DESIGN OF AN INDUSTRIAL MULTIPURPOSE ROBOT

Project Report submitted in partial fulfillment of the requirement for the degree of

Bachelor of Technology

in

Electronics and Communication Engineering

under the Supervision of

Ms. Vanita Rana

By

Armaan Singla (101018)

Shrey Krishna (101072)

Sanchit Jain (101117)

to

Department of Electronics And Communication Engineering

Jaypee University of Information Technology

Waknaghat, Solan – 173234, Himachal Pradesh

Certificate

This is to certify that project report entitled "**Design of an industrial multipurpose robot**", submitted by **Armaan singla, Shrey Krishna** and **Sanchit Jain** in partial fulfillment for the award of degree of Bachelor of Technology in Electronics and Communication Engineering to Jaypee University of Information Technology, Waknaghat, Solan has been carried out under my supervision.

This work has not been submitted partially or fully to any other University or Institute for the award of this or any other degree or diploma.

Date:

Supervisor's Name: Ms. Vanita Rana

Designation: Asst. Professor(ECE)

Signature:

Acknowledgement

We would like to express our gratitude and appreciation to all those who gave us the possibility to complete this report. A special thanks to our final year project coordinator, **Ms. Vanita Rana**, whose help, stimulating suggestions and encouragement, helped us to coordinate our project especially in writing this report.

Last but not least, many thanks go to the head of the department, Prof. S.V. Bhooshan who has given his full effort in guiding the team in achieving the goal as well as his encouragement to maintain our progress in track. We would to appreciate the guidance given by other supervisor as well as the panels especially in our project presentation that has improved our presentation skills by their comment and tips.

Date: Name of students: Shrey krishna-101072

Armaan Singla-101018

Sanchit Jain- 101117

LIST OF FIGURES

ABSTRACT

The main control unit of our project is a microcontroller which is Atmega16. This project utilizes two DC Motors respectively. The DC motor generates torque directly from DC power supplied to the motor by using stationary permanent magnets, and rotating electrical magnets. The controller is interfaced with dc motors, which are fixed to the Robot to control the direction of the robot. Robot, a machine that perform various complex acts; a device that automatically performs complicated, often repetitive tasks; a mechanism guided by automatic controls .This is a multipurpose robot which can do more than one things at a time. The main purpose of our project is to implement a robot with various types of sensors which are capable of detecting human beings, metal components and serves multi-purpose industrial activities such as:

- Capable of detecting objects.
- Capable of detecting human beings in its line of path.
- Capable of detecting metal.
- Capable of detecting high temperature.
- Capable of detecting light intensity.

Table of Contents

CHAPTER-1

INTRODUCTION

A robot is a virtual or mechanical artificial agent. It is usually an electro-mechanical machine, which is guided by computer or electronic programming, and is thus able to do tasks on its own. Another common characteristic is that by its appearance or movements, a robot often conveys a sense that it has intent or agency of its own. Wireless-controlled robots use RF circuits, which have the drawbacks of limited working range, limited frequency range, and limited control. Use of a joystick for robotic control can overcome these limitations. Input from the user is transmitted serially over an RF link to the robot, where it is received, identified and relayed to the appropriate module. This input is then received at the robot and processed again. Robot is an automatically operated machine that replaces human effort, though it may not resemble human beings in appearance or perform functions in a humanlike manner. The term is derived from Czech word robota, meaning "forced labour".

All robots share the features of a mechanical, movable structure under some form of control. The control of robot involves three distinct phases a) perception, b) processing and c) action. The *industrial multipurpose robot* has been designed in such a way that it can cater to the needs of the industry, the police and also for the personnel safety. It has countless applications and can be used in different environments and scenarios. For instance, at one place the bomb disposal squad can use it, while at another instance it can be used for handling mines.

1.1 HISTORY

Robot Timeline:

- **350BC-** The Greek mathematician, Archytas builds a mechanical bird dubbed "the pigeon" that is propelled by steam.
- **270BC-** a Greek engineer named Ctesibus made a pipe organ called a "hydraulis" and water clocks with movable figures. These clocks were the most accurate until the use of the pendulum in the 17th century.
- **1801- Joseph Jacquard** builds an automated loom that is controlled by a punch card. Punch cards are later used as an input method for some early 20th century computers.
- **1818-** Mary Shelley wrote "Frankenstein" which was about a frightening artificial lifeform created by Dr. Frankenstein.
- **1921-** The term "robot" was first used in a play called "R.U.R" or "Rossum's Universal Robots" by the Czech writer Karel Capek.
- **1940-** Issac Asimov produces a series of short stories about robots starting with "A Strange Playfellow" for Super Series Stories magazine. The story is about a robot bound to protect a child.
- **1941-** Science fiction writer Issac Asimov first used the word "robotics" to describe the technology of robots and predicted the rise of powerful robot industry.

- **1942-** Asimov wrote "Runaround" a story about robots which contained the "Three Laws of Robotics":
  - A robot may not injure a human or through inaction, allow a human being to come to harm.
  - A robot must obey the orders it by human beings except where such orders would conflict with the First law.
  - A robot must protect its own experience as long as such protection does not conflict with First or Second Law.
  - He later adds the "Zeroth Law". A robot may not injure humanity,or, through inaction, allow humanity to come to harm.

- **1948-** "Cybernetics" an influence on artificial intelligence research was published by Norbert Wiener.
- **1997-** Pathfinder lands on Mars. The first node of the ISS is placed in orbit using a robotic arm.
- **2004-** The Mars Exploration Rovers Spirit and Opportunity land on Mars and prove that Mars was once covered with water.
- **2005-** Honda debuts new Asimo robot that can complete office tasks.

1.2 FUNCTIONALITY OF ROBOTS

Word “Robot” can refer to both physical robots and virtual software agents, but the later are usually referred to as bots. Robots tend to do some or all of the following: move around, operate a mechanical limb, sense and manipulate their environment, and exhibit intelligent behavior — especially behavior which mimics humans or other animals.

1.2.1 DEFINING CHARACTERISTICS

A Typical Robot will have several, or possibly all, of the following characteristics. It is an electric machine which has some ability to interact with physical objects and to do a specific task or to do a whole range of tasks. It may also have some ability to perceive and absorb data on physical objects, or on its local physical environment, or to process data, or to respond to various stimuli. This is in contrast to a simple mechanical device such as a gear or a hydraulic press.

1.2.2 METAL AGENCY

The physical appearance of a machine is less important than the way its actions are controlled. The more the control system seems to have agency of its own, the more likely the machine is to be called a robot. An important feature of agency is the ability to make choices. A clockwork car is never considered a robot. A mechanical device able to perform some preset motions but with no ability to adapt (an automaton) is considered a robot. A remotely operated vehicle is sometimes considered a robot. A car with an onboard computer, which could drive in a programmable sequence, might be called a robot.

A self-controlled car that could sense its environment and make driving decisions based on this information, such as the 1990s driverless cars of Ernst Dickmanns, would quite likely be called a robot. A sentient car, like the fictional KITT, which can make decisions, navigate freely and converse fluently with a human, is usually considered a robot.

1.2.3 PHYSICAL AGENCY

A player piano is rarely characterized as a robot. A CNC milling machine is very occasionally characterized as a robot. A factory automation arm is almost always characterized as an industrial robot. An autonomous wheeled or tracked device, such as a self-guided rover or self-guided vehicle, is almost always characterized as a mobile robot or service robot. A zoomorphic mechanical toy, like Roboraptor, is usually characterized as a robot. A mechanical humanoid, like ASIMO, is almost always characterized as a robot, usually as a service robot.

CHAPTER – 2

BLOCK DIAGRAM

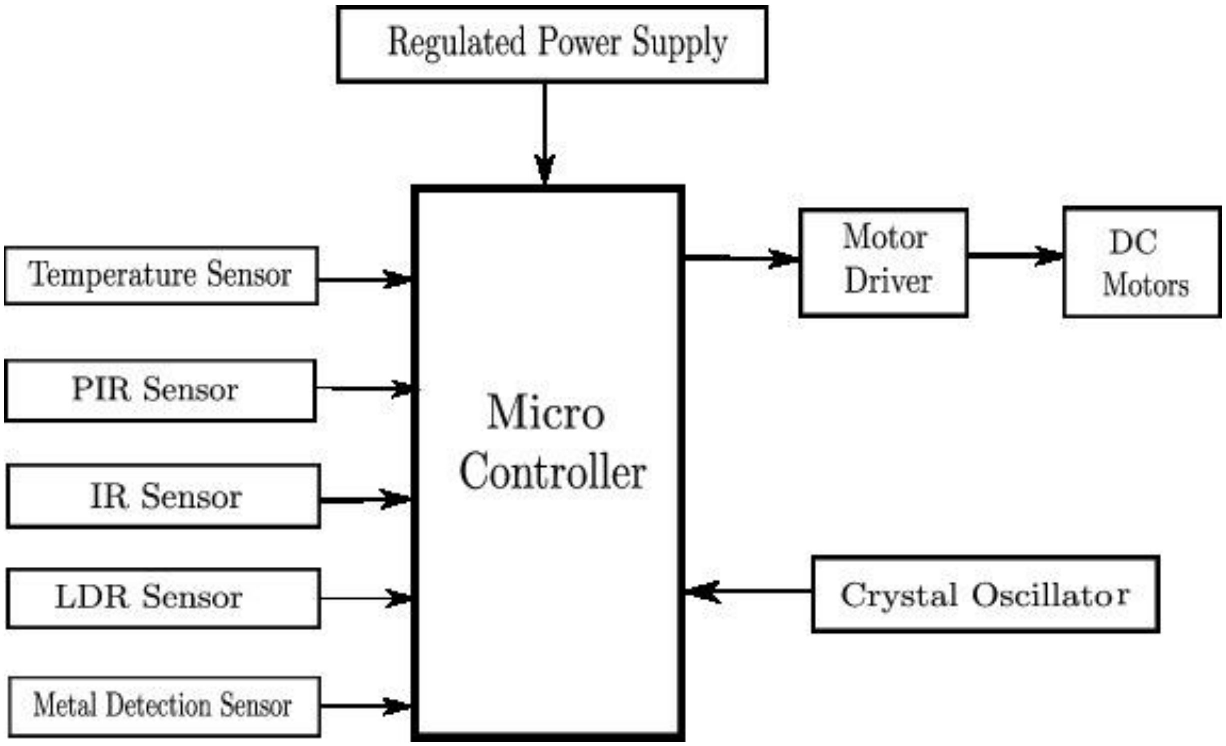

Figure 21 - Main block diagram of the circuit

The project focuses on the following advancements:.

- Characteristics of IR Sensor.
- Characteristics of PIR sensor.
- Characteristics of Temperature Sensor.
- Characteristics of Metal Detection sensor.
- DC motor interfacing to microcontroller.

CHAPTER-3

HARDWARE DESCRIPTION

3.1 COMPONENTS USED

- Regulated power supply
- Microcontroller
- PIR sensor
- Metal detection sensor
- LDR sensor
- IR sensor
- Temperature sensor
- RF module
- DC motor with driver
- Robot's chassis
- Buzzer with driver

3.2 DESCRIPTION OF COMPONENTS

3.2.1 POWER SUPPLY

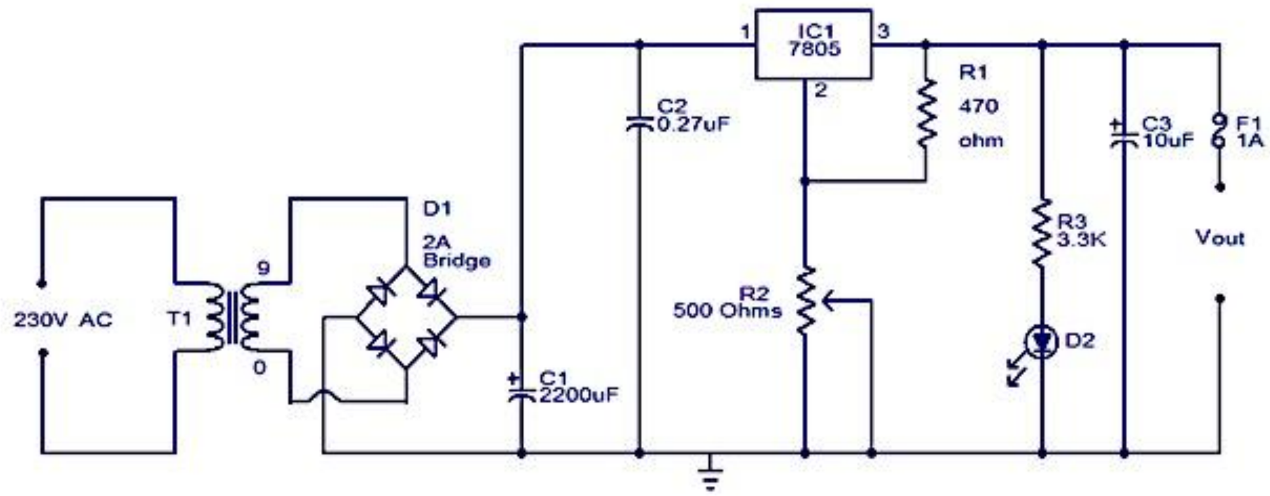

Figure 22 - Power supply circuit diagram

For Micro-controller,+5V is required. For Buzzer +12V is required. The power supply provides regulated output of +5V and non-regulated output of +12V.The three terminal IC7805 meet the requirement of +5V regulated. The secondary voltage from the main transformer is rectified by electronic rectifier and filtered by capacitor. DC voltage is supplied to the input pin of the IC. The IC used are fixed regulator with internal short circuit current limiting and thermal shutdown capability.

3.2.2 MICRO CONTROLLER

INTRODUCTION

Microprocessors and microcontrollers are widely used in embedded systems products. Microcontroller is a programmable device. A microcontroller has a CPU in addition to a fixed amount of RAM, ROM, I/O ports and a timer embedded all on a single chip. The microcontroller used in this project is ATmega16.

ATmega16

ATmega16 is an 8-bit high performance microcontroller of Atmel's Mega AVR family with low power consumption. Atmega16 is based on enhanced RISC (Reduced Instruction Set Computing) architecture with 131 powerful instructions. Most of the instructions execute in one machine cycle. Atmega16 can work on a maximum frequency of 16MHz.ATmega16 has 16 KB programmable flash memory, static RAM of 1 KB and EEPROM of 512 Bytes.ATmega16 is a 40 pin microcontroller.

PIN DIAGRAM:

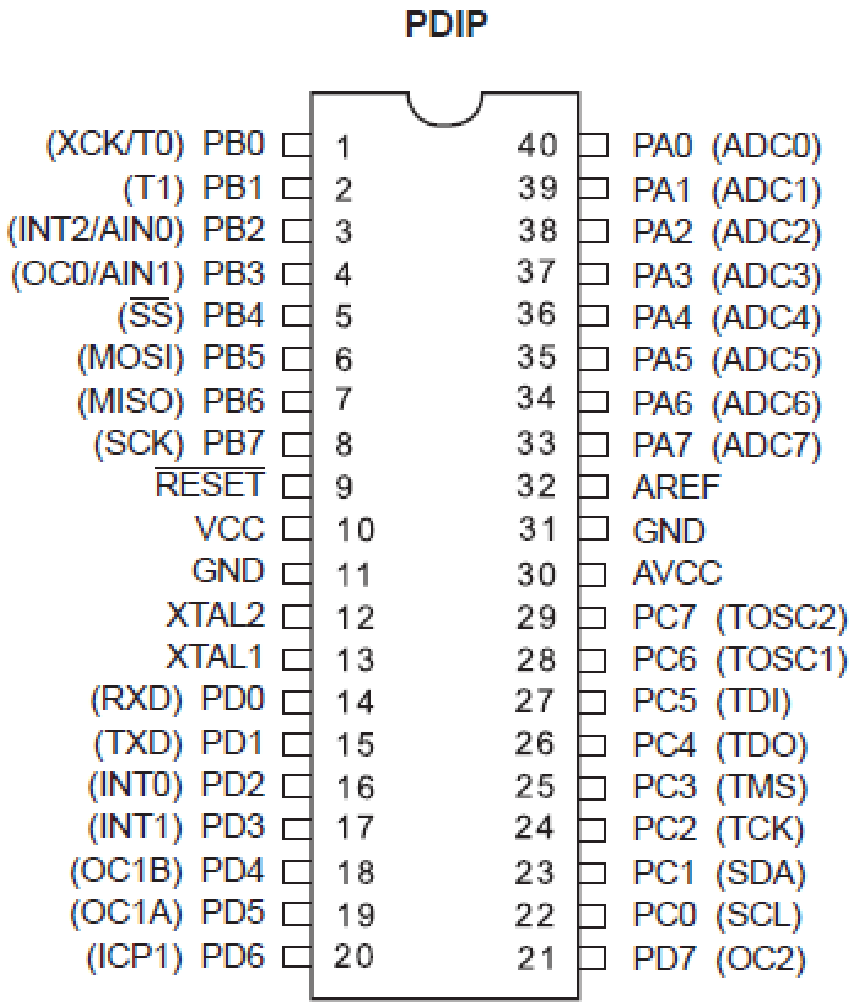

Figure 23 - Pin diagram of ATmega16

PIN Description:

Pin No.	Pin name	Description	Alternate Function
1	(XCK/T0) PB0	I/O PORTB, Pin 0	T0: Timer0 External Counter Input. XCK : USART External Clock I/O
2	(T1) PB1	I/O PORTB, Pin 1	T1:Timer1 External Counter Input
3	(INT2/AIN0) PB2	I/O PORTB, Pin 2	AIN0: Analog Comparator Positive I/P INT2: External Interrupt 2 Input
4	(OC0/AIN1) PB3	I/O PORTB, Pin 3	AIN1: Analog Comparator Negative I/P OC0 : Timer0 Output Compare Match Output
5	(SS) PB4	I/O PORTB, Pin 4	In System Programmer (ISP) Serial Peripheral Interface (SPI)
6	(MOSI) PB5	I/O PORTB, Pin 5	
7	(MISO) PB6	I/O PORTB, Pin 6	
8	(SCK) PB7	I/O PORTB, Pin 7	
9	RESET	Reset Pin, Active Low Reset	
10	Vcc	Vcc = +5V	
11	GND	GROUND	
12	XTAL2	Output to Inverting Oscillator Amplifier	
13	XTAL1	Input to Inverting Oscillator Amplifier	
14	(RXD) PD0	I/O PORTD, Pin 0	USART Serial Communication Interface
15	(TXD) PD1	I/O PORTD, Pin 1	
16	(INT0) PD2	I/O PORTD, Pin 2	External Interrupt INT0
17	(INT1) PD3	I/O PORTD, Pin 3	External Interrupt INT1
18	(OC1B) PD4	I/O PORTD, Pin 4	PWM Channel Outputs
19	(OC1A) PD5	I/O PORTD, Pin 5	
20	(ICP) PD6	I/O PORTD, Pin 6	Timer/Counter1 Input Capture Pin
21	PD7 (OC2)	I/O PORTD, Pin 7	Timer/Counter2 Output Compare Match Output
22	PC0 (SCL)	I/O PORTC, Pin 0	TWI Interface
23	PC1 (SDA)	I/O PORTC, Pin 1	

24	PC2 (TCK)	I/O PORTC, Pin 2	JTAG Interface
25	PC3 (TMS)	I/O PORTC, Pin 3	
26	PC4 (TDO)	I/O PORTC, Pin 4	
27	PC5 (TDI)	I/O PORTC, Pin 5	
28	PC6 (TOSC1)	I/O PORTC, Pin 6	Timer Oscillator Pin 1
29	PC7 (TOSC2)	I/O PORTC, Pin 7	Timer Oscillator Pin 2
30	Avcc	Voltage Supply = Vcc for ADC	
31	GND	GROUND	
32	AREF	Analog Reference Pin for ADC	
33	PA7 (ADC7)	I/O PORTA, Pin 7	ADC Channel 7
34	PA6 (ADC6)	I/O PORTA, Pin 6	ADC Channel 6
35	PA5 (ADC5)	I/O PORTA, Pin 5	ADC Channel 5
36	PA4 (ADC4)	I/O PORTA, Pin 4	ADC Channel 4
37	PA3 (ADC3)	I/O PORTA, Pin 3	ADC Channel 3
38	PA2 (ADC2)	I/O PORTA, Pin 2	ADC Channel 2
39	PA1 (ADC1)	I/O PORTA, Pin 1	ADC Channel 1
40	PA0 (ADC0)	I/O PORTA, Pin 0	ADC Channel 0

Table 1 - Pin description of Atmega16

3.2.3 DC MOTOR

In any electric motor, operation is based on simple electromagnetism. A current carrying conductor generates a magnetic field; when this is then placed in an external magnetic field, It will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field. The internal configuration of a DC motor is designed to harness the magnetic interaction between a current carrying conductor and an external magnetic field to generate rotational motion.

Every DC motor has six basic parts a) axle, b) rotor, c) stator, d) commutator, e) field magnets, and f) brushes. In DC motors, the external magnetic field is produced by high-strength permanent magnets. The stator is the stationary part of the motor. This includes the motor casing, as well as two or more permanent magnet pole pieces. The rotor rotates with respect to the stator. As the rotor reaches alignment, the brushes move to the next commutator contacts, and energize the next winding. The rotation reverses the direction of current through the rotor winding, leading to a "flip" of the rotor's magnetic field, driving it to continue rotating.

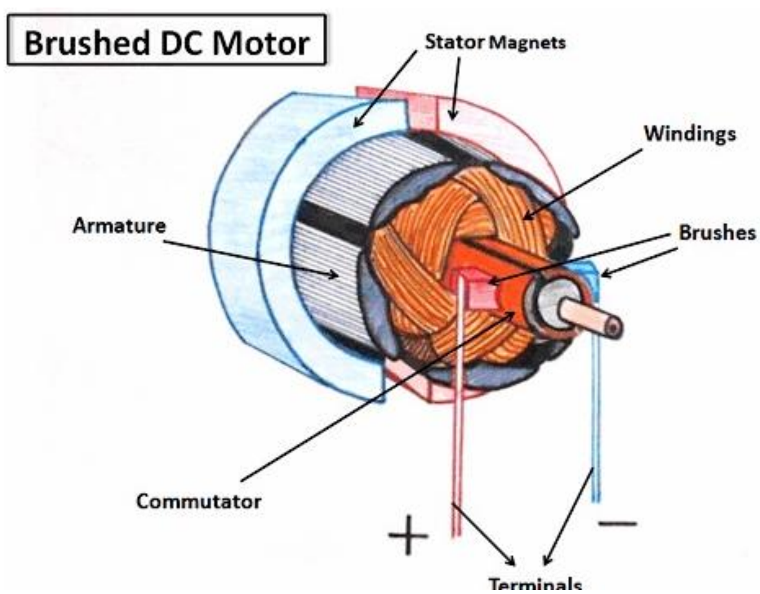

Figure 24 – Labeled diagram Of Brushed DC motor

DC Motor Interfacing with Microcontroller

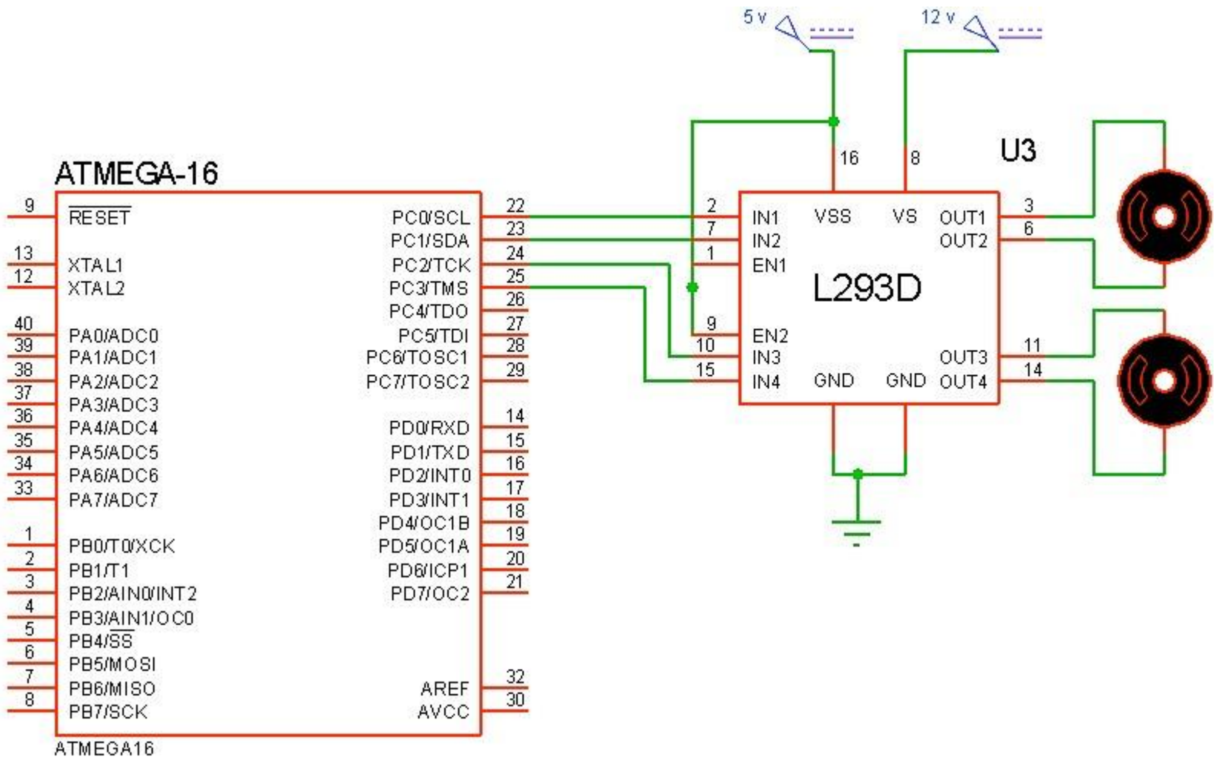

Figure 25 - Circuit diagram of DC motor interfacing with microcontroller

3.2.4 H-BRIDGE

An H-bridge is an electronic circuit, which enables a voltage to be applied across a load in either direction. These circuits are often used in robotics and other applications to allow DC motors to run forwards and backwards. H-bridges are available as integrated circuits, or can be built from discrete components.

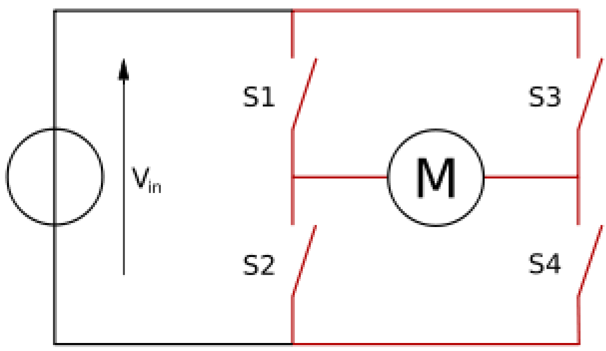

Figure 26 - Circuit diagram of H-Bridge

DESCRIPTION

"H-bridge" is derived from the typical graphical representation of such a circuit. An H-bridge is built with four switches. When the switches S1 and S4 are closed (and S2 and S3 are open) a positive voltage will be applied across the motor. By Opening S1 and S4 switches and closing S2 and S3 switches reverse this voltage reversed, allowing reverse operation of the motor. Using the nomenclature above, the switches S1 and S2 should never be closed at the same time, as this would cause a short circuit on the input voltage source. The same applies to the switches S3 and S4. This condition is known as shoot-through.

OPERATION OF H-BRIDGE

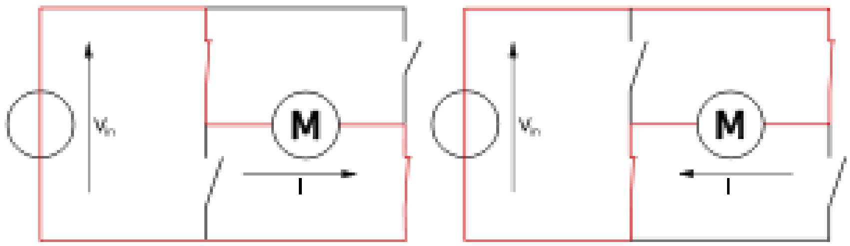

Figure 27 - Operation Of H-Bridge

The H-Bridge arrangement is generally used to reverse the polarity of the motor, but can also be used to 'brake' the motor, where the motor comes to a sudden stop, as the motor's terminals are shorted, or to let the motor 'free run' to a stop, as the motor is effectively disconnected from the circuit. The following table summarizes operation.

S1	S2	S3	S4	Result
1	0	0	1	Motor moves right
0	1	1	0	Motor moves left
0	0	0	0	Motor free runs
0	1	0	1	Motor brakes
1	0	1	0	Motor brakes

Table 2 - Operation of H-Bridge

3.2.5 ROBOT'S BASE

LEFT MOTOR	RIGHT MOTOR	ROBOT MOVEMENT
Straight	Straight	Straight
Reverse	Straight	Left
Straight	Reverse	Right
Reverse	Reverse	Reverse

Table 3 - Movement of robot using motors

3.2.6 PIR SENSOR

Figure 28 - PIR sensor

INTRODUCTION

Passive infrared sensor (PIR) is a device used to detect motion by receiving infrared radiation. When a person walks past the sensor, it detects a rapid change of infrared energy and sends a signal. PIR sensors are used for applications such as automatically turning on lights when someone enters a room or causing a video camera to begin operating.

Every object that has a temperature above perfect zero emits thermal energy (heat) in form of radiation. We, homo sapiens, radiate at wavelength of 9-10micrometers all time of the day. The PIR sensors are tuned to detect this IR wavelength which only emanates when a human being arrives in their proximity. The term "pyroelectricity" means: heat that generates electricity (here, an electric signal of small amplitude). Since these sensors do not have an infrared source of their own, they are also termed as passive.

PIRs are basically made of a pyro electric sensor, which can detect levels of infrared radiation. Everything emits some low level radiation, and the hotter something is, the more radiation is emitted. The sensor in a motion detector is actually split in two halves. The reason for that is that we are looking to detect motion (change) not average IR levels. The two halves are wired up so that they cancel each other out. If one half sees more or less IR radiation than the other, the output will swing high or low.

Along with the pyro electric sensor is a bunch of supporting circuitry, resistors and capacitors. It seems that mostly BISS0001 ("Micro Power PIR Motion Detector IC"), undoubtedly a very inexpensive chip is used. This chip takes the output of the sensor and does some minor processing on it to emit a digital output pulse from the analog sensor.

Our new PIRs have more adjustable settings and have a header installed in the 3-pin ground/out/power pads.

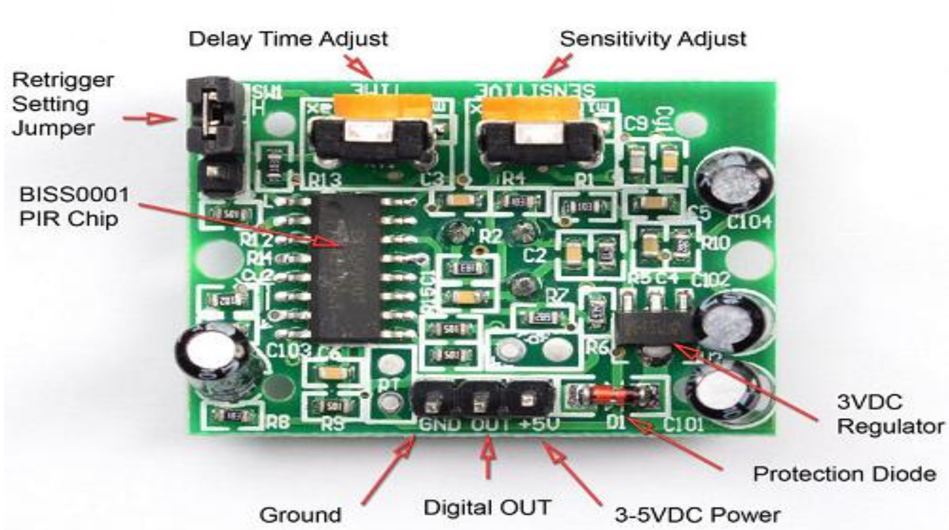

Figure 29 - Labeled diagram of PIR sensor

PIR Sensors are low power and low cost, pretty rugged, have a wide lens range, and are easy to interface with. Note that PIRs won't tell you how many people are around or how close they are to the sensor, the lens is often fixed to a certain sweep and distance and they are also sometimes set off by house pets.

BASIC STATS FOR PIR SENSOR

- **Size:** Rectangular
- **Price:** $10.00 /Rs.500-600
- **Output:** Digital pulse high (3V) when triggered (motion detected) digital low when idle (no motion detected). Pulse lengths are determined by resistors and capacitors on the PCB and differ from sensor to sensor.
- **Sensitivity range:** up to 20 feet (6 meters) 110° x 70° detection range
- **Power supply:** 3V-9V input voltage, but 5V is ideal.

WORKING OF PIR SENSOR

PIR sensors are more complicated than many of the other sensors (like photocells, FSRs) because there are multiple variables that affect the sensors input and output. The PIR sensor has two slots; each slot is made of special material that is sensitive to IR. When the sensor is idle, both slots detect the same amount of IR, the ambient amount radiated from the room or walls or outdoors. When a warm body like a human or animal passes by, it first intercepts one half of the PIR sensor, which causes a positive differential change between the two halves.

When the warm body leaves the sensing area, the reverse happens, whereby the sensor generates a negative differential change. These change pulses are what is detected. The IR sensor itself is housed in a hermetically sealed metal can to improve noise/temperature/humidity immunity. There is a window made of IR-transmissive material that protects the sensing element. Behind the window are the two balanced sensors.

3.2.7 METAL DETECTION SENSOR

Metal detector is a portable electronic instrument which detects the presence of metal nearby. Metal detectors are useful for finding metal inclusions hidden within objects, or metal objects buried underground. They often consist of a handheld unit with a sensor probe which can be swept over the ground or other objects. If the sensor comes near a piece of metal this is indicated by an indicator. Usually the device gives some indication of distance; the closer the metal is, the higher the tone in the earphone or the higher the needle goes.

Another common type are stationary "walk through" metal detectors used for security screening at access points in prisons, courthouses, and airports to detect concealed metal weapons on a person's body. The simplest form of a metal detector consists of an oscillator producing an alternating current that passes through a coil producing an alternating magnetic field. If a piece of electrically conductive metal is close to the coil, eddy currents will be induced in the metal, and this produces a magnetic field of its own. If another coil is used to measure the magnetic field (acting as a magnetometer), the change in the magnetic field due to the metallic object can be detected.

WORKING OF METAL DETECTOR SENSOR

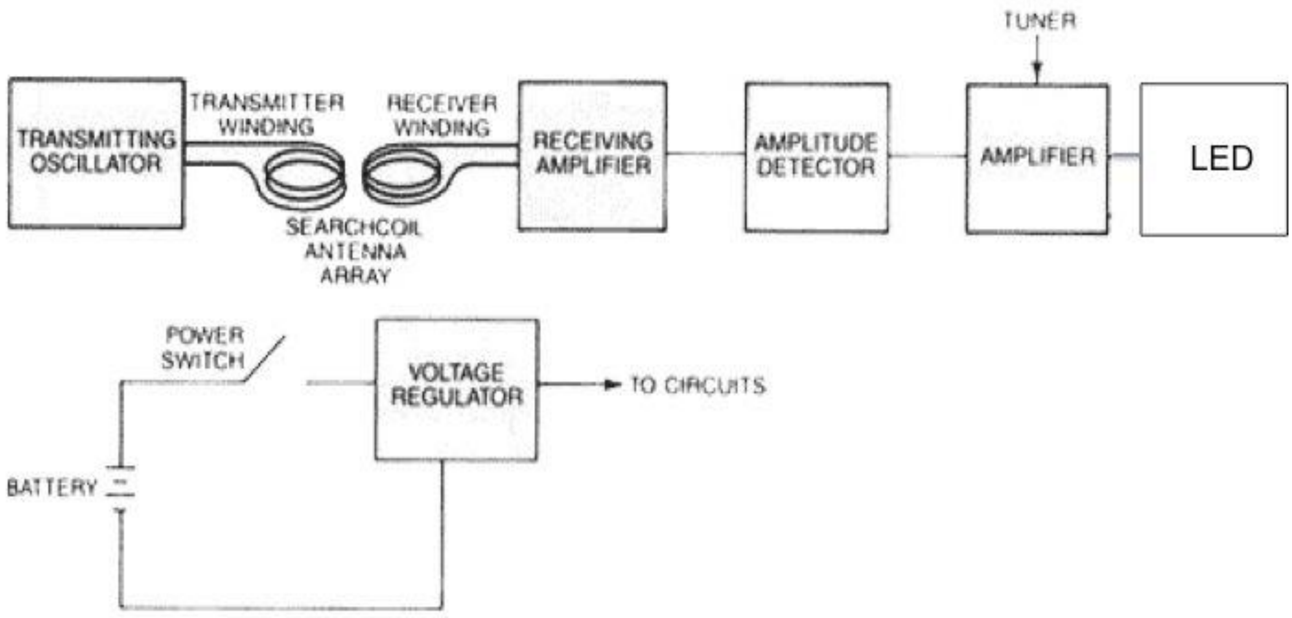

Figure 30 - Circuit diagram for metal detector sensor

As the current circulates in the transmitter antenna, an invisible electromagnetic field is generated that flows out into any surrounding medium, i.e.: air, wood, rock, earth materials, water, etc. in all directions. If this electromagnetic field were visible, with the transmitter antenna embedded in its center. Consequently, they crowd together as they pass through the circular antenna, but they are not crowded on the outside. Whenever metal comes within the detection pattern, electromagnetic field lines penetrate the metal's surface. Tiny circulating currents called "eddy currents" are caused to flow on the metal surface. The power or motivating force that causes eddy currents to flow comes from the electromagnetic field itself.

The detector's circuits sense resulting power loss by this field. Also, eddy currents generate a secondary electromagnetic field that, in some cases, flows out into the surrounding medium. The portion of the secondary field that intersects the receiver winding, causes a detection signal to occur in that winding. Thus, the detector alerts the operator that metal has been detected.

3.2.8 LDR SENSOR

A **light-dependent resistor**, alternatively called an **LDR**, **photoresistor**,**photoconductor**, or *photocell*, is a variable resistor whose value decreases with increasing incident light intensity. An LDR is made of a high-resistance semiconductor. If light falling on the device is of high enough frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electron (and its hole partner) conduct electricity, thereby lowering resistance.

A photoelectric device can be either intrinsic or extrinsic. In intrinsic devices, the only available electrons are in the valence band, and hence the photon must have enough energy to excite the electron across the entire bandgap. Extrinsic devices have impurities added, which have a ground state energy closer to the conduction band - since the electrons don't have as far to jump, lower energy photons (i.e. longer wavelengths and lower frequencies) are sufficient to trigger the device. Two of its earliest applications were as part of smoke and fire detection systems and camera light meters. Because cadmium sulphide cells are inexpensive and widely available, LDRs are still used in electronic devices that need light detection capability, such as security alarms, street lamps, and clock radios.

LIGHT DEPENDENT RESISTOR

Figure 31 - Light dependent resistor

As its name implies, the **Light Dependent Resistor** (LDR) is made from a piece of exposed -semiconductor material such as cadmium sulphide that changes its electrical resistance from several thousand Ohms in the dark to only a few hundred Ohms when light falls upon it by creating hole-electron pairs in the material.

The net effect is an improvement in its conductivity with a decrease in resistance for an increase in illumination. Also, photoresistive cells have a long response time requiring many seconds to respond to a change in the light intensity. Materials used as the semiconductor substrate include, lead sulphide (PbS), lead selenide (PbSe), indium antimonide (InSb) which detect light in the infra-red range with the most commonly used of all photoresistive light sensors being**Cadmium Sulphide** (Cds).

. An LDR is a component that has a resistance that changes with the light intensity that falls upon it. They have a resistance that falls with an increase in the light intensity falling upon the device.

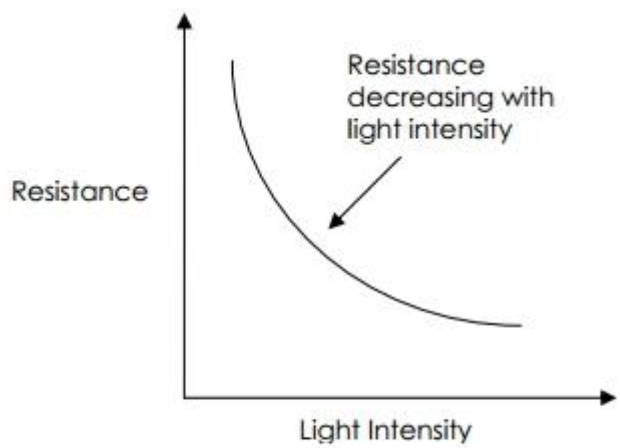

Figure 32 - Resistance vs light intensity

The resistance of an LDR may typically have the following resistances.

Daylight = 5000 ohms

Dark = 20000000 ohms

Circuit Diagram Of LDR Sensor

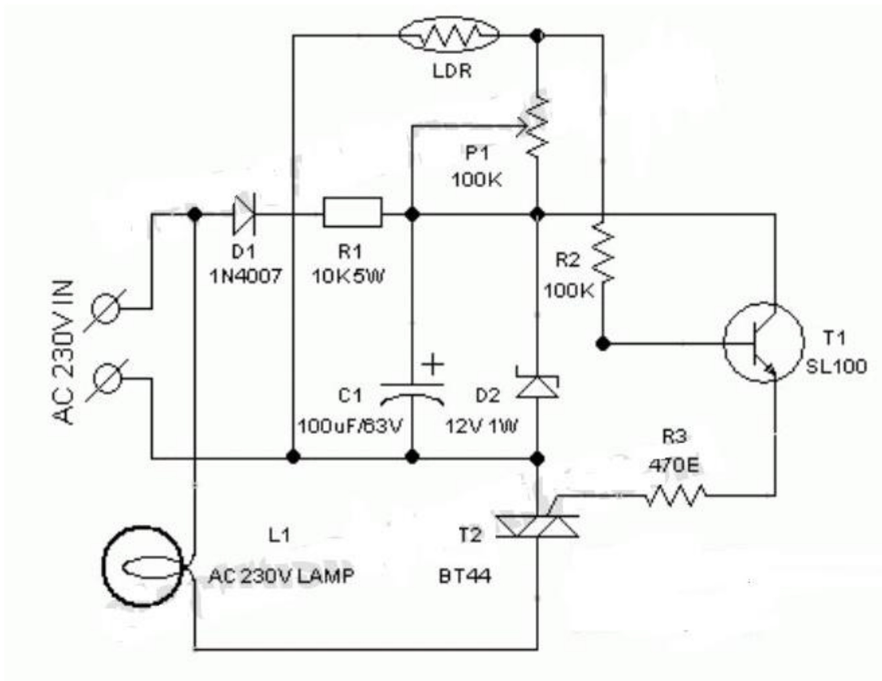

Figure 33 - Circuit diagram of LDR sensor

Applications

There are many applications for Light Dependent Resistors. These include.

LIGHTING SWITCH

The most obvious application for an LDR is to automatically turn on a light at certain light level. An example of this could be a street light.

CAMERA SHUTTER CONTROL

LDRs can be used to control the shutter speed on a camera. The LDR would be used the measure the light intensity and the set the camera shutter speed to the appropriate level.

3.2.9 IR Sensor

An IR sensor is a device which detects IR radiation falling on it. There are numerous types of IR sensors that are built and can be built depending on the application. Proximity sensors (Used in Touch Screen phones and Edge Avoiding Robots), contrast sensors (Used in Line Following Robots) and obstruction counters/sensors (Used for counting goods and in Burglar Alarms) are some examples, which use IR sensors.

WORKING OF IR SENSOR

An IR sensor is basically a device which consists of a pair of an IR LED and a photodiode which are collectively called a photo-coupler or an opto-coupler. The IR LED emits IR radiation, reception and/or intensity of reception of which by the photodiode dictates the output of the sensor.

A. Direct incidence

We may hold the IR LED directly in front of the photodiode, such that almost all the radiation emitted, reaches the photodiode. This creates an invisible line of IR radiation between the IR LED and the photodiode. Now, if an opaque object is placed obstructing this line, the radiation will not reach the photodiode and will get either reflected or absorbed by the obstructing object. This mechanism is used in object counters and burglar alarms.

B. Indirect Incidence

High school physics taught us that black color absorbs all radiation, and the color white reflects all radiation. We use this very knowledge to build our IR sensor. If we place the IR LED and the photodiode side by side, close together, the radiation from the IR LED will get emitted straight in the direction to which the IR LED is pointing towards, and so is the photodiode, and hence there will be no incidence of the radiation on the photodiode. Please refer to the right part of the illustration given below for better understanding. But, if we place an opaque object in front the two, two cases occur:

C. Reflective Surface

If the object is reflective, (White or some other light color), then most of the radiation will get reflected by it, and will get incident on the photodiode.

D. Non-reflective Surface

If the object is non-reflective, (Black or some other dark color), then most of the radiation will get absorbed by it, and will not become incident on the photodiode. It is similar to there being no surface (object) at all, for the sensor, as in both the cases, it does not receive any radiation.

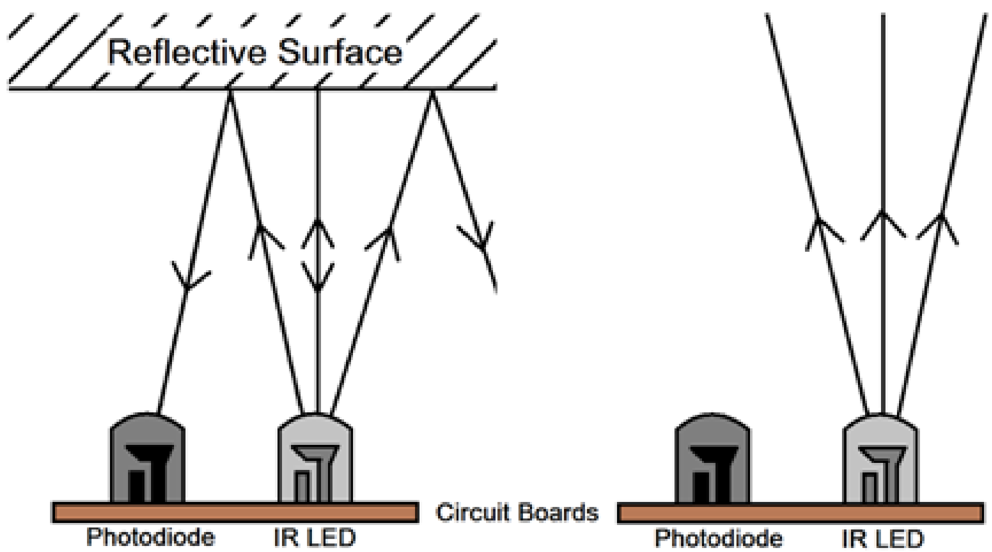

Figure 34 – Reflective and non-reflective surfaces

USES OF IR SENSOR

A. Proximity Sensors

We use reflective indirect incidence for making proximity sensors. The radiation emitted by the IR LED is reflected back on the photodiode by an object. Closer the object, higher will be the intensity of the incident radiation on the photodiode. This intensity is made analogous to a voltage by a circuit, which is then used to determine the distance.

Proximity sensors find use in Touch Screen phones, apart from many other devices. In a Touch Screen Phone, the touch screen needs to disabled when it is held near the ear, while in use, so that even if the cheek makes contact with the tough screen, there is no effect.

B. Line Follower Robots

IR sensors are the main triggers of the whole line following robot's action mechanism. IR sensors are the ones which detect the color of the surface underneath it and send a signal to the microcontroller or the main circuit which then takes decisions according to the algorithm set by the creator of the bot. The sensors used in them are based on **reflective/non-reflective indirect incidence**. The IR LED emits IR radiation, which in normal state gets reflected back to the module from the white surface around the black line, which gets incident on the photodiode. But, as soon as the IR radiation falls on the black line, the IR radiation gets absorbed completely by the black color, and hence there is no reflection of the IR radiation going back to the sensor module.

C. Item Counter

This is based on **direct incidence** of radiation on the photodiode. Whenever an item obstructs the invisible line of IR radiation, we make an increment in the value of a stored variable in a computer/microcontroller which may be indicated by LEDs, Seven Segment Displays, LCDs etc.

These counters are often used in monitoring systems of large factories, where products on conveyor belts, that are loaded/unloaded are counted.

D. Burglar Alarm

This is also based on **direct incidence** of radiation on the photodiode. Here, the IR LED is fitted on one side of the door frame, and the photodiode on the other, such that in normal condition, the IR radiation emitted by the IR LED falls on the photodiode directly. As soon as a person obstructs the IR path, the alarm goes off. This alarm can be switched on at night, and switched off in the day, during normal use of the door.

This mechanism is used extensively in security systems and is replicated on a smaller scale for smaller objects, such as exhibits in an exhibition, etc.

COMPONENT REQUIRED FOR DIGITAL SENSOR

1. IR LED
2. Photodiode
3. LM-358M (Op-Amp)
4. 2 x 150 Ω Resistance
5. 1 x 10 kΩ Resistance
6. 1 x 10 kΩ Variable Resistance (Potentiometer/Preset)
7. 5 Volt power source

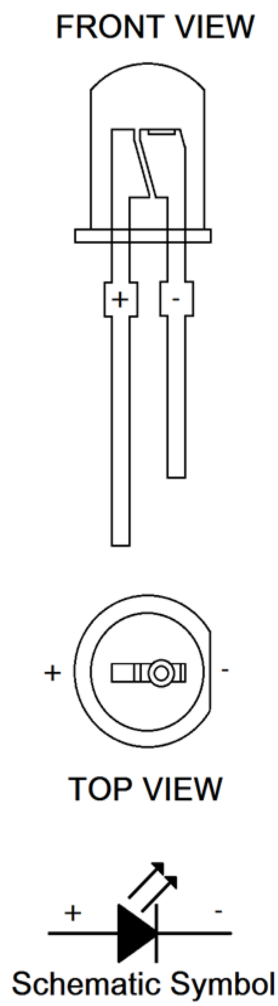

Figure 35 - Detailed diagram of LED

PHOTODIODE

A photodiode is a type of diode which detects light. We can think of it as having a very high resistance when no light is falling on it. As we increase the intensity of light incident on it, the current through it gradually increases too. So, by increasing the incident light on a photodiode, we convert it into a normal low value resistor, which conducts current. We should note here that a photodiode looks exactly like an LED, sometimes, with a dark blue or black film on the outer casing, but we make use of it in reverse bias, that means opposite in configuration as in the case of an LED. You can refer to the diagram above for the connections of the photodiode, but remember to connect it in reverse bias as shown in the circuit diagram given in the "How does it work?" section below.

IC Op-Amp LM358M (as a voltage comparator)

LM358M is a general purpose Dual Operational Amplifier (Op-Amp). Knowing the working of an Op-amp here is really of no use to us, as we are not using it as an amplifier as such, so we will only be talking about how we use it here in the IR sensor circuit, what it does, but not much about how it does it. So basically, we use it to compare two voltages, one is fixed and the other varies with an environmental parameter. If the parameter controlled voltage is higher than the fixed the voltage, then the IC should give one output, and if it is lower than the fixed voltage, then it should give another output. So, we see that the IC gives only two types of outputs, which we design to be 5 Volts and 0 Volts. This makes our sensor digital.

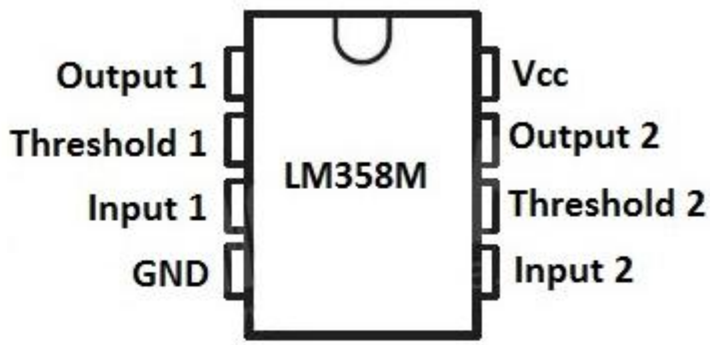

Figure 36 - Pin Configuration for LM358M

Now, we know how to use our Op-Amp, so let's talk about how to connect components to it. This IC is an 8 pin IC. Check the illustration above for the pin layout. Output (pin 1) is where we get the 5/0 Volts, Threshold (pin 2) is the fixed voltage, Input (pin 3) is where we supply our environment controlled voltage, and pin 4 & 8 are used to power up the IC. The best part about this IC is that it is a **Dual Op-Amp**, so you can make two completely separate IR sensors using the same IC! All you need to do is mirror all the connections on the lower three terminals of the other half of the IC (Refer to the pin diagram of the IC).

Variable Resistor

A variable resistor is a 3 pin device which is used to vary resistance. In this circuit, we use it to calibrate the IR sensor according to the environment. We give Vcc and GND to the terminals which are close together and connect the center terminal to the threshold of the IC (Assuming you are using the small triangular PCB mountable package like the one shown below).

Working of IR sensors

If the IR LED emissions become incident on the photodiode, the photodiode's resistance comes down to a finite value. The drop across the 10K series resistor is what we use as the input, which is compared with the threshold. The point to be noted here is that more the incident radiation on the photodiode, less will be the drop across it, and hence more will be the drop across the series resistor. If the voltage developed across the resistor is greater than the threshold set by us, the output of the IC will be high, else it will be low. Hence, if our reflected radiation is never strong enough to be greater than the threshold and we have a constant low as output, we can reduce the threshold voltage by turning the "minus shaped" slit in the variable resistance towards its terminal where we connected Gnd. In case our threshold is very low and the output is always high in spite of no radiation or if it is just too sensitive, then you can increase the threshold by turning the slit the other way. When the emissions are absorbed by a black surface, the resistance of the photodiode becomes very high due to no incidence of IR emissions on it, and the output remains low. An LED to indicate the output.

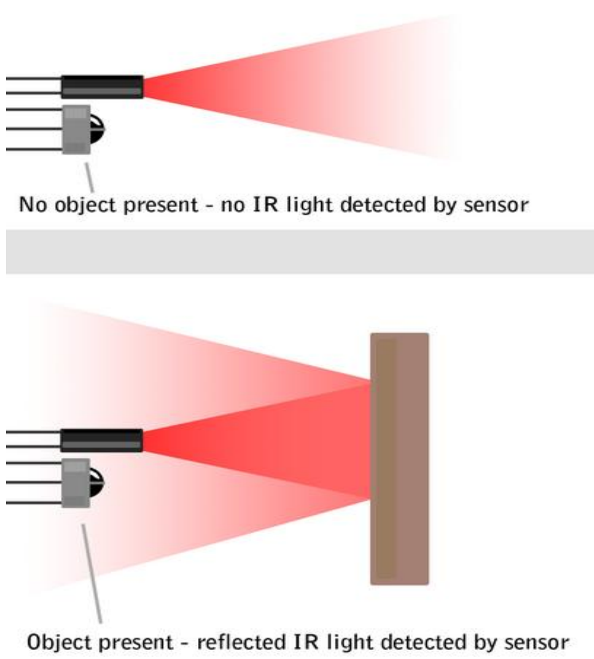

Figure 37 - Working of LM358

Circuit Diagram of IR Sensor:

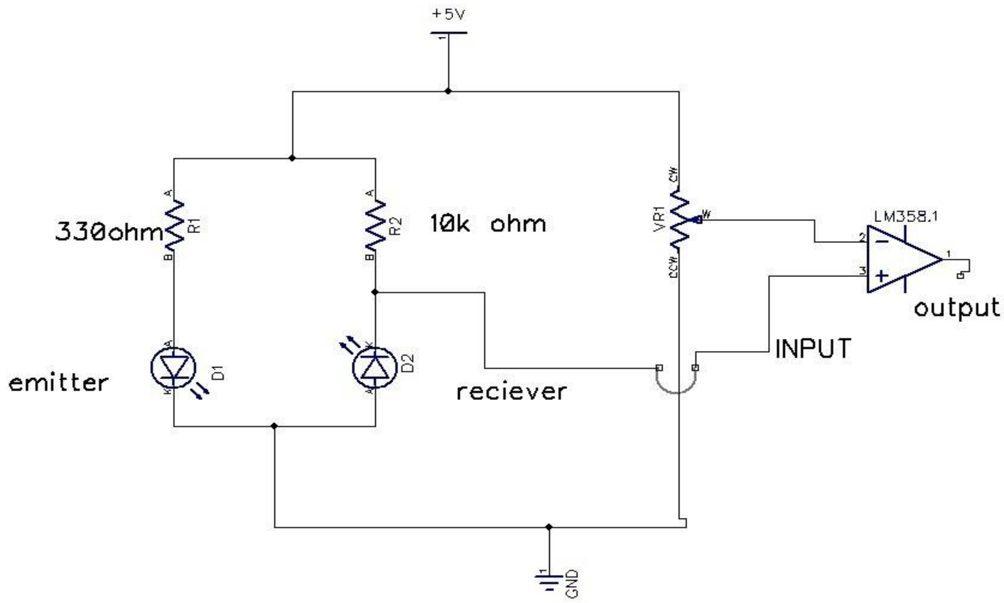

Figure 38 - Circuit diagram of IR sensor

3.2.10 TEMPERATURE SENSOR

The LM35 - An Integrated Circuit Temperature Sensor

The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in ^{o}C).

The LM35 temperature sensor provides an output of 10mV per degree Celsius, with an accuracy of 0.5°C at 25°C. It can be powered by any DC voltage in the range 4 – 30v. The operating range is –55°C to +150°c.

PIN DIAGRAM:-

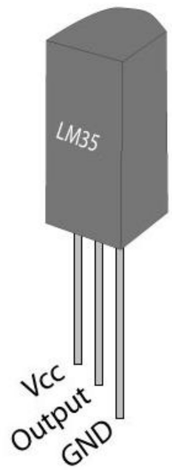

Figure 39 - Pin diagram of LM35

Pin Description:

Pin No	Function	Name
1	Supply voltage; 5V (+35V to -2V)	Vcc
2	Output voltage (+6V to -1V)	Output
3	Ground (0V)	Ground

Table 4 - Pin description of LM35

LM35 is a precision IC **temperature sensor** with its output proportional to the temperature (in °C). The sensor circuitry is sealed and therefore it is not subjected to oxidation and other processes. With **LM35**, temperature can be measured more accurately than with a thermistor. It also possess low self heating and does not cause more than 0.1 °C temperature rise in still air.

The operating temperature range is from -55°C to 150°C. The output voltage varies by 10mV in response to every °C rise/fall in ambient temperature, *i.e.*, its scale factor is 0.01V/ °C.

Working of LM35D

It has an output voltage that is proportional to the Celsius temperature. The scale factor is .01V/^{o}CThe LM35 does not require any external calibration or trimming and maintains an accuracy of +/-0.4 ^{o}C at room temperature and +/- 0.8 ^{o}C over a range of 0^{o}C to +100 ^{o}C.Another important characteristic of the LM35DZ is that it draws only 60 micro amps from its supply and possesses a low self-heating capability. The sensor self-heating causes less than 0.1 ^{o}C temperature rise in still air.

3.2.11 BUZZER

A **buzzer** or **beeper** is an audio signaling device that operates around the audible 2kHz range. it operates directly from a 5V PIC to generate the tones . Buzzers are used to create simple music or user interfaces.

CHAPTER-4

Software Description

4.1 RF TECHNOLOGY

A Radio Frequency (RF) signal refers to a wireless electromagnetic signal used as a form of communication in wireless electronics. Radio waves are a form of electromagnetic radiation with identified radio frequencies that range from 3Hz to 300 GHz. Frequency refers to the rate of oscillation (of the radio waves.) RF propagation occurs at the speed of light and does not need a medium like air in order to travel. RF waves occur naturally from sun flares, lightning, and from stars in space that radiate RF waves as they age. Humankind communicates with artificially created radio waves that oscillate at various chosen frequencies. Individual radio components such as mixers, filters, and power amplifiers can be classified according to operating frequency range, they cannot be strictly categorized by wireless standard (e.g. Wi-Fi, Bluetooth, etc.).

4.2 CVAVR

An IDE has following functions:

- Pre-processing
- Compilation
- Assembly
- Linking
- Object translation
- Text editor

FLOW CHART

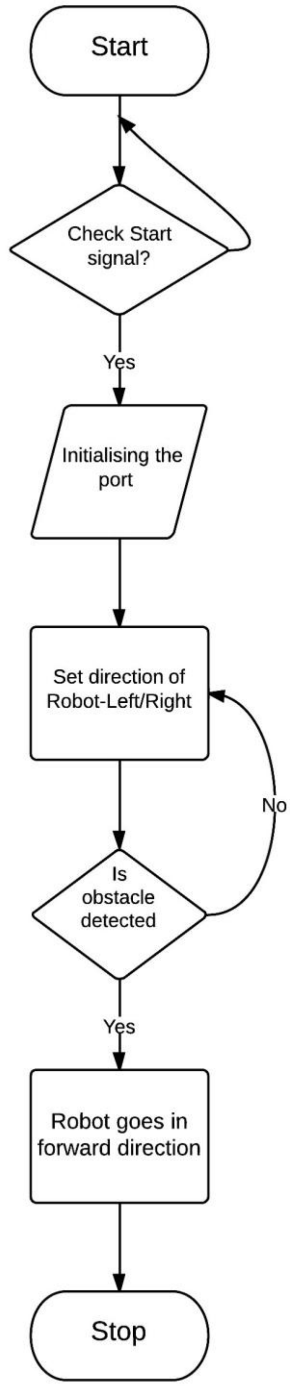

Figure 40 - Flow chart for working of RF module

CHAPTER - 5

APPLICATIONS AND FUTURE ENHANCEMENT

5.1 Challenges

Platform Design

Careful design of the robot’s body can reduce the need for perception and control, compensate for uncertainty, and enhance sensing. Human environments have very different requirements from industrial settings, and attendees of the workshop agreed that the lack of suitable off-the-shelf robotic platforms is a serious impediment to research.

Safety

Robots that work with people must be safe. Traditional industrial manipulators are dangerous, so people are usually prohibited from being in a robot’s workspace when it is in motion. Injury commonly occurs through unexpected physical contact, where forces are exerted through impact, pinching, and crushing.

Designing for Uncertainty

Traditionally, industrial robots have eschewed passive physical compliance at the joints in favor of stiff, precise, and fast operation. This is a reasonable design tradeoff when the state of the world is known with near certainty. Within human environments, compliance and force control are more advantageous since they help the robot safely interact with people, explore the environment, and cope with uncertainty.

5.2 APPLICATIONS

- For surveillance .This spy robot can be used in star hotels, shopping malls and jewellery showrooms where there can be a threat from intruders
- Military reconnaissance mission
- Wirless security and surveillance in hot spots
- Search and rescue operation
- Maneuvering in hazardous environment
- Hidden-object detection

ADVANTAGES:

- Performs different tasks faster
- Makes an activity safer and easier
- Time saving

DISADVANTAGES:

- Requires expertise
- It is not self-sufficient
- A robot is a big investment

5.3 CONCLUSION

This project has been successfully developed and satisfies the aim and objectives of the given assignment. The robot system is a microcontroller based system which can easily be reprogrammed to suit different results and hardware based system. The system is implemented by a program in C programming language .One important area of robotics is to enable the robot to cope with its environment whether this is on land, underwater, in the air, underground, or in space. A fully autonomous robot has the ability to work for an extended period without human intervention. Move either all or part of itself throughout its operating environment without human assistance. Avoid situations that are harmful to people, property, or itself unless those are part of its design specifications.

The Multipurpose Robot has been designed in such a way that it can cater to the needs of the military, the police and armed forces. It has countless applications and can be used in different environments and scenarios. For instance, at one place it can be used by the armed forces, military purposes, while at another instance it can be used for Industrial purposes.

FUTURE SCOPE:

It involves installment of a wireless camera which captures live images of the war field. The robot is wirelessly controlled through PC using RF technology and the live images can be seen on the TV. The camera will have an automatic motion detection feature with a minimum 100 meters transmission distance without block. We also wish to implement spy robot for face recognition where justlook application is installed in terminal PC and will process enrollment and identification of faces. Database can be kept on a separate server or in the same terminal as per organization and requirements.

5.4 REFERENCES

[1] Pete Miles & Tom Carroll, " Build Your Own Combat Robot".

[2] K.S.Fu , R.C.Gonzalez , C.S.G..Lee," Tutorials Robotics ".

[3] Asaro,P. How just could a robot war be?

[4] Frontiers in Artificial Intelligence and Applications

[5] Dr.S.Bhargavi ,"Design of an Intelligent Combat Robot for war fields", International journal of advanced computer science and applications, Vol 2, No. 8, 2011.

[6] Patrick Lin, George Bekey, Keith Abney, "Robots in war: Issues of Risk and Ethics"