AUTOMATED FARE COLLECTION USING CONTACTLESS SMART CARDS

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

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By

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to

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY

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Solan – 173234, Himachal Pradesh

CERTIFICATE

This is to certify that project report entitled "**AUTOMATED FARE COLLECTION USING CONTACTLESS SMART CARDS**", submitted by **Priyanka Awasthi (091032), Sakshi Mishra (091036) and Srijna Badola (091061)** in partial fulfillment for the award of degree of Bachelor of Technology in Electronics and Communication Engineering to Jaypee University of Information Technology, Waknaghat, and 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: 29/05/2013

Supervisor's Name: Mr. Pardeep Garg

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Signature: 29/05

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LIST OF SYMBOLS

S.No.	Symbols	Meaning
1.	c	speed of light
2.	r	radius of the near field
3.	λ	wavelength of the radio signal
4.	ν	frequency of the radio signal
5.	π	22/7
6.	V	voltage
7.	t	time

ABSTRACT

The goal of this project is to develop a working model of Automated Fare Collection system (AFC) based on the RFID technology (Radio Frequency Identification) which is now being installed worldwide in many public transport systems like railway stations, bus stands etc. This advancement in technology facilitates the fare collection mechanism in an efficient manner and has replaced the existing antiquated methods.

Radio Frequency Identification (RFID) is a contactless data capturing technique, which uses RF waves for automatic identification of objects. The contactless ID system relies on RF waves for data transmission between the data carrying device called the RFID Transponder(RFID Tag) and the Interrogator, which is also known as RFID Reader.

In our working model, the card, with some initial balance in it, is shown at the entry gate. It is then checked for validation in the database, where we have already listed all the valid users and their required information. If the card is valid, the entry is allowed to the user .A gear motor has been used to rotate the barrier akin to the original gates. A similar procedure takes place at the exit gate, where according to the distance travelled, the specified amount is deducted from the initial balance in the card. Thus, the user exits at this gate, with a new balance in his/her card. Also if the balance is less than a certain amount at the entry gate, the buzzer would be activated restricting the user entry.

The main aim of our project is to understand the RFID technology better which has many applications in the near future. Also we have been able to comprehend with the working of Automated Fare Collection system through the development of our working model of the same.

CHAPTER 1

INTRODUCTION

Automated Fare Collection system (AFC) is based on RFID technology. This implies that radio frequency waves are used for identification of an object or a Contactless Smart Card (CSC) in our case. A Contactless Smart Card is called so because it has a memory of its own for storing the identification code and also it does not require physical contact with the interrogator for processing.

This project requires the following hardware components:

- *INTERROGATOR:*
- *TRANSPONDER:*
- *HOST COMPUTER*
- *DISPLAY DEVICES*

Database consisting of the following:

- Data of all registered users
- Information of all entry and exit points
- Information regarding the fare to be charged

The purpose of this project and its benefits can be listed as follows:

SNAP-SHOT OF METRO GATES [1]

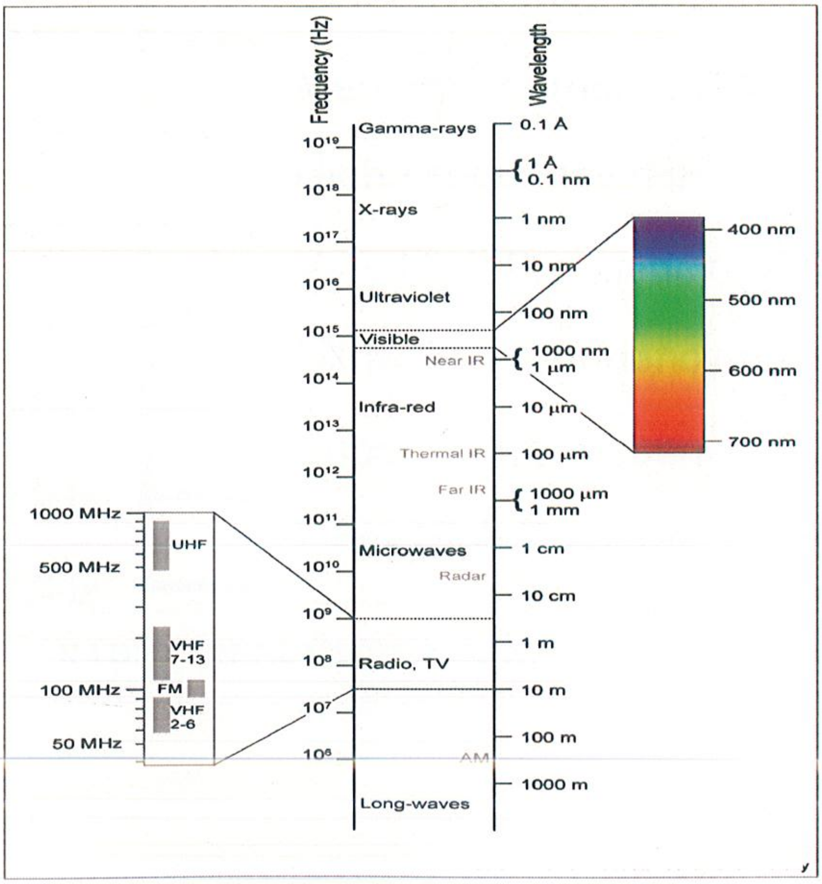
- Commercialization of RFID Technology
- To study the fare collection model on a smaller scale and demonstrate its working
- To provide faster and efficient way of fare collection
- To provide user comfort and reliability
- Theft prevention

CHAPTER 2

ELECTROMAGNETIC SPECTRUM

1.1What is electromagnetic spectrum?

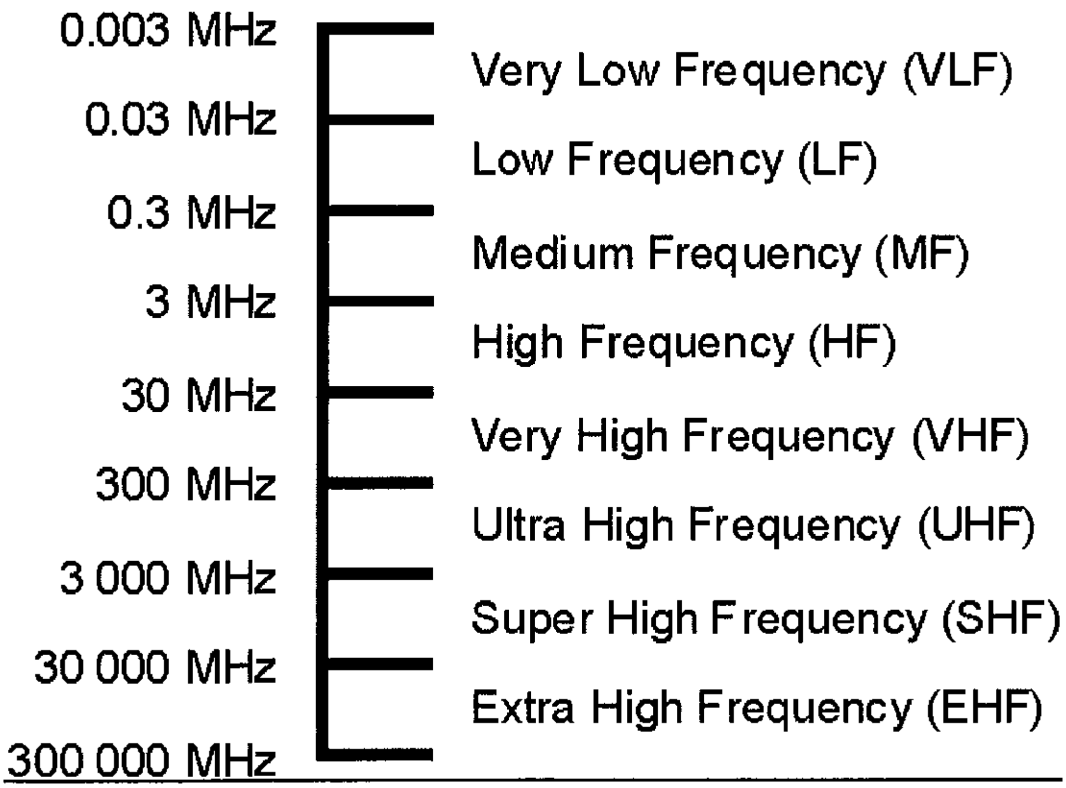
The entire range of wavelengths or frequencies of electromagnetic radiation extending from gamma rays to the longest radio waves and including visible light. The electromagnetic spectrum is a continuum of all electromagnetic waves arranged according to frequency and wavelength. The sun, earth, and other bodies radiate electromagnetic energy of varying wavelengths. Electromagnetic energy passes through space at the speed of light in the form of sinusoidal waves.



[2]

1.2 Radio Frequency:

Radio frequency (**RF**) is a rate of oscillation in the range of about 3 kHz to 300 GHz, which corresponds to the frequency of radio waves, and the alternating currents which carry radio signals. The energy in an RF current can radiate off a conductor into space as electromagnetic waves (radio waves); this is the basis of radio technology.



RADIO FREQUENCY RANGE [3]

CHAPTER 3

RFID (RADIO FREQUENCY IDENTIFICATION)

3.1 The basics of RFID:

RF Identification (RFID) is a contactless data capturing technique, which uses RF waves for automatic identification of objects. The contactless ID system relies on RF waves for data transmission between the data carrying device called the RFID Transponder and the Interrogator, which is also known as RFID reader.

- **Radio frequency identification (RFID)** 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. RFID is in use all around us. If you have ever chipped your pet with an ID tag, used EZ Pass through a toll booth, or paid for gas using Speed Pass, you've used RFID.
- In addition, RFID is increasingly used with biometric technologies for security.
- Unlike ubiquitous UPC bar-code technology, RFID technology does not require contact or line of sight for communication. RFID data can be read through the human body, clothing and non-metallic materials.

3.2 Components in an RFID system:

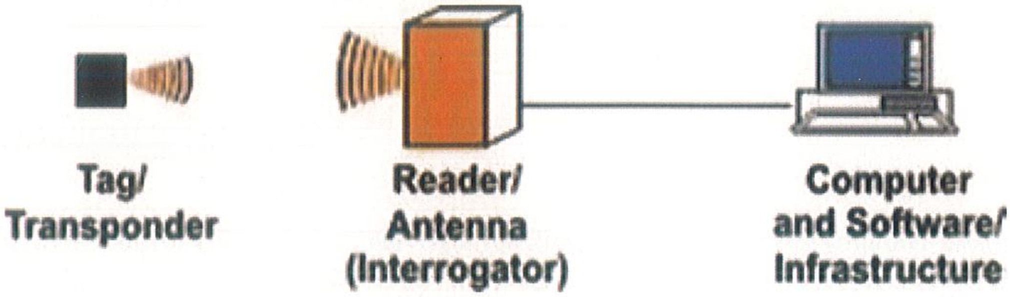
A basic RFID system consists of three components:

- An antenna or coil
- A transceiver (with decoder)
- A transponder (RF tag) electronically programmed with unique information

3.3 Functioning of RFID system:

- The antenna emits radio signals to activate the tag and to read and write data to it.
- The reader emits radio waves in ranges of anywhere from one inch to 100 feet or more, depending upon its power output and the radio frequency used.
- When an RFID tag passes through the electromagnetic zone, it detects the reader's activation signal.
- The reader decodes the data encoded in the tag's integrated circuit (silicon chip) and the data is passed to the host computer for processing.
- The purpose of an RFID system is to enable data to be transmitted by a portable device, called a tag, which is read by an RFID reader and processed according to the needs of a particular application.
- The data transmitted by the tag may provide identification or location information or specifics about the product tagged, such as price, color, date of purchase, etc.
- RFID technology has been used by thousands of companies for a decade or more. It quickly gained attention because of its ability to track moving objects.
- As the technology is refined, more pervasive and invasive - uses for RFID tags are in the works.
- A typical RFID tag consists of a microchip attached to a radio antenna mounted on a substrate. The chip can store as much as 2 kilobytes of data.

- To retrieve the data stored on an RFID tag, you need a reader. A typical reader is a device that has one or more antennas that emit radio waves and receive signals back from the tag. The reader then passes the information in digital form to a computer system.



RFID BASIC FUNCTIONING [4]

3.4 Commonly used frequency bands for RFID systems:

FREQUENCY BAND	FREQUENCY RANGE	TYPICAL FREQUENCIES USED
Low frequency (LF)	100kHz-500kHz	125 kHz, 134.2 kHz
High frequency (HF)	10Mhz-15MHz	13.56MHz
Ultra high frequency (UHF)	400MHz-950MHz	866MHz, 915MHz
Microwaves (uW)	2.4GHz-6.8GHz	2.45GHz, 3GHz

3.5 Why use RFID?

In past few years, RFID has been largely seen as the next technology replacing BAR CODES which work on the principle of 'Optical transmission' while RFID system works on 'Radio transmission'. Bar code systems require the object to be in the 'line of sight' and are dependent on weather conditions whereas RFID systems do not require a line of sight and are weather independent.

3.6 Applications of RFID:

Asset Tracking: It's no surprise that asset tracking is one of the most common uses of RFID. Companies can put RFID tags on assets that are lost or stolen often, that are underutilized or that are just hard to locate at the time they are needed. Just about every type of RFID system is used for asset management.

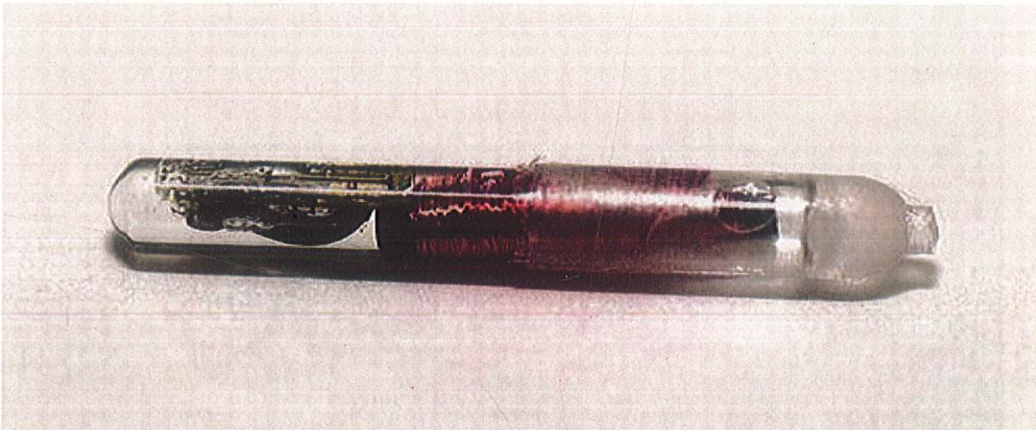
Manufacturing: RFID has been used in manufacturing plants for more than a decade. It's used to track parts and work in process and to reduce defects, increase throughput and manage the production of different versions of the same product.

Supply Chain Management: RFID technology has been used in closed loop supply chains or to automate parts of the supply chain within a company's control for years. As standards emerge, companies are increasingly turning to RFID to track shipments among supply chain partners.

Retailing: Retailers such as Best Buy, Metro, Target, Tesco and Wal-Mart are in the forefront of RFID adoption. These retailers are currently focused on improving supply chain efficiency and making sure product is on the shelf when customers want to buy it.

Payment Systems: RFID is all the rage in the supply chain world, but the technology is also catching on as a convenient payment mechanism. One of the most popular uses of RFID today is to pay for road tolls without stopping. These active systems have caught on in many countries, and quick service restaurants are experimenting with using the same active RFID tags to pay for meals at drive-through windows.

Security and Access Control: RFID has long been used as an electronic key to control who has access to office buildings or areas within office buildings. The first access control systems used low-frequency RFID tags. Recently, vendors have introduced 13.56 MHz systems that offer longer read range.



GRAIN SIZED MICROCHIP USED FOR ANIMAL IDENTIFICATION [5]

The advantage of RFID is it is convenient (an employee can hold up a badge to unlock a door, rather than looking for a key or swiping a magnetic stripe card) and because there is no contact between the card and reader, there is less wear and tear, and therefore less maintenance.

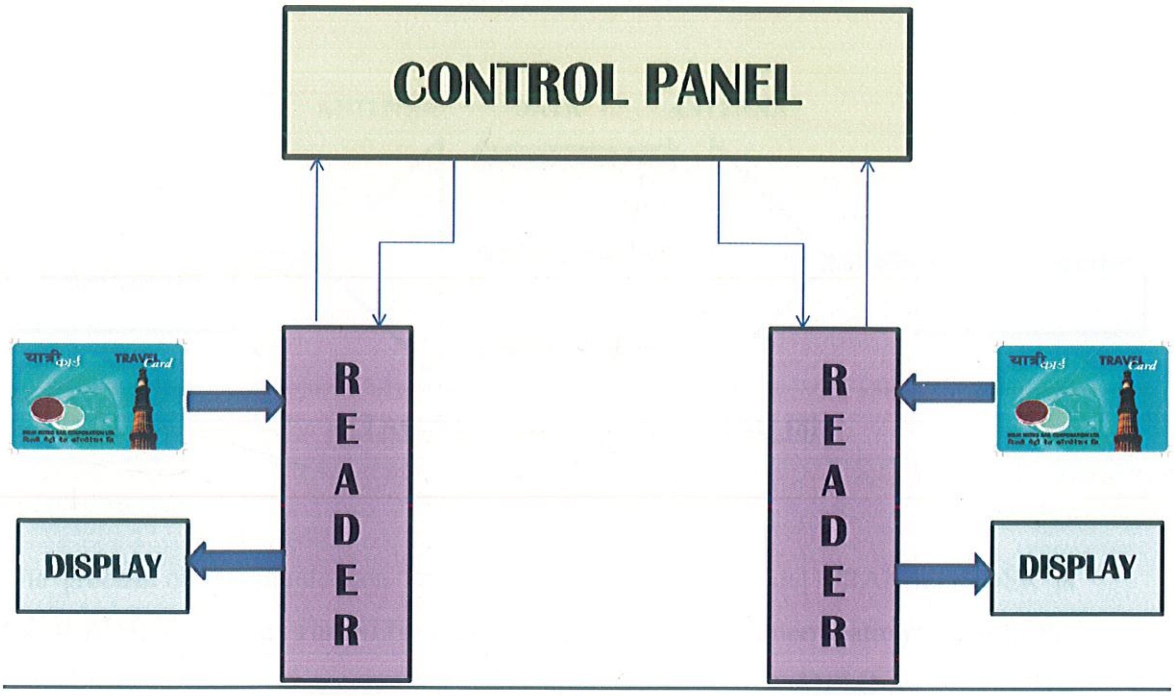
As RFID technology evolves and becomes less expensive and more robust, it's likely that companies and RFID vendors will develop many new applications to solve common and unique business problems.

COMMERCIALLY USED RFID SYSTEM [6]

CHAPTER 4

AUTOMATED FARE COLLECTION SYSTEM (AFC)

4.1 AFC's Basic working:



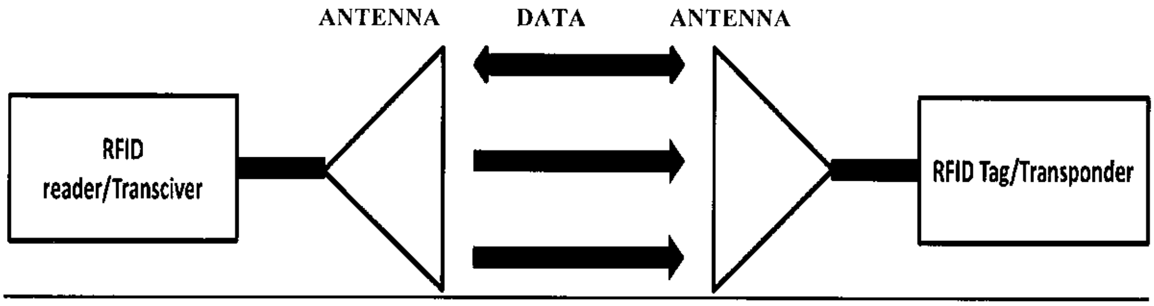
BLOCK DIAGRAM [7]

The Automated Fare Collection process consists of the following steps:

- The reading of the RFID card takes place at the entry gate to extract the user information by reader-tag interfacing.
- Then the validation of the card occurs by matching the user information extracted from the card with the already stored information in the data base.

- If the user is authenticated, he will be allowed to enter .If not, then a message that the 'User is invalid' is displayed.
- At the exit gates the user has to show the card to the reader for fare deduction according to the distance travelled.

4.2 Principle of working of AFC system: RFID coupling:



TAG READER INTERFACING [8]

The process of communication between INTERROGATOR and TRANSPONDER is called RFID Coupling. The RFID reader sends a broadband interrogation signal to the transponder in order to extract the information using NEAR FIELD EFFECT. The transponder receives the interrogation signal which is retransmitted after being modulated. The encoded data is then received by the reader and further processed. The reader finally decodes the tag's ID.

4.3 Near Field Effect:

The Near Field is the phenomenon that occurs in a radio transmission where the magnetic portion of the Electromagnetic field is strong enough to induce an electrical field in a coil. As the name implies the near field occurs in an area to the antenna. Just how big the near field is depends on the wavelength of the radio signal being used.

$$r = \lambda/2*\pi$$

For example for high frequency (13.56 MHz)

The dimension of near field following the above mentioned formula will be:

$\lambda = c/v$ where c is speed of light.

Wavelength=22m

Therefore, r=22/6.28 =3.5m.

CHAPTER 5

BASIC COMPONENTS OF AFC SYSTEM

The basic components of the AFC system are as follows:

- Transponder
- Interrogator

5.1 TRANSPONDER

Transponder (transmitter-responder) is a data carrying device and it is called so because it responds to the signal generated by the reader and transmits the response signal.

TYPES OF TRANSPONDERS

ACTIVE TAGS:

Active RFID transponders have an on-board power supply in the form of a battery. An active tag uses battery power to amplify the signal and then transmit data back to the reader. Therefore, active tags do not need to use the RF carrier signal's energy to energize the data processing section and hence have a longer reading range. Active tags have the ability to process and store more data than passive tags due to the on-board power supply and are less sensitive to the strength of the reader's interrogation signal. When communicating with the reader, the tag is the first entity to be engaged in data transmission. Because the presence of the reader is not necessary for data transmission from the tag, an active tag can maintain a continuous data transmission without the presence of a reader. This type of communication between the reader and the tag is known as transponder driven. Active tags that do not detect the interrogation zone of a reader hibernate by going into a sleep mode, and thus they do not waste power. The most significant advantage of active RFID transponders is that they are reprogrammable, and therefore, can be used on a variety of items repetitively until the battery power is exhausted.

PASSIVE TAGS:

Passive Tags do not possess an on-board power supply and therefore rely only on the power emitted from the reader for both data processing and transmission. Passive tags may or may not contain an IC or memory block. This means that some passive tags perform data processing, but others do not. All passive transponders must have an RF front end, an analog circuit, and depending on their data processing techniques, a digital circuit. The RF front end of the passive RFID tag consists of the antenna and the impedance matching circuit in order to minimize signal reflection between the antenna and transponder circuit. The analog part of the passive tag may comprise an LC tuning circuit and a rectifier. The rectifier supplies the required dc voltage to the digital circuit . Due to the absence of on-board power supplies, passive RFID tags have a much shorter reading range (up to 2m). They are more vulnerable to environmental effects and have poorer or no data processing abilities at all and hence can't be easily reprogrammed. The advantages of passive RFID systems are low cost and low maintenance.

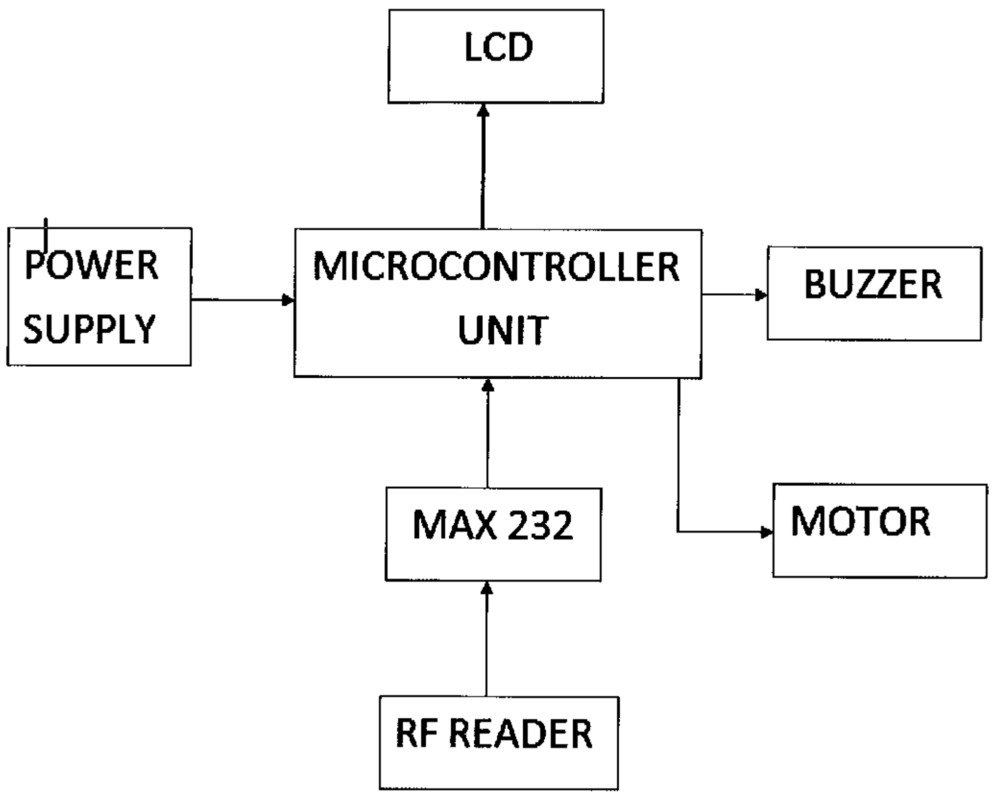
5.2 RFID READER (INTERROGATOR)

A RFID reader is a miniature radar system with two operating modes, given as follows:

- During talk mode, the reader sends data to the tag for inquiring tag contents.
- During receive mode, the reader listens to the tag.

CHAPTER 6

WORKING MODEL OF THE AFC SYSTEM



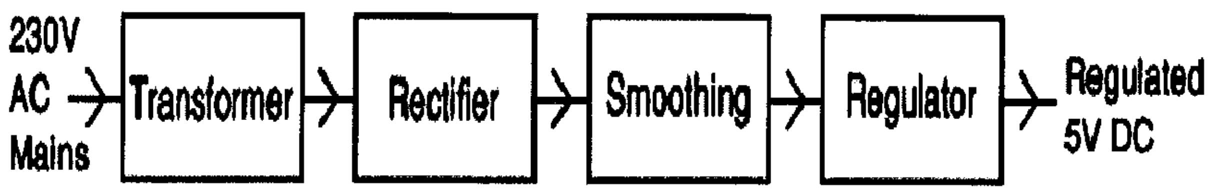
FUNCTIONAL DIAGRAM OF AFC SYSTEM [9]

CHAPTER 7

REGULATED POWER SUPPLY

7.1 Regulated Power Supply:

Power supplies are designed to convert high voltage AC mains to a suitable low voltage supply for electronic circuits and other devices. A power supply can be broken down into a series of blocks, each of which performs a particular function.



POWER SUPPLY [10]

Each of the blocks has its own function as described below:

1. Transformer – steps down high voltage AC mains to low voltage AC.

2. Rectifier – converts AC to DC, but the DC output is varying.

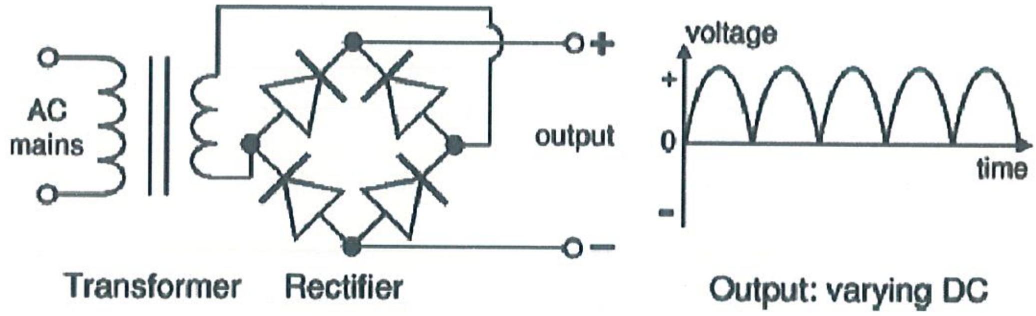
3. Smoothing – smoothes the DC from varying greatly to a small ripple.

4. Regulator – eliminates ripple by setting DC output to a fixed voltage.

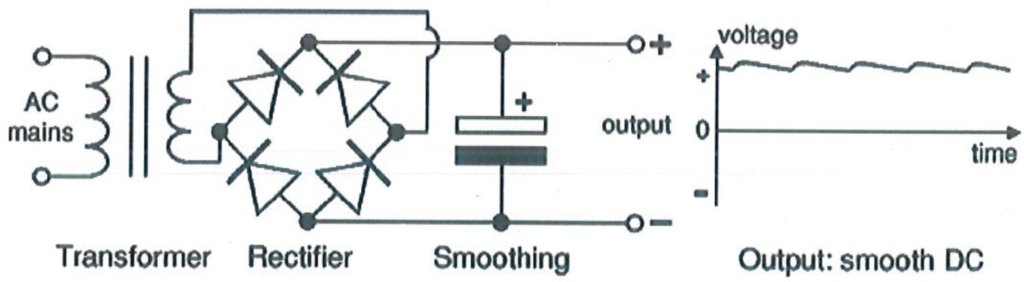
7.2 Generation of varying and smooth DC

The varying DC is generated using a transformer and a rectifier and in order to generate a smooth DC a smoothening capacitor is added to the circuit as shown below.

Transformer + Rectifier + Smoothing + Regulator



GENERATION OF VARYING DC [11]

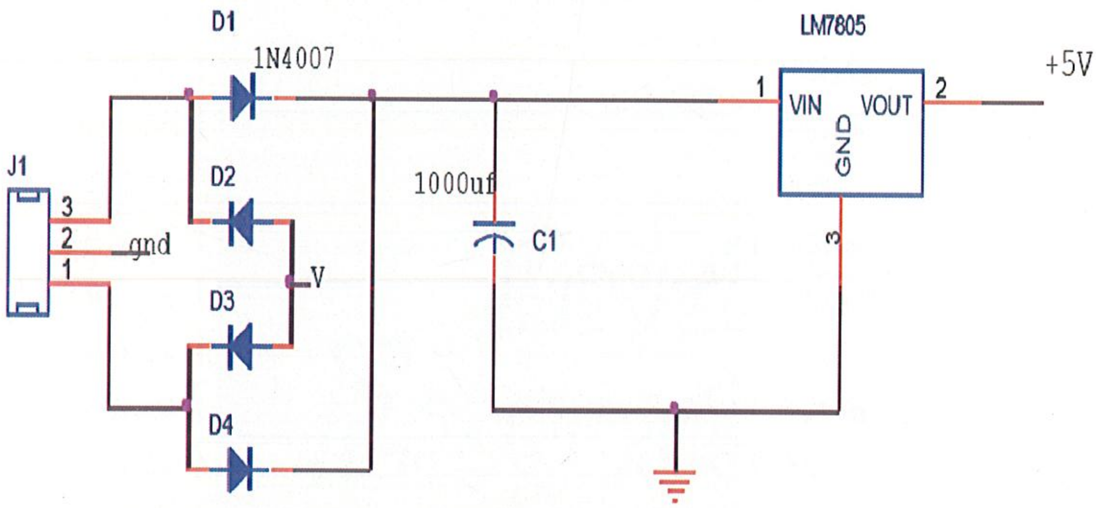


GENERATION OF SMOOTH DC [12]

- The low voltage AC **output** is suitable for lamps, heaters and special AC motors. It is not suitable for electronic circuits unless they include a rectifier and a smoothing capacitor.

- The varying DC output is suitable for lamps, heaters and standard motors. It is not suitable for electronic circuits unless they include a smoothing capacitor.

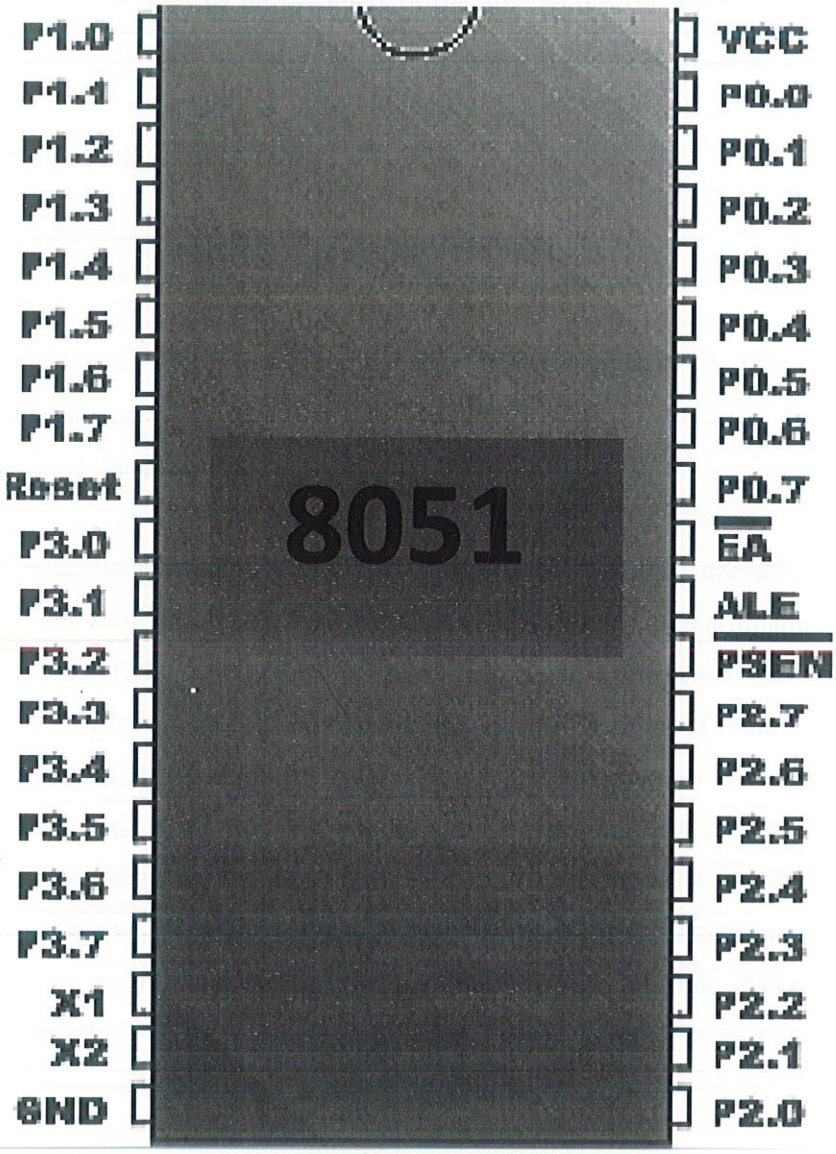
- The smooth DC output has a small ripple. It is suitable for most electronic circuits.



<u>CIRCUIT DIAGRAM OF REGULATED POWER SUPPLY [13]</u>

CHAPTER 8

MICRO CONTROLLER UNIT:



PIN DIAGRAM OF MICROCONTROLLER 8051[14]

7.1 Pin description

The 89C51 have a total of 40 pins that are dedicated for various functions such as I/O, RD, WR, address and interrupts. Out of 40 pins, a total of 32 pins are set aside for the four ports P0, P1, P2, and P3, where each port takes 8 pins. The rest of the pins are designated as Vcc, GND, XTAL1, XTAL, RST, EA, and PSEN. All these pins except PSEN and ALE are used by all members of the 8051 and 8031 families. In other words, they must be connected in order for the system to work, regardless of whether the microcontroller is of the 8051 or the 8031 family. The other two pins, PSEN and ALE are used mainly in 8031 based systems.

The Pins of the 8051 are describes as follows:

Vcc : Pin 40 provides supply voltage to the chip. The voltage source is +5V.

GND: Pin 20 is the ground.

RST: Pin 9 is the reset pin. It is an input and is active high (normally low). Upon applying a high pulse to this pin, the microcontroller will reset and terminate all activities .This is often referred to as a power –on reset. Activating a power-on reset will cause all values in the registers to be lost. Notice that the value of Program Counter is 0000 upon reset, forcing the CPU to fetch the first code from ROM memory location 0000. This means that we must place the first line of source code in ROM location 0000 that is where the CPU wakes up and expects to find the first instruction. In order to RESET input to be effective, it must have a minimum duration of 2 machine cycles. In other words, the high pulse must be high for a minimum of 2 machine cycles before it is allowed to go low.

EA: All the 8051 family members come with on-chip ROM to store programs. In such cases, the EA pin is connected to the Vcc. For family members such as 8031 and 8032 in which there is no on-chip ROM, code is stored on an external ROM and is fetched by the 8031/32. Therefore for the 8031 the EA pin must be connected to ground to indicate that the code is stored externally. EA, which stands for "external access," is pin number 31 in the DIP packages. It is input pin and must be connected to either Vcc or GND. In other words, it cannot be left unconnected.

PSEN: This is an output pin. PSEN stands for "program store enable." It is the read strobe to external program memory. When the microcontroller is executing from external memory, PSEN is activated twice each machine cycle.

ALE: ALE (Address latch enable) is an output pin and is active high. When connecting a Microcontroller to external memory, port 0 provides both address and data. In other words the microcontroller multiplexes address and data through port 0 to save pins. The ALE pin is used for de-multiplexing the address and data by connecting to the G pin of the 74LS373 chip.

I/O port pins and their functions : The four ports P0, P1, P2, and P3 each use 8 pins, making them 8-bit ports. All the ports upon RESET are configured as output, ready to be used as output ports. To use any of these as input port, it must be programmed.

Port 0

Port 0 occupies a total of 8 pins (pins 32 to 39). It can be used for input or output. To use the pins of port 0 as both input and output ports, each pin must be connected externally to a 10K-ohm pull-up resistor. This is due to fact that port 0 is an open drain, unlike P1, P2 and P3. With external pull-up resistors connected upon reset, port 0 is configured as output port. In order to make port 0 an input port, the port must be programmed by writing 1 to all the bits of it. Port 0 is also designated as AD0-AD7, allowing it to be used for both data and address. When connecting a microcontroller to an external memory, port 0 provides both address and data. The microcontroller multiplexes address and data through port 0 to save pins. ALE indicates if P0 has address or data. When ALE=0, it provides data D0- D7, but when ALE=1 it has address A0-A7. Therefore, ALE is used for demultiplexing address and data with the help of latch 74LS373.

Port 1

Port 1 occupies a total of 8 pins (pins 1 to 8). It can be used as input or output. In contrast to port 0, this port does not require pull-up resistors since it has already pull-up resistors internally. Upon reset, port 1 is configures as an output port. Similar to port 0, port 1 can be used as an input port by writing 1 to all its bits.

Port 2

Port 2 occupies a total of 8 pins (pins 21 to 28). It can be used as input or output. Just like P1, port 2 does not need any pull-up resistors since it has pull-up resistors internally. Upon reset port 2 is configured as output port. To make port 2 as input port, it must be programmed as such by writing 1s to it.

Port 3

Port 3 occupies a total of 8 pins (pins 10 to 17). It can be used as input or output. P3 does not need any pull-up resistors, the same as P1 and P2 did not. Although port 3 is configured as output port upon reset, this is not the way it is most commonly used. Port 3 has an additional function of providing some extremely important signals such as interrupts. Some of the alternate functions of P3 are
listed below:

P3.0 RXD (Serial input)

P3.1 TXD (Serial output)

P3.2 INT0 (External interrupt 0)

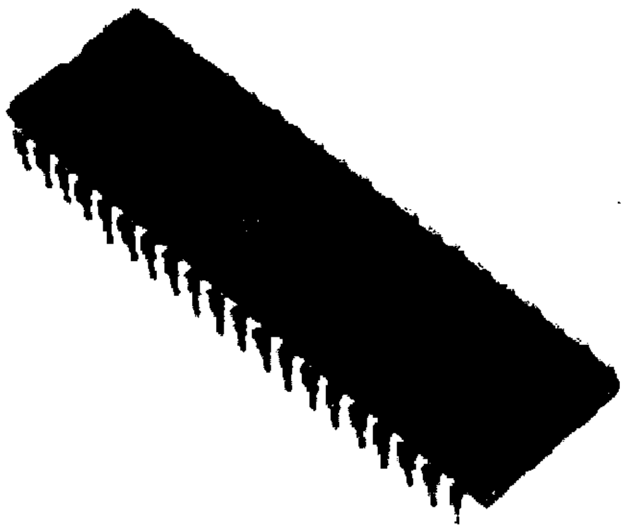
P3.3 INT1 (External interrupt 1)

P3.4 T0 (Timer 0 external input)

P3.5 T1 (Timer 1 external input)

P3.6 WR (External memory write strobe)

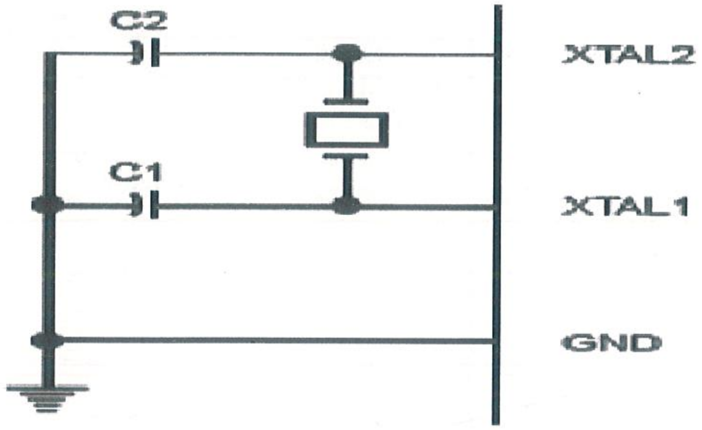
P3.7 RD (External memory read strobe)



ATMEL 8051[15]

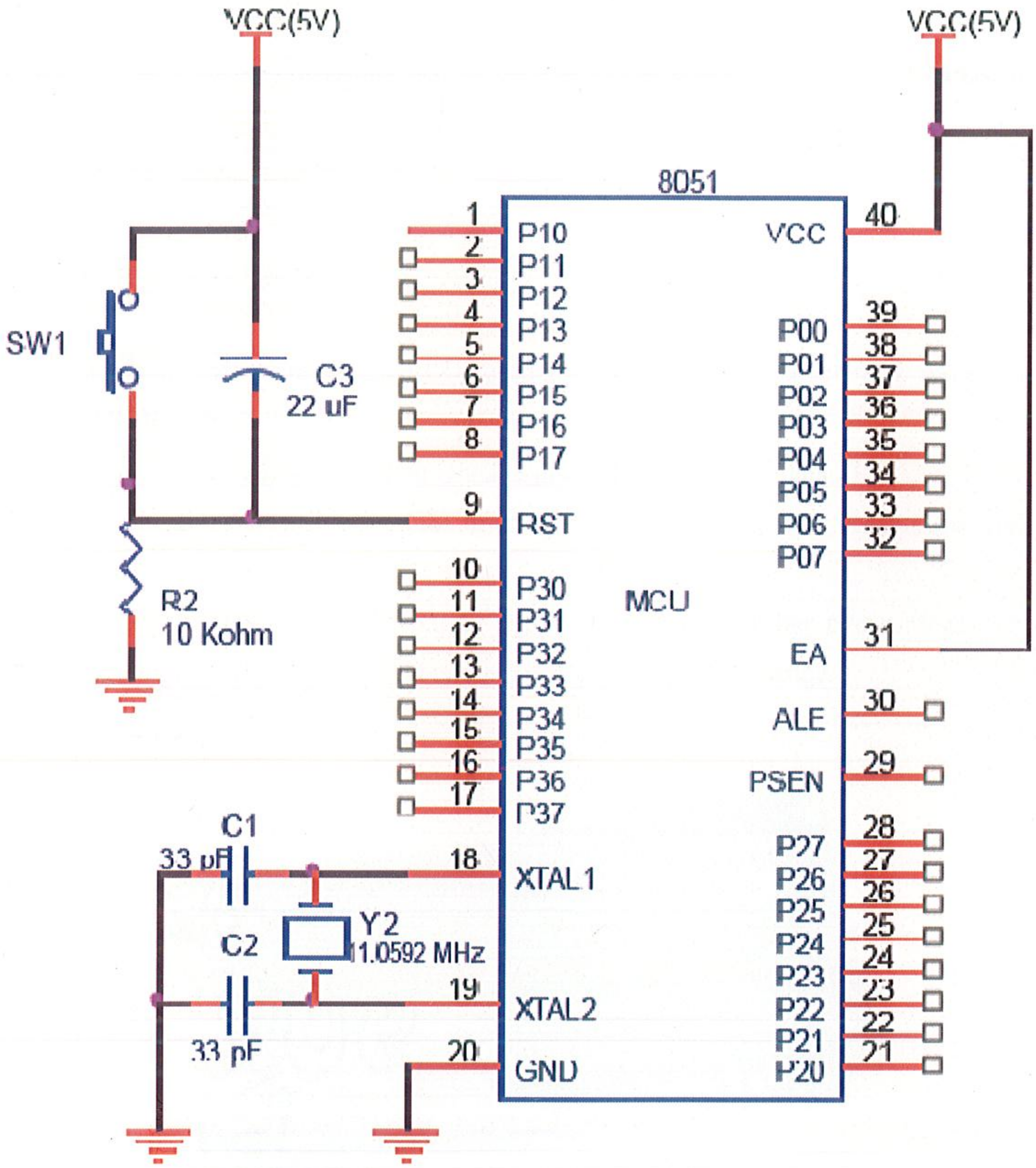
7.2 Oscillator Characteristics:

XTAL1 and XTAL2 are the input and output, respectively, of an inverting amplifier which can be configured for use as an on-chip oscillator, as shown in Figure. Either a quartz crystal or ceramic resonator may be used. To drive the device from an external clock source, XTAL2 should be left unconnected while XTAL1 is driven as shown in Figure..



OSCILLATOR CONNECTIONS[16]

It must be noted that there are various speeds of the 8051 family. Speed refers to the maximum oscillator frequency connected to the XTAL. For example, a 12 MHz chip must be connected to a crystal with 12 MHz frequency or less. Likewise, a 20 MHz microcontroller requires a crystal frequency of no more than 20 MHZ. When the 8051 is connected to a crystal oscillator and is powered up, we can observe the frequency on the XTAL2 pin using oscilloscope.



CIRCUIT DIAGRAM OF MICROCONTROLLER UNIT[17]

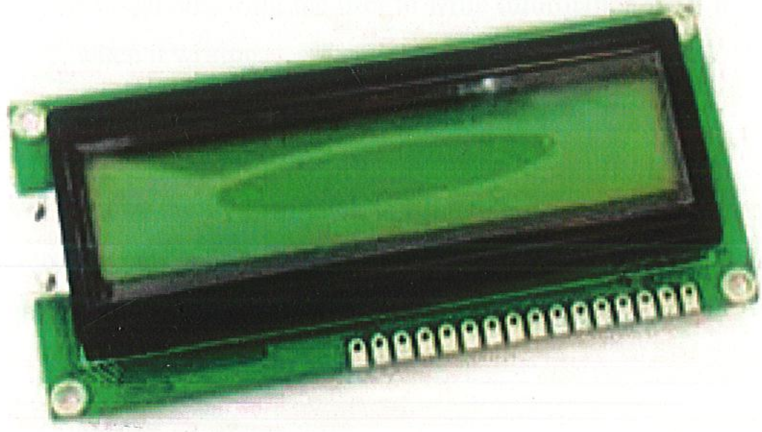
CHAPTER 9

DISPLAY DEVICE(LCD)

Liquid crystal displays (LCD) are widely used in recent years as compares to LEDs. It has the ability to display numbers, characters and graphics. The LCD, which is used as a display in the system, is LMB162A.

The main features of this LCD are:

- 16 X 2 display intelligent LCD, used for alphanumeric characters & based on ASCII codes.
- This LCD contains 16 pins, in which 8 pins are used as 8-bit data I/O.
- Three pins are used as control lines these are Read/Write pin, Enable pin and Register select pin.
- Two pins are used for Backlight and LCD voltage, another two pins are for Backlight & LCD ground and one pin is used for contrast change.



LIQUID CRYSTAL DISPLAY [18]

8.1 LCD pin description

The LCD discuss in this section has the most common connector used for the Hitachi 44780 based LCD is 14 pins in a row and modes of operation and how to program and interface with microcontroller is describes in this section.

The voltage VCC and VSS provided by +5V and ground respectively while VEE is used for controlling LCD contrast. Variable voltage between Ground and Vcc is used to specify the contrast (or "darkness") of the characters on the LCD screen.

The pins of the LCD are as follows:

RS (register select)

There are two important registers inside the LCD. The RS pin is used for their selection as follows. If RS=0, the instruction command code register is selected, then allowing to user to send a command such as clear display, cursor at home etc. If RS=1, the data register is selected, allowing the user to send data to be displayed on the LCD.

R/W (read/write)

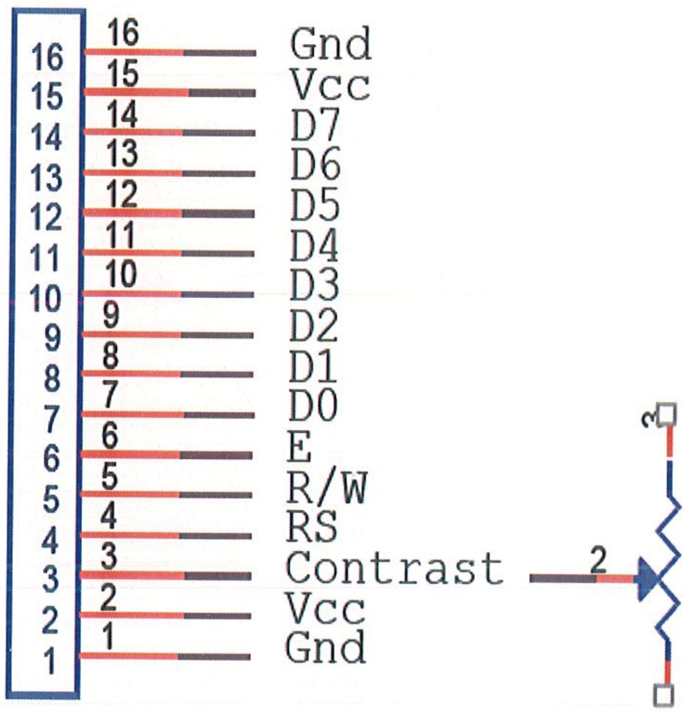
The R/W (read/write) input allowing the user to write information from it. R/W=1, when it read and R/W=0, when it writing.

EN (enable)

The enable pin is used by the LCD to latch information presented to its data pins. When data is supplied to data pins, a high power, a high-to-low pulse must be applied to this pin in order to for the LCD to latch in the data presented at the data pins.

D0-D7 (data lines)

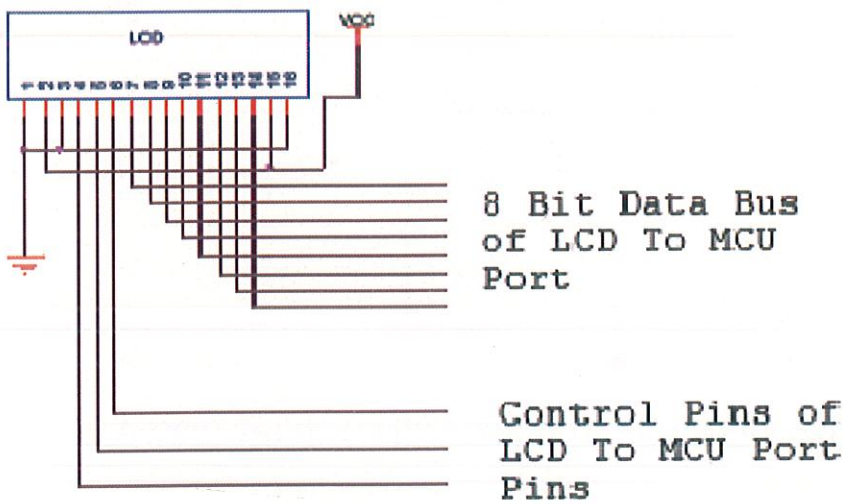
The 8-bit data pins, D0-D7, are used to send information to the LCD or read the contents of the LCD's internal registers. To displays the letters and numbers, we send ASCII codes for the letters A-Z, a-z, and numbers 0-9 to these pins while making RS =1. There are also command codes that can be sent to clear the display or force the cursor to the home position or blink the cursor. We also use RS =0 to check the busy flag bit to see if the LCD is ready to receive the information. The busy flag is D7 and can be read when R/W =1 and RS =0, as follows: if R/W =1 and RS =0, when D7 =1(busy flag =1), the LCD is busy taking care of internal operations and will not accept any information. When D7 =0, the LCD is ready to receive new information.



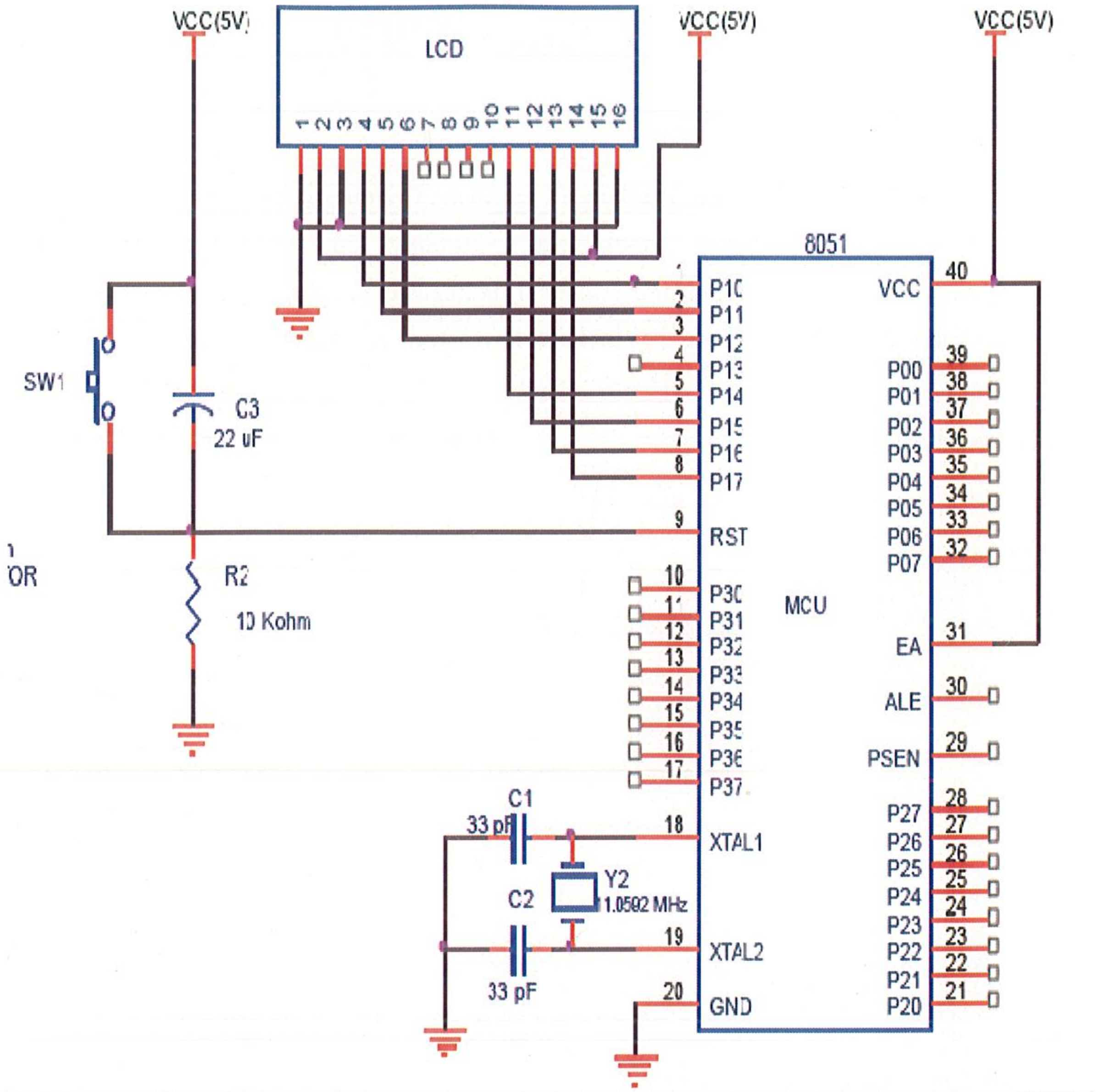
PIN DIAGRAM OF LCD[19]

8.2 Interfacing of micro controller with LCD display

In most applications, the "R/W" line is grounded. This simplifies the application because when data is read back, the microcontroller I/O pins have to be alternated between input and output modes. In this case, "R/W" to ground and just wait the maximum amount of time for each instruction (4.1ms for clearing the display or moving the cursor/display to the "home position", 160μs for all other commands) and also the application software is simpler, it also frees up a microcontroller pin for other uses. Different LCD execute instructions at different rates and to avoid problems later on (such as if the LCD is changed to a slower unit). Before sending commands or data to the LCD module, the Module must be initialized. Once the initialization is complete, the LCD can be written to with data or instructions as required. Each character to display is written like the control bytes, except that the "RS" line is set. During initialization, by setting the "S/C" bit during the "Move Cursor/Shift Display" command, after each character is sent to the LCD, the cursor built into the LCD will increment to the next position (either right or left). Normally, the "S/C" bit is set (equal to "1")



INTERFACING OF LCD AND MICROCONTROLLER UNIT[20]



LCD ATTACHED TO THE MICROCONTROLLER UNIT [21]

CHAPTER 10

RFID READER

Radio Frequency Identification (RFID) Card Readers provide a low-cost solution to read passive RFID transponder tags up to 7 cm away. This RFID Card Reader can be used in a wide variety of hobbyist and commercial applications, including access control, automatic identification, robotics navigation, inventory tracking, payment systems, and car immobilization. The RFID card reader read the RFID tag in range and outputs unique identification code of the tag at baud rate of 9600. The data from RFID reader can be interfaced to be read by microcontroller or PC.

Features:

- Low-cost method for reading passive RFID transponder tags.
- 9600 bps serial interface at 5V TTL level for direct interface to
- microcontrollers
- Buzzer & LED indicate valid RFID Tag detection
- Range up to 7 cm for 125 KHz RFID Cards or Key chains

Information:

Each transponder tag contains a unique identifier (one of 2, or 1,099,511,627,776 possible combinations) that is read by the RFID Card Reader and transmitted to host via a simple serial interface.

Communication

When the RFID Card Reader is active and a valid RFID transponder tag is placed within range of the activated reader, the unique ID will be transmitted as a 12-byte printable ASCII string serially to the host.

The start byte and stop byte are used to easily identify that a correct string has been received from the reader (they correspond to a line feed and carriage return characters respectively). The middle ten bytes are the actual tag's unique ID. For example, for a tag with a valid ID of 0F0184F07A, the following ASCII data would be sent 0F0184F07A

Same data in HEX bytes can be interpreted as:
0x0A, 0x30, 0x46, 0x30, 0x31, 0x38, 0x34, 0x46, 0x30, 0x37, 0x41, 0x0D

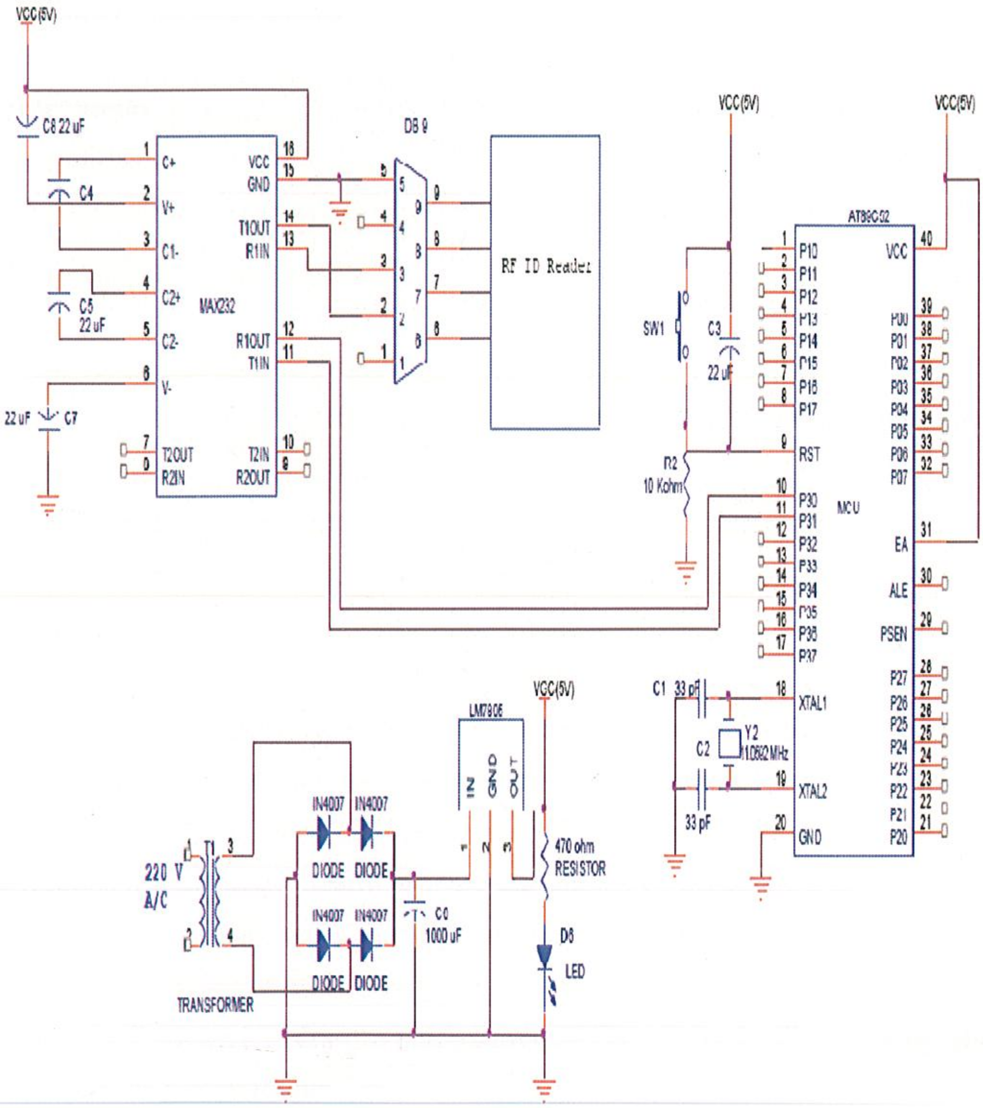
All communication is 8 data bits, no parity, 1 stop bit, and least significant bit first (8N1). The baud rate is configured for 9600 bps, a standard communications speed supported by most any microprocessor or PC, and cannot be changed. The RFID Card Reader initiates all communication. This allows easy access to the serial data stream from any programming language that can open a COM port.

10.1 Using RFID Reader

When powered on the RFID reader will activate a RF field waiting for a tag to come into its range. Once tag is detected, its unique ID number is read and data is sent via serial interface. The valid tag detecting is indicated by LED blink and Buzzer beep. The face of the RFID tag should be held parallel to the front of the antenna (where the majority of RF energy is focused). If the tag is held sideways (perpendicular to the antenna) you may have difficulty getting the tag to be read. Only one transponder tag should be held up to the antenna at any time. The use of multiple tags at one time will cause tag collisions and confuse the reader. The tags available with us have a read distance of approximately 7 cm. Actual distance may vary slightly depending on the size of the transponder tag and environmental conditions of the application.

10.2 Connecting to Microcontroller

Connect data output pin of RFID reader to RXD pin of any microcontroller and configure your MCU to receive data at 9600baud rate. You also have to keep common ground signal between RFID reader and microcontroller.



INTERFACING OF RFID READER WITH THE MICROCONTROLLER[22]

CHAPTER 11

DC GEAR MOTOR DRIVER USING MOTOR DRIVER(L293D):

11.1 What is gear motor?

A **gear motor** is a type of electrical motor. Like all electrical motors, it uses the magnetism induced by an electrical current to rotate a rotor that is connected to a shaft. The energy transferred from the rotor to the shaft is then used to power a connected device.

In a gear motor, the energy output is used to turn a series of gears in an integrated gear train. There are a number of different types of gear motors, but the most common are AC (alternating current) and DC (direct current).

Function:

In a gear motor, the magnetic current (which can be produced by either permanent magnets or electromagnets) turns gears that are either in a gear reduction unit or in an integrated gear box. A second shaft is connected to these gears.

The result is that the gears greatly increase the amount of torque the motor is capable of producing while simultaneously slowing down the motor's output speed.

The motor will not need to draw as much current to function and will move more slowly, but will provide greater torque.

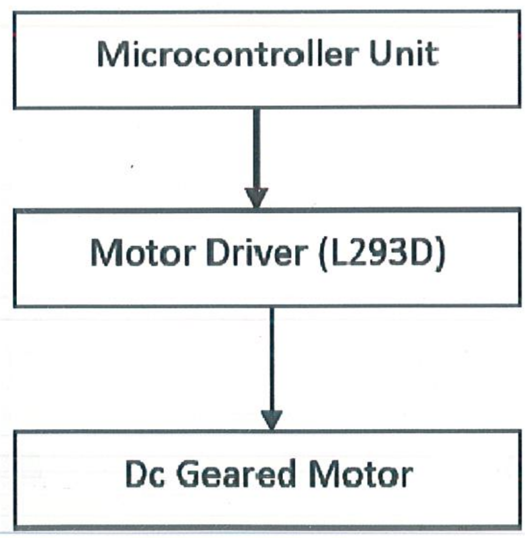
Uses:

Gear motors are commonly used in conveyor-belt drives, home appliances, in handicap and platform lifts, medical and laboratory equipment, machine tools, packaging machinery and printing presses.

A special type of gear motor, the servo motor, provides more power in a compact, precise fashion, and is used when a motor with a rapid, accurate response is needed.

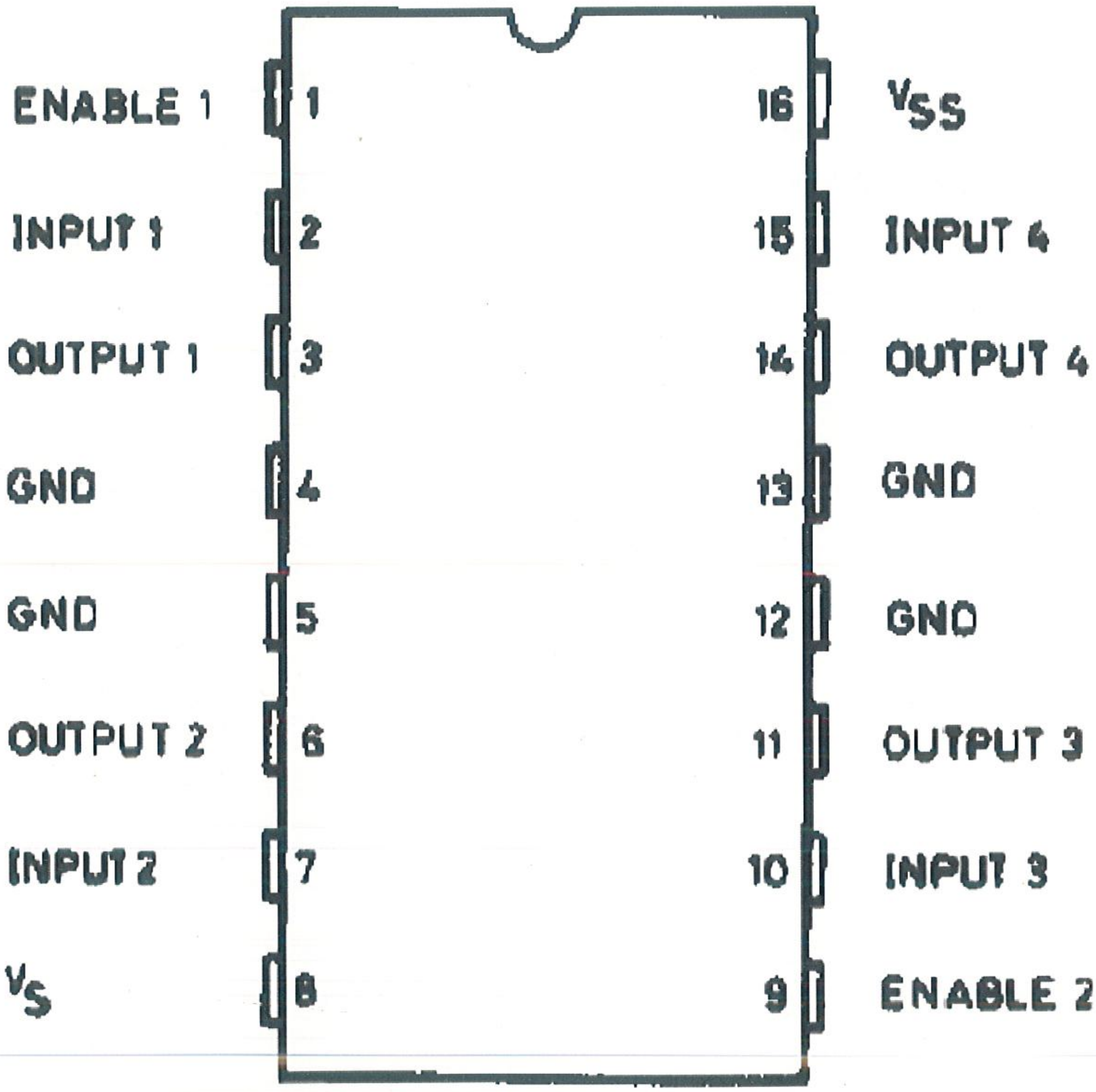
11.2 DC Geared Motor Driver:

To derive the DC geared motor near about 50-100 mA current is required. But any I/O pin of any MCU can source/sink a current of near about 20 mA. So for its interfacing with microcontrollers a power or current amplifier circuit is required, known as motor driver circuits. Mainly two such driver circuits i.e. ULN2003 and transistor/opto-couplers are often used. Or a motor driver like L293D can be used which is an H bridge IC to control the direction of motor rotation.



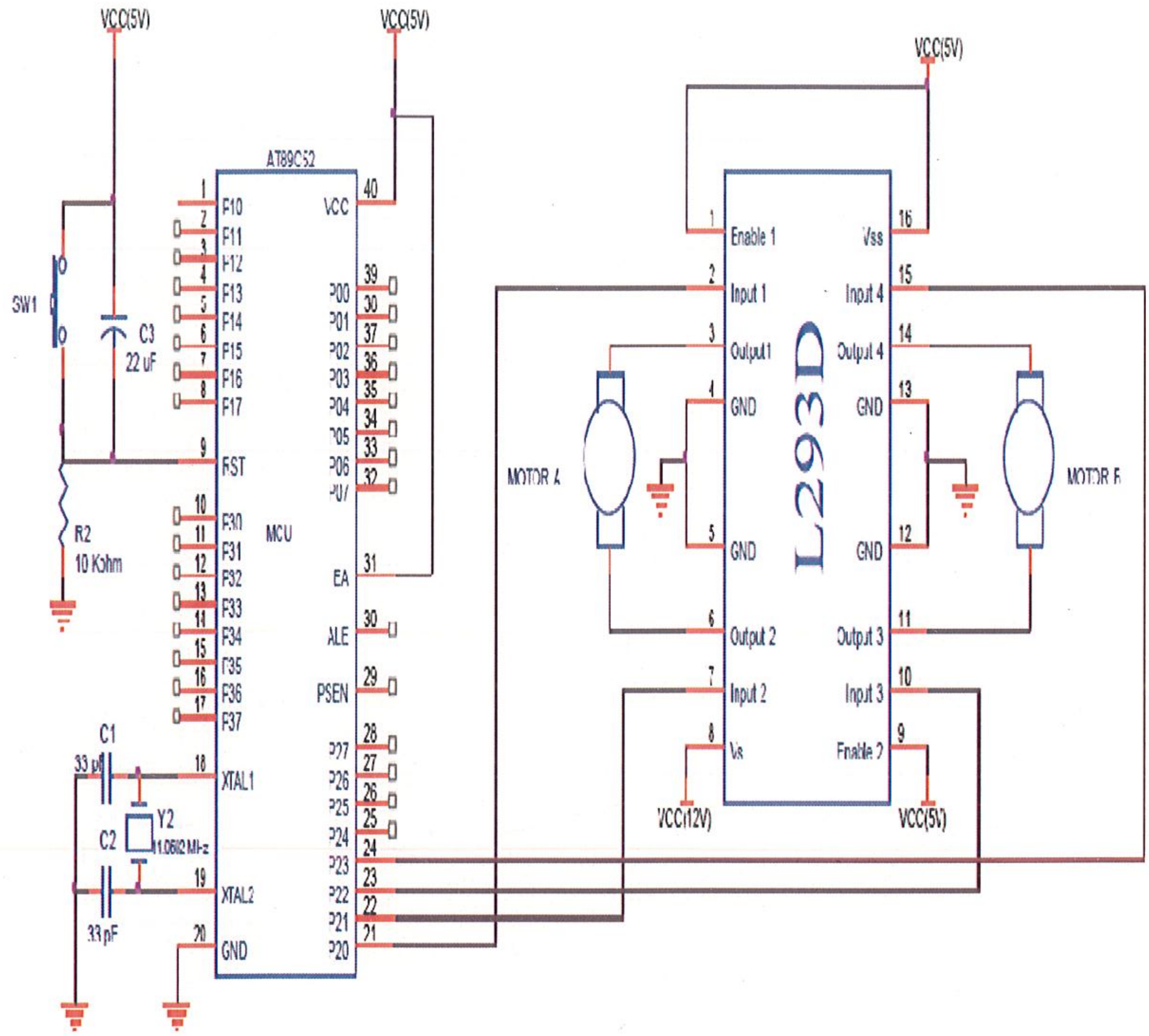
DC MOTOR CONNECTED TO MICROCONTROLLER[23]

The L293D is assembled in a 16 lead plastic package which has 4 center pins connected together and used for heat sinking. The L293DD is assembled in a 20 lead surface mount which has 8 center pins connected together and used for heat sinking.



Pin Diagram of Gear Motor Driver[24]

To interface any dc gear motor and control its direction of rotation L293D is used to derive the motor and to start in the particular direction the command to L293D is given by the Microcontroller unit. Two motors can be controlled simultaneously using a single L293D IC. Pin no.1 & 9 of this IC are ENABLE 1 and ENABLE 2 which is used to enable the output 1 and output 2. They are connected to the +VCC (+5V). This IC is operated at +5V provided at Pin no.16. And one motor can be connected across the output 1 and output 2. When input 1 and input 2 is given a logic 0 and logic 1 by the microcontroller unit then motor start running in one direction and when the logics on these pins are reversed the direction of motor will also be reversed. And to stop the motor both the input pins should be provided with high logic by the microcontroller unit. Similarly we can connect and control the direction of the 2nd motor by connecting it across output 3 and output 4 and controlling it through input 3 and input 4. Motor voltage is provided to the Pin no.8 of this IC.



Interfacing Of the Gear Motor Driver with the Reader[25]

SOURCE CODE

```
#define DATA P1
#define RS P35
#define RW P36
#define E P37
#include<lcdrout.h>

#define M1 P20
#define M2 P21
#define buzz P27

#include<serial.h>
#include<rdreader.h>

void clk(unsigned char sec)
{
        M1=1;
        M2=0;
        secdelay(sec);
        M1=M2=0;
}

void aclk(unsigned char sec)
{
        M1=0;
        M2=1;
        secdelay(sec);
        M1=M2=0;
}
```

```
void main(void)
{
        unsigned char bal1=250,bal2=250,bal3=250,sta=1,s1,s2,s3;
        bit flag1=0,a1=0,a2=0,a3=0,id_flag,id;
        lcd_init();
        init_serial(9600);
        M1=M2=0;
        IE=0x90;
        lcd_cmd1(0x80);
        lcd_puts("  RF ID BASED    ");
        lcd_cmd1(0xc0);
        lcd_puts("METRO PROTOTYPE ");
        secdelay(2);
        lcd_cmd1(0x01);
        EA=1;
while(1)
{
        lcd_cmd1(0x80);
        lcd_puts("Station No:       ");
        lcd_cmd1(0x8c);
        displaypval(sta);
        secdelay(2);

        if(id_flag==1)
                {
                        if(id==101)
                        {
                         if(bal1<=10)
                                {
```

```
        lcd_cmd1(0xc0);
        lcd_puts("Low Balance    ");
        secdelay(1);
        lcd_cmd1(0xc0);
        lcd_puts("                ");

        }
      else
      {
      if(a1==0)
   {
        lcd_cmd1(0xc0);
        lcd_puts("Welcome A       ");
        s1=sta;
        lcd_cmd1(0xcd);
            displaypval(bal1);
        a1=~a1;
        clk(1);
   secdelay(2);
   aclk(1);
        lcd_cmd1(0xc0);
        lcd_puts("                ");
        }
 else
  {
        lcd_cmd1(0xc0);
        lcd_puts("Exit A  Bal:       ");
        lcd_cmd1(0xcd);
        bal1=bal1-((sta-s1)*10);
        displaypval(bal1);
        a1=~a1;
```

```
        clk(1);
    secdelay(2);
    aclk(1);
        lcd_cmd1(0xc0);
        lcd_puts("                ");
        }
  }
}


if(id==106)
{

  if(bal2<=10)
        {
        lcd_cmd1(0xc0);
        lcd_puts("Low Balance     ");
        secdelay(1);
        lcd_cmd1(0xc0);
        lcd_puts("                ");

        }
       else
       {
       if(a2==0)
    {
        lcd_cmd1(0xc0);
        lcd_puts("Welcome B       ");
        s2=sta;
        lcd_cmd1(0xcd);
        displaypval(bal2);
```

```
            a2=~a2;
            clk(1);
        secdelay(2);
        aclk(1);
            lcd_cmd1(0xc0);
            lcd_puts("                ");
            }
    else
      {
            lcd_cmd1(0xc0);
            lcd_puts("Exit B  Bal:        ");
            lcd_cmd1(0xcd);
            bal2=bal2-((sta-s2)*10);
            displaypval(bal2);
            a2=~a2;
            clk(1);
        secdelay(2);
        aclk(1);
            lcd_cmd1(0xc0);
            lcd_puts("                ");
            }
    }
  }

  if(id==109)
  {

    if(bal3<=10)
            {
            lcd_cmd1(0xc0);
            lcd_puts("Low Balance    ");
```

```
secdelay(1);
lcd_cmd1(0xc0);
lcd_puts("                    ");

}
else
{
if(a3==0)
{
lcd_cmd1(0xc0);
lcd_puts("Welcome C        ");
s3=sta;
lcd_cmd1(0xcd);
displaypval(bal3);
a3=~a3;
clk(1);
secdelay(2);
aclk(1);
lcd_cmd1(0xc0);
lcd_puts("                    ");
}
else
{
lcd_cmd1(0xc0);
lcd_puts("Exit C  Bal:        ");
lcd_cmd1(0xcd);
bal3=bal3-((sta-s3)*10);
displaypval(bal3);
a3=~a3;
clk(1);
secdelay(2);
```

```
                aclk(1);
                    lcd_cmd1(0xc0);
                    lcd_puts("                  ");
                    }
                    }
                }


            }


        sta++;
        if(sta>20)
        sta=1;
        secdelay(2);


    }
    }
```

REFERENCES

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