularly indicators) and in traffic signals. The compact size of LEDs has allowed new text and video displays and sensors to be developed, while their high switching rates are useful in advanced communications technology. The electrical symbol and polarities of led are shown in fig: 3.17.

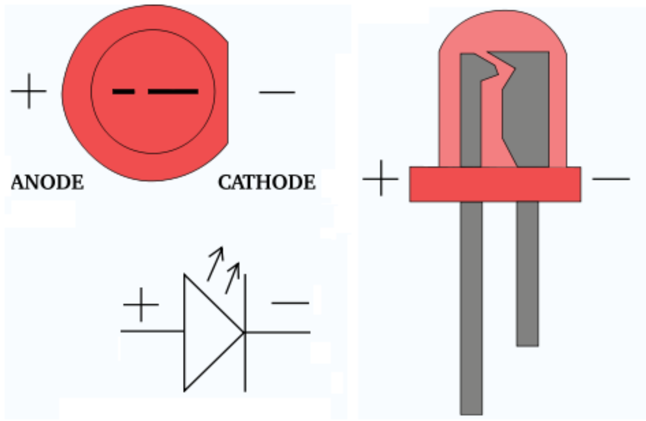


Fig 2.17: Electrical Symbol & Polarities of LED

LED lights have a variety of advantages over other light sources:

- High-levels of brightness and intensity
- High-efficiency
- Low-voltage and current requirements
- Low radiated heat
- High reliability (resistant to shock and vibration)
- No UV Rays
- Long source life
- Can be easily controlled and programmed

Applications of LED fall into three major categories:

- Visual signal application where the light goes more or less directly from the LED to the human eye, to convey a message or meaning.
- Illumination where LED light is reflected from object to give visual response of these objects.
- Generate light for measuring and interacting with processes that do not involve the human visual system.

2.2Rechargeable Battery

A rechargeable battery, storage battery, or accumulator is a type of electrical battery. It comprises one or more electrochemical cells, and is a type of energy accumulator. It is known as a secondary cell because its electrochemical reactions are electrically reversible. Rechargeable batteries come in many different shapes and sizes, ranging from button to megawatt systems connected to stabilize an electrical distribution network. Several different combinations of chemicals are commonly used, including: acid, nickel cadmium (NiCd), nickel metal hydride (NiMH), lithium ion (Li-ion), and lithium ion polymer (Li-ion polymer).

Rechargeable batteries have lower total cost of use and environmental impact than disposable batteries. Some rechargeable battery types are available in the same sizes as disposable types. Rechargeable batteries have higher initial cost but can be recharged very cheaply and used many times.

Usage and applications

Rechargeable batteries are used for automobile starters, portable consumer devices, light vehicles (such as motorized wheelchairs, golf carts, electric bicycles, and electric forklifts), tools, and uninterruptible power supplies. Emerging applications in hybrid electric vehicles and electric vehicles are driving the technology to reduce cost and weight and increase lifetime.

Traditional rechargeable batteries have to be charged before their first use; newer low self-discharge NiMH batteries hold their charge for many months, and are typically charged at the factory to about 70% of their rated capacity before shipping.

Grid energy storage applications use rechargeable batteries for load leveling, where they store electric energy for use during peak load periods, and for renewable energy uses, such as storing power generated from photovoltaic arrays during the day to be used at night. By charging batteries during periods of low demand and returning energy to the grid during periods of high electrical demand, load-leveling helps eliminate the need for expensive peaking power plants and helps amortize the cost of generators over more hours of operation.

The US National Electrical Manufacturers Association has estimated that U.S. demands for rechargeable batteries is growing twice as fast as demand for non rechargeable.

Charging and discharging

Further information: Battery charger

During charging, the positive active material is oxidized, producing electrons, and the negative material is reduced, consuming electrons. These electrons constitute the current flow in the external circuit. The electrolyte may serve as a simple buffer for internal ion flow between the electrodes, as in lithium-ion and nickel-cadmium cells, or it may be an active participant in the electrochemical reaction, as in lead–acid cells.

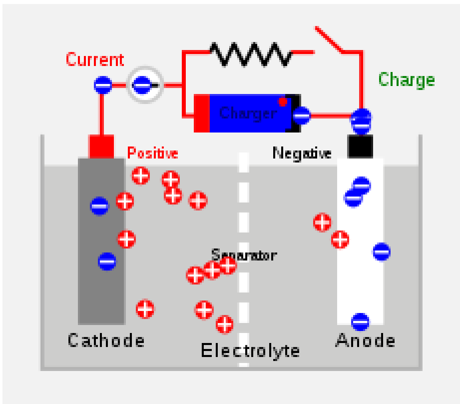
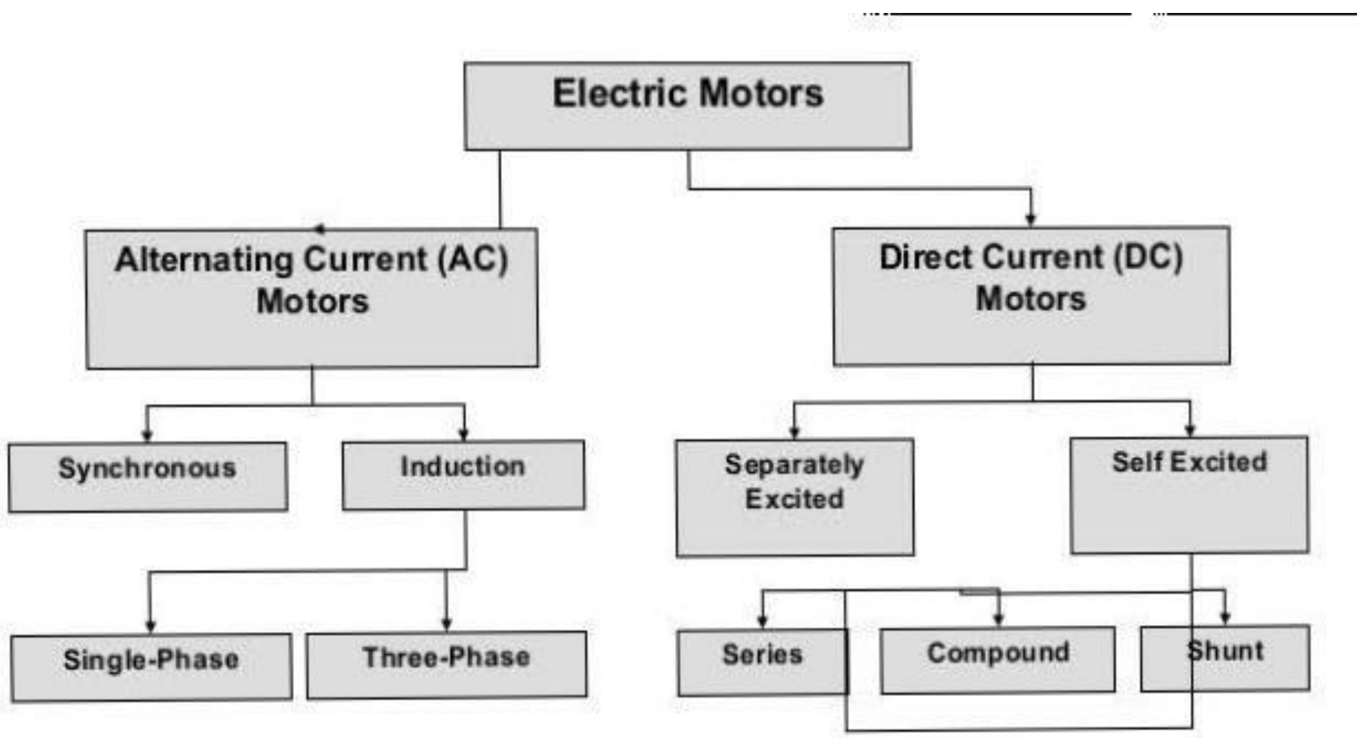


Diagram of the charging of a secondary cell battery.

2.3MOTORS

<u>Definition</u>: "motor_ is an electronic device which converts electrical energy into mechanical energy according to the Faraday's laws".

CLASSIFICATION OF MOTORS:



D.C. Motor:

A dc motor uses electrical energy to produce mechanical energy, very typically through the interaction of magnetic fields and current-carrying conductors. The reverse process, producing electrical energy from mechanical energy, is accomplished by an alternator, generator or dynamo. Many types of electric motors can be run as generators, and vice versa. The input of a DC motor is current/voltage and its output is torque (speed).

Fig 2.19: DC Motor

The DC motor has two basic parts: the rotating part that is called the armature and the stationary part that includes coils of wire called the field coils. The stationary part is also called the stator. Figure shows a picture of a typical DC motor, Figure shows a picture of a DC armature, and Fig shows a picture of a typical stator. From the picture you can see the armature is made of coils of wire wrapped around the core, and the core has an extended shaft that rotates on bearings. You should also notice that the ends of each coil of wire on the armature are terminated at one end of the armature. The termination points are called the commutator, and this is where the brushes make electrical contact to bring electrical current from the stationary part to the rotating part of the machine.

Operation:

The DC motor you will find in modem industrial applications operates very similarly to the simple DC motor described earlier in this chapter. Figure 12-9 shows an electrical diagram of a simple DC motor. Notice that the DC voltage is applied directly to the field winding and the brushes. The armature and the field are both shown as a coil of wire. In later diagrams, a field resistor will be added in series with the field to control the motor speed.

When voltage is applied to the motor, current begins to flow through the field coil from the negative terminal to the positive terminal. This sets up a strong magnetic field in the field winding. Current also begins to flow through the brushes into a commutator segment and then through an armature coil. The current continues to flow through the coil back to the brush that is attached to other end of the coil and returns to the DC power source. The current flowing in the armature coil sets up a strong magnetic field in the armature.

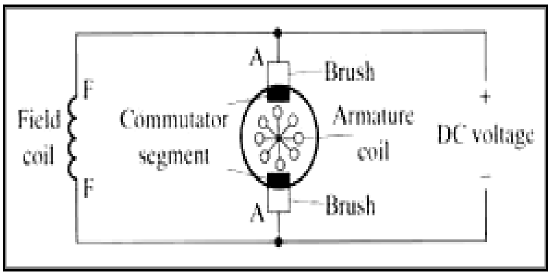


Fig 2.20: Simple electrical diagram of DC motor

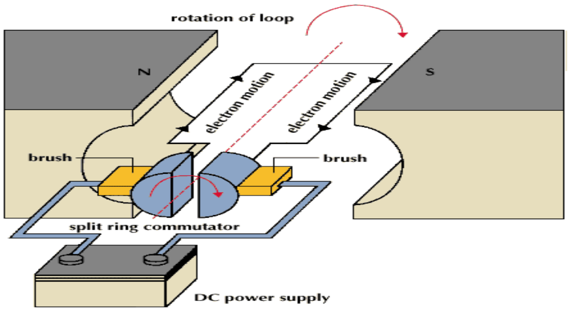


Fig 2.21: Operation of a DC Motor

The magnetic field in the armature and field coil causes the armature to begin to rotate. This occurs by the unlike magnetic poles attracting each other and the like magnetic poles repelling each other. As the armature begins to rotate, the commutator segments will also begin to move under the brushes. As an individual commutator segment moves under the brush connected to positive voltage, it will become positive, and when it moves under a brush connected to negative voltage it will become negative. In this way, the commutator segments continually change polarity from positive to negative. Since the commutator segments are connected to the ends of the wires that make up the field winding in the armature, it causes the magnetic field in the armature to change polarity continually from north pole to south pole. The commutator segments and brushes are aligned in such a way that the switch in polarity of the armature coincides with the location . The switching action is timed so that the armature will not lock up magnetically with the field. Instead the magnetic fields tend to build on each other and provide additional torque to keep the motor shaft rotating.

When the voltage is de-energized to the motor, the magnetic fields in the armature and the field winding will quickly diminish and the armature shaft's speed will begin to drop to zero. If voltage is applied to the motor again, the magnetic fields will strengthen and the armature will begin to rotate again.

Types of DC motors:

1. DC Shunt Motor,

2. DC Series Motor,

3. DC Long Shunt Motor (Compound)

4. DC Short Shunt Motor (Compound)

The rotational energy that you get from any motor is usually the battle between two magnetic fields chasing each other. The DC motor has magnetic poles and an armature, to which DC electricity is fed, The Magnetic Poles are electromagnets, and when they are energized, they produce a strong magnetic field around them, and the armature which is given power with a commutator, constantly repels the poles, and therefore rotates.

1. The DC Shunt Motor:

In a 2 pole DC Motor, the armature will have two separate sets of windings, connected to a commutator at the end of the shaft that are in constant touch with carbon brushes. The brushes are static, and the commutator rotate and as the portions of the commutator touching the respective positive or negative polarity brush will energize the respective part of the armature with the respective polarity. It is usually arranged in such a way that the armature and the poles are always repelling.

The general idea of a DC Motor is, the stronger the Field Current, the stronger the magnetic field, and faster the rotation of the armature. When the armature revolves between the poles, the magnetic field of the poles induce power in the armature conductors, and some electricity is generated in the armature, which is called back emf, and it acts as a resistance for the armature. Generally an armature has resistance of less than 1 Ohm, and powering it with heavy voltages of Direct Current could result in immediate short circuits. This back emf helps us there.

When an armature is loaded on a DC Shunt Motor, the speed naturally reduces, and therefore the back emf reduces, which allows more armatures current to flow. This results in more armature field, and therefore it results in torque.

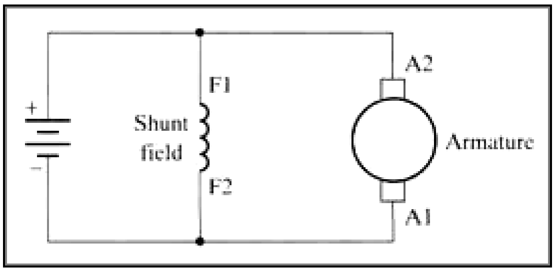


Fig: Diagram of DC shunt motor

When a DC Shunt Motor is overloaded, if the armature becomes too slow, the reduction of the back emf could cause the motor to burn due to heavy current flow thru the armature.

The poles and armature are excited separately, and parallel, therefore it is called a Shunt Motor.

2. The DC Series Motor:

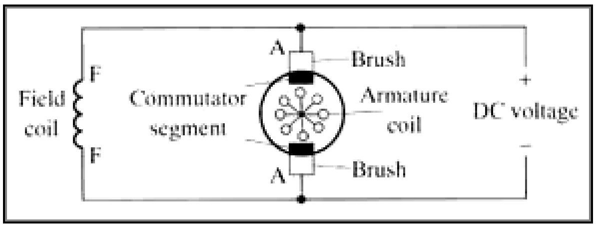


Fig: Diagram of DC series motor

A DC Series Motor has its field coil in series with the armature. Therefore any amount of power drawn by the armature will be passed thru the field. As a result you cannot start a Series DC Motor without any load attached to it. It will either run uncontrollably in full speed, or it will stop.

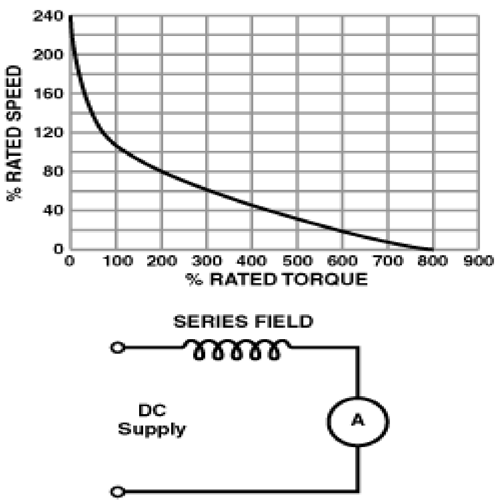


Fig: Diagram of DC series motor graph representation

3. DC Compound Motor:

A compound of Series and Shunt excitation for the fields is done in a Compound DC Motor. This gives the best of both series and shunt motors. Better torque as in a series motor, while the possibility to start the motor with no load.

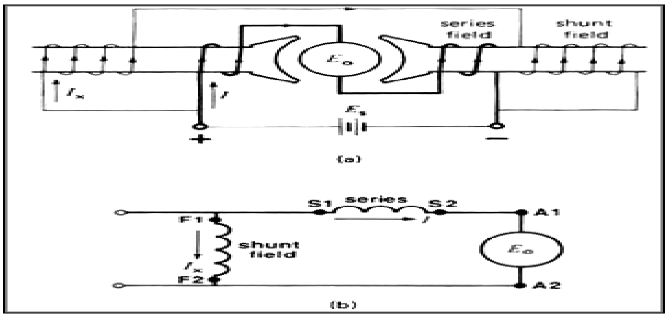


Fig: Diagram of DC compound motor

Above is the diagram of a long shunt motor, while in a short shunt, the shunt coil will be connected after the serial coil.

A Compound motor can be run as a shunt motor without connecting the serial coil at all but not vice versa.

Applications of DC Motors:

1. Electric Train: A kind of DC motor called the DC Series Motor is used in Electric Trains. The DC Series Motors have the property to deliver more power when they are loaded more. So the more the people get on a train, the more powerful the train becomes.

2. Elevators: The best bidirectional motors are DC motors. They are used in elevators. Compound DC Motors are used for this application.

3. PC Fans, CD ROM Drives, and Hard Drives: All these things need motors, very miniature motors, with great precision. AC motors can never imagine any application in these places.

4. Starter Motors in Automobiles: An automobile battery supplies DC, so a DC motor is best suited here. Also, you cannot start an engine with a small sized AC motor,

5. Electrical Machines Lab in Colleges.

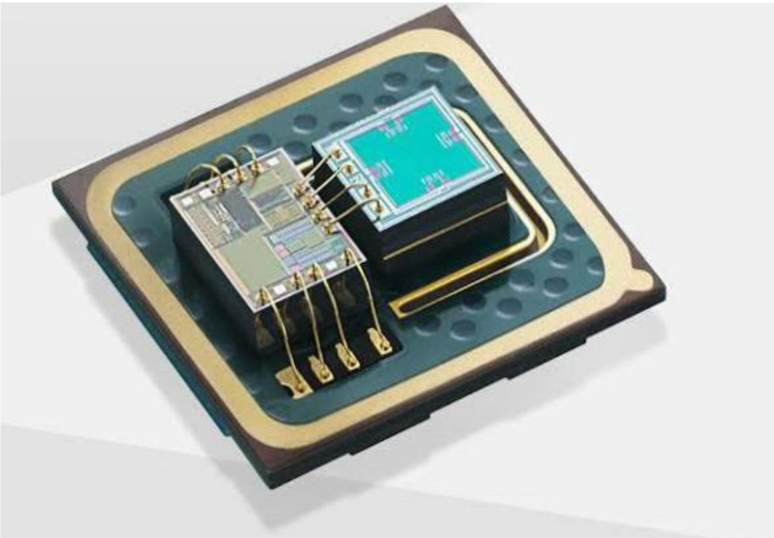
2.3MICRO-ELECTRO MECHANICAL SYSTEM (MEMS)

Introduction

This three-axis accelerometer is essentially a carrier board or breakout board for Freescale's MMA7260QT MEMS (micro-electro-mechanical systems) accelerometer. The MMA7260QT is a great IC, but its small, leadless package.

Overview

This three-axis accelerometer is essentially a carrier board or breakout board for Freescale’s MMA7260QT MEMS (micro-electro-mechanical systems) accelerometer. The MMA7260QT is a great IC, but its small, leadless package makes it difficult for the typical student or hobbyist to use. The device also operates at 2.2 V to 3.6 V, which can make interfacing difficult for microcontrollers operating at 5 V. This carrier board addresses both issues while keeping the overall size as compact as possible.



Principle of operation

The Freescale accelerometer is a surface-micromachined integrated-circuit accelerometer.

The device consists of two surface micromachined capacitive sensing cells (g-cell) and a signal conditioning ASIC contained in a single integrated circuit package. The sensing elements are sealed hermetically at the wafer level using a bulk micromachined cap wafer. The g-cell is a mechanical structure formed from semiconductor materials (polysilicon) using semiconductor processes (masking and etching). It can be modeled as a set of beams attached to a movable central mass that move between fixed beams. The movable beams can be deflected from their rest position by subjecting the system to acceleration.

As the beams attached to the central mass move, the distance from them to the fixed beams on one side will increase by the same amount that the distance to the fixed beams on the other side decreases. The change in distance is a measure of acceleration. The g-cell beams form two back-to-back capacitors. As the center beam moves with acceleration, the distance between the beams changes and each capacitor's value will change, ($C = A\varepsilon/D$). Where A is the area of the beam, ε is the dielectric constant, and D is the distance between the beams. The ASIC uses switched capacitor techniques to measure the g-cell capacitors and extract the acceleration data from the difference between the two capacitors. The ASIC also signal conditions and filters (switched capacitor) the signal, providing a high level output voltage that is ratiometric and proportional to acceleration.

MEMS Working Function: The schematic for the 3-axis accelerometer is shown below. The device can be powered directly through the Vcc/3.3 V pin using a supply that is within the MMA7260QT's acceptable power supply range of 2.2 V to 3.6 V. Alternatively, the board can be powered by higher voltages, up to 16 V, using the VIN pin, which connects to a low-dropout 3.3 V regulator. In this configuration, the Vcc/3.3 V pin can serve as an output to be used as a reference voltage or power source for other low-power devices (up to around 50 mA, depending on the input voltage).

The sensitivity selection pins GS1 and GS2 are pulled up to the Vcc line, making the default sensitivity 6g; these pins can be pulled low by a microcontroller or through jumpers. For 5 V microcontroller applications, the lines should not be driven high. Instead, the microcontroller I/O pin can emulate an open-drain or open-collector output by alternating between low output and high-impedance (input) states. Put another way, if you are using a 5 V microcontroller, you should make your sensitivity selection I/O lines inputs and rely upon the internal pull-ups on the GS1 and GS2 lines if you want them to be high. It is always safe for you to drive these lines low.

Each of the three outputs is an RC-filtered analog voltage that ranges from 0 to Vcc. For 5 V applications, the outputs will range from 0 to 3.3 V. The 3.3 V output can be used as a reference for analog-to-digital converters to gain full resolution samples. Otherwise, your conversions will be limited to 66% of the full range (e.g. an 8-bit ADC will yield numbers from 0 to 168).

Features

• Selectable Sensitivity (1.5g/2g/4g/6g)

• Low Current Consumption: 500 µA

• Sleep Mode: 3 µA

• Low Voltage Operation: 2.2 V – 3.6 V

• 6mm x 6mm x 1.45mm QFN

• High Sensitivity (800 mV/g @ 1.5g)

• Fast Turn On Time

• Integral Signal Conditioning with Low Pass Filter

• Robust Design, High Shocks Survivability

• Pb-Free Terminations

• Environmentally Preferred Package

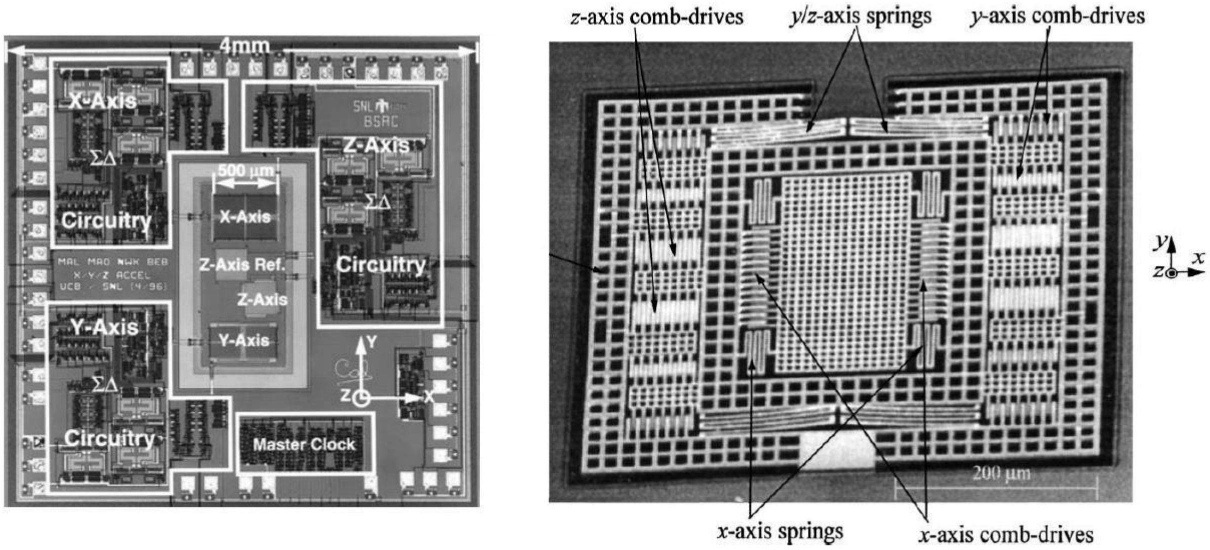
• Low Cost

Typical Applications

1. HDD MP3 Player: Freefall Detection
2. Laptop PC: Freefall Detection, Anti-Theft
3. Cell Phone: Image Stability, Text Scroll, Motion Dialing, E-Compass
4. Pedometer: Motion Sensing
5. PDA: Text Scroll
6. Navigation and Dead Reckoning: E-Compass Tilt Compensation
7. Gaming: Tilt and Motion Sensing, Event Recorder
8. Robotics: Motion Sensing

Pin Descriptions

These pin descriptions refer to Sparkfun's breakout board. Sparkfun has helpfully added the necesary capacitors and resistors to each output pin so you don't have to. Here is the schematic of the Sparkfun breakout board.



a) b)

Fig.4.19: Inner diagram of MMA 7260

Applications

- Accelerometers are real workhorses in the sensor world because they can sense such a wide range of motion.
- They're used in the latest Apple Powerbooks (and other laptops) to detect when the computer's suddenly moved or tipped, so the hard drive can be locked up during movement.
- They're used in cameras, to control image stabilization functions. They're used in pedometers, gait meters, and other exercise and physical therapy devices.
- They're used in gaming controls to generate tilt data. They're used in automobiles, to control airbag release when there's a sudden stop.
- The GS1 and GS2 pins allow you to set the accelerometer's sensitivity, depending on how much force it will be subjected to in your application.
- For low-force activities like measuring the tilt of an object, the lowest setting, 1.5g, is probably enough.
- If it's going to be attached to a crash-test dummy, you might want to set the sensitivity to the full 6G, or get a better accelerometer.

2.4FLEX SENSOR

Introduction:

The Flex Sensor patented technology is based on resistive carbon elements. As a variable printed resistor, the Flex Sensor achieves great form-factor on a thin flexible substrate. When the substrate is bent, the sensor produces a resistance output correlated to the bend radius—the smaller the radius, the higher the resistance value.

In 1982 Thomas G. Zimmerman filed a patent (US Patent 4542291) on an optical flex sensor mounted in a glove to measure finger bending. Zimmerman worked with Jaron Lanier to incorporate ultrasonic and magnetic hand position tracking technology to create the Power Glove and Data Glove, respectively (US Patent 4988981, filed 1989). The optical flex sensor used in the Data Glove was invented by Young **L. Harvill** (US Patent 5097252, filed 1989) who scratched the fiber near the finger joint to make it locally sensitive to bending.

A wired glove is a glove-like input device for human-computer interaction, often in virtual reality environments. Various sensor technologies are used to capture physical data such as bending of fingers. Often a motion tracker, such as a magnetic tracking device or inertial tracking device, is attached to capture the global position/rotation data of the glove. These movements are then interpreted by the software that accompanies the glove, so any one movement can mean any number of things. Gestures can then be categorized into useful information, such as to recognize Sign Language or other symbolic functions.

Expensive high-end wired gloves can also provide haptic feedback, which is a simulation of the sense of touch. This allows a wired glove to also be used as an output device. Traditionally, wired gloves have only been available at a huge cost, with the finger bend sensors and the tracking device having to be bought separately.

Wired gloves are often called "datagloves" or "cybergloves". The latter term is a trademark of Immersion Corporation (which acquired Virtual Technologies, Inc. and its patent portfolio in September 2000).

An alternative to wired gloves is to use a camera and computer vision to track the 3D pose and trajectory of the hand, at the cost of tactile feedback.

The Flex Sensor patented technology is based on resistive carbon elements. As a variable printed resistor, the Flex Sensor achieves great form-factor on a thin flexible substrate. When the substrate is bent, the sensor produces a resistance output correlated to the bend radius—the smaller the radius, the higher the resistance value.

Spectra Symbol Designers can vary the actual nominal resistance of the Flex Sensors to meet customer's needs. We can produce our Flex Sensors on a variety of substrates, for example, we can use DuPont's Kapton material if you require high temperature operations.

Description:

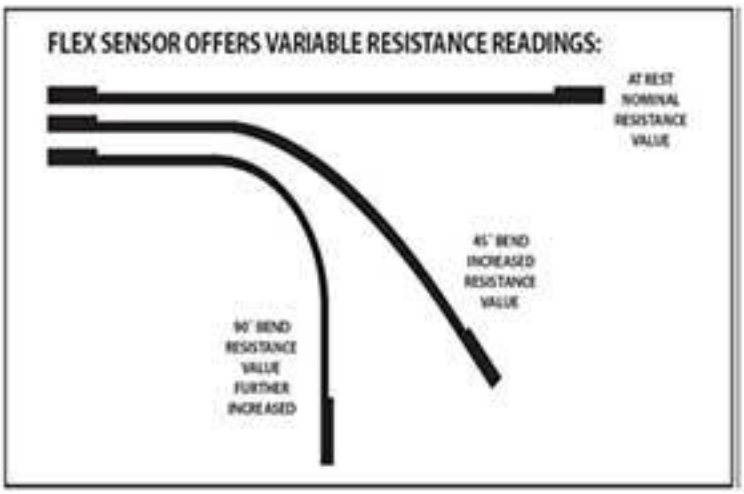
Working of flex sensor:

Flex sensor are sensors that change in resistance depending on the amount of bend on the sensor. They convert the change in bend to electrical resistance the more bend the more the resistance value. They are usually in the form of a thin strip from 1"-5" long that vary in resistance. They can be made uni-directional and bi-directional.

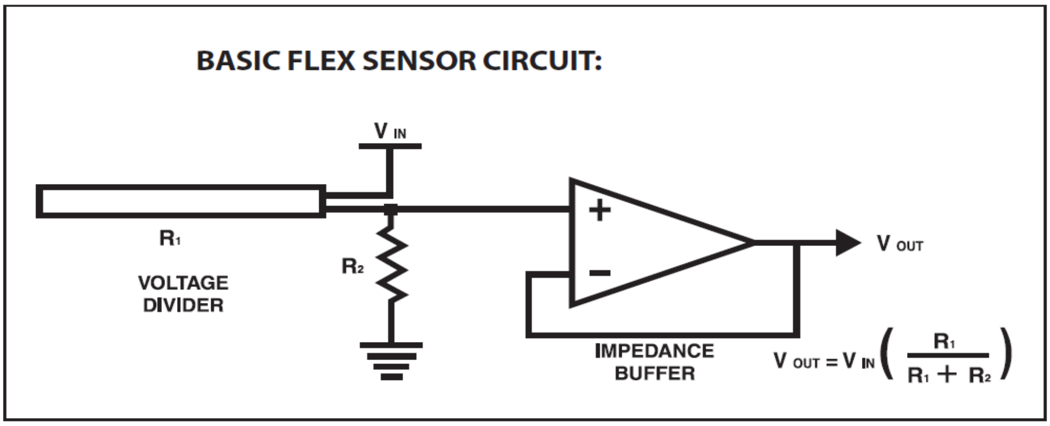
Sizes - 1K to 20K

50K to 50ohm

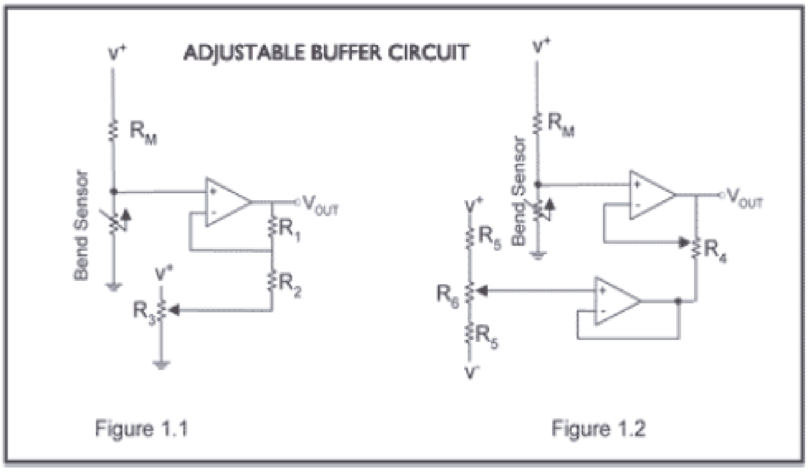
50K to 200k



Basic circuit operation of the flex sensor:

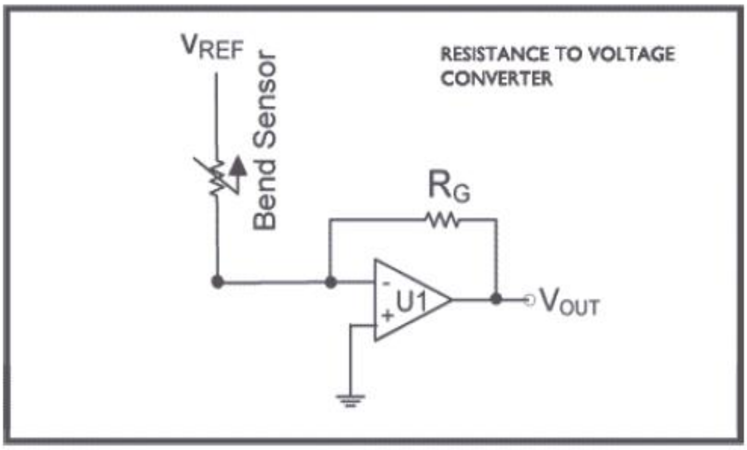


"The impedance buffer in the [Basic Flex Sensor Circuit] (above) is a single sided operational amplifier, used with these sensors because the low bias current of the op amp reduces errer due to source impedance of the flex sensor as voltage divider. Suggested op amps are the LM358 or LM324." "You can also test your flex sensor using the simplest circuit, and skip the op amp." **"Adjustable Buffer** - a potentiometer can be added to the circuit to adjust the sensitivity range."



`**"Variable Deflection Threshold Switch** - an op amp is used and outputs either high or low depending on the voltage of the inverting input. In this way you can use the flex sensor as a switch without going through a microcontroller."

"Resistance to Voltage Converter - use the sensor as the input of a resistance to voltage converter using a dual sided supply op-amp. A negative reference voltage will give a positive output. Should be used in situations when you want output at a low degree of bending"



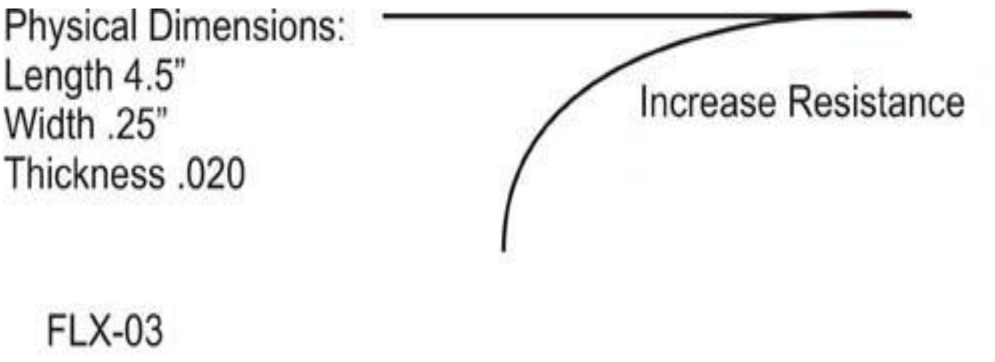
ATTRIBUTES:

Custom designed to match customer specs High level of reliability, consistency, repeatability Harsh temperature resistance Variety of flexible or stationary surfaces for mounting Infinite number of resistance possibilities and bend ratios Please call our full Design Engineering team or Sales Engineers for any questions or ideas at One directional Flex Sensor is a unique component that changes resistance when bent or flexed (Patent 5086785). A UN flexed sensor has a nominal resistance of approximately 10,000 ohms (10 K). As the flex sensor is bent in one direction the resistance gradually increases. Range of resistance's of the FLX-03 sensor may vary between 10K and 40K depending upon the degree of the flex.

The flex sensor operating temperature is -45F to 125F.

Connection - Pin connector .100" spacing

The sensor measures 1/4 inch wide, 4 1/2 inches long and only .019 inches thick!



FEATUTRES:

- Size: approx 0.28" wide and 1"/3"/5" long
- Resistance Range: 1.5-40K ohms depending on sensor. Flex point claims a 0-250 resistance range.
- Lifetime: Greater than 1 million life cycles
- Temperature Range: -35 to +80 degrees Celsius
- Hysteresis: 7%
- Voltage: 5 to 12 V

SPECIFICATION:

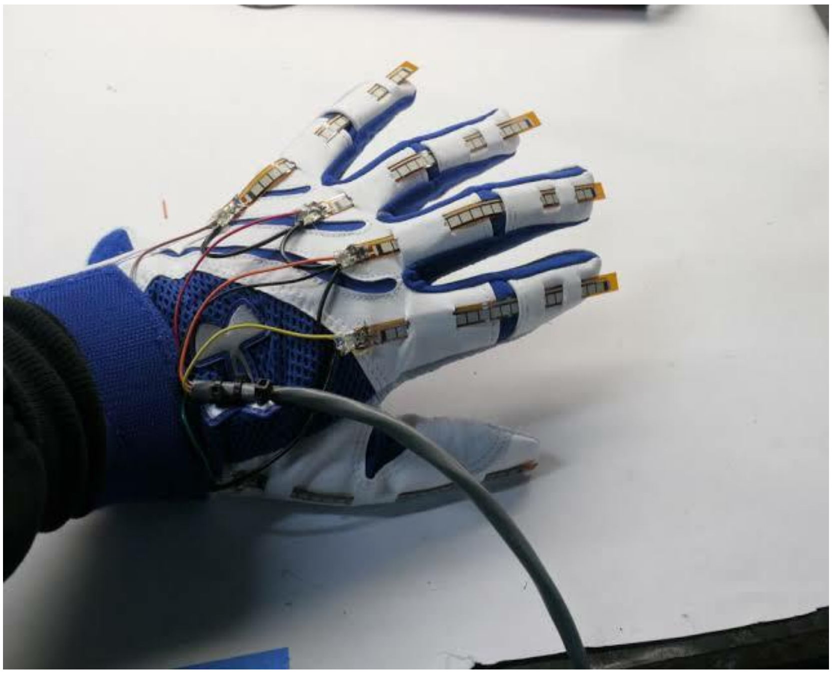
parameter	**value**
Operating Voltage	+5V DC regulated
Operating Current	100mA
Output	Analog output
Flex Bending	Nominal,45 degree,90 degree

Mechanical Specifications:

1. Life Cycle: >1 million

2. Height: 0.43mm (0.017")

3. Temperature Range: -35°C to +80°C



Electrical Specifications:

1. Flat Resistance: 10K Ohms

2. Resistance Tolerance: ±30%

3. Bend Resistance Range: 60K to 110K Ohms

4. Power Rating: 0.50 Watts continuous. 1 Watt Peak

Advantages of the flex sensor:

- **Environmental impact.** Ethanol burns cleaner than gasoline and therefore is responsible for fewer toxic fumes, which is highly advantageous from an anti-pollution point of view. The fact that ethanol does not contribute significantly to greenhouse gasses, makes it a popular alternative among the environmentally conscious
- **Burning facility.** Possibly the greatest advantage is that the flex fuel vehicle has been designed to burn whatever proportion of mixture is in its combustion chamber. Electronic sensors gauge the blend, while microprocessors adjust the fuel injection and timing.
- **Alternative to oil.** Many flex fuel vehicles make use of ethanol, which originates from corn and sugar cane, a viable alternative to purchasing foreign oil.
- **Tax benefit.** Another significant advantage of driving a flex fuel vehicle is the flex fuel tax credit which replaced the clean-fuel burning deduction. This tax credit substantially reduces and may even eliminate a taxpayer's tax obligation

Disadvantages of the flex sensor:

Flex does not read or write files to the end-user's computer. This is a restriction of the Flash Player. You may find information in this forum about ways to circumvent that, but it is tricky, tedious, and messy. If you need an app that works like a stand-alone application, Flex isn't it. If you data lives on a server and you want to easily deploy a good-looking application with quick development and excellent return-on-investment, then Flex is the way to go.

Flex does not 'naturally' handle lots of records easily. That's similar to any client/server application however. If you write a Java/Swing application that needs to get 3000 records from a server, it is going to take awhile. Flex is better than HTML for displaying large quantities of data, but you should look into better ways of managing data.

Uses: Symbol has used this technology in supplying Flex Sensors for the Nintendo Power Glove, the P5 gaming glove, and the below applications:

- ✓ Automotive controls
- ✓ Medical devices
- ✓ Industrial controls
- ✓ Computer peripherals
- ✓ Fitness products
- ✓ Musical instruments
- ✓ Consumer products
- ✓ Physical therapy
- ✓ Connect regulated DC power supply of 5 Volts. Black wire is Ground, Next middle wire is Brown which is output and Red wire is positive supply. These wires are also marked on PCB.
- ✓ To test sensor you only need power the sensor by connect two wires +5V and GND. You can leave the output wire as it is.
- ✓ The flex sensor analog resistors. They work as analog voltage dividers.
- ✓ When the substrate is bend the sensor produces resistance output relative to bending radius nominal, 45 degree and 90 degree.
- ✓ Measure the output voltage through multi-meter between OUT and Ground pins or Use a microcontroller to measure the voltage output.

Some applications for the Flex Sensor are:

- Collision detection on mobile robots
- VR Gloves and VR suits
- Physics applications and experiments
- gaming gloves

- auto controls
- fitness products
- measuring devices
- assistive technology
- musical instruments and joysticks

2.5Zigbee technology

Introduction:

When we hold the TV remote and wish to use it we have to necessarily point our control at the device. This one-way, line-of-sight, short-range communication uses infrared (IR) sensors to enable communication and control and it is possible to operate the TV remotely only with its control unit.

Add other home theatre modules, an air- conditioner and remotely enabled fans and lights to our room, and we become a juggler who has to handle not only these remotes, but also more numbers that will accompany other home appliances we are likely to use.

Some remotes do serve to control more than one device after ‘memorizing' access codes, but this interoperability is restricted to LOS, that too only for a set of related equipment, like the different units of a home entertainment system

Now picture a home with entertainment units, security systems including fire alarm, smoke detector and burglar alarm, air-conditioners and kitchen appliances all within whispering distance from each other and imagine a single unit that talks with all the devices, no longer depending on line-of-sight, and traffic no longer being one-way.

This means that the devices and the control unit would all need a common standard to enable intelligible communication. ZigBee is such a standard for embedded application software and has been ratified in late 2004 under IEEE 802.15.4 Wireless Networking Standards.

ZigBee is an established set of specifications for wireless personal area networking (WPAN), i.e., digital radio connections between computers and related devices. This kind of network eliminates use of physical data buses like USB and Ethernet cables. The devices could include telephones, hand-held digital assistants, sensors and controls located within a few meters of each other.

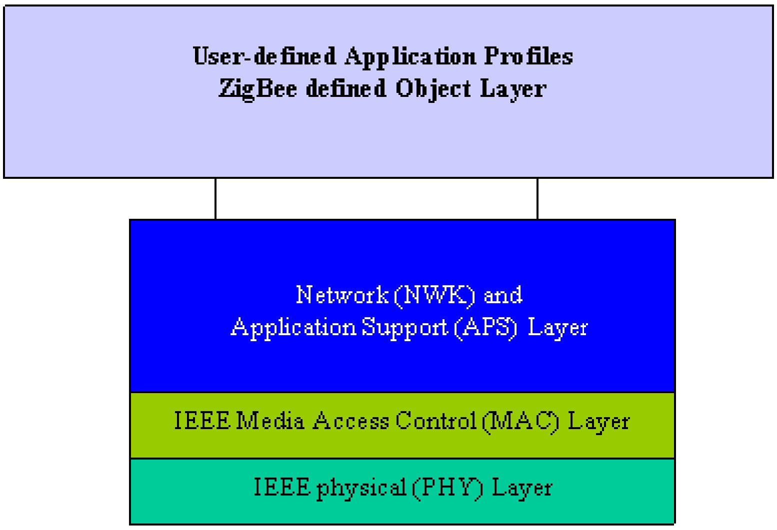
ZigBee is one of the global standards of communication protocol formulated by the relevant task force under the IEEE 802.15 working group. The fourth in the series, WPAN Low Rate/ZigBee is the newest and provides specifications for devices that have low data rates, consume very low power and are thus characterized by long battery life. Other standards like Blue tooth and IrDA address high data rate applications such as voice, video and LAN communications.

The ZigBee Alliance has been set up as “an association of companies working together to enable reliable, cost-effective, low-power, wirelessly networked, monitoring and control products based on an open global standard”.

Once a manufacturer enrolls in this Alliance for a fee, he can have access to the standard and implement it in his products in the form of ZigBee chipsets that would be built into the end devices. Philips, Motorola, Intel, HP are all members of the Alliance. The goal is “to provide the consumer with ultimate flexibility, mobility, and ease of use by building wireless intelligence and capabilities into every day devices.

ZigBee technology will be embedded in a wide range of products and applications across consumer, commercial, industrial and government markets worldwide. For the first time, companies will have a standards-based wireless platform optimized for the unique needs of remote monitoring and control applications, including simplicity, reliability, low-cost and low-power”.

The target networks encompass a wide range of devices with low data rates in the Industrial, Scientific and Medical (ISM) radio bands, with building-automation controls like intruder/fire alarms, thermostats and remote (wireless) switches, video/audio remote controls likely to be the most popular applications. So far sensor and control devices have been marketed as proprietary items for want of a standard. With acceptance and implementation of ZigBee, interoperability will be enabled in multi-purpose, self-organizing mesh networks



1: IEEE 802.15.4 / ZigBee Stack Architecture

Device types:

There are three different ZigBee device types that operate on these layers in any self-organizing application network.

These devices have 64-bit IEEE addresses, with option to enable shorter addresses to reduce packet size, and work in either of two addressing modes – star and peer-to-peer.

ZigBee wireless devices are expected to transmit 10-75 meters, depending on the RF environment and the power output consumption required for a given application, and will operate in the unlicensed RF worldwide (2.4GHz global, 915MHz Americas or 868 MHz Europe). The data rate is 250kbps at 2.4GHz, 40kbps at 915MHz and 20kbps at 868MHz.

Technology Comparisons:

The “Why ZigBee” question has always had an implied, but never quite worded follower phrase “…when there is Blue tooth”. A comparative study of the two can be found in ZigBee: 'Wireless Control That Simply Works’.

The bandwidth of Blue tooth is 1 Mbps; ZigBee's is one-fourth of this value. The strength of Blue tooth lies in its ability to allow interoperability and replacement of cables, ZigBee's, of course, is low costs and long battery life.

In terms of protocol stack size, ZigBee's 32 KB is about one-third of the stack size necessary in other wireless technologies (for limited capability end devices, the stack size is as low as 4 KB).

Most important in any meaningful comparison are the diverse application areas of all the different wireless technologies. Blue tooth is meant for such target areas as wireless USB's, handsets and headsets, whereas ZigBee is meant to cater to the sensors and remote controls market and other battery operated products.

In a gist, it may be said that they are neither complementary standards nor competitors, but just essential standards for different targeted applications. The earlier Blue tooth targets interfaces between PDA and other device (mobile phone / printer etc) and cordless audio applications.

The IEEE 802.15.4–based ZigBee is designed for remote controls and sensors, which are very many in number, but need only small data packets and, mainly, extremely low power consumption for (long) life. Therefore they are naturally different in their approach to their respective application arenas.

ZigBee Applications:

The ZigBee Alliance targets applications "across consumer, commercial, industrial and government markets worldwide".

Unwired applications are highly sought after in many networks that are characterized by numerous nodes consuming minimum power and enjoying long battery lives.

ZigBee technology is designed to best suit these applications, for the reason that it enables reduced costs of development, very fast market adoption, and rapid ROI.

Airbee Wireless Inc has tied up with Radio crafts AS to deliver "out-of-the-box" ZigBee-ready solutions, the former supplying the software and the latter making the module platforms. With even light controls and thermostat producers joining the ZigBee Alliance, the list is growing healthily and includes big OEM names like HP, Philips, Motorola and Intel.

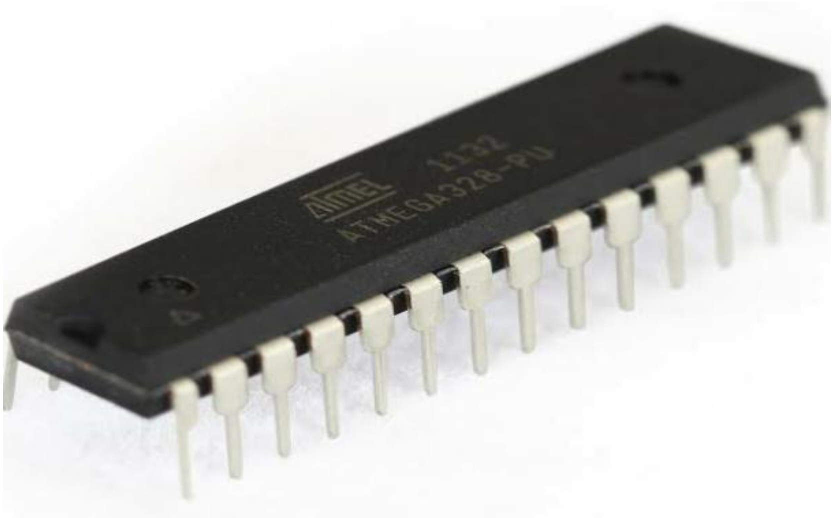
With ZigBee designed to enable two-way communications, not only will the consumer be able to monitor and keep track of domestic utilities usage, but also feed it to a computer system for data analysis.

A recent analyst report issued by West Technology Research Solutions estimates that by the year 2008,

"annual shipments for ZigBee chipsets into the home automation segment alone will exceed 339 million units," and will show up in "light switches, fire and smoke detectors, thermostats, appliances in the kitchen, video and audio remote controls, landscaping, and security systems."

2.6MICROCONTROLLER:

A Microcontroller is a programmable digital processor with necessary peripherals. Both microcontrollers and microprocessors are complex sequential digital circuits meant to carry out job according to the program / instructions. Sometimes analog input/output interface makes a part of microcontroller circuit of mixed mode (both analog and digital nature).



1. A smaller computer

2. On-chip RAM, ROM, I/O ports...

Example: Motorola’s 6811, Intel’s 8051, Zilog’s Z8 and PIC 16X

General-purpose microprocessor

1. CPU for Computers

2. No RAM, ROM, I/O on CPU chip itself

3. Example: Intel’s x86, Motorola’s 680x0

Microprocessor vs. Microcontroller

Microprocessor

- CPU is stand-alone, RAM, ROM, I/O, timer are separate
- Designer can decide on the amount of ROM, RAM and I/O ports.
- expansive
- versatility
- general-purpose

Microcontroller

- CPU, RAM, ROM, I/O and timer are all on a single chip
- fix amount of on-chip ROM, RAM, I/O ports

- for applications in which cost, power and space are critical
- single-purpose

Choosing a MC

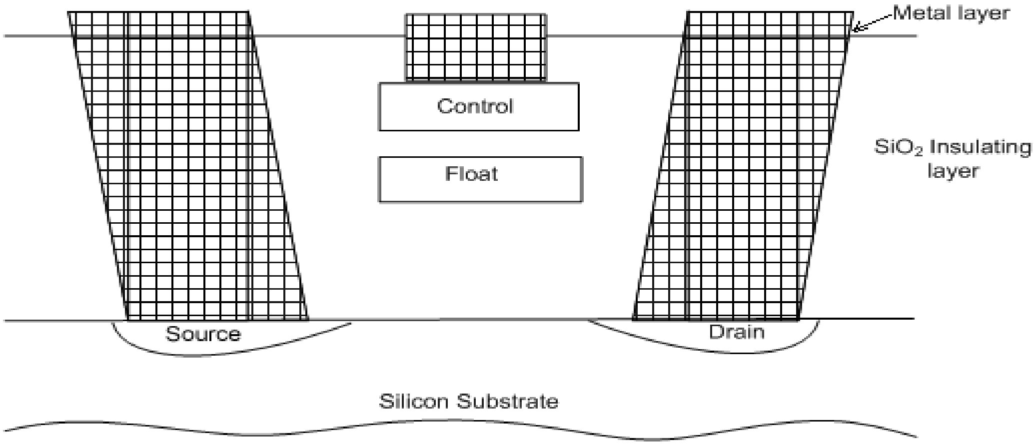
- Speed
- Packaging(Ex. DIP,QFP Quad Flat Package)
- Power Consumption
- Amount of RAM,ROM
- I/O Pins
- Final Cost of The product
- How easy it is Upgraded

Memory types

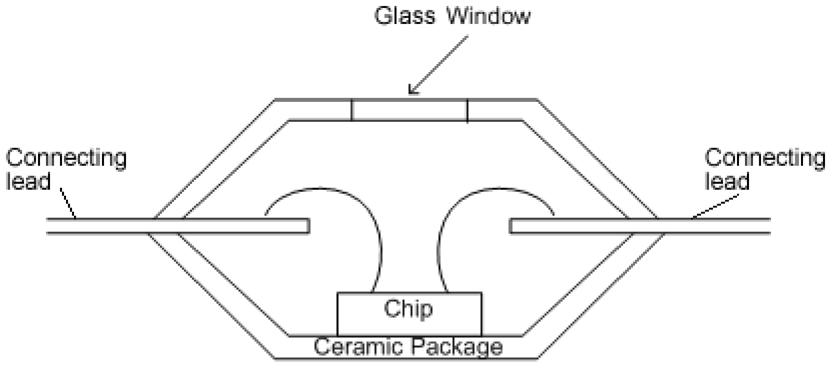
In a microcontroller, two types of memory are found. They are, program memory and data memory respectively. Program memory is also known as 'control store' and 'firm ware'. It is non-volatile i.e, the memory content is not lost when the power goes off. Non-volatile memory is also called Read Only Memory (ROM). There are various types of ROM.

1. **Mask ROM:** Some microcontrollers with ROM are programmed while they are still in the factory. This ROM is called Mask ROM. Since the microcontrollers with Mask ROM are used for specific application, there is no need to reprogram them. Some times, this type of manufacturing reduces the cost for bulk production.

2. Reprogrammable program memory (or) Erasable PROM (EPROM): Microcontrollers with EPROM were introduced in late 1970's. These devices are electrically programmable but are erased with UV radiation. The construction of a EPROM memory cell is somewhat like a MOSFET but with a control and float semiconductor as shown in the figure.



In the unprogrammed state, the 'float' does not have any charge and the MOSFET is in the OFF state. To program the cell, the 'control' above the 'float' is raised to a high enough potential such that a charge leaks to the float through SiO_2 insulating layer. Hence a channel is formed between 'Source' and 'Drain' in the silicon substrate and the MOSFET becomes 'ON'. The charge in the 'float' remains for a long time (typically over 30 years). The charge can be removed by exposing the float to UV radiation. For UV erasable version, the packaging is done in a ceramic enclosure with a glass window.



Usually, these versions of micro controllers are expensive

3. OTP EPROM: One time programmable (OTP) EPROM based microcontrollers do not have any glass window for UV erasing. These can be programmed only once. This type of packaging results in microcontroller that have the cost 10% of the microcontrollers with UV erase facility (i.e., 1/10th cost).

4. **EEPROM**: (Electrically Erasable Programmable ROM): This is similar to EPROM but the float charge can be removed electrically.

5. **FLASH (EEPROM Memory)**: FLASH memory was introduced by INTEL in late 1980's.

This memory is similar to EEPROM but the cells in a FLASH memory are bussed so that they can be erased in a few clock cycles. Hence the reprogramming is faster.

Different Data memory types:

1. Random access memory (RAM)

2. Read only memory (ROM)

Random access memory (RAM): data will disappear after power down.

– Static RAM (SRAM): each bit is a flip-flop, fast but expensive.

– Dynamic RAM (DRAM): each bit is a small capacitor, and is needed to be recharged regularly, slower but cheap. To be used as primary memory in a computer.

Data memory can be classified into the following categories

- Bits
- Registers
- Variable RAM
- Program counter stack

Microcontroller can have ability to perform manipulation of individual bits in certain registers (bit manipulation). This is a unique feature of a microcontroller, not available in a microprocessor. Eight bits make a byte. Memory bytes are known as file registers. Registers are some special RAM locations that can be accessed by the processor very easily.

PIC Microcontrollers:

PIC stands for Peripheral Interface Controller given by Microchip Technology to identify its single-chip microcontrollers. These devices have been very successful in 8-bit microcontrollers. The main reason is that Microchip Technology has continuously upgraded the device architecture and added needed peripherals to the microcontroller to suit customers' requirements. The development tools such as assembler and simulator are freely available on the internet at www.microchip.com .

Low - end PIC Architectures:

Microchip PIC microcontrollers are available in various types. When PIC microcontroller MCU was first available from General Instruments in early 1980's, the microcontroller consisted of a simple processor

executing 12-bit wide instructions with basic I/O functions. These devices are known as low-end architectures. They have limited program memory and are meant for applications requiring simple interface functions and small program & data memories. Some of the low-end device numbers are12C5XX12C5XX,16C5X
16C505

Mid range PIC Architectures

Mid range PIC architectures are built by upgrading low-end architectures with more number of peripherals, more number of registers and more data/program memory. Some of the mid-range devices are

16C6X
16C7X
16F87X

Program memory type is indicated by an alphabet.

C = EPROM

F = Flash

RC = Mask ROM

Popularity of the PIC microcontrollers is due to the following factors.

1. Speed: Harvard Architecture, RISC architecture, 1 instruction cycle = 4 clock cycles.
2. Instruction set simplicity: The instruction set consists of just 35 instructions (as opposed to 111 instructions for 8051).
3. Power-on-reset and brown-out reset. Brown-out-reset means when the power supply goes below a specified voltage (say 4V), it causes PIC to reset; hence malfunction is avoided.

A watch dog timer (user programmable) resets the processor if the software/program ever malfunctions and deviates from its normal operation.

4. PIC microcontroller has four optional clock sources.
   - Low power crystal
   - Mid range crystal
   - High range crystal

- RC oscillator (low cost).

5. Programmable timers and on-chip ADC.
6. Up to 12 independent interrupt sources.
7. Powerful output pin control (25 mA (max.) current sourcing capability per pin.)

Peripheral Features

• Timer0: 8-bit timer/counter with 8-bit prescaler

• Timer1: 16-bit timer/counter with prescaler, can be incremented during SLEEP via external crystal/clock

• Timer2: 8-bit timer/counter with 8-bit period register, prescaler and postscaler

• Capture, Compare, PWM(CCP) module

- Capture is 16-bit, max resolution is 12.5 ns

- Compare is 16-bit, max resolution is 200 ns

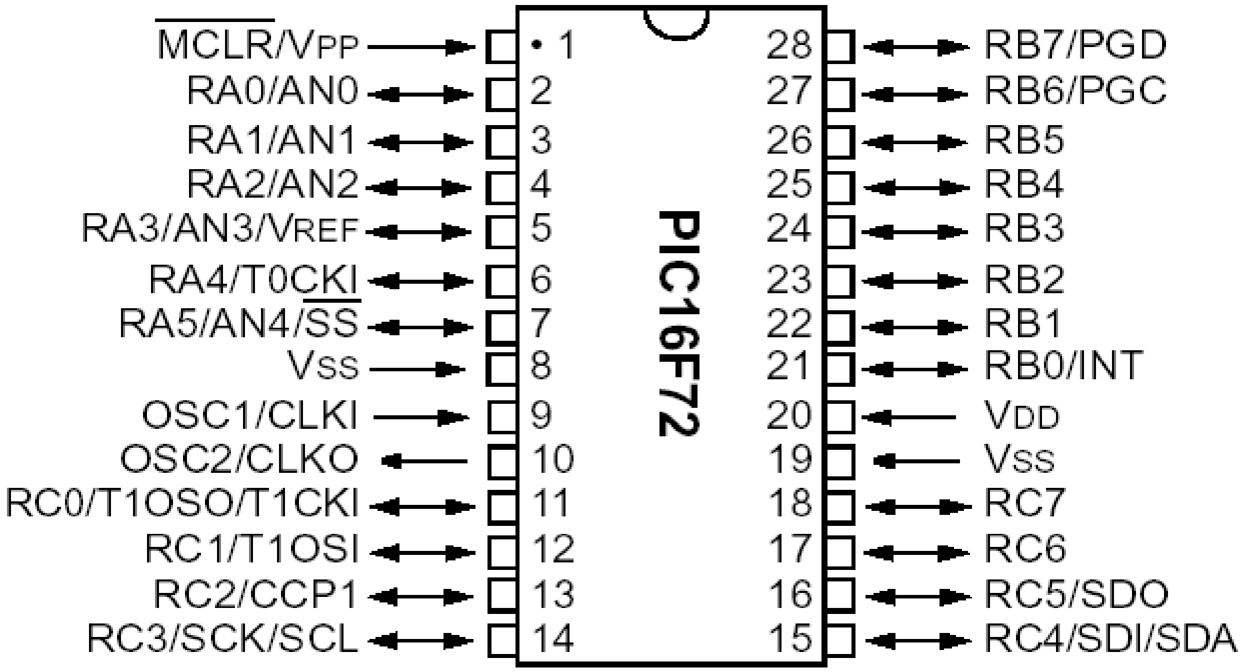
- PWM max resolution is 10-bit

• 8-bit, 5-channel Analog-to-Digital converter

• Synchronous Serial Port (SSP) with SPI (Master mode) and I2C (Slave)

• Heat sink/Source Current: 25 mA

• Brown-out detection circuitry for Brown-out Reset (BOR)



Pins on PIC16F72 microcontroller have the following meaning:

There are 28 pins on PIC16F72. Most of them can be used as an IO pin. Others are already for specific functions. These are the pin functions.

1. MCLR – to reset the PIC
2. RA0 – port A pin 0
3. RA1 – port A pin 1
4. RA2 – port A pin 2
5. RA3 – port A pin 3
6. RA4 – port A pin 4
7. RA5 – port A pin 5
8. VSS – ground
9. OSC1 – connect to oscillator
10. OSC2 – connect to oscillator
11. RC0 – port C pin 0 VDD – power supply
12. RC1 – port C pin 1
13. RC2 – port C pin 2
14. RC3 – port C pin 3
15. RC4 - port C pin 4
16. RC5 - port C pin 5

17. RC6 - port C pin 6
18. RC7 - port C pin 7
19. VSS - ground
20. VDD – power supply
21. RB0 - port B pin 0
22. RB1 - port B pin 1
23. RB2 - port B pin 2
24. RB3 - port B pin 3
25. RB4 - port B pin 4
26. RB5 - port B pin 5
27. RB6 - port B pin 6
28. RB7 - port B pin 7

By utilizing all of this pin so many application can be done such as:

1. LCD – connect to Port B pin.
2. LED – connect to any pin declared as output.
3. Relay and Motor - connect to any pin declared as output.
4. External EEPROM – connect to I2C interface pin – RC3 and RC4 (SCL and SDA)
5. LDR, Potentiometer and sensor – connect to analogue input pin such as RA0.
6. GSM modem dial up modem – connect to RC6 and RC7 – the serial communication interface using RS232 protocol.

For more detail function for each specific pin please refer to the device datasheet from Microchip.

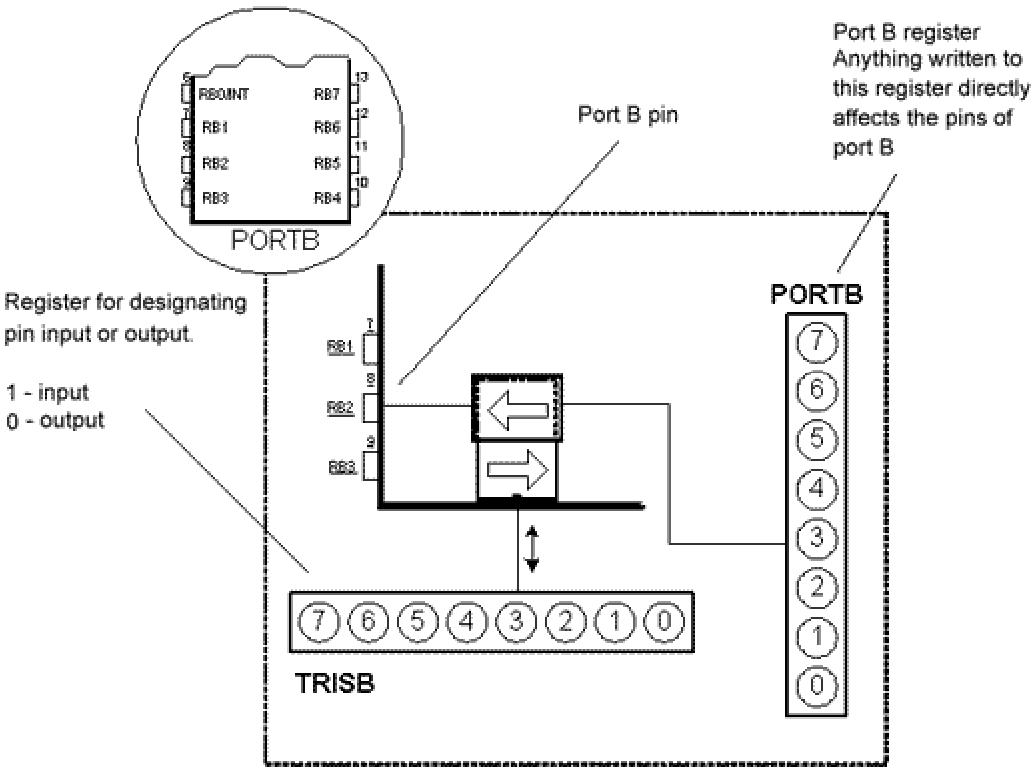
Ports

Term "port" refers to a group of pins on a microcontroller which can be accessed simultaneously, or on which we can set the desired combination of zeros and ones, or read from them an existing status. Physically, port is a register inside a microcontroller which is connected by wires to the pins of a microcontroller. Ports represent physical connection of Central Processing Unit with an outside world. Microcontroller uses them in order to monitor or control other components or devices. Due to functionality, some pins have twofold roles like PA4/TOCKI for instance, which is in the same time the fourth bit of port A and an external input for free-run counter. Selection of one of these two pin functions is done in one of the configuration registers. An illustration of this is the fifth bit T0CS in OPTION register. By selecting one of the functions the other one is disabled.

All port pins can be designated as input or output, according to the needs of a device that's being developed. In order to define a pin as input or output pin, the right combination of zeros and ones must be written in TRIS register. If the appropriate bit of TRIS register contains logical "1", then that pin is an input pin, and if the opposite is true, it's an output pin. Every port has its proper TRIS register. Thus, port A has TRISA, and port B has TRISB. Pin direction can be changed during the course of work which is particularly fitting for one-line communication where data flow constantly changes direction. PORTA and PORTB state registers are located in bank 0, while TRISA and TRISB pin direction registers are located in bank 1.

PORTB and TRISB

PORTB have adjoined 8 pins. The appropriate register for data direction is TRISB. Setting a bit in TRISB register defines the corresponding port pin as input, and resetting a bit in TRISB register defines the corresponding port pin as output.



Each PORTB pin has a weak internal pull-up resistor (resistor which defines a line to logic one) which can be activated by resetting the seventh bit RBPU in OPTION register. These 'pull-up' resistors are automatically being turned off when port pin is configured as an output. When a microcontroller is started, pull-ups are disabled.

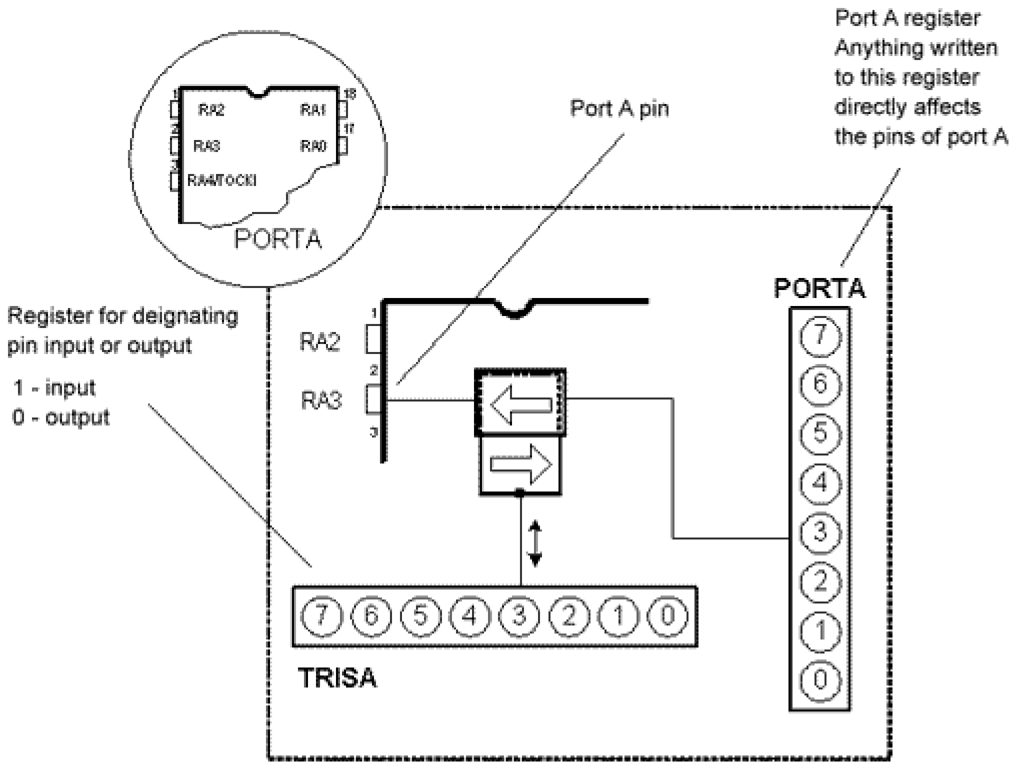
Four pins PORTB, RB7:RB4 can cause an interrupt which occurs when their status changes from logical one into logical zero and opposite. Only pins configured as input can cause this interrupt to occur (if any RB7:RB4 pin is configured as an output, an interrupt won't be generated at the change of status.) This interrupt option along with internal pull-up resistors makes it easier to solve common problems we find in practice like for instance that of matrix keyboard. If rows on the keyboard are connected to these pins, each push on a key will then cause an interrupt. A microcontroller will determine which key is at hand while processing an interrupt It is not recommended to refer to port B at the same time that interrupt is being processed.

PORTA and TRISA

PORTA have 5 adjoining pins. The corresponding register for data direction is TRISA at address 85h. Like with port B, setting a bit in TRISA register defines also the corresponding port pin as input, and clearing a bit in TRISA register defines the corresponding port pin as output.

It is important to note that PORTA pin RA4 can be input only. On that pin is also situated an external input for timer TMR0. Whether RA4 will be a standard input or an input for a counter depends on T0CS bit (TMR0 Clock Source Select bit). This pin enables the timer TMR0 to increment either from internal oscillator or via external impulses on RA4/T0CKI pin.

Example shows how pins 0, 1, 2, 3, and 4 are designated input, and pins 5, 6, and 7 outputs. After this, it is possible to read the pins RA2, RA3, RA4, and to set logical zero or one to pins RA0 and RA1.



Memory organization

PIC16F72 has two separate memory blocks, one for data and the other for program. EEPROM memory with GPR and SFR registers in RAM memory make up the data block, while FLASH memory makes up the program block.

Program memory

Program memory has been carried out in FLASH technology which makes it possible to program a microcontroller many times before it's installed into a device, and even after its installment if eventual changes in program or process parameters should occur. The size of program memory is 1024 locations with 14 bits width where locations zero and four are reserved for reset and interrupt vector.

Data memory

Data memory consists of EEPROM and RAM memories. EEPROM memory consists of 256 eight bit locations whose contents are not lost during loosing of power supply. EEPROM is not directly addressable, but is accessed indirectly through EEADR and EEDATA registers. As EEPROM memory usually serves for storing important parameters (for example, of a given temperature in temperature regulators)

Applications

PIC16F72 perfectly fits many uses, from automotive industries and controlling home appliances to industrial instruments, remote sensors, electrical door locks and safety devices. It is also ideal for smart cards as well as for battery supplied devices because of its low consumption.

EEPROM memory makes it easier to apply microcontrollers to devices where permanent storage of various parameters is needed (codes for transmitters, motor speed, receiver frequencies, etc.). Low cost, low consumption, easy handling and flexibility make PIC16F72 applicable even in areas where microcontrollers had not previously been considered (example: timer functions, interface replacement in larger systems, coprocessor applications, etc.).

In System Programmability of this chip (along with using only two pins in data transfer) makes possible the flexibility of a product, after assembling and testing have been completed. This capability can be used to create assembly-line production, to store calibration data available only after final testing, or it can be used to improve programs on finished products.

COMPLETE ARDUINO PROGRAM:

```
/*  Arduino Robot Arm
*/
#include <SoftwareSerial.h>
#include <Servo.h>
Servo servo01;
Servo servo02;
Servo servo03;
Servo servo04;
Servo servo05;
Servo servo06;
SoftwareSerial Bluetooth(3, 4); // Arduino(RX, TX) - HC-05 Bluetooth (TX, RX)
int servo1Pos, servo2Pos, servo3Pos, servo4Pos, servo5Pos, servo6Pos; // current position
int servo1PPos, servo2PPos, servo3PPos, servo4PPos, servo5PPos, servo6PPos; // previous position
int servo01SP[50], servo02SP[50], servo03SP[50], servo04SP[50], servo05SP[50], servo06SP[50]; // for storing positions/steps
int speedDelay = 20;
int index = 0;
String dataIn = "";
void setup() {
servo01.attach(5);
servo02.attach(6);
servo03.attach(7);
servo04.attach(8);
servo05.attach(9);
servo06.attach(10);
Bluetooth.begin(38400); // Default baud rate of the Bluetooth module
Bluetooth.setTimeout(1);
delay(20);
// Robot arm initial position
servo1PPos = 90;
servo01.write(servo1PPos);
servo2PPos = 150;
servo02.write(servo2PPos);
servo3PPos = 35;
servo03.write(servo3PPos);
servo4PPos = 140;
servo04.write(servo4PPos);
servo5PPos = 85;
servo05.write(servo5PPos);
servo6PPos = 80;
servo06.write(servo6PPos);
}
void loop() {
// Check for incoming data
```

```
if (Bluetooth.available() > 0) {
dataIn = Bluetooth.readString(); // Read the data as string
// If "Waist" slider has changed value - Move Servo 1 to position
if (dataIn.startsWith("s1")) {
String dataInS = dataIn.substring(2, dataIn.length()); // Extract only the number. E.g. from "s1120" to "120"
servo1Pos = dataInS.toInt(); // Convert the string into integer
// We use for loops so we can control the speed of the servo
// If previous position is bigger then current position
if (servo1PPos > servo1Pos) {
for ( int j = servo1PPos; j >= servo1Pos; j--) { // Run servo down
servo01.write(j);
delay(20); // defines the speed at which the servo rotates
}
}
// If previous position is smaller then current position
if (servo1PPos < servo1Pos) {
for ( int j = servo1PPos; j <= servo1Pos; j++) { // Run servo up
servo01.write(j);
delay(20);
}
}
servo1PPos = servo1Pos; // set current position as previous position
}
// Move Servo 2
if (dataIn.startsWith("s2")) {
String dataInS = dataIn.substring(2, dataIn.length());
servo2Pos = dataInS.toInt();
if (servo2PPos > servo2Pos) {
for ( int j = servo2PPos; j >= servo2Pos; j--) {
servo02.write(j);
delay(50);
}
}
if (servo2PPos < servo2Pos) {
for ( int j = servo2PPos; j <= servo2Pos; j++) {
servo02.write(j);
delay(50);
}
}
servo2PPos = servo2Pos;
}
// Move Servo 3
if (dataIn.startsWith("s3")) {
String dataInS = dataIn.substring(2, dataIn.length());
```

```
servo3Pos = dataInS.toInt();
if (servo3PPos > servo3Pos) {
for ( int j = servo3PPos; j >= servo3Pos; j--) {
servo03.write(j);
delay(30);
}
}
if (servo3PPos < servo3Pos) {
for ( int j = servo3PPos; j <= servo3Pos; j++) {
servo03.write(j);
delay(30);
}
}
servo3PPos = servo3Pos;
}
// Move Servo 4
if (dataIn.startsWith("s4")) {
String dataInS = dataIn.substring(2, dataIn.length());
servo4Pos = dataInS.toInt();
if (servo4PPos > servo4Pos) {
for ( int j = servo4PPos; j >= servo4Pos; j--) {
servo04.write(j);
delay(30);
}
}
if (servo4PPos < servo4Pos) {
for ( int j = servo4PPos; j <= servo4Pos; j++) {
servo04.write(j);
delay(30);
}
}
servo4PPos = servo4Pos;
}
// Move Servo 5
if (dataIn.startsWith("s5")) {
String dataInS = dataIn.substring(2, dataIn.length());
servo5Pos = dataInS.toInt();
if (servo5PPos > servo5Pos) {
for ( int j = servo5PPos; j >= servo5Pos; j--) {
servo05.write(j);
delay(30);
}
}
if (servo5PPos < servo5Pos) {
```

```
for ( int j = servo5PPos; j <= servo5Pos; j++) {
servo05.write(j);
delay(30);
}
}
servo5PPos = servo5Pos;
}
// Move Servo 6
if (dataIn.startsWith("s6")) {
String dataInS = dataIn.substring(2, dataIn.length());
servo6Pos = dataInS.toInt();
if (servo6PPos > servo6Pos) {
for ( int j = servo6PPos; j >= servo6Pos; j--) {
servo06.write(j);
delay(30);
}
}
if (servo6PPos < servo6Pos) {
for ( int j = servo6PPos; j <= servo6Pos; j++) {
servo06.write(j);
delay(30);
}
}
servo6PPos = servo6Pos;
}
// If button "SAVE" is pressed
if (dataIn.startsWith("SAVE")) {
servo01SP[index] = servo1PPos; // save position into the array
servo02SP[index] = servo2PPos;
servo03SP[index] = servo3PPos;
servo04SP[index] = servo4PPos;
servo05SP[index] = servo5PPos;
servo06SP[index] = servo6PPos;
index++; // Increase the array index
}
// If button "RUN" is pressed
if (dataIn.startsWith("RUN")) {
runservo(); // Automatic mode - run the saved steps
}
// If button "RESET" is pressed
if ( dataIn == "RESET") {
memset(servo01SP, 0, sizeof(servo01SP)); // Clear the array data to 0
memset(servo02SP, 0, sizeof(servo02SP));
memset(servo03SP, 0, sizeof(servo03SP));
```

```
memset(servo04SP, 0, sizeof(servo04SP));
memset(servo05SP, 0, sizeof(servo05SP));
memset(servo06SP, 0, sizeof(servo06SP));
index = 0; // Index to 0
}
}
}
// Automatic mode custom function - run the saved steps
void runservo() {
while (dataIn != "RESET") { // Run the steps over and over again until "RESET" button is pressed
for (int i = 0; i <= index - 2; i++) { // Run through all steps(index)
if (Bluetooth.available() > 0) { // Check for incomding data
dataIn = Bluetooth.readString();
if ( dataIn == "PAUSE") { // If button "PAUSE" is pressed
while (dataIn != "RUN") { // Wait until "RUN" is pressed again
if (Bluetooth.available() > 0) {
dataIn = Bluetooth.readString();
if ( dataIn == "RESET") {
break;
}
}
}
}
// If speed slider is changed
if (dataIn.startsWith("ss")) {
String dataInS = dataIn.substring(2, dataIn.length());
speedDelay = dataInS.toInt(); // Change servo speed (delay time)
}
}
// Servo 1
if (servo01SP[i] == servo01SP[i + 1]) {
}
if (servo01SP[i] > servo01SP[i + 1]) {
for ( int j = servo01SP[i]; j >= servo01SP[i + 1]; j--) {
servo01.write(j);
delay(speedDelay);
}
}
if (servo01SP[i] < servo01SP[i + 1]) {
for ( int j = servo01SP[i]; j <= servo01SP[i + 1]; j++) {
servo01.write(j);
delay(speedDelay);
}
}
```

```
// Servo 2
if (servo02SP[i] == servo02SP[i + 1]) {
}
if (servo02SP[i] > servo02SP[i + 1]) {
for ( int j = servo02SP[i]; j >= servo02SP[i + 1]; j--) {
servo02.write(j);
delay(speedDelay);
}
}
if (servo02SP[i] < servo02SP[i + 1]) {
for ( int j = servo02SP[i]; j <= servo02SP[i + 1]; j++) {
servo02.write(j);
delay(speedDelay);
}
}
// Servo 3
if (servo03SP[i] == servo03SP[i + 1]) {
}
if (servo03SP[i] > servo03SP[i + 1]) {
for ( int j = servo03SP[i]; j >= servo03SP[i + 1]; j--) {
servo03.write(j);
delay(speedDelay);
}
}
if (servo03SP[i] < servo03SP[i + 1]) {
for ( int j = servo03SP[i]; j <= servo03SP[i + 1]; j++) {
servo03.write(j);
delay(speedDelay);
}
}
// Servo 4
if (servo04SP[i] == servo04SP[i + 1]) {
}
if (servo04SP[i] > servo04SP[i + 1]) {
for ( int j = servo04SP[i]; j >= servo04SP[i + 1]; j--) {
servo04.write(j);
delay(speedDelay);
}
}
if (servo04SP[i] < servo04SP[i + 1]) {
for ( int j = servo04SP[i]; j <= servo04SP[i + 1]; j++) {
servo04.write(j);
delay(speedDelay);
}
```

```
}
// Servo 5
if (servo05SP[i] == servo05SP[i + 1]) {
}
if (servo05SP[i] > servo05SP[i + 1]) {
for ( int j = servo05SP[i]; j >= servo05SP[i + 1]; j--) {
servo05.write(j);
delay(speedDelay);
}
}
if (servo05SP[i] < servo05SP[i + 1]) {
for ( int j = servo05SP[i]; j <= servo05SP[i + 1]; j++) {
servo05.write(j);
delay(speedDelay);
}
}
// Servo 6
if (servo06SP[i] == servo06SP[i + 1]) {
}
if (servo06SP[i] > servo06SP[i + 1]) {
for ( int j = servo06SP[i]; j >= servo06SP[i + 1]; j--) {
servo06.write(j);
delay(speedDelay);
}
}
if (servo06SP[i] < servo06SP[i + 1]) {
for ( int j = servo06SP[i]; j <= servo06SP[i + 1]; j++) {
servo06.write(j);
delay(speedDelay);
}
}
}
}
}
```

CHAPTER 3: ADVANTAGES AND DISADVANTAGES

Advantages:

- Our robot can handle dangerous chemicals in chemical lab or in nuclear reactor labs which are hazardous to human body.
- Having a android control facility this robot can perform many tasks that human cannot or dangerous for human to handle.
- With some modifications this robot can be used for helping the physically challenged people. Stable performance and long life
- Simple drive circuit
- Low power consumption.
- This system helps in accidents.
- Efficient and low cost design.

Disadvantages:

- Manual attention is required
- Movement is limited to one direction at one time
- Up to 8-10 meters the zigbee. Can transfers the data
- Robots can’t take self dessisions with out programming.

Applications**:**

- Most pick and place applications can be run autonomously by the UR robot arm, making it a perfect pick and place robot.
- Increase productivity and flexibility with Universal Robots pick and place robots. It requires superhuman abilities to repeat the same movement over and over again for many hours with exactly the same precision. That’s why the UR robot’s repeatability of +/- 0.1 mm (.004 in) is perfect for automating quick-precision handling.
- Because of their small size and lightweight robot design, Universal Robots pick and place robots can be easily deployed in applications in tight space conditions.
- Easy programming and a fast average set-up time make Universal Robots robot arms ideal even for small-volume productions, where rearranging large-scale facilities wouldn’t be cost-effective.
- Moving the pick and place robot to new processes is fast and easy, giving you the agility to automate almost any manual task, including those with small batches or fast change-overs. The robot is able to re-use programs for recurrent tasks.

- All Universal Robots robot arms are certified IP-54. They will need protection when working in corrosive liquid environments.

CHAPTER 4: RESULTS

4.1 Result:

The project "**Pick and Place Robotic ARM**" The work is designed to develop a pick and place robotic arm with a soft catching gripper that is designed to avoid extra pressure on the suspected object (Like Bombs) for safety reasons. At the transmitting end using Mems and flex sensors, commands are sent to the motors to control the movement of the ARM either to move up, down, open, close, left and right using zigbee. At the receiving end three motors are interfaced to the zigbee where two of them are used for arm and gripper movement of the ARM. The main advantage of this robot is its soft catching arm that is designed to avoid extra pressure on the suspected object for safety reasons.

4.2 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 project has been successfully implemented. Thus the project has been successfully designed and tested.

4.3 Future Scope:

Our efforts to develop a low-cost integrated system for development of pick and place robot have thus far resulted in the iterative development of a tested, proven hardware platform. The software stack has been developed for localization, navigation, and radioactive element detection. Future work can be done on the robustness of court localization and further code optimizations, which are two necessary steps for the integration of these components. The eventual goal for this project is fully automated bottle filling pick and place robot with minimum space. The preliminary results for localization, motion planning and bottle detection are encouraging. The communication from the Robots to GUI application can be implemented through the base station so that it can control up to 10 Robots from the GUI application through the base station that use a secured wireless channel using encryption and decryption. Considerably larger bandwidth system should be on board because video streaming service is desired. The future work can make the system robust to environmental variations; it can also aim to develop the decision-making functionality of the platform to create a truly autonomous system.

5).REFERENCES

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