LIBRARY MANAGEMENT SYSTEM USING MOBILE ROBOT

A PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

Certified that this project report titled **"LIBRARY MANAGEMENT SYSTEM USING MOBILE ROBOT"** is the bonafied work of "**Srimitha.R, Sujitha.S, Suruthi.A, Shruthi.B"** who carried out the project work under my supervision.

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INTERNAL EXAMINER   **EXTERNAL EXAMINER**

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ABSTRACT

Generally in library, an annual library database checklist is undertaken as a mandatory system. During this period more staffs are engaged for about few days in verifying the availability of books with the computer database. To reduce the time consuming and tiring labour, we suggest a robot to play this role.

The robot consists of a mobile platform running on wheels. It's a line follower robot. The LDR sensor is attached to the robot for determining the path to travel. RF ID reader is used to scan the book number. The robot initially scans the books in the return area and starts scanning the books in the rack and if the book was found missing it will be displayed in the LCD. In case if a book is misplaced a buzzer sound will be given and the book number will be displayed. DC gear motors are engaged to the movement of wheels and RFID. This robot can also be implemented in shopping malls, departmental stores and in many places where stock verification is implemented.

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LIST OF ABBREVIATIONS

ACV   Automated Guided Vehicle

LCD   Liquid Crystal Display

LED   Light Emitting Diode

LDR   Light Dependent Resistor

PIC   Peripheral Interface Controller

RISC   Reduced Instruction Set Computer

ROM   Read Only Memory

EPROM   Erasable Programmable Memory

RAM   Random Access Memory

PWM   Pulse Width Modulation

USART   Universal Synchronous Asynchronous Receiver Transmitter

TRIS   Tristate

PC   Program Counter

SPR   Special Purpose Register

GPR   General Purpose Register

RFID   Radio Freqency identifier

WORM   Write Once Read Many

NO   Normally open

NC   Normally close

LIST OF FIQURES

1.INTRODUCTION

1.1 ROBOTICS:

Robotics is the branch of technology that deals with the design, construction, operation, structural disposition, manufacture and application of robots. Robotics is related to the sciences of electronics, engineering, mechanics, and software. When societies first began developing, nearly all production and effort was the result of human labour, as well as with the aid of semi- and fully domesticated animals. As mechanical means of performing functions were discovered, and mechanics and complex mechanisms were developed, the need for human labour was reduced. Machinery was initially used for repetitive functions, such as lifting water and grinding grain.

There is no consensus on which machines qualify as robots but there is general agreement among experts, and the public, that robots tend to do some or all of the following: move around, operate a mechanical limb, sense and manipulate their environment, and exhibit intelligent behaviour especially behaviour which mimics humans or other animals.

1.2 ROBOTS TYPES:

- Automatic or Semi-Automatic.
- Humanoid.
- Industrial robots or Mobile or Servicing robots.

1.3 MOBILE ROBOTS:

Mobile robots have the capability to move around in their environment and are not fixed to one physical location. An example of a mobile robot that is in

common use today is the automated guided vehicle (AGV). An AGV is a mobile robot that follows markers or wires in the floor, or uses vision or lasers.

Mobile robots are also found in industry, military and security environments. They also appear as consumer products, for entertainment or to perform certain tasks like vacuum cleaning. Mobile robots are the focus of a great deal of current research and almost every major university has one or more labs that focus on mobile robot research.

1.4 LIBRARY MANAGEMENT SYSTEM USING MOBILE ROBOT:

A robot ultimately aims to reduce man power and laborious monotonous task. Likewise, in this project the target is to develop one such intelligent robotic device to outdo manual labor in libraries. This project consists of a mobile platform which will follow the path and reads the books using RF reader. The books are located in the rack. The movement is necessary to read the books which are kept in increasing shelf's. The DC gear motors are used for driving the RF sreader motor and also for the movement of the wheels of the robot.
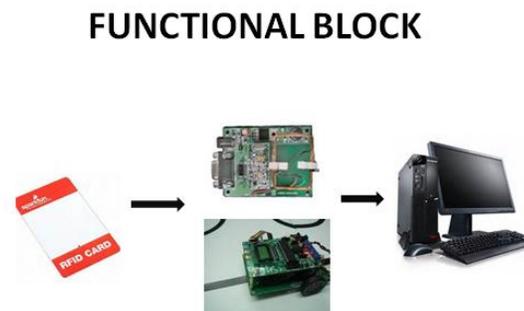
FUNCTIONAL BLOCK

Fig1.1 functional block

2.BLOCK DIAGRAM

INTRODUCTION:

The block diagram of the robot basically consists of the principle parts and functions of the robot which are represented by blocks connected by lines, that show the relationships of the block
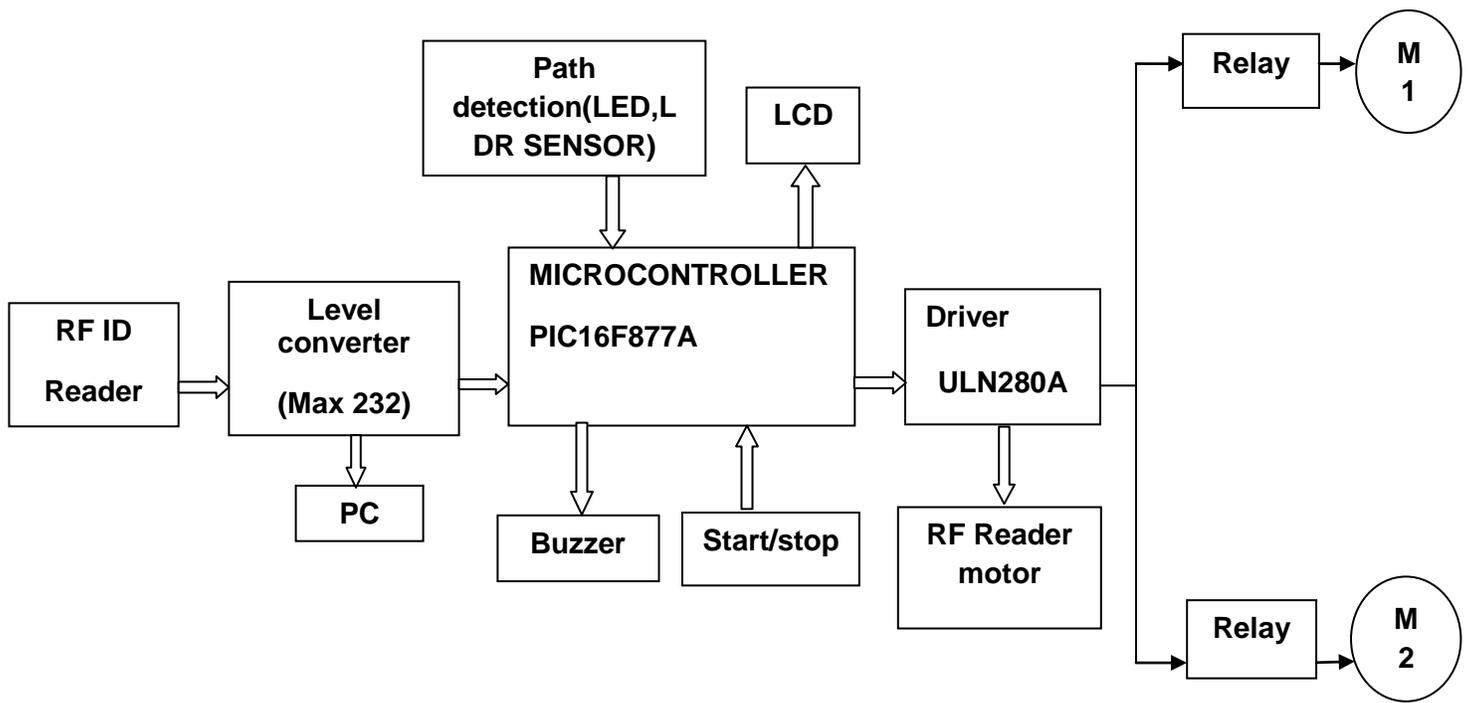
Fig.2.1 Block Diagram

2.2 DESCRIPTION:

- **Line following sensor:** The line following sensor is an IR sensor. The IR reflectance sensors contain a matched infrared transmitter and infrared receiver pair. These devices work by measuring the amount of light that is reflected into the receiver. The robot moves on the line follower track and reads the book details using RF ID.

- **LCD:** A **liquid crystal display** (**LCD**) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals (LCs). LCs does not emit light directly. The LCD here is used for displaying the scanned book details and error details.

- **RFID Reader:** An **RFID reader** is used for reading the book's call number, accession number, book name and author's name. It is generally a device that is used to interrogate an RFID tag. The reader has an antenna that emits radio waves. The tag responds by sending back its data.

- **Path detection sensors:** Line follower accomplishes its task of detecting colour by using an LDR. A light source such as LED is used to transmit light over the track and an LDR sensor is placed near to LED to sense the light.

- **Level converter:** It's a simple RS232 to logic level converter for PIC micros / TTL / CMOS. It will convert logic level voltages to and from RS232 serial voltages levels.

- **Microcontroller PIC16F877A:** This is the brain of the robot. It consists of the basic programming and control of the robot.

- **Driver:** The relays and motors are run by the driver. The driver act as the second most important part in terms of controlling the robot.

- **Motor:** The DC gear motors are used for actuation of the front wheels and the back wheels. The two DC gear motors are used for controlling four wheels .The motor voltage rating is 6V at 10 rpm speed.

- **Personal computer:** The PC is used for the database of the books. The VB.NET software is accessed for the database.

- **Buzzer:** The alarm or the buzzer is an output indication defining the errors identification.

- **Relay:** A relay circuit which can be a motor driver in special cases can pulse motors on and off but without some complexity, which would only control

them in one direction at a time but in some cases for one direction, it might be a viable solution.

- **RF reader motor:** Controls the movement of the RF reader by a 6V 10rpm motor. The motor is interfaced with the RF ID reader which reads the book in the rack.

2.3 ALGORITHM:

- **STEP1:** Start

- **STEP2:** The robot scans the book in the return area and stores the details in the memory.

- **STEP3**: Then the robot starts scanning books inside the library.

- **STEP4**: When a misplaced book is scanned robot indicates with a buzzer and then it can be placed in the respective rack

- **STEP 5:** If the book scanned outside can be placed in the rack the robot displays the book number with a buzzer.

- **STEP 6:** This process is continued for all the racks

- **STEP 7:** Finally its interfaced with the library database.

- **STEP 8:** Stop

2.4 CIRCUIT DIAGRAM:
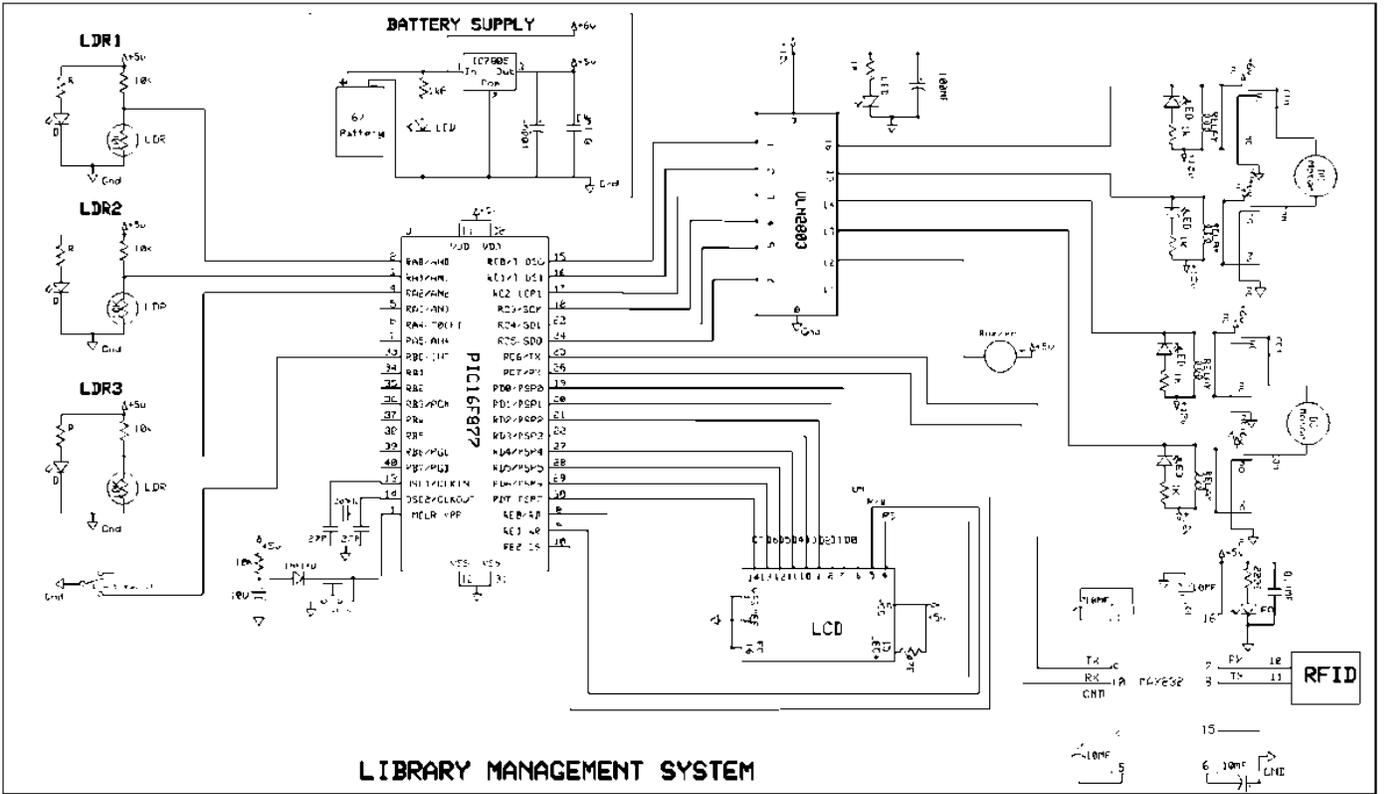
Fig.2.2 circuit diagram

3. MICROCONTROLLER

INTRODUCTION:

The Microcontroller PIC16F877A is from Microchip. It features all the components which modern microcontrollers normally have. For its low price, wide range of application, high quality and easy availability it is an ideal solution in a wide range of applications.

3.1 FEATURES OF PIC16F877A:

- RISC architecture
  - Only 35 instructions to learn
  - All single-cycle instructions except branches
- Operating frequency 0-20 MHz
- Precision internal oscillator
  - Factory calibrated
  - Software selectable frequency range of 8MHz to 31KHz
- Power supply voltage 2.0-5.5V
- Power-Saving Sleep Mode
- Brown-out Reset (BOR) with software control option
- 35 input/output pins
- 8K ROM memory in FLASH technology
- In-Circuit Serial Programming Option
- 256 bytes EEPROM memory
- 368 bytes RAM memory
- A/D converter:
  - 14-channels

- 3 independent timers/counters
- Watch-dog timer
- PWM output steering control
- Enhanced USART module

3.2 DESCRIPTION ABOUT PIC16F877A:

PIC16F877A microcontroller is a fully featured processor with internal RAM, EEROM FLASH memory and peripherals. One of the smallest ones occupies the space of a 555 timer but has a 10bit ADC, 1k of memory, 2 timers, high current I/O ports a comparator a watch dog timer. One of the most useful features of this PIC microcontroller is that you can re-program them as they use flash memory. It can control outputs and react to inputs. The PIC microcontroller has many built in peripherals.

3.3 ARCHITECTURE OF PIC16F877A:
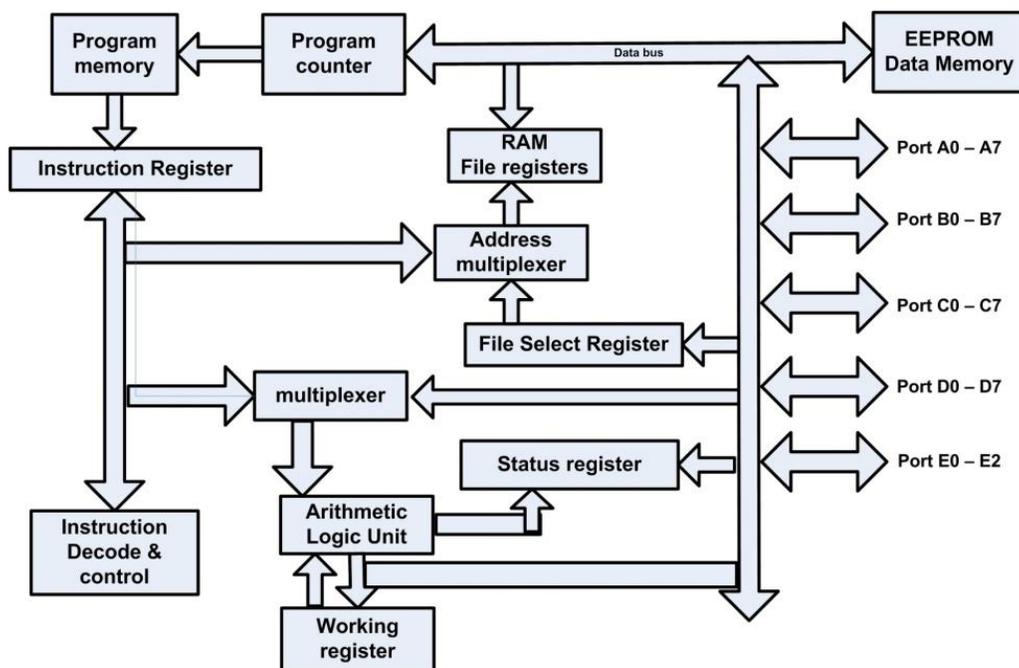
Fig.3.1 Basic Architecture

Device	Program FLASH	Data Memory	Data EEPROM
PIC16F874	4K	192 Bytes	128 Bytes
PIC16F877	8K	368 Bytes	256 Bytes
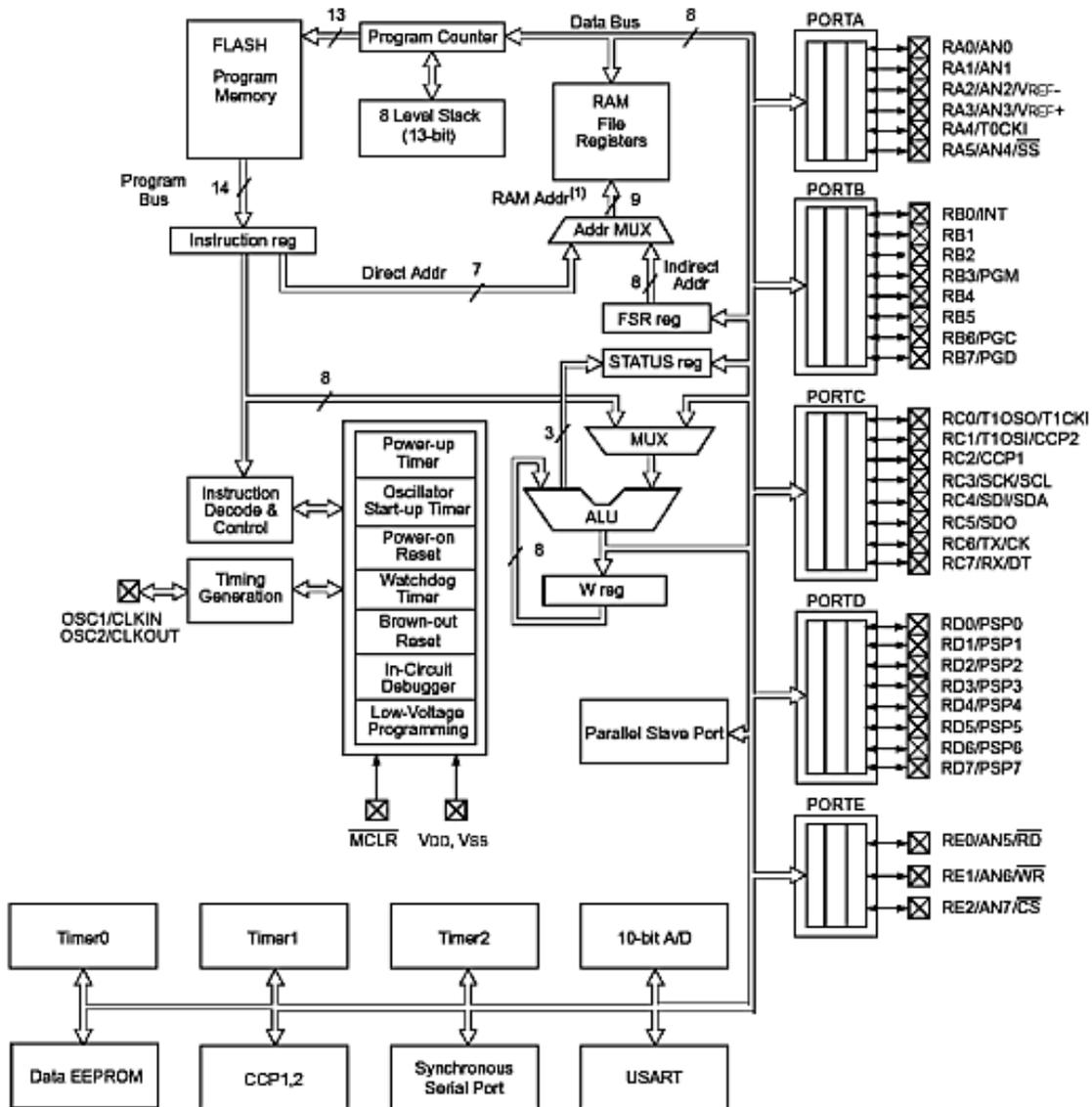
Note 1: Higher order bits are from the STATUS register.

Fig.3.2 internal architecture

3.4 PIN DESCRIPTION:
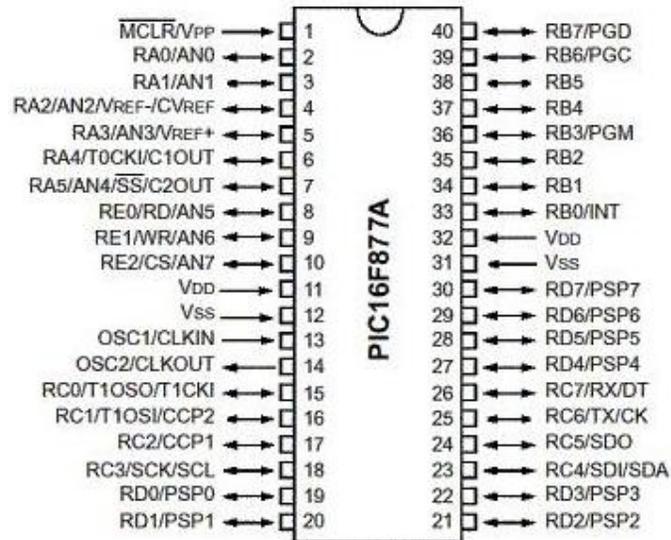
Fig. 3.3 Pin Details

Pin Name	DIP PIN#	I/O/P Type	Buffer Type	Description
MCLR/VPP/TH V	1	I/P	ST	Master clear (reset) input or programming voltage input or high voltage test mode control. This pin is an active low reset to the device.
				PORTA is a bidirectional I/O port.
RA0/AN0	2	I/O	TTL	RA0 can also be analog input0.
RA1/AN1	3	I/O	TTL	RA1 can also be analog input1.
RA2/AN2/VRE F-	4	I/O	TTL	RA2 can also be analog input2 or negative analog reference voltage.
RA3/AN3/VRE F+	5	I/O	TTL	RA3 can also be analog input3 or positive analog reference voltage.
RA4/T0CKI	6	I/O	ST	RA4 can also be the clock input to the Timer0 timer/counter. Output is open drain type.
RA5/SS/AN4	7	I/O	TTL	RA5 can also be analog input4 or the slave select for the synchronous serial port.
				PORTE is a bi-directional I/O port.
RE0/RD/AN5	8	I/O	ST/TTL(3)	RE0 can also be read control for the parallel slave port, or analog input5.
RE1/WR/AN6	9	I/O	ST/TTL(3)	RE1 can also be write control for the parallel slave port, or analog input6.
RE2/CS/AN7	10	I/O	ST/TTL(3)	RE2 can also be select control for the parallel slave port, or analog input7.
VSS	12,31	P	-	Ground reference for logic and I/O pins.
VDD	11,32	P	-	Positive supply for logic and I/O pins.

OSC1/CLKIN	13	I	ST/CMOS (4)	Oscillator crystal input/external clock source input.
OSC2/CLKOUT	14	O	-	Oscillator crystal output. Connects to crystal or resonator in crystal oscillator mode. In RC mode, OSC2 pin outputs CLKOUT which has 1/4 the frequency of OSC1, and denotes the instruction cycle rate.
				PORTC is a bi-directional I/O port.
RC0/T1OSO/T1CKI	15	I/O	ST	RC0 can also be the Timer1 oscillator output or a Timer1 clock input.
RC1/T1OSI/CCP2	16	I/O	S T	RC1 can also be the Timer1 oscillator input or Capture2 input/Compare2 output/PWM2 output.
	17	I/O	ST	RC2 can also be the Capture1 input/Compare1 output/PWM1 output.
RC2/CCP1	18	I/O	ST	RC3 can also be the synchronous serial clock input/output for both SPI and I2C modes.
RC3/SCK/SCL	23	I/O	ST	RC4 can also be the SPI Data In (SPI mode) or data I/O (I2C mode).
RC4/SDI/SDA	24	I/O	ST	RC5 can also be the SPI Data Out (SPI mode).
RC5/SDO	25	I/O	ST	RC6 can also be the USART Asynchronous Transmit or Synchronous Clock.
RC6/TX/CK	26	I/O	ST	RC7 can also be the USART Asynchronous Receive or Synchronous Data.
RC7/RX/DT				
				PORTD is a bi-directional I/O port or
RD0/PSP0	19	I/O	ST/TTL(3)	parallel slave port when interfacing to a microprocessor bus.
RD1/PSP1	20	I/O	ST/TTL(3)	
RD2/PSP2	21	I/O	ST/TTL(3)	
RD3/PSP3	22	I/O	ST/TTL(3)	
RD4/PSP4	27	I/O	ST/TTL(3)	
RD5/PSP5	28	I/O	ST/TTL(3)	
RD6/PSP6	29	I/O	ST/TTL(3)	
RD7/PSP7	30	I/O	ST/TTL(3)	
RB0/INT	33	I/O	TTL/ST(1)	RB0 can also be the external interrupt pin.
RB1	34	I/O	TTL	
RB2	35	I/O	TTL	
RB3/PGM	36	I/O	TTL	RB3 can also be the low voltage programming input Interrupt on change pin.
RB4	37	I/O	TTL	
RB5	38	I/O	TTL	
RB6/PGC	39	I/O	TTL/ST(2)	Interrupt on change pin. Interrupt on change pin. Interrupt on change pin or In-Circuit
RB7/PGD	40	I/O	TTL/ST(2)	Debugger pin. Serial programming

Table 3.4 pin description

3.5 INPUT/ OUTPUT PORTS:

PIC 16F877 series normally has five input/output ports. They are used for the input/output interfacing with other devices/circuits. Most of these port pins are

multiplexed for handling alternate function for peripheral features on the devices. All ports in a PIC chip are bi-directional. When the peripheral action is enabled in Sa pin, it may not be used as its general input/output functions. The PIC 16F877 chip basically has 5 input/output ports. The five input/output ports and its functions are given below.

PORT A and the TRIS A Registers:

PORT A is a 6-bit wide bi-directional port, the direction of this port is controlled by TRIS A data direction register. Setting a TRIS A (=1) makes corresponding PORT A pin as an input, clearing the TRIS A (=0) making the corresponding PORT A pin as an output. Pin RA4 is multiplexed with the "Timer0" module clock input to become the RA4/T0CKI pin and functioning either input/output operation or Timer 0 clock functioning module. The RA4/T0CKI pin is a Schmitt Trigger input and an open-drain output. All other PORT A pins have TTL input levels and full CMOS output drivers.

PORT B and the TRIS B Registers:

PORT B is also an 8 bit bi-directional PORT. Its direction controlled and maintained by TRIS B data direction register. Setting the TRIS B into logic '1' makes the corresponding "PORT B" pin as an input. Clearing the TRIS B bit make PORT B as an output. Three pins of PORT B are multiplexed with the In-Circuit Debugger and Low-Voltage Programming function: RB3/PGM, RB6/PGC and RB7/PGD for performing its alternate functions.

PORT C and the TRIS C Registers:

PORT C is an 8-bit wide, bidirectional PORT which controlled and maintained by TRIS C data direction register. Setting a TRIS C bit (= 1) will make

the corresponding PORT C pin an input (i.e., put the corresponding output driver in a High-Impedance mode). Clearing a TRIS C bit (= 0) will make the corresponding PORT C pin an output PORT C is also multiplexed with several peripheral functions. PORT C pins have Schmitt Trigger input buffers.

PORT D and TRIS D Registers:

PORT D is an 8-bit PORT with bi-directional nature. This port also with Schmitt Trigger input buffers, each pin in this PORT D individually configurable as either input or output. PORT D can be configured as an 8-bit wide microprocessor PORT (functioning as Parallel Slave PORT) by setting control bit, PSPMODE ((TRISE<4>). In this mode, the input buffers are TTL.

PORT E and TRIS E Registers:

PORT E has only three pins (RE0/RD/AN5, RE1/WR/AN6 and RE2/CS/AN7) which are individually configurable as inputs or outputs. These pins controllable by using its corresponding data direction register "TRIS E". These pins also have Schmitt Trigger input buffers. The PORT E pins become the I/O control inputs for the microprocessor PORT when bit PSPMODE is set. In this mode, the user must make certain that the TRIS E bits are set and that the pins are configured as digital inputs.

3.6 MEMORY ORGANIZATION:

The memory of a PIC 16F877 chip is divided into 3 sections. They are

- Program memory
- Data memory and
- Data EEPROM

3.6.1 Program memory:

Program memory contains the programs that are written by the user. The program counter (PC) executes these stored commands one by one. Usually PIC16F877 devices have a 13 bit wide program counter that is capable of addressing 8K×14 bit program memory space. This memory is primarily used for storing the programs that are written (burned) to be used by the PIC. These devices also have 8K*14 bits of flash memory that can be electrically erasable /reprogrammed. The figure below shows the program memory map and stack.
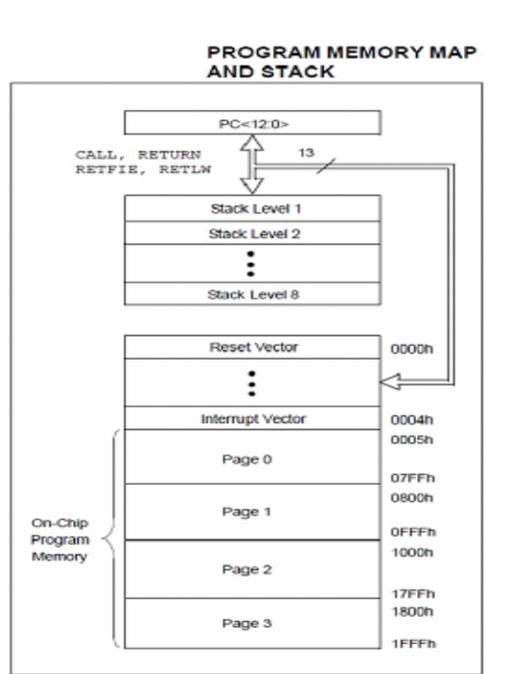

Fig.3.4 program memory

Program counters (PC) is used to keep the track of the program execution by holding the address of the current instruction. The counter is automatically incremented to the next instruction during the current instruction execution.

3.6.2 DATA MEMORY:

The data memory of PIC16F877 is separated into multiple banks which contain the general purpose registers (GPR) and special function registers (SPR). According to the type of the microcontroller, these banks may vary. The PIC16F877 chip only has four banks (BANK 0,BANK 1, BANK 2, and BANK4). Each bank holds 128 bytes of addressable memory.

	File Address		File Address		File Address		File Address
Indirect addr.(*)	00h	Indirect addr.(*)	80h	Indirect addr.(*)	100h	Indirect addr.(*)	180h
TMR0	01h	OPTION_REG	81h	TMR0	101h	OPTION_REG	181h
PCL	02h	PCL	82h	PCL	102h	PCL	182h
STATUS	03h	STATUS	83h	STATUS	103h	STATUS	183h
FSR	04h	FSR	84h	FSR	104h	FSR	184h
PORTA	05h	TRISA	85h		105h		185h
PORTB	06h	TRISB	86h	PORTB	106h	TRISB	186h
PORTC	07h	TRISC	87h		107h		187h
PORTD(1)	08h	TRISD(1)	88h		108h		188h
PORTE(1)	09h	TRISE(1)	89h		109h		189h
PCLATH	0Ah	PCLATH	8Ah	PCLATH	10Ah	PCLATH	18Ah
INTCON	0Bh	INTCON	8Bh	INTCON	10Bh	INTCON	18Bh
PIR1	0Ch	PIE1	8Ch	EEDATA	10Ch	EECON1	18Ch
PIR2	0Dh	PIE2	8Dh	EEADR	10Dh	EECON2	18Dh
TMR1L	0Eh	PCON	8Eh	EEDATH	10Eh	Reserved(2)	18Eh
TMR1H	0Fh		8Fh	EEADRH	10Fh	Reserved(2)	18Fh
T1CON	10h		90h		110h		190h
TMR2	11h	SSPCON2	91h		111h		191h
T2CON	12h	PR2	92h		112h		192h
SSPBUF	13h	SSPADD	93h		113h		193h
SSPCON	14h	SSPSTAT	94h		114h		194h
CCPR1L	15h		95h		115h		195h
CCPR1H	16h		96h		116h		196h
CCP1CON	17h		97h	General Purpose Register 16 Bytes	117h	General Purpose Register 16 Bytes	197h
RCSTA	18h	TXSTA	98h		118h		198h
TXREG	19h	SPBRG	99h		119h		199h
RCREG	1Ah		9Ah		11Ah		19Ah
CCPR2L	1Bh		9Bh		11Bh		19Bh
CCPR2H	1Ch	CMCON	9Ch		11Ch		19Ch
CCP2CON	1Dh	CVRCON	9Dh		11Dh		19Dh
ADRESH	1Eh	ADRESL	9Eh		11Eh		19Eh
ADCON0	1Fh	ADCON1	9Fh		11Fh		19Fh
	20h		A0h		120h		1A0h
General Purpose Register 96 Bytes		General Purpose Register 80 Bytes		General Purpose Register 80 Bytes		General Purpose Register 80 Bytes	
			EFh		16Fh		1EFh
		accesses 70h-7Fh	F0h	accesses 70h-7Fh	170h	accesses 70h-7Fh	1F0h
	7Fh		FFh		17Fh		1FFh
Bank 0		Bank 1		Bank 2		Bank 3	

Fig 3.5 data memory

4.LEAD ACID BATTERY

INTRODUCTION:

An electrical battery is one or more electrochemical cells that convert stored chemical energy into electrical energy. Batteries have become a common power source for many household and industrial applications.

Fig. 4.1 Robot Battery

4.1 TYPES OF BATTERY:

There are two types of batteries: primary batteries or disposable batteries, which are designed to be used once and discarded, and secondary batteries or rechargeable batteries, which are designed to be recharged and used multiple times. Batteries come in many sizes, from miniature cells used to power hearing aids and wristwatches to battery banks the size of rooms that provide standby power.

4.2 LEAD-ACID BATTERY:

A lead-acid battery is a electrical storage device that uses a reversible chemical reaction to store energy. It uses a combination of lead plates or grids and

an electrolyte consisting of a diluted sulphuric acid to convert electrical energy into potential chemical energy and back again. The electrolyte of lead-acid batteries is hazardous to your health and may produce burns and other permanent damage if you come into contact with it.

4.3 OPERATION OF LEAD ACID BATTERIES:

Lead acid battery consists of a negative electrode made of spongy or porous lead. The positive electrode consists of lead oxide. Both electrodes are immersed in a electrolytic solution of sulfuric acid and water. In case the electrodes come into contact with each other through physical movement of the battery or through changes in thickness of the electrodes, an electrically insulating, but chemically permeable membrane separates the two electrodes. This membrane also prevents electrical shorting through the electrolyte.

4.4 ADVANTAGES:

- Inexpensive and simple to manufacture.
- Mature, reliable and well-understood technology - when used correctly, lead-acid is durable and provides dependable service.
- The self-discharge is among the lowest of rechargeable battery systems.
- Capable of high discharge rates.

4.5 LIMITATIONS:

- Low energy density - poor weight-to-energy ratio limits use to stationary and wheeled applications.
- Cannot be stored in a discharged condition - the cell voltage should never drop below 2.10V.

- Allows only a limited number of full discharge cycles - well suited for standby applications that require only occasional deep discharges.

- Lead content and electrolyte make the battery environmentally unfriendly.

- Transportation restrictions on flooded lead acid - there are environmental concerns regarding spillage.

4.6 BATTERY USED IN THE MOBILE ROBOT:

In this mobile robot 6V lead acid battery is used. Then the supply from the battery is regulated using regulator and given to the different parts of the robot.

The battery is placed in the base part of the robot with outer casing. The regulator IC 7805 is used to produce the 5v output for the microcontroller. And 6V is directly given to the 3 motors using the 6 relays. Then the battery can be charged with the help of the charger adapter. The charger part consists of transformer, bridge rectifier and filtering circuits which is connected to two ends of the battery. This lead acid battery has the standby time of 2 hours.

5. SENSORS

INTRODUCTION:

A sensor or also called detectors is a device that measures a physical quantity and converts it into a signal which can be read by an observer or by an instrument. A sensor receives and responds to a signal. A sensor's sensitivity indicates how much the sensor's output changes when the measured quantity changes.

5.1 TYPES OF SENSORS USED:

- LDR
- LED

5.2 LDR:

Light dependent resistors or LDRs are often used in circuits where it is necessary to detect the presence or the level of light. They can be described by a variety of names from light dependent resistor, LDR, photo resistor, or even photo cell (photocell) or photoconductor.

5.2.1 SYMBOL:
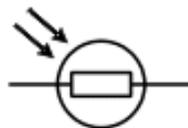
Fig. 4.1 LDR Symbol

Although other devices such as photodiodes or photo-transistor can also be used, LDRs are a particularly convenient electronics component to use. They provide large change in resistance for changes in light level.

5.2.2 CIRCUIT DIAGRAM:
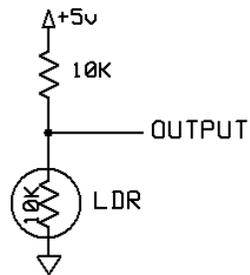
Fig. 4.1 LDR Circuit

A photo resistor or light dependent resistor is a component that is sensitive to light. When light falls upon it then the resistance changes. Values of the resistance of the LDR may change over many orders of magnitude the value of the resistance falling as the level of light increases.

5.2.3 WORKING PRINCIPLE:

It is relatively easy to understand the basics of how an LDR works without delving into complicated explanations. It is first necessary to understand that an electrical current consists of the movement of electrons within a material. Good conductors have a large number of free electrons that can drift in a given direction under the action of a potential difference. Insulators with a high resistance have very few free electrons, and therefore it is hard to make the them move and hence a current to flow.

An LDR or photo resistor is made any semiconductor material with a high resistance. It has a high resistance because there are very few electrons that are free and able to move - the vast majority of the electrons are locked into the crystal lattice and unable to move. Therefore in this state there is a high LDR resistance.

5.3 LIGHT EMITTING DIODE:

Light emitting diode (LED) is basically a P-N junction semiconductor diode particularly designed to emit visible light. There are infrared emitting LEDs which emit invisible light. The LEDs are now available in many colours red, green and yellow. A normal LED emits at 2.4V and consumes mA of current. The LEDs are made in the form of flat tiny P-N junction enclosed in a semi-spherical dome made up of clear coloured epoxy resin. The dome of a LED acts as a lens and diffuser of light. The diameter of the base is less than a quarter of an inch. The actual diameter varies somewhat with different makes.

LEDs often have leads of dissimilar length and the shorter one is the cathode. All manufacturers do not strictly adhere this to. Sometimes the cathode side has a flat base. If there is doubt, the polarity of the diode should be identified. A simple bench method is to use the ohmmeter incorporating 3-volt cells for ohmmeter function. When connected with the ohmmeter: one way there will be no deflection and when connected the other way round there will be a large deflection of a pointer. When this occurs the anode lead is connected to the negative of test lead and cathode to the positive test lead of the ohmmeter.

Fig. 4.1 LED

6. RADIO FREQUENCY IDENTIFICATION

INTRODUCTION:

An RFID tag is a microchip combined with an antenna in a compact package; the packaging is structured to allow the RFID tag to be attached to an object to be tracked. "RFID" stands for Radio Frequency Identification. The tag's antenna picks up signals from an RFID reader or scanner and then returns the signal, usually with some additional data like a unique serial number or other customized information.

It is a generic term that is used to describe a system that transmits the identity in the form of a unique serial number of an object or person wirelessly, using radio waves. It's grouped under the broad category of automatic identification technologies.

6.1 RFID MODULE AND PRINCIPLE OF WORKING:

RFID Reader Module, are also called as interrogators. They convert radio waves returned from the RFID tag into a form that can be passed on to Controllers, which can make use of it. RFID tags and readers have to be tuned to the same frequency in order to communicate. RFID systems use many different frequencies, but the most common and widely used & supported by reader is 125 KHz.
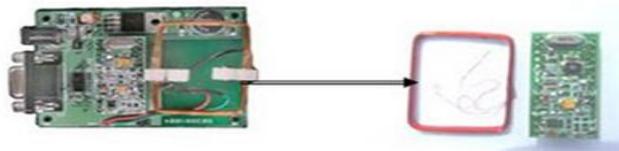
.

Fig 6.1 RF Reader and Tag

An RFID system consists of two separate components: a tag and a reader. Tags are analogous to barcode labels, and come in different shapes and sizes. The tag contains an antenna connected to a small microchip containing up to two kilobytes of data. The reader, or scanner, functions similarly to a barcode scanner; however, while a barcode scanner uses a laser beam to scan the barcode, an RFID scanner uses electromagnetic waves. To transmit these waves, the scanner uses an antenna that transmits a signal, communicating with the tags antenna. The tags antenna receives data from the scanner and transmits its particular chip information to the scanner.

6.2 DIFFERENT TYPES OF TAG:

The three different types of tags are described below

- Active
- Passive
- Semi-Passive

Active, semi-passive and passive RFID tags are making RFID technology more accessible and prominent in our world. These tags are less expensive to produce, and they can be made small enough to fit on almost any product. Active and semi-passive RFID tags use internal batteries to power their circuits. An active tag also uses its battery to broadcast radio waves to a reader, whereas a semi-passive tag relies on the reader to supply its power for broadcasting. Because these tags contain more hardware than passive RFID tags, they are more expensive. Active and semi-passive tags are reserved for costly items that are read over greater distances -- they broadcast high frequencies from 850 to 950 MHz that can be read 100 feet or 30.5 meters or more away. If it is necessary to read the tags from even farther away, additional batteries can boost a tag's range to over 300 feet or 100 meters.

Passive RFID tags rely entirely on the reader as their power source. These tags are read up to 20 feet or six meters away, and they have lower production costs, meaning that they can be applied to less expensive merchandise. These tags are manufactured to be disposable, along with the disposable consumer goods on which they are placed. Whereas a railway car would have an active RFID tag, a bottle of shampoo would have a passive tag.

Another factor that influences the cost of RFID tags is data storage. There are three storage types:

- **Read-Write,**
- **Read-Only**
- **WORM (write once, read many).**

A read-write tag's data can be added to or overwritten. Read-only tags cannot be added to or overwritten -- they contain only the data that is stored in them when they were made. WORM tags can have additional data added once, but they cannot be overwritten.

Fig 6.2 RF ID Tags

6.3   APPLICATIONS:

- An RFID tag can be affixed to an object and used to track and manage inventory, assets, people, etc. For example, it can be affixed to cars, computer equipment, books, mobile phones, etc.
- RFID offers advantages over manual systems or use of bar codes. The tag can be read if passed near a reader, even if it is covered by the object or not visible.
- The tag can be read inside a case, carton, box or other container, and unlike barcodes RFID tags can be read hundreds at a time. Bar codes can only be read one at a time.
- Active tags for tracking containers, medical assets, or monitoring environmental conditions in data centers start.
- Access management.
- Tracking of goods, Tracking of persons and animals, Tracking sports memorabilia to verify authenticity.
- Airport baggage tracking logistics.

6.4 OPERATION OF RF READER:

The RF reader is placed as an extra projected part in the hood of the robot. It reads the RF tag which is stuck on the books in the library rack. The RF tag will contain the call number of that particular book. The magnetic coils are presented in the reader and in the tag. An electromagnetic field is produced when the reader and the tag gets closer. The RF readers are very sensitive so it must be placed very close to the tag to produce a electromagnetic field. So thus the information in the tag is read and therefore the LCD displays the call number of the book which was stored in the tag.

7. MOTORS AND RELAY

INTRODUCTION:

An electric motor is an electromechanical device that converts electrical energy into mechanical energy. Electric motors are found in applications as diverse as industrial fans, blowers and pumps, machine tools, household appliances, power tools, and disk drives. They may be powered by direct current, *e.g.*, a battery power portable device or motor vehicle, or by alternating current from a central electrical distribution grid or inverter. The smallest motors may be found in electric wristwatches. Medium-size motors of highly standardized dimensions and characteristics provide convenient mechanical power for industrial uses. The very largest electric motors are used for propulsion of ships, pipeline compressors, and water pumps with ratings in the millions of watts. Electric motors may be classified by the source of electric power, by their internal construction, by their application, or by the type of motion they give.

Fig 7.1 DC Gear Motor

In an electric motor the moving part is called the rotor and the stationary part is called the stator. Magnetic fields are produced on poles, and these can be salient poles where they are driven by windings of electrical wire. A shaded-pole motor has a winding around part of the pole that delays the phase of the magnetic field for that pole. A commentator switches the current flow to the rotor windings depending on the rotor angle.

A DC motor is powered by direct current, although there is almost always an internal mechanism converting DC to AC for part of the motor. An AC motor is supplied with alternating current, often avoiding the need for a commutator. A synchronous motor is an AC motor that runs at a speed fixed to a fraction of the power supply frequency, and an asynchronous motor is an AC motor, usually an induction motor, whose speed slows with increasing torque to slightly less than synchronous speed. Universal motors can run on either AC or DC, though the maximum frequency of the AC supply may be limited.

7.1 TYPES OF MOTOR:

Electric motors are all around us, from common appliances to our most sophisticated computers. In fact, the technology has been present for over a century, with many of the earliest motor types still in broad use. Motors provide motion. Whether rotating or linear, motors enable us to move people and machines. They impact every aspect of our daily lives. Electric motors are clean and relatively efficient for the tasks they perform when compared to pneumatic or hydraulic alternatives.

- Stepper motor
- Brushed DC motor
- Permanent Magnet Synchronous Motor

- AC Induction Motors
- Switched Reluctance Motor
- DC gear motor

7.2. DC GEAR MOTOR:

Most DC motors are normally very easy to reverse, simply changing the polarity of the DC input will reverse the direction of the drive shaft. This changeover process can be achieved via a simple changeover switch or for remote or electronic control, via a suitable relay.

Fig 7.2 DC Motor

Stall Torque is the torque which is produced by a motor when the output rotational speed is zero, it may also mean the torque load that causes the output rotational speed of a motor
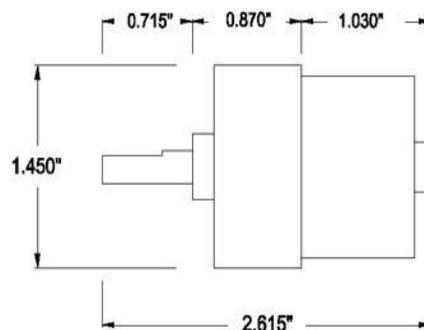
Fig 7.3 Layout of the Motor

7.3 SPECIFICATIONS OF DC MOTOR:

- **.**Operating Range: 3-12VDC
- · Torque @ Max Efficiency: 2.5kg oz-in.@12VDC
- · Gear ratio: 90:1
- · Motor size: 1.30"Dia. x 1.03"L
- · Gear size: 1.45"Dia. x .870"L
- · Shaft size: 0.24" (6mm) Dia. x 0.715"L
- · Weight: 0.2688 lbs. (4.3 oz.)
- · DC reversible motors

7.4 OPERATION OF DC GEAR MOTOR:

The direct current (DC) motor is one of the first machines devised to convert electrical power into mechanical power. Permanent magnet (PM) direct current converts electrical energy into mechanical energy through the interaction of two magnetic fields. One field is produced by a permanent magnet assembly; the other field is produced by an electrical current flowing in the motor windings. These two fields result in a torque which tends to rotate the rotor. As the rotor turns, the current in the windings is commutated to produce a continuous torque output. The stationary electromagnetic field of the motor can also be wire-wound like the armature called a wound-field motor or can be made up of permanent magnets called a permanent magnet motor.

As electrical energy is passed through the brushes and consequently through the armature a torsional force is generated as a reaction between the motor's field and the armature causing the motor's armature to turn.
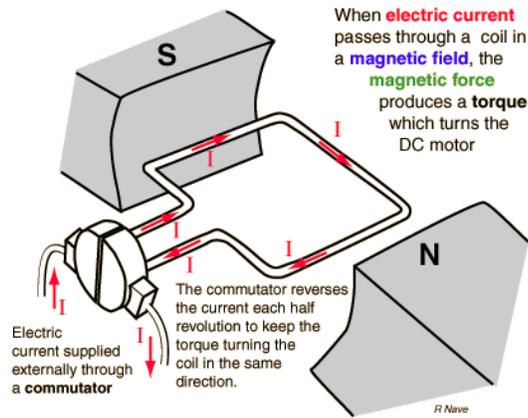
Fig 8.4 Operation of Motor

Motor speed control of DC motor is nothing new. A simplest method to control the rotation speed of a DC motor is to control it's driving voltage. The higher the voltage is, the higher speed the motor tries to reach. In many applications a simple voltage regulation would cause lots of power loss on control circuit, so a pulse width modulation method (PWM)is used in many DC motor controlling applications.

7.5 RELAYS:

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts.
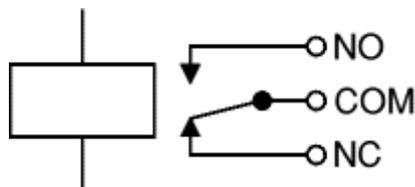
Fig 7.5 Circuit Symbol for a Relay

Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical.

The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. Most ICs chips cannot provide this current and a <u>transistor</u> is usually used to amplify the small IC current to the larger value required for the relay coil. The maximum output current for the popular 555 timer IC is 200mA so these devices can supply relay coils directly without amplification.

Relays are usually SPDT or DPDT but they can have many more sets of switch contacts, for example relays with 4 sets of changeover contacts are readily available.

The coil will be obvious and it may be connected either way round. Relay coils produce brief high voltage 'spikes' when they are switched off and this can destroy transistors and ICs in the circuit. To prevent damage you must connect a <u>protection diode</u> across the relay coil.

The relay's switch connections are usually labeled COM, NC and NO:

- COM = Common, always connect to this; it is the moving part of the switch.
- NC = Normally Closed, COM is connected to this when the relay coil is off.
- NO = Normally Open, COM is connected to this when the relay coil is on.
- Connect to COM and NO if you want the switched circuit to be on when the relay coil is on.

- Connect to COM and NC if you want the switched circuit to be on when the relay coil is off.

7.6 PROTECTION DIODES FOR RELAYS:

Transistors and ICs must be protected from the brief high voltage produced when a relay coil is switched off. The diagram shows how a signal <u>diode</u> is connected 'backwards' across the relay coil to provide this protection.
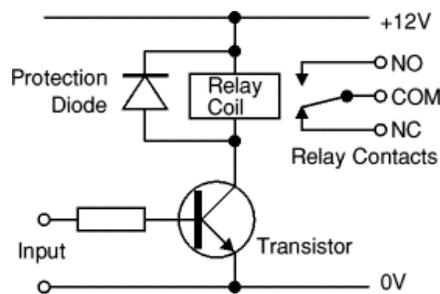

Fig. 7.6 Relay Circuit

Current flowing through a relay coil creates a magnetic field which collapses suddenly when the current is switched off. The sudden collapse of the magnetic field induces a brief high voltage across the relay coil which is very likely to damage transistors and ICs. The protection diode allows the induced voltage to drive a brief current through the coil and diode so the magnetic field dies away quickly rather than instantly. This prevents the induced voltage becoming high enough to cause damage to transistors and ICs.

7.7 ADVANTAGES OF RELAYS:

- Relays can switch AC and DC, transistors can only switch DC.
- Relays can switch higher voltages than standard transistors.
- Relays are often a better choice for switching large currents (> 5A).

- Relays can switch many contacts at once.

7.8 DISADVANTAGES OF RELAYS:

- Relays are bulkier than transistors for switching small currents.
- Relays cannot switch rapidly except reed relays, transistors can switch many times per second.
- Relays use more power due to the current flowing through their coil.
- Relays require more current than many ICs can provide, so a low power.

8. DRIVER CIRCUIT

INTRODUCTION:

The driver circuit is constructed and used for the relay and motor driving purposes. The buffer is used for providing true datas at the output. The driver IC used in the robot is ULN 2803 .

8.1 DRIVER CIRCUIT:

A relay driver is an electro-magnetic switch which is useful for low voltage circuit to switch on and off a light bulb or anything else connected to the 220v mains supply.

There are 6 relays in the robot and these are divided into 3 pairs and each is used for driving the DC Gear motors.

8.1.1 DRIVER USING IC ULN 2803:

A ULN2803 is an Integrated Circuit (IC) chip with a High Voltage/High Current Darlington Transistor Array. It allows you to interface TTL signals with higher voltage/current loads. The ULN2803 comes in an 18-pin IC configuration and includes eight transistors. Pins 1-8 receive the low level signals; pin 9 is grounded for the low level signal reference. Pin 10 is the common on the high side and would generally be connected to the positive of the voltage that are applying to the relay coil. Pins 11-18 are the outputs Pin 1 drives Pin 18, Pin 2 drives 17, etc.

8.1.2 DRIVER FEATURES:

- TTL, DTL, PMOS, or CMOS Compatible Inputs
- Output Current to 500 mA
- Output Voltage to 95 V
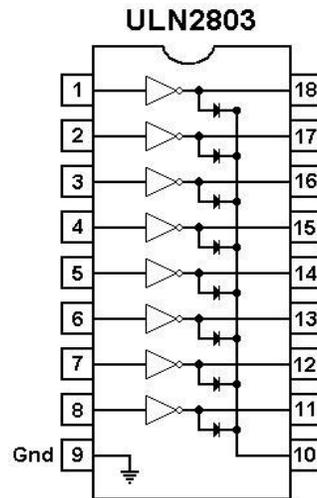- Transient-Protected Outputs

8.1.3 LOGICAL DIAGRAM:

Fig 8.2 Logical Diagram of ULN2803

8.1.4 SPECIFICATION:

- Output Voltage, VCE - 50 V

- Input Voltage, VIN - 30 V

- Continuous Output Current, IC - 500 mA

- Continuous Input Current, IIN - 25 mA

- One Darlington pair - 1.0 W

- Total package - 2.0 W

- Operating Temperature Range, TA (-20°C to + 85°C)

9.INPUT AND OUTPUT DEVICES

INTRODUCTION:

A liquid crystal display (LCD) is a thin, flat panel used for electronically displaying information such as text, images, and movies pictures. Among its major features are its lightweight construction, its portability, and its ability to be produced in much larger screen sizes. It is an electronically-modulated optical device made up of any number of pixels filled with liquid crystals and arrayed in front of a light source or reflector to produce image in color or monochrome. The 16x4 LCD is used to display the scanned call number and counter number.

There are three LCD types:
- Segment or alphanumeric,
- Dot matrix or character and
- Graphic LCD.

9.1. SEGMENT LCD:

Segment LCD can display Arabic numbers represented by 7 segments or Arabic numbers and Roman letters represented by 14 segments. Symbols, such as plus/minus signs, measurement units and any custom icons, can also be displayed. Each symbol is treated as one segment.

9.1.1 DOT MATRIX LCD OR CHARACTER LCD:

Dot matrix LCD is us ed to display a number of lines of characters. The most commonly used dot matrix LCD displays 1 to 4 lines of 16 to

40 characters. Each character is represented by 5x7 dots plus cursor actually 5x8 dots including the cursor. Each character block is addressed separately and can form numbers, Roman letters, character in other languages and a limited number of symbols.Dot matrix LCD is used when you need to display more characters than those in English alphabet. It is relatively simple to control and also inexpensive than graphic models.

9.1.2 GRAPHIC LCD:

Graphic LCD provides users with a greater degree of flexibility. They are composed of pixels arranged in rows and columns. Each pixel can be addressed individually for text, graphics or any combination of the two. Graphic LCD is used in applications when the use needs to have total control of the whole viewing area. However, flexibility also comes with the difficulty in designing the control circuitry.

Fig 9.1 **16x4 LCD**

9.2 ADVANTAGE OF 16x4 LCD:

- Sharpness

- Geometric distortion

- Brightness

- Screen shape

- Physical

9.3 DISADVANTAGE:

- Limited viewing angle, causing color, saturation, contrast and brightness to vary, even within the intended viewing angle, by variations in posture.

- Bleeding and uneven backlighting in some monitors, causing brightness distortion, especially toward the edges.

9.4 START/STOP BUTTON:

This button is basically used to turn on and off the robot.

9.5 BUZZER:

- The sound buzzer is part of working memory reserved by Pratt for the signal recorded by the Sound recorder.

- The buzzer is used for a error or fault identification purpose and also used for a obstacle detection.

Fig 9.3 Audio Circle Buzzer

10.WHEELS AND PATH

INTRODUCTION:

A wheel is a device that allows heavy objects to be moved easily through rotating on an axle, through its centre, facilitating movement or transportation while supporting a load, or performing labour in machines. In order for wheels to rotate, a moment needs to be applied to the wheel about its axis, either by way of gravity, or by application of another external force. More generally the term is also used for other circular objects that rotate or turn, such as a ship's wheel, steering wheel and flywheel. A Wheel is an anchor attraction for every location and draws tourists like a magnet. Structurally, it instantaneously transforms the local horizon. A wheel is used for free acceleration purpose.

10.1TYPES OF WHEELS:

- One Wheel
- 2-wheeled robots
- 3-wheeled vehicles
- Omni Wheels
- 4-wheeled vehicles
- 2 power, 2 wheel rotating wheels

10.2 WORKING PRINCIPLE AND OPERATION OF WHEELS:

Wheeled robots are robots that navigate around the ground using motorized wheels to propel themselves. This design is simpler than using treads or legs and

by using wheels they are easier to design, build, and program for movement in flat, not-so-rugged terrain. Wheeled robots are most popular among the consumer market; their differential steering provides low cost and simplicity.
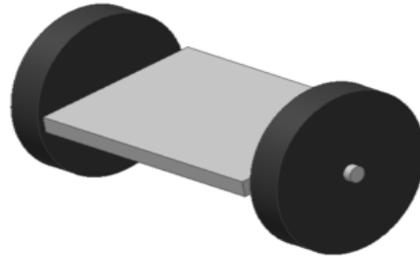

Fig 10.1 Two Wheel Swing-type

It is necessary that the wheels are allowed to turn at different speeds; otherwise the wheels will scrub against the road surface causing excessive tire wear, drive train damage through "wind-up" induced stresses, and somewhat interesting handling characteristics. The downside of this situation is that the usual "open" differential, when one wheel is on a low-friction surface and the torque applied exceeds the adhesion of the tyre, will spin away all that torque, the other wheels will get none and the car will go nowhere.
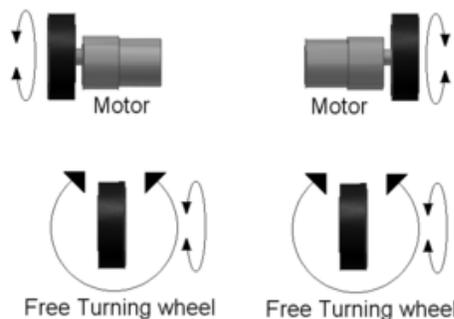

Fig10.2 Free turning wheel

10.3 PATH FOLLOWER:

A Path Follower is an invisible thing that follows a path of interpolation points and can provide something for a camera to aim. The camera to follow a path with a complicated aiming sequence. A path follower or line follower robot is one which follows a given line (path). A line can be of any shape i.e. circle, straight, square or whatever. A path follower is otherwise called as line follower.

The path follower uses a set of Interpolation points (9070) that define a path to follow. They operate similar to the path node of a monster patrol route.

Fig 10.3 Line Follower

10.4 PATH FOLLOWER BEHAVIOUR:

In this demonstration, the green vehicle shows path following behavior. Its task is to traverse the path in a given direction entering on the left, exiting on the right while keeping its center on the gray region. In this case the path is defined by a series of connected line segments a polyline and a radius. This behavior is related to containment and wall following but differs because the path implies a direction of travel.

.

10.5 DISTANCES BETWEEN THE CELLS:

Line tracking is a very important notion in the world of robotics as it give to the robot a precise, error-less and easy to implement navigation scheme.Many robotics competitions promote this concept, by adding lines on the playground for the robot to follow, or sometimes, the sole purpose of the competition is to race with other robots following a line along a track.
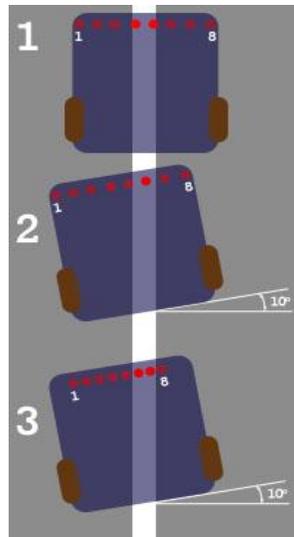

Fig 10.4 Distance Between the Cells

10.5.1 MOVEMENT OF WHEELS IN PATH:

Wheels move along the path, which is black in colour. The path is sensed by the LDR. When the LDR is out of the path, the wheels stop moving in the forward direction and starts correcting the path. After that the wheels again starts moving in the forward direction.

11. MPLAB

11.1 INTRODUCTION:

The **MPLAB** series of devices are programmers and debuggers for Microchip PIC and dsPIC microcontrollers, developed by Microchip Technology. The ICD family of debuggers has been produced since the release of the first Flash-based PIC microcontrollers, and the latest ICD 3 currently supports all current PIC and dsPIC devices. It is the most popular combination debugging/programming tool from Microchip. The REAL ICE emulator is similar to the ICD, with the addition of better debugging features, and various add-on modules that expand its usage scope. The ICE is a family of discontinued in-circuit emulators for PIC and dsPIC devices, and is currently superseded by the REAL ICE.

MPLAB is a free integrated development environment for the development of embedded applications on PIC and dsPIC microcontrollers and is developed by Microchip Technology. MPLAB is designed to work with MPLAB-certified devices such as the MPLAB ICD 3 and MPLAB REAL ICE, for programming and debugging PIC microcontrollers using a personal computer.

11.2 STEPS TO DO PROGRAM IN MPLAB:

Open MPLAB IDE v8.56.From the 'Projects' tab, select the first option 'Project Wizard 'Click on 'Next' in the welcome window that appears
Select the desired PIC which you need to program or build your project on and click on 'Next' .Select the active tool suite you require; among the list of tool suites given (Usually the HI-TECH Universal tool suite is preferred, if installed)

heck if the Tool suite contents listed contains a compiler suiting your programming needs ("HI-TECH ANSI C Compiler" in the case of a HI-TECH Universal too lsuite) and click 'Next'.Create a new project file at your desired location in the desired name.Take care that the project file is saved in the '*.mcp' format and click 'Next'. In the next window, add any files you desire to add to your new project, if required. else just skip this step by clicking 'Next'.

Now click 'finish' and your new project is created. Now select the 'New' option from the 'File' tab. Select 'Save as' option from the 'File' tab and save the new file in the same folder in which you have created the project by selecting a suitable option from 'save as type'(depending on which type of program you're doing)

Select 'Save as' option from the 'File' tab and save the new file in the same folder in which you have created the project by selecting a suitable option from 'save as type'(depending on which type of program you're doing) Begin programming in the file.

11.3 VERSION USED:

MPLAB 8.X is the last version of the legacy MPLAB IDE technology, custom built by Microchip Technology in Microsoft Visual C++. MPLAB supports project management, editing, debugging and programming of Microchip 8-bit, 16-bit and 32-bit PIC microcontrollers. MPLAB only works on Microsoft Windows. MPLAB is still available from Microchip's archives, but is not recommended for new projects.

12. EMBEDDED C

12.1 Introduction :

Embedded C is a set of language extensions for the C Programming language by the C Standards committee to address commonality issues that exist between C extensions for different embedded systems. Historically, embedded C programming requires nonstandard extensions to the C language in order to support exotic features such as fixed-point arithmetic,multiple distinct memory banks, and basic I/O operations.

12.2 ADVANTAGES:

- Small and simpler to learn, understand, program and debug.
- Compared to assembly language, C code written is more reliable and scalable, more portable between different platform.
- C compilers are available for almost all embedded devices in use today, and there is a large pool of experienced C programmers. Unlike assembly, C has advantage of processor-independence and is not specific to any particular microprocessor/microcontroller or any system.
- C is treated as a 'middle-level computer language' or 'high level assembly language'.
- It is fairly efficient. It supports access to I/O and provides ease of management of large embedded projects.Java is also used in many embedded systems but Java programs require the Java Virtual Machine (JVM), which consumes a lot of resources.

CONCLUSION

The main function of this module replaces the tiring work of man power and the work is finished effectively in less time. Thus the inference is, that this mobile robot covers various parts of electronics like communication, sensors, RF reader, motors and microcontroller. This module can also be applicable in departmental stores, shopping malls, production plants, industries and hospitals.

FUTURE SCOPE

- RF ID Tags can be placed inbuilt within the book. The tags can be reduced to size of a grain.

- Implementation of wireless communication like zigbee, GSM can be used for communication between user and the module.

- For vast and fast applications the pneumatics or hydraulics can be used.

- The line following mobile robot can be replaced by a Humanoid robot in the near future, which can be used for picking and placing the books, and also to manually organise it.

BIBLIOGRAPHY

1. www.instructables.com/id/Line-Follower-Robot

2. www.engineersgarage.com/contribution/line-follower-robot

3. playwithrobots.com/simple-line-follower-robot

4. http://www.seattlerobotics.org

5. http://www.robotstorehk.com/sensors/sensor.html

6. http://robfatland.net/seamonster/index.php?title=Sensor_Specifications

7. www.vegarobotkit.com

8. www.robotshop.com

9. www.circuitstoday.com/introduction-to-pic-16f877