Project report
On
RFID based smart garage with intruder protection

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Submitted in partial fulfilment for the award of the degree of
BACHELOR OF TECHNOLOGY
IN
ELECTRICAL ENGINEERING

Under the guidance of
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ABSTRACT

SMART GARAGE

Our Smart Garage project is to develop and design a smarter garage with more security features system for the house. Automatic Garage is one of the most preferable domestic intended to provide easy excess to gate and to reduce human effort to open and close. Cost of installation might be comparable with the most commonwell-built garage system but the features and operational systems are much better and more reliable.

So, the smart garage with rich features having more quality of safety from the existing smart garage in the market isgoing to be developed in this project.

Throughout the project, we attempt to construct a small and simple model of rich features smart garage will be built. The features included are, automatic opening and closing of the shutter using RFID, garage shutter locking and automatic lighting system at the gate by using LDR sensor.

This explains the decision to have sensitive places protected, using Arduino, from unwanted individuals orgroup of individuals that usually take advantages of loose security systems at the point of entry.

The controller used is smart phone that is integrated by android program which is very light and fast functioning and user-friendly. The controller is linked with the software and hardware component to bridgethe gap of their operation which is very eco-friendly.

<u>Certificate form the Supervisor</u>

This is to certify that the project report has been carried out and presented by

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Students of B. Tech 8th semester (Electrical Engineering), Assam Engineering College, under my supervision and guidance in a manner satisfactory to warrant its acceptance as a prerequisite for the award of the degree of Bachelor of Technology of the Assam Science and Technology University.

Further, the report has not been submitted/ reproduced in any form from the award of any degree.

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CONTENTS:

1) Introduction
2) Objective of The Project
3) Methodology
    3.1 Block Diagram
    3.2 Circuit Diagram
    3.3 Working Principle
4) Literature Review
5) Embedded System
    5.1 What is embedded system
    5.2 How it works
    5.3 Characteristics
    5.4 Advantages and disadvantages
    5.5 Basic structure of embedded system
6)Background study
    6.1 I2C communication
    6.2 RFID Technology
7) LCD
    7.1 Introduction
    7.2 PIN Diagram
    7.3 LCD Commands
8) POWER SUPPLY
    8.1 Introduction to power supply
    8.2 Transformer and it's types
    8.3 Rectifier
    8.4 Filter Circuit for Noise reduction
9) PROTEUS
10) ARDUINO IDE

11)DC GEARED MOTOR

11.1 Motor selection process

11.2 Motor performance curve

12)IC-L293D

12.1 Pinouts of L293D motor driver IC

12.2 Specifications of L293D motor driver IC

12.3 Working of L293D motor driver IC

13)PIR

14)LASER

14.1 Laser beam characteristics

14.2 Type of lasers

14.3 Laser sensors

15)RFID Module

15.1 How RFID works

15.2 RC522 RFID module pinout

16) Photographs

16.1 Experimental prototype

16.2 Individual components

17) Conclusion

18) Bibliography

INTRODUCTION

SMART GARAGE

Smart Garage is the automation process of automatic application and function so that they can be controlled with a registered RFID card. This project is mostly concerned in monitoring, controlling and security of the garage. Since the development of electronics devices, automation has been made much easier. The aims and objectives of the project are:

1. Secure Access Control of the Garage Door using RFID
2. Intruder Detection
3. Security Alarm Activation
4. Garage light controlling automation
5. Detection of Rat/Small animals and Alarming System

The theory of the smart garage is very simple, it opens when it detects the registered RFID card and closes after some delay. It helps us in saving human effort and energy while opening or closing. The automatic shutter we have developed consists of lock system and it also has the lighting system implemented on the garage which automatically switches on when it is dark.

The importance of the work is that it gives more privacy, safety and convenience. For the future scope, theproject has the potential to be:

1. Completely automated
2. More cost effective
3. Accidents prevention

PROJECT OBJECTIVE

1. Secure Access Control of the Garage Door using RFID
2. Intruder Detection
3. Security Alarm Activation
4. Garage light controlling automation
5. Detection of Rat/Small animals and Alarming System

METHODOLOGY

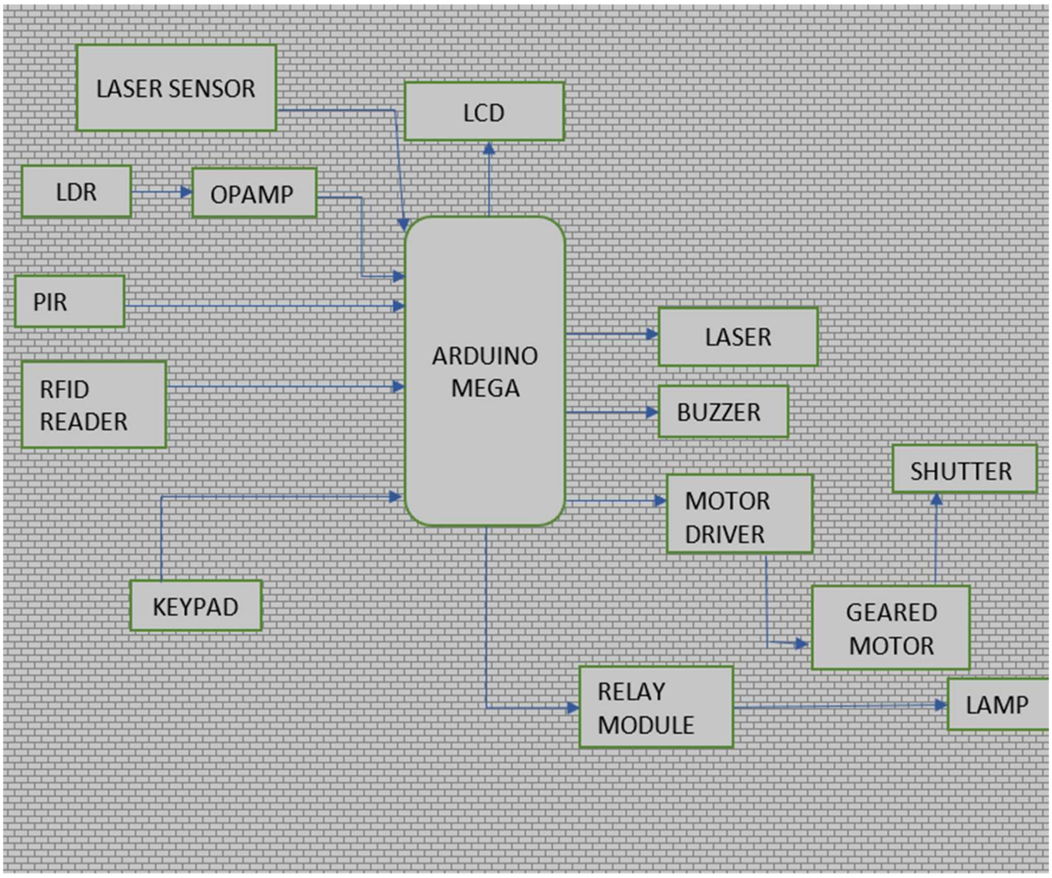
There are a wide variety of project management frameworks which have been evolved over a year with their own strength and weaknesses. The system development methodologies are not suitable for all projects. Thus, the methodology should be chosen based on the specific project after acquiring the required knowledge by research.

SELECTED METHODOLOGY

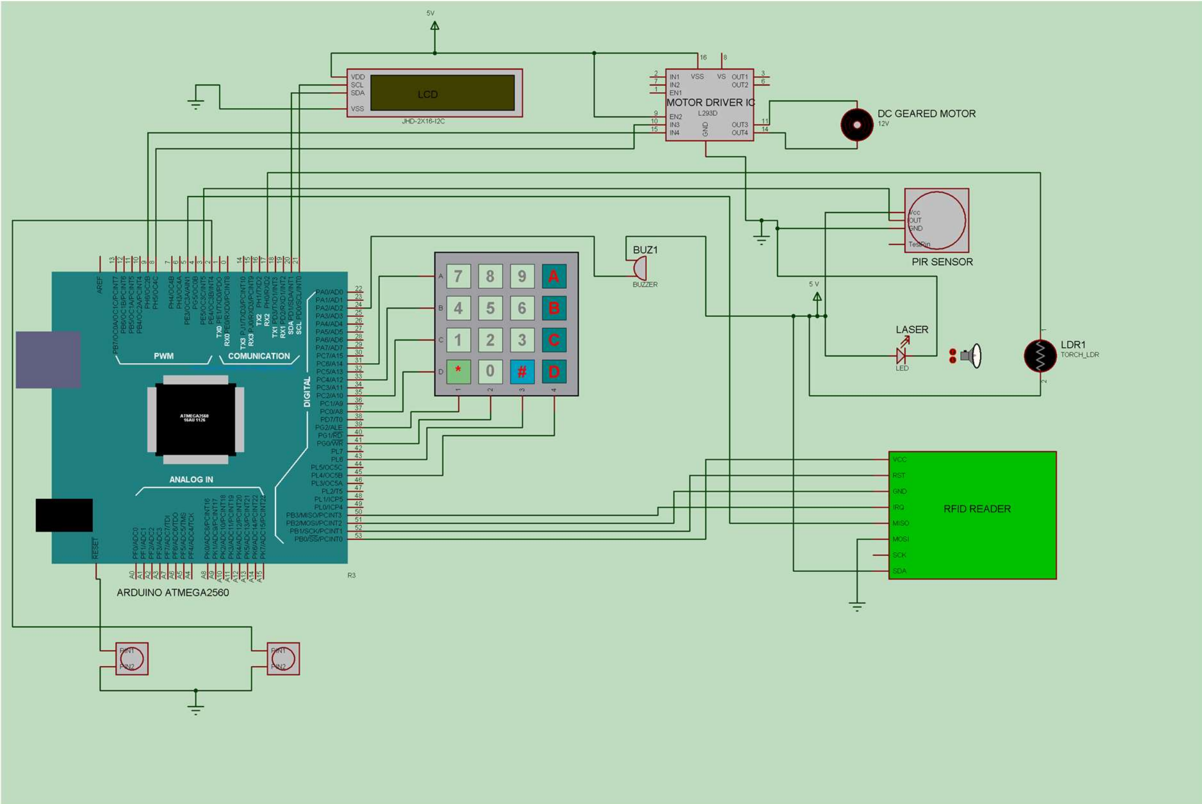
The main goal of this project is to design a smart garage system and intruder detection system. Therefore, after researching and by discussing the need for a potential user Agile methodology is followed in this project.

The agile methodology was developed after the downfall of a traditional methodology called the Waterfall methodology. Usually, In the waterfall methodology, the testing team does not get enough time to complete the testing process as more time is spent and wasted during the early phase for detailed documentation. But, in Agile methodology testing is not taken as a separate phase but as an important phase of the development process.

3.1 BLOCK DIAGRAM



3.2 CIRCUIT DIAGRAM



3.3 WORKING PRINCIPLE

The working principle of the proposed system is based on multiple technique and objectives. The heart of the system is AVR based ARDUINO MEGA 2560 development board. To authenticate a valid user the system is implementing RFID Reader. There will be multiple number or RFID card registered in the system. When an RFID card placed near to the RFID reader, the card will power by the induction method and activates the inbuilt chip in the card. Every card transmits a unique ID to the READER. The RFID reader encodes the CARD ID and transmits to the Microcontroller using serial communication. The program executing in the microcontroller is responsible for verifying the card with pre-registered card ID. If the card is valid, it will send signal to the motor driver, the motor driver will operate a motor which is connected to the garage door mechanism. If the card is not valid it will give a long beep on buzzer and not allow opening the door.

In this project work the aspect is to detect rat inside the garage. To detect rate we are using PIR sensor. The PIR sensor detect IR signal emitted from the RAT as well as human body. The program running in the microcontroller will check for the IP pin status where the PIR sensor out pin is connected. If it detect rat the system will activate a ultrasonic sound based rat replant unit. We have planned to activate the rate replant only after detection of the rate to minimize the power consumption.

The system is also equipped with automatic light controlling system. To detect the light intensity in the garage the system is using an LDR, the output of the LDR is fetch to the IO pin of the microcontroller. The program running in the microcontroller will check the status of the IO pin where the LDR is connected. If the light intensity in the garage is low or dark, it will automatically activate a light source to light up the inside of the garage. To activate light source, a relay module is used, the relay module is responsible for activating or deactivating an AC lamp.

LITERATURE REVIEW

Arduino RFID-Gas Garage Door Opener

by robotgeek_official

In this project, they used the power of RFID to tap into the garage door opening system and bridged a connection in the opener switch via relay board, initiating the door opening as if the button has been pressed.

This system just has minimal security for door opening systems. It can't provide security for intruder activities. Moreover, if the card is lost or not available at that place, the whole system is a failure. They have to open the doon manually.

Apart from the cons, there are a few things that we learned from this project paper. Primarily the interfacing of a RFID module with relay board and the switching operation of door mechanism.

**** How to open your garage door with RFID***

by Ben Miller.

In this project, they used an RFID tag and an Arduino to open a garage door when an authorised tag is sensed. One breakout board is there that does the low-level reading and transmits the tag code via serial pins. Firstly, the RFID reads the tag and transmits the tag to the Arduino. The Arduino then reads the code from the serial connection and compares it to a list of authorised RFID codes. If the tag is on the authorised list, the Arduino pulls a pin high to 5v to close a relay. When the relay closes, it connects the terminals of the garage door signal contacts. The garage door then open.

This paper is so helpful for us to understand the operations and procedures to interface the Arduino with the RFID module and relay switches. We got a minimal idea to move forward.

Similarly to the previous paper, this paper cannot provide the promising security of the door lock mechanism either.

A Digital security system with door lock system using RFID Technology

By Gyanendra Kumar Verma, NIT Raipur.

A digital door locking system is implemented and governed by an RFID reader, which authenticates and validates the user and opens the door automatically. It also keeps a record of the check in and check out of the user.

The new idea of keeping records of check in and check out has a vital role in security purposes. But this project has a satisfying security approach. We considered it as a reference at various points in our project.

**** Arduino based RFID Door lock***

By Nikhil Agnihotri.

Here, The door lock system consists of two critical circuits-the access control system and a locking mechanism. The complete access control system is designed by interfacing the RC522 RFID reader and SSD 1906 OLED display with an Arduino UNO.

The system is similar to the other mentioned systems. This got an extra OLED display feature, but security systems are not directly mentioned in the paper; only the operational possibilities of safety equipment are pointed out.

EMBEDDED SYSTEM

5.1 WHAT IS EMBEDDED SYSTEM

An embedded system is a microprocessor-based computer hardware system with software that is designed to perform a dedicated function, either as an independent system or as a part of a large system. At the core is an integrated circuit designed to carry out computation for real-time operations. Complexities range from a single microcontroller to a suite of processors with connected peripherals and networks; from no user interface to complex graphical user interfaces. The complexity of an embedded system varies significantly depending on the task for which it is designed. Embedded system applications range from digital watches and microwaves to hybrid vehicles and avionics. As much as 98 percent of all microprocessors manufactured are used in embedded systems.

5.2 HOW IT WORKS

Embedded systems are managed by microcontrollers or digital signal processors (DSP), application-specific integrated circuits (ASIC), field-programmable gate arrays (FPGA), and gate arrays. These processing systems are integrated with components dedicated to handling electric and/or mechanical interfacing. Embedded systems programming instructions, referred to as firmware, are stored in read-only memory or flash memory chips, running with limited computer hardware resources. Embedded systems connect with the outside world through peripherals, linking input and output devices.

As its name suggests, embedded means something that is attached to another thing. An embedded system can be thought of as a computer hardware system having software embedded in it. An embedded system can be an independent system or it can be a part of a large system. An embedded system is a microcontroller or microprocessor-based system which is designed to perform a specific task. For example, a fire alarm is an embedded system; it will sense only smoke.

An embedded system has three components −

- It has hardware.
- It has application software.
- It has Real Time Operating system (RTOS) that supervises the application software and provide mechanism to let the processor run a process as per scheduling by following a plan to control the latencies. RTOS defines the way the system works. It sets the rules during the execution of application program. A small-scale embedded system may not have RTOS.

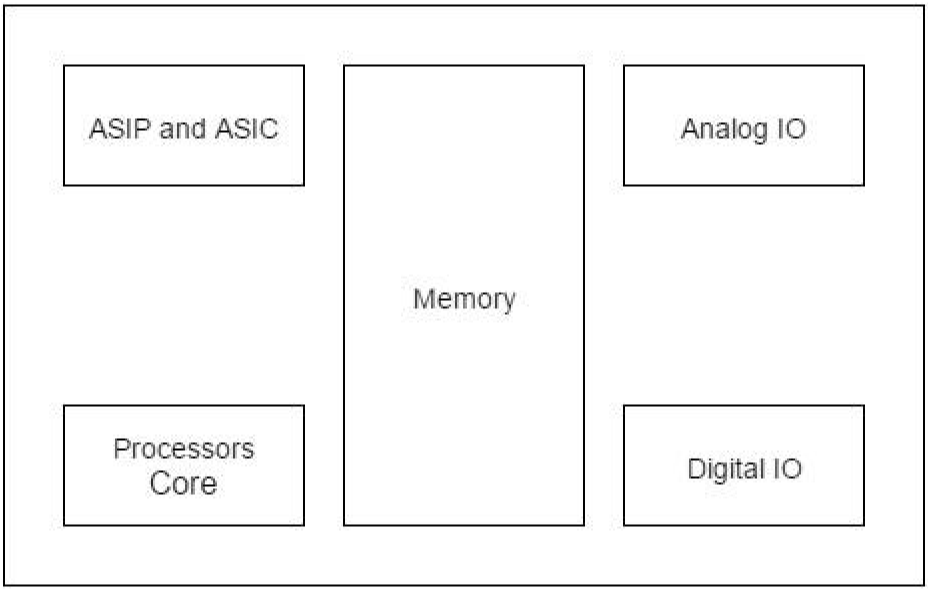
So we can define an embedded system as a Microcontroller based, software driven, reliable, real-time control system.

5.3 CHARACTERISTICS OF AN EMBEDDED SYSTEM

- **Single-functioned** − An embedded system usually performs a specialized operation and does the same repeatedly. For example: A pager always functions as a pager.
- **Tightly constrained** − All computing systems have constraints on design metrics, but those on an embedded system can be especially tight. Design metrics is a measure of an implementation's features such as its cost, size, power, and performance. It must be of a size to fit on a single chip, must perform fast enough to process data in real time and consume minimum power to extend battery life.
- **Reactive and Real time** − Many embedded systems must continually react to changes in the system's environment and must compute certain results in real time without any delay. Consider an example of a car cruise controller; it continually monitors and reacts to speed and brake sensors. It must compute acceleration or de-accelerations

repeatedly within a limited time; a delayed computation can result in failure to control of the car.

- **Microprocessors based** − It must be microprocessor or microcontroller based.
- **Memory** − It must have a memory, as its software usually embeds in ROM. It does not need any secondary memories in the computer.
- **Connected** − It must have connected peripherals to connect input and output devices.
- **HW-SW systems** − Software is used for more features and flexibility. Hardware is used for performance and security.



5.4 ADVANTAGES

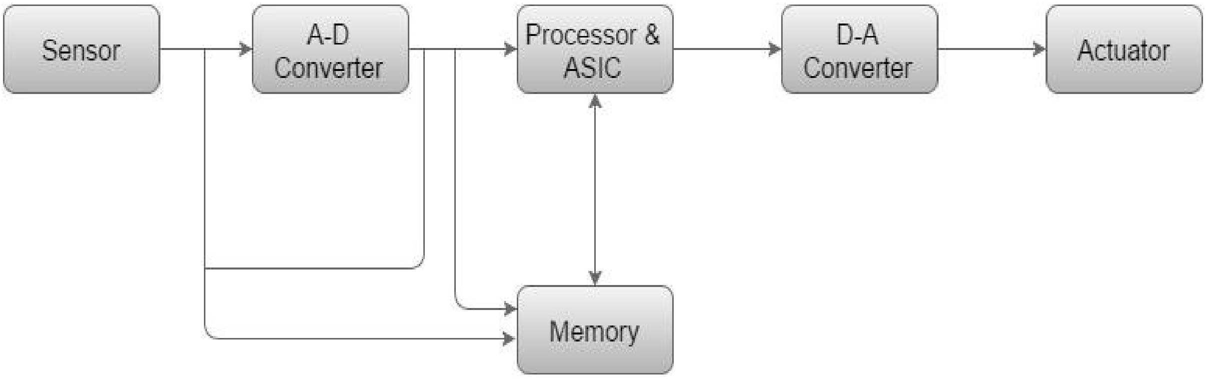
- Easily Customizable
- Low power consumption
- Low cost
- Enhanced performance

5.4 DISADVANTAGES

- High development effort
- Larger time to market

5.5 BASIC STRUCTURE OF AN EMBEDDED SYSTEM

The following illustration shows the basic structure of an embedded system −



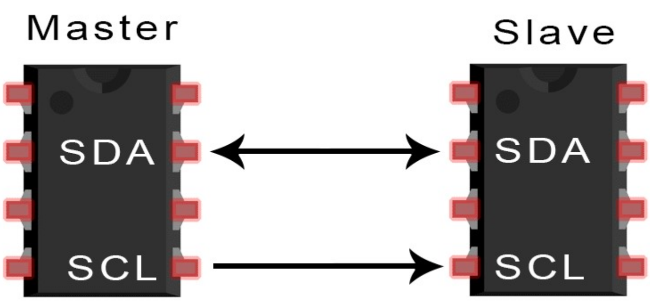
- **Sensor** − It measures the physical quantity and converts it to an electrical signal which can be read by an observer or by any electronic instrument like an A2D converter. A sensor stores the measured quantity to the memory.
- **A-D Converter** − An analogue-to-digital converter converts the analogue signal sent by the sensor into a digital signal.
- **Processor & ASICs** − Processors process the data to measure the output and store it to the memory.
- **D-A Converter** − A digital-to-analogue converter converts the digital data fed by the processor to analogue data
- **Actuator** − An actuator compares the output given by the D-A Converter to the actual (expected) output stored in it and stores the approved output.

BACKGROUND STUDY

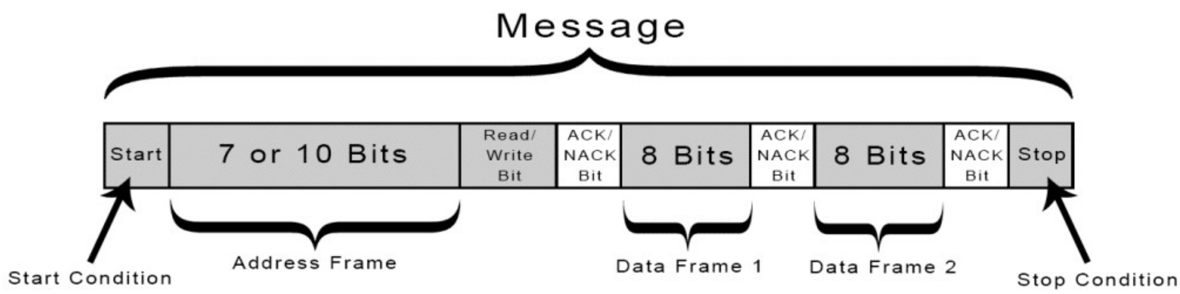
6.1 I2C COMMUNICATION

INTRODUCTION TO I2C COMMUNICATION

I2C combines the best features of SPI and UARTs. With I2C, you can connect multiple slaves to a single master (like SPI) and you can have multiple masters controlling single, or multiple slaves. This is really useful when you want to have more than one microcontroller logging data to a single memory card or displaying text to a single LCD.



SDA (Serial Data) – The line for the master and slave to send and receive data.
SCL (Serial Clock) – The line that carries the clock signal.
I2C is a serial communication protocol, so data is transferred bit by bit along a single wire (the SDA line).Like SPI, I2C is synchronous, so the output of bits is synchronized to the sampling of bits by a clock signal shared between the master and the slave. The clock signal is always controlled by the master.



HOW I2C WORKS

With I2C, data is transferred in *messages.* Messages are broken up into *frames* of data. Each message has an address frame that contains the binary address of the slave, and one or more data frames that contain the data being transmitted. The message also includes start and stop conditions, read/write bits, and ACK/NACK bits between each data frame.

Start Condition: The SDA line switches from a high voltage level to a low voltage level *before* the SCL line switches from high to low.
Stop Condition: The SDA line switches from a low voltage level to a high voltage level *after* the SCL line switches from low to high.
Address Frame: A 7 or 10 bit sequence unique to each slave that identifies the slave when the master wants to talk to it.
Read/Write Bit: A single bit specifying whether the master is sending data to the slave (low voltage level) or requesting data from it (high voltage level).
ACK/NACK Bit: Each frame in a message is followed by an acknowledge/no-acknowledge bit. If an address frame or data frame was successfully received, an ACK bit is returned to the sender from the receiving device.

ADDRESSING

I2C doesn't have slave select lines like SPI, so it needs another way to let the slave know that data is being sent to it, and not another slave. It does this by *addressing*. The address frame is always the first frame after the start bit in a new message.
The master sends the address of the slave it wants to communicate with to every slave connected to it. Each slave then compares the address sent from the master to its own address. If the address matches, it sends a low voltage ACK bit back to the master. If the address doesn't match, the slave does nothing and the SDA line remains high.

READ/WRITE BIT

The address frame includes a single bit at the end that informs the slave whether the master wants to write data to it or receive data from it. If the master wants to send data to the slave, the read/write bit is a low voltage level. If the master is requesting data from the slave, the bit is a high voltage level.

THE DATA FRAME

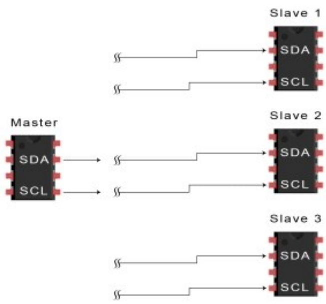
After the master detects the ACK bit from the slave, the first data frame is ready to be sent.

The data frame is always 8 bits long, and sent with the most significant bit first. Each data frame is immediately followed by an ACK/NACK bit to verify that the frame has been received successfully. The ACK bit must be received by either the master or the slave (depending on who is sending the data) before the next data frame can be sent.

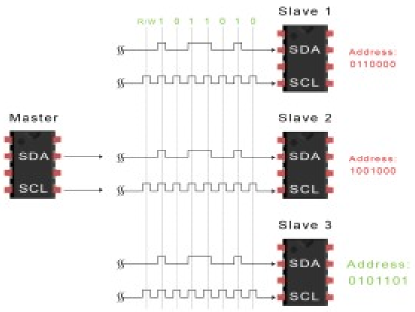
After all of the data frames have been sent, the master can send a stop condition to the slave to halt the transmission. The stop condition is a voltage transition from low to high on the SDA line after a low to high transition on the SCL line, with the SCL line remaining high.

STEPS OF I2C DATA TRANSMISSION

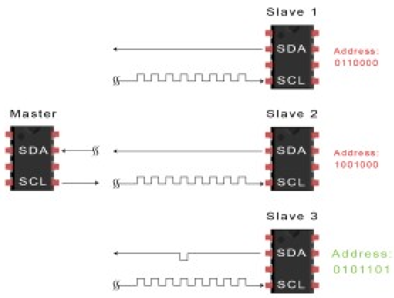
1. The master sends the start condition to every connected slave by switching the SDA line from a high voltage level to a low voltage level *before* switching the SCL line from high to low



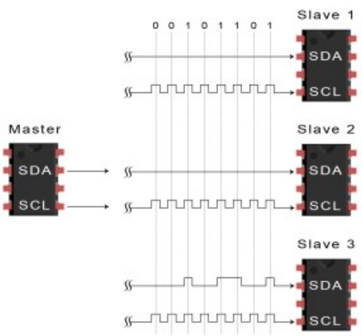
2. The master sends each slave the 7 or 10 bit address of the slave it wants to communicate with, along with the read/write bit.



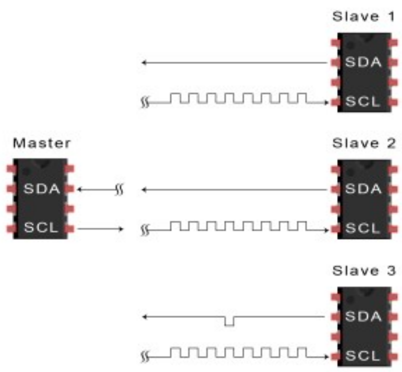
3. Each slave compares the address sent from the master to its own address. If the address matches, the slave returns an ACK bit by pulling the SDA line low for one bit. If the address from the master does not match the slave's own address, the slave leaves the SDA line high.



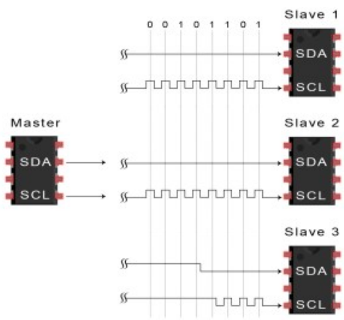
4. The master sends or receives the data frame:



5. After each data frame has been transferred, the receiving device returns another ACK bit to the sender to acknowledge successful receipt of the frame:

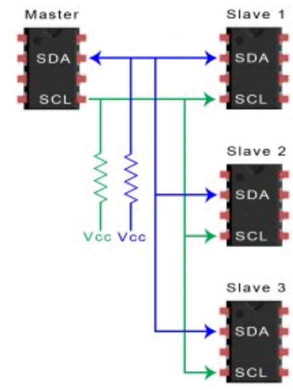


6. To stop the data transmission, the master sends a stop condition to the slave by switching SCL high before switching SDA high:



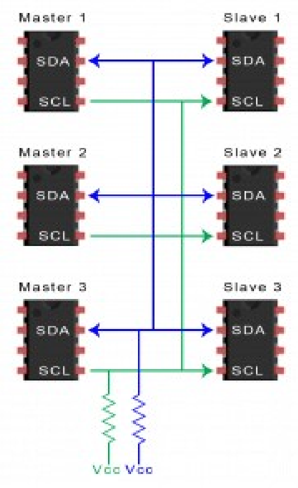
SINGLE MASTER WITH MULTIPLE SLAVES

Because I2C uses addressing, multiple slaves can be controlled from a single master. With a 7 bit address, 128 (2^7) unique address are available. Using 10 bit addresses is uncommon, but provides 1,024 (2^{10}) unique addresses. To connect multiple slaves to a single master, wire them like this, with 4.7K Ohm pull-up resistors connecting the SDA and SCL lines to Vcc:



MULTIPLE MASTERS WITH MULTIPLE SLAVES

Multiple masters can be connected to a single slave or multiple slaves. The problem with multiple masters in the same system comes when two masters try to send or receive data at the same time over the SDA line. To solve this problem, each master needs to detect if the SDA line is low or high before transmitting a message. If the SDA line is low, this means that another master has control of the bus, and the master should wait to send the message. If the SDA line is high, then it's safe to transmit the message. To connect multiple masters to multiple slaves, use the following diagram, with 4.7K Ohm pull-up resistors connecting the SDA and SCL lines to Vcc:



ADVANTAGES AND DISADVANTAGES OF I2C

There is a lot to I2C that might make it sound complicated compared to other protocols, but there are some good reasons why you may or may not want to use I2C to connect to a particular device:

ADVANTAGES

- Only uses two wires
- Supports multiple masters and multiple slaves
- ACK/NACK bit gives confirmation that each frame is transferred successfully
- Hardware is less complicated than with UARTs
- Well known and widely used protocol

DISADVANTAGES

- Slower data transfer rate than SPI
- The size of the data frame is limited to 8 bits
- More complicated hardware needed to implement than SPI

6.2 RFID TECHNOLOGY

INTRODUCTION TO RFID:

Radio-frequency identification (**RFID**) is a technology that uses radio waves to transfer data from an electronic tag, called RFID tag or label, attached to an object, through a reader for the purpose of identifying and tracking the object. Some RFID tags can be read from several meters away and beyond the line of sight of the reader. The application of bulk reading enables an almost-parallel reading of tags.

RFID can be used in many applications. For example, a tag can tag affixed to any object and used to track and manage inventory, assets, people, etc. For sample, it can be affixed to cars, computer equipment, books, mobile phones, etc. The Healthcare industry has used RFID to reduce counting, looking for things and auditing items. Many financial institutions use RFID to track key assets and automate compliance. Also with recent advances in social media RFID is being used to tie the physical world with the virtual world.

RFID MODULE

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.

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.

The data on the chip is usually stored in one of two types of memory. The most common is Read-Only Memory (ROM). Read-only memory cannot be altered once programmed onto the chip during the manufacturing process. The second type of memory is Read/Write Memory;

though it is also programmed during the manufacturing process, it can later be altered by certain devices.

TYPES OF RFID TAGS

a) Passive tags.
b) Semi passive tags.
c) Active tags.
Three different type of tags are describe below:

a)Passive tags: Passive tags are the simplest, smallest and cheapest version of an RFID tag as they do not contain a built-in power source and consequently cannot initiate communication with a reader. As the available power from the reader field diminishes rapidly with distance, passive tags have practical read ranges that vary from about 10 mm up to about 5 metres.
b)Semi-passive tags: Semi passive tags have built-in batteries and do not require energy from the reader field to power the microchip. This allows them to function with much lower signal power levels and act over greater distances.

c)Active tags: Active RFID tags have their own internal power source which is used to power any ICs that generate the outgoing signal. Active tags are typically much more reliable (e.g. fewer errors) than passive tags due to the ability for active tags to conduct a "session" with a reader.

BASIC TYPE OF RFID SYSTEM

FREQUENCY BAND	**CHARACTERISICS**	**TYPICAL APPLICATION**
Low 100-500 KHz	Short to medium read range, inexpensive, low reading speed	Access control Animal/Human identification Inventory Control
Medium 10-15 MHz	Short to medium read range Potentially inexpensive Medium reading range	Access Control Smart Cards
High UHF: 850-950MHz Microwave: 2.4 – 5.8 GHz	Long read range High reading speed Line of sight required (Microwave) Expensive	Railroad car monitoring Toll collection systems

OPERATING PRINCIPLE OF RFID SYSTEM

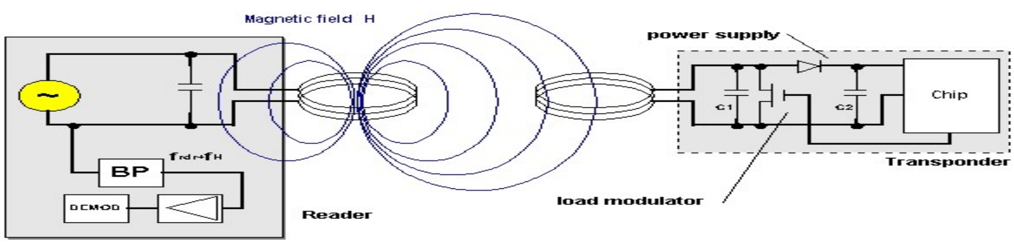
There is a huge variety of different operating principles for RFID systems. The most important principles - ‘inductive coupling’ and ‘backscatter coupling’ are described below.

a)Inductive Coupling

An inductively coupled transponder comprises of an electronic data carrying device, usually a single microchip and a large area coil that functions as an antenna. Inductively coupled transponders are almost always operated passively. This means that all the energy needed for the operation of the microchip has to be provided by the reader. For this purpose, the reader's antenna coil generates a strong, high frequency electro-magnetic field, which penetrates the cross-section of the coil area and the area around the coil. Because the wavelength of the frequency range used (< 135 kHz: 2400 m, 13.56 MHz: 22.1 m) is several times greater than the distance between the reader's antenna and the transponder, the electro-magnetic field may be treated as a simple magnetic alternating field with regard to the distance between transponder and antenna .

A small part of the emitted field penetrates the antenna coil of the transponder, which is some distance away from the coil of the reader. By induction, a voltage is generated in the transponder's antenna coil. This voltage is rectified and serves as the power supply for the data carrying device (microchip). A capacitor C1 is connected in parallel with the reader's antenna coil, the capacitance of which is selected such that it combines with the coil inductance of the antenna coil to form a parallel resonant circuit, with a resonant frequency that corresponds with the transmission frequency of the reader. Very high currents are generated in the antenna coil of the reader by resonance step-up in the parallel resonant circuit, which can be used to generate the required field strengths for the operation of the remote transponder.

The antenna coil of the transponder and the capacitor C1 to form a resonant circuit tuned to the transmission frequency of the reader. The voltage at the transponder coil reaches a maximum due to resonance step-up in the parallel resonant circuit.



As described above, inductively coupled systems are based upon a *transformer-type coupling* between the primary coil in the reader and the secondary coil in the transponder. This is true when the distance between the coils does not exceed 0.16 l, so that the transponder is located in the *near field* of the transmitter antenna .

b)Backscatter Coupling

We know from the field of *RADAR technology* that electromagnetic waves are reflected by objects with dimensions greater than around half the wavelength of the wave. The efficiency with which an object reflects electromagnetic waves is described by its *reflection cross-section.* Objects that are in resonance with the wave front that hits them, as is the case for antenna at the appropriate frequency for example, have a particularly large reflection cross-section.

Power P1 is emitted from the reader's antenna, a small proportion of which (free space attenuation) reaches the transponder's antenna. The power P1' is supplied to the antenna connections as HF voltage and after rectification by the diodes D1 and D2 this can be used as turn on voltage for the deactivation or activation of the power saving "power-down" mode. The diodes used here are *low barrier Schottky diodes*, which have a particularly low threshold voltage. The voltage obtained may also be sufficient to serve as a power supply for short ranges.

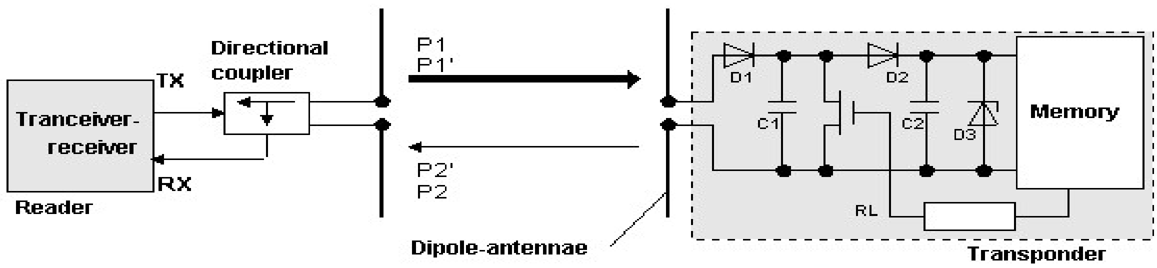


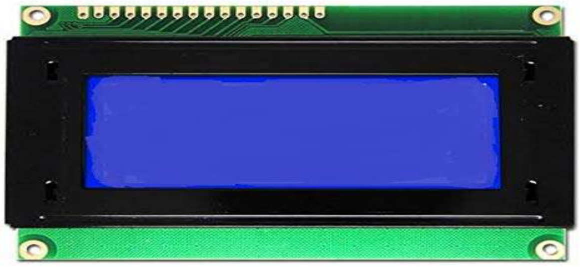
figure:2.4. backscatters principle

A proportion of the incoming power P1' is reflected by the antenna and returned as power P2. The *reflection characteristics* (= reflection cross-section) of the antenna can be influenced by altering the load connected to the antenna. In order to transmit data from the transponder to the reader, a load resistor RL connected in parallel with the antenna is switched on and off in time with the data stream to be transmitted. The amplitude of the power P2 reflected from the transponder can thus be modulated.

The power P2 reflected from the transponder is radiated into free space. A small proportion of this (free space attenuation) is picked up by the reader's antenna. The reflected signal therefore travels into the antenna connection of the reader in the "backwards direction" and can be decoupled using a *directional coupler* and transferred to the receiver input of a reader. The "forward" signal of the transmitter, which is stronger by powers of ten, is to a large degree suppressed by the directional coupler.

LIQUID CRYSTAL DISPLAY (LCD)

7.1 INTRODUCTION



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 do not emit light directly.

LCDs are used in a wide range of applications, including computer monitors, television, instrument panels, aircraft cockpit displays, signage, etc. They are common in consumer devices such as video players, gaming devices, clocks, watches, calculators, and telephones. LCDs have replaced cathode ray tube (CRT) displays in most applications. They are available in a wider range of screen sizes than CRT and plasma displays, and since they do not use phosphors, they cannot suffer image burn-in. LCDs are, however, susceptible to image persistence.

7.2 LCD-JHD16A2 PIN CONFIGURATIONS

FEATURES

- 5 x 8 dots with cursor
- Built-in controller (KS 0066 or Equivalent)
- + 5V power supply (Also available for + 3V)
- 1/16 duty cycle
- B/L to be driven by pin 1, pin 2 or pin 15, pin 16 or A.K (LED)
- N.V. optional for + 3V power supply

LCDs are more energy efficient and offer safer disposal than CRTs. Its low electrical power consumption enables it to be used in battery-powered electronic equipment. It is an electronically modulated optical device made up of any number of segments filled with liquid crystals and arrayed in front of a light source (backlight) or reflector to produce images in color or monochrome. The most flexible ones use an array of small pixels. Each pixel of an LCD typically consists of a layer of molecules aligned between two transparent electrodes, and two polarizing filters, the axes of transmission of which are (in most of the cases) perpendicular to each other. With no actual liquid crystal between the polarizing filters, light passing through the first filter would be blocked by the second (crossed) polarizer.

PIN NUMBER	SYMBOL	FUNCTION
1	Vss	GND
2	Vdd	+ 3V or + 5V
3	Vo	Contrast Adjustment
4	RS	H/L Register Select Signal
5	$R/\overline{W}$	H/L Read/Write Signal
6	E	H →L Enable Signal
7	DB0	H/L Data Bus Line
8	DB1	H/L Data Bus Line
9	DB2	H/L Data Bus Line
10	DB3	H/L Data Bus Line
11	DB4	H/L Data Bus Line
12	DB5	H/L Data Bus Line
13	DB6	H/L Data Bus Line
14	DB7	H/L Data Bus Line
15	A/Vee	+ 4.2V for LED/Negative Voltage Output
16	K	Power Supply for B/L (OV)

The surface of the electrodes that are in contact with the liquid crystal material are treated so as to align the liquid crystal molecules in a particular direction. This treatment typically consists of a thin polymer layer that is unidirectionally rubbed using, The Liquid Crystal Display is intrinsically a “passive” device, it is a simple light valve. The managing and control of the data to be displayed is performed by one or more circuits commonly denoted as LCD drivers.

Before applying an electric field, the orientation of the liquid crystal molecules is determined by the alignment at the surfaces of electrodes. In a twisted nematic device (still the most common liquid crystal device), the surface alignment directions at the two electrodes are perpendicular to each other, and so the molecules arrange themselves in a helical structure, or twist. This induces the rotation of the polarization of the incident light, and the device appears grey. If the applied voltage is large enough, the liquid crystal molecules in the center of the layer are almost completely untwisted and the polarization of the incident light is not rotated as it passes through the liquid crystal layer. This light will then be mainly polarized perpendicular to the second filter, and thus be blocked and the pixel will appear black. By controlling the voltage applied across the liquid crystal layer in each pixel, light can be allowed to pass through in varying amounts thus constituting different levels of gray

7.3 LCD COMMAND CODES

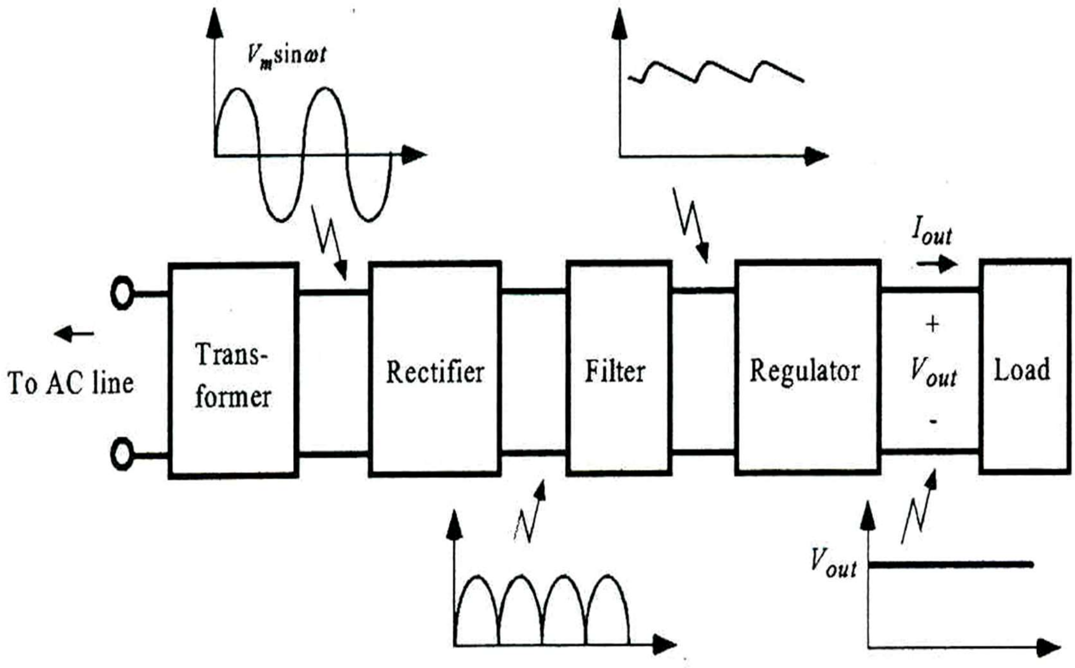
1. 80 Force cursors to beginning to 1st line
2. C0 Force cursor to beginning to 2nd line
3. 38 2 lines and 5x7 matrix
4. 1C Shift the entire display to the right
5. 18 Shift the entire display to the left
6. 14 Shift cursor position to right
7. 10 Shift cursor position to left
8. F Display on, cursor blinking
9. E Display on, cursor blinking
10. A Display off, cursor on
11. 8 Display off, cursor off
12. 7 Shift display left
13. 5 Shift display right
14. 6 Increment cursor (shift cursor to right)
15. 4 Decrement cursor (shift cursor to left)
16. 2 Return home
17. 1 Clear display screen

POWER SUPPLY

8.1 INTRODUCTION

The power supplies are designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronic circuits and other devices. A power supply can by broken down into a series of blocks, each of which performs a particular function. A d.c power supply which maintains the output voltage constant irrespective of a.c mains fluctuations or load variations is known as "Regulated D.C Power Supply"

For example, a 5V regulated power supply system as shown below:



Components of a typical linear power supply

8.2 TRANSFORMER:

A transformer is an electrical device which is used to convert electrical power from one electrical circuit to another without changes in frequency.

Transformers convert AC electricity from one voltage to another with little loss of power. Transformers work only with AC and this is one of the reasons why mains electricity is AC. Step-up transformers increase in output voltage, step-down transformers decrease in output voltage. Most power supplies use a step-down transformer to reduce the dangerously high mains voltage to a safer low voltage. The input coil is called the primary and the output coil is called the secondary. There is no electrical connection between the two coils; instead, they are linked by an alternating magnetic field created in the soft-iron core of the transformer. The two lines in the middle of the circuit symbol represent the core. Transformers waste very little power so the power out is (almost) equal to the power in. Note that as voltage is stepped down current is stepped up.

The ratio of the number of turns on each coil, called the turn's ratio, determines the ratio of the voltages. A step-down transformer has a large number of turns on its primary (input) coil which is connected to the high voltage mains supply, and a small number of turns on its secondary (output) coil to give a low output voltage.

An Electrical Transformer

$$\underline{\text{Turns ratio} = V_p / V_S = N_p / N_S}$$

$$\underline{\text{Power Out} = \text{Power In}}$$

$$\underline{V_S \times I_S = V_P \times I_P}$$

V_p = primary (input) voltage
N_p = number of turns on primary coil
I_p = primary (input) current

8.3 RECTIFIER:

A circuit which is used to convert AC to DC is known as RECTIFIER. The process of conversion AC to DC is called "rectification"

TYPES OF RECTIFIERS:

- Half wave Rectifier
- Full wave rectifier
    1. Centre tap full wave rectifier.
    2. Bridge type full bridge rectifier.

Comparison of rectifier circuits:

Parameter	Type of Rectifier		
	Half wave	Full wave	Bridge
Number of diodes	1	2	4
PIV of diodes	Vm	2Vm	Vm
D.C output voltage	Vm/ π	2Vm/ π	2Vm/ π
Vdc,at no-load	0.318Vm	0.636Vm	0.636Vm
Ripple factor	1.21	0.482	0.482
Ripple Frequency	f	2f	2f
Rectification Efficiency	0.406	0.812	0.812
Transformer Utilization Factor (TUF)	0.287	0.693	0.812
RMS voltage Vrms	Vm/2	Vm/√2	Vm/√2

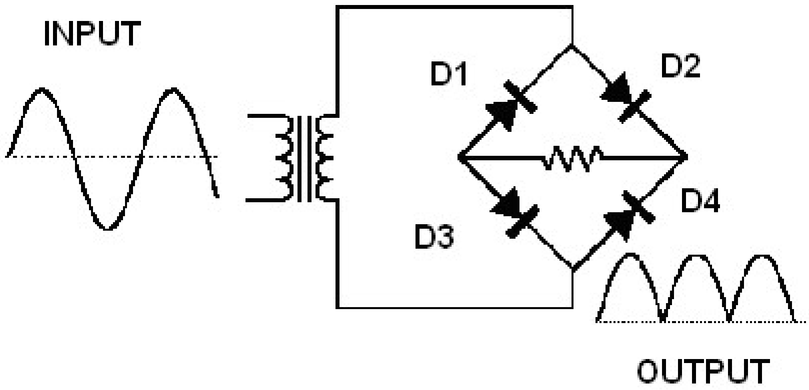
Full-wave Rectifier:

From the above comparison we came to know that full wave bridge rectifier as more advantages than the other two rectifiers. So, in our project we are using full wave bridge rectifier circuit.

Bridge Rectifier:

A bridge rectifier makes use of four diodes in a bridge arrangement to achieve full-wave rectification. This is a widely used configuration, both with individual diodes wired as shown and with single component bridges where the diode bridge is wired internally.

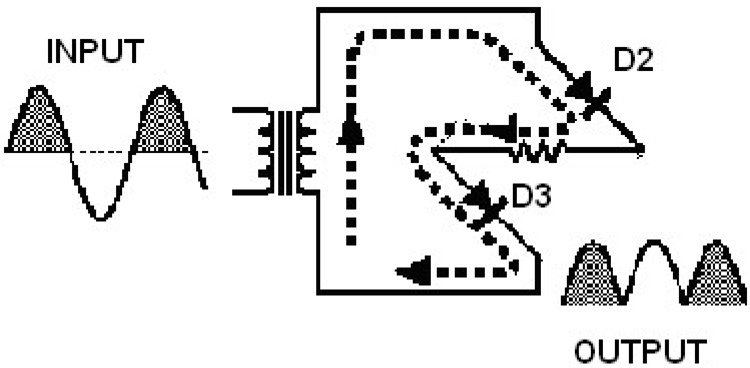
A bridge rectifier makes use of four diodes in a bridge arrangement as shown in fig(a) to achieve full-wave rectification. This is a widely used configuration, both with individual diodes wired as shown and with single component bridges where the diode bridge is wired internally.



Fig(A)

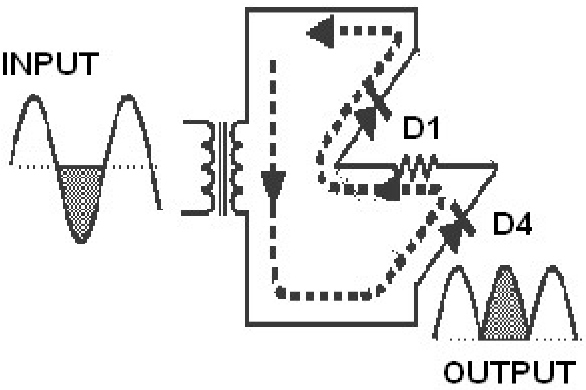
Operation:

During positive half cycle of secondary, the diodes D2 and D3 are in forward biased while D1 and D4 are in reverse biased as shown in the fig(b). The current flow direction is shown in the fig (b) with dotted arrows.



Fig(B)

During negative half cycle of secondary voltage, the diodes D1 and D4 are in forward biased while D2 and D3 are in reverse biased as shown in the fig(c). The current flow direction is shown in the fig (c) with dotted arrows.



Fig(C)

8.4 FILTER:

A Filter is a device which removes the a.c component of rectifier output but allows the d.c component to reach the load

Capacitor Filter:

We have seen that the ripple content in the rectified output of half wave rectifier is **121%** or that of full-wave or bridge rectifier or bridge rectifier is **48%** such high percentages of ripples is not acceptable for most of the applications. Ripples can be removed by one of the following methods of filtering.

(a) A capacitor, in parallel to the load, provides an easier by –pass for the ripples voltage though it due to low impedance. At ripple frequency and leave the d.c.to appears the load.

(b) An inductor, in series with the load, prevents the passage of the ripple current (due to high impedance at ripple frequency) while allowing the d.c (due to low resistance to d.c)

(c) Various combinations of capacitor and inductor, such as L-section filter π section filter, multiple section filter etc. which make use of both the properties mentioned in (a) and (b) above. Two cases of capacitor filter, one applied on half wave rectifier and another with full wave rectifier.

Filtering is performed by a large value electrolytic capacitor connected across the DC supply to act as a reservoir, supplying current to the output when the varying DC voltage from the rectifier is falling. The capacitor charges quickly near the peak of the varying DC, and then discharges as it supplies current to the output. Filtering significantly increases the average DC voltage to almost the peak value (1.4 × RMS value).

To calculate the value of capacitor(C),

$$C = ¼*\sqrt{3}*f*r*Rl$$

Where,

f = supply frequency,

r = ripple factor,

Rl = load resistance

Note: In our circuit we are using 1000µF. Hence large value of capacitor is placed to reduce ripples and to improve the DC component.

Regulator:

Voltage regulator ICs is available with fixed (typically 5, 12 and 15V) or variable output voltages. The maximum current they can pass also rates them. Negative voltage regulators are available, mainly for use in dual supplies. Most regulators include some automatic protection from excessive current ('overload protection') and overheating ('thermal protection'). Many of the fixed voltage regulator ICs have 3 leads and look like power transistors, such as the 7805 +5V 1A regulator shown on the right. The LM7805 is simple to use. You simply connect the positive lead of your unregulated DC power supply (anything from 9VDC to 24VDC) to the Input pin, connect the negative lead to the Common pin and then when you turn on the power, you get a 5 volt supply from the output pin.

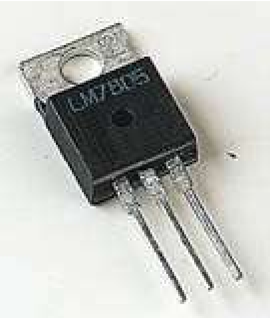


Fig 6.1.6 A Three Terminal Voltage Regulator

78XX:

The Bay Linear LM78XX is integrated linear positive regulator with three terminals. The LM78XX offer several fixed output voltages making them useful in wide range of applications. When used as a zener diode/resistor combination replacement, the LM78XX usually results in an effective output impedance improvement of two orders of magnitude, lower quiescent current. The LM78XX is available in the TO-252, TO-220 & TO-263packages,

Features:

• Output Current of 1.5A
• Output Voltage Tolerance of 5%
• Internal thermal overload protection
• Internal Short-Circuit Limited
• No External Component
• Output Voltage 5.0V, 6V, 8V, 9V, 10V,12V, 15V, 18V, 24V
• Offer in plastic TO-252, TO-220 & TO-263
• Direct Replacement for LM78XX

PROTEUS

Proteus is a simulation and design software tool developed by Labcenter Electronics for Electrical and Electronic circuit design. It also possesses 2D CAD drawing feature. It deserves to bear the tagline “From concept to completion”.

About Proteus

It is a software suite containing schematic, simulation as well as PCB designing.

ISIS is the software used to draw schematics and simulate the circuits in real time. The simulation allows human access during run time, thus providing real time simulation.
ARES is used for PCB designing. It has the feature of viewing output in 3D view of the designed PCB along with components.
The designer can also develop 2D drawings for the product.
Features

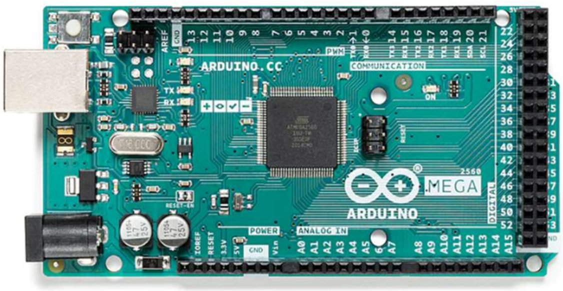
ISIS has wide range of components in its library. It has sources, signal generators, measurement and analysis tools like oscilloscope, voltmeter, ammeter etc., probes for real time monitoring of the parameters of the circuit, switches, displays, loads like motors and lamps, discrete components like resistors, capacitors, inductors, transformers, digital and analog Integrated circuits, semi-conductor switches, relays, microcontrollers, processors, sensors etc.

ARES offers PCB designing up to 14 inner layers, with surface mount and through hole packages. It is embedded with the foot prints of different category of components like ICs, transistors, headers, connectors and other discrete components. It offers Auto routing and manual routing options to the PCB Designer. The schematic drawn in the ISIS can be directly transferred ARES.

ARDUINO IDE

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board -- you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.



Atmega 2560

The **Arduino Mega 2560** is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Mega 2560 board is compatible with most shields designed for the Uno and the former boards. The Mega 2560 is an update to the Arduino Mega, which it replaces.

DC geared motor

A gear motor is an all-in-one combination of a motor and gearbox. The addition of a gear head to a motor reduces the speed while increasing the torque output. The most important parameters in regards to gear motors are speed (rpm), torque (lb-in) and efficiency (%). In order to select the most suitable gear motor for your application you must first compute the load, speed and torque requirements for your application. ISL Products offers a variety of Spur Gear Motors, Planetary Gear Motors and Worm Gear Motors to meet all application requirements. Most of our DC motors can be complemented with one of our unique gearheads, providing you with a highly efficient gear motor solution.

11.1MOTOR SELECTION PROCESS

The motor selection process, at the conceptual design phase, can be challenging but our engineers are here to help. We provide a concierge approach to all of our DC motors and gear motors projects. Our team of engineers work with you to provide the optimal component solution. The following key points can help you determine and select the most appropriate motor or gear motor for our application.

1. **Design Requirements** – A design assessment phase where the product development requirements, design parameters, device functionality, and product optimization are studied.
2. **Design Calculations** – Calculations used to determine which motor would be the best solution for your application. Design calculations determine gear ratio, torque, rotating mass, service factor, overhung load, and testing analysis.

3. **Types of DC Motors/Gearmotors** – The most common electrical motors convert electrical energy to mechanical energy. These types of motors are powered by direct current (DC).
    - Brushed
    - Brushless (BLDC)
    - Planetary Gear Motors
    - Spur Gear Motors
    - Stepper
    - Coreless & Coreless Brushless
    - Servo
    - Gear heads

4. **Motor Specifications** – Once the design calculations are performed, and the application parameters are defined, you can use this data to determine which motor or gear motor will best fit your application. Some of the most common specs to consider when selecting a motor or gear motor would be:
    - Voltage
    - Current
    - Power
    - Torque
    - RPM
    - Life Expectancy / Duty Cycle
    - Rotation (CW or CCW)
    - Shaft Diameter and Length
    - Enclosure Restrictions

11.2MOTORS PERFORMANCE CURVE

A motors performance and gearbox performance are combined into one graph by displaying three specific parameters. These three parameters are speed, torque and efficiency. These performance curves are essential when selecting a gear motor for your application.

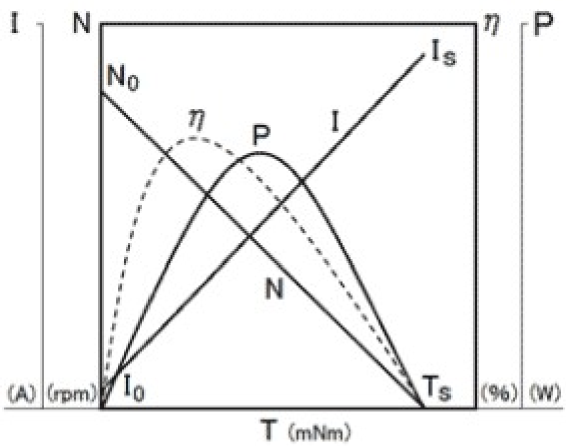


Figure 4 - Performance Curve

- ***Speed/Revolutions*** (N) – (*unit: rpm)* indicated as a straight line that shows the relationship between the gear motor's torque and speed. This line will shift laterally depending on voltage increase or decrease.
- ***Efficiency*** (η) – (*unit: %)* is calculated by the input and output values, represented by the dashed line. To maximize the gear motor's potential it should be used near its peak efficiency.
- ***Torque*** (T) – (*unit: gf-cm)* this is the load borne by the motor shaft, represented on the X-axis.
- ***Current*** (I) – (*unit: A)* indicated by a straight line, from no load to full motor lock. This shows the relationship between amperage and torque.
- ***Output*** (P) – *(unit: W)* is the amount of mechanical energy the gear motor puts out.

For example, let's consider the performance curve below for a DC gear motor.

- Maximum operating efficiency (70%) for this motor would occur at 3.75 lb-in / 2,100 rpm.

- As torque increases the speed and efficiency decrease. The result of increased torque is poor output performance and the device will eventually fail to function once the motor reaches its stall torque (18 lb-in).

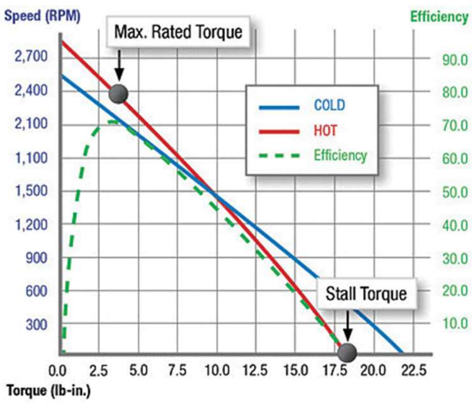


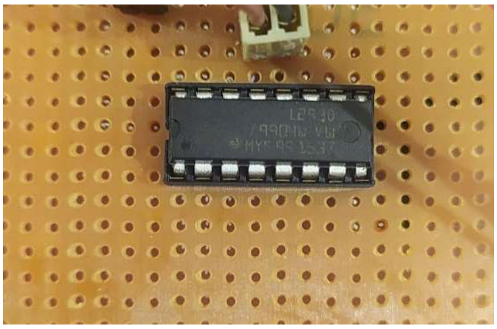
Figure 5 - DC Gear Motor Performance Curve

Gear motor performance curves are a helpful tool when selecting a motor for your application. To get the most out of the performance curves it's important to thoroughly understand the applications requirements. You can use your load and speed requirements to help determine the required torque. Most DC motor and gear motor manufacturers provide performance curves upon request.

IC-L293D

L293D is a basic motor driver integrated chip (IC) that enables us to drive a DC motor in either direction and also control the speed of the motor. The L293D is a 16 pin IC, with 8 pins on each side, allowing us to control the motor. It means that we can use a single L293D to run up to two DC motors. L293D consist of two H-bridge circuit. H-bridge is the simplest circuit for changing polarity across the load connected to it.

There are 2 OUTPUT pins, 2 INPUT pins, and 1 ENABLE pin for driving each motor. It is designed to drive inductive loads such as solenoids, relays, DC motors, and bipolar stepper motors, as well as other high-current/high-voltage loads.



IN1, IN2, and IN3, IN4 are input pins used for providing a control signal from the controller to run the motor in different directions.

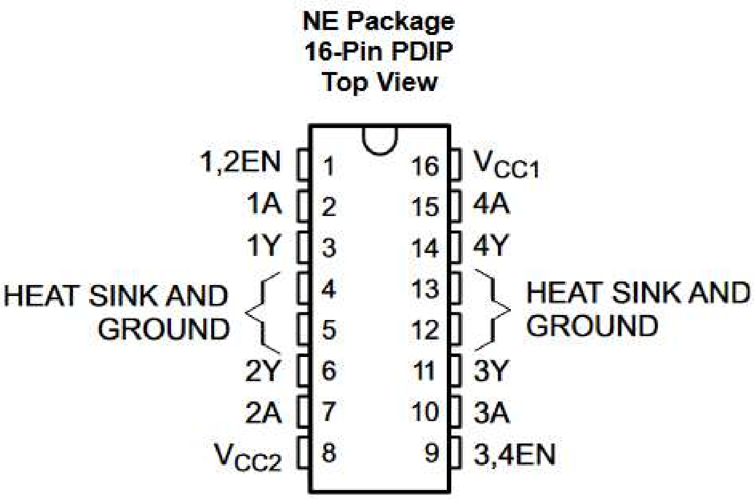
- If input logic at IN1, IN2 is (1,0) the motor rotates in one direction.
- If input logic at IN1, IN2 is (0,1) the motor rotates in the other direction.

EN1 and EN2 are enable pins. Connect 5v DC to EN1 and EN2 pin to operate the motor at its normal speed

- If speed control is needed, then give PWM output at pin EN1 and En2 from the microcontroller.

Power for the motor. If 12V DC gear motor is used then apply 12V.

12.1PINOUTS OF L293D MOTOR DRIVER IC



Pin No.	Name	Function
1	Enable 1-2	When this pin is given HIGH or Logic 1, the left side of the IC works and when it is low, the left side doesn’t work.
2	INPUT 1	When this pin is given HIGH or logic 1, the output 1 becomes HIGH.
3	OUTPUT 1	This pin is connected to one of the terminals of the motor 1.
4,5	GND	Should be connected to the circuit’s ground.
6	OUTPUT 2	This pin is connected to one of the terminals of the motor 1.
7	INPUT 2	When this pin is given HIGH or Logic 1, the output 2 becomes HIGH.
8	VCC2	This is the voltage required to run the motor. IT can be greater than the IC voltage(VCC1).
16	VCC1	It provides power to the l293D IC. So, this pin should be supplied with 5 V.
15	INPUT 4	When this pin is given HIGH or logic 1, the output 4 becomes HIGH.

14	OUTPUT 4	This pin is connected to one of the terminals of the motor 2.
13,12	GND	Should be connected to the circuit's ground.
11	OUTPUT 3	This pin is connected to one of the terminals of the motor 2.
10	INPUT 3	When this pin is given HIGH or logic 1, the output 3 becomes HIGH.
9	Enable 3-4	When this pin is given HIGH or Logic 1, the right side of the IC works and when it is low, the right side doesn't work

Note: There are total 4 ground pins in L293D IC because it has to deal with heavy currents. So, we need a heat sink to reduce the heating and protect the IC from damage. When we solder these pins on PCB, we get a large metallic area between the grounds where the heat can be released.

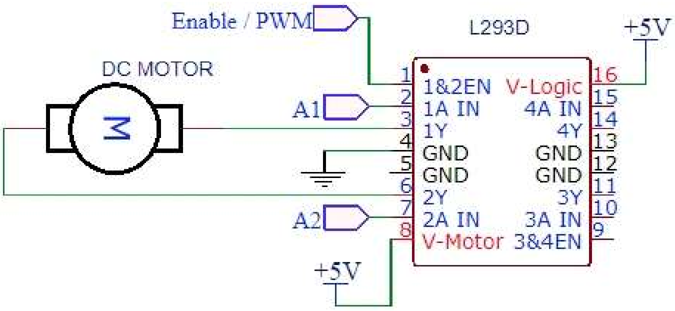
12.2SPECIFICATIONS OF L293D MOTOR DRIVER IC:

- Wide Supply-Voltage Range: 4.5 V to 36 V
- Separate Input-Logic Supply
- Internal ESD Protection
- High-Noise-Immunity Inputs
- Output Current 600 mA Per Channel
- Peak Output Current 1.2 A Per Channel
- Output Clamp Diodes for Inductive Transient Suppression
- Operation Temperature 0°C to 70°C.
- Automatic thermal shutdown is available

12.3WORKING OF L293D MOTOR DRIVER IC

There are 4 input pins for direction control in L293d. Pin 2,7 (1A and 2A) on the left side and pin 15,10 (3A and 4A) on the right of the IC. The left side input pins regulate the rotation of the motor connected across the left end and the right-side input pins regulate the motor on the right-side. The motors are rotated based on the inputs provided across the input pins as HIGH or LOW signals.

Let's take an example, a motor is connected on the left side output pins (pin 3,6). To control this motor, we have to provide an input logic to pin 2,7 (1A,2A).



- Pin 2 = HIGH and Pin 7 = LOW | Clockwise Direction
- Pin 2 = LOW and Pin 7 = HIGH | Counter clockwise Direction
- Pin 2 = LOW and Pin 7 = LOW | Idle (No rotation)
- Pin 2 = HIGH and Pin 7 = HIGH | Idle (No rotation)

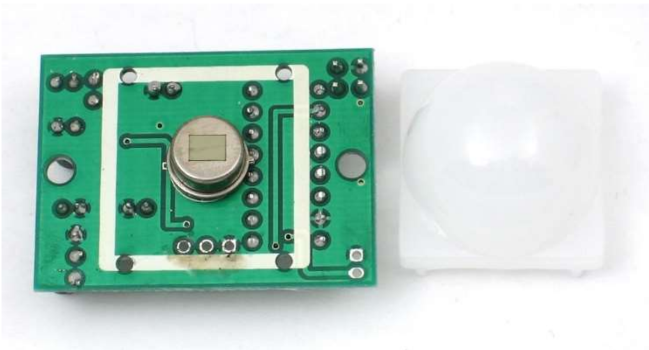
In a similar manner, we can control the motor on the right side connected to pin (11,14). For this, we need to provide HIGH and LOW input signal across pin (10,15).

- Pin 10 = HIGH and Pin 15 = LOW | Clockwise Direction
- Pin 10 = LOW and Pin 15 = HIGH | Counter clockwise Direction
- Pin 10 = LOW and Pin 15 = LOW | Idle (No rotation)
- Pin 10 = HIGH and Pin 15 = HIGH | Idle (No rotation)

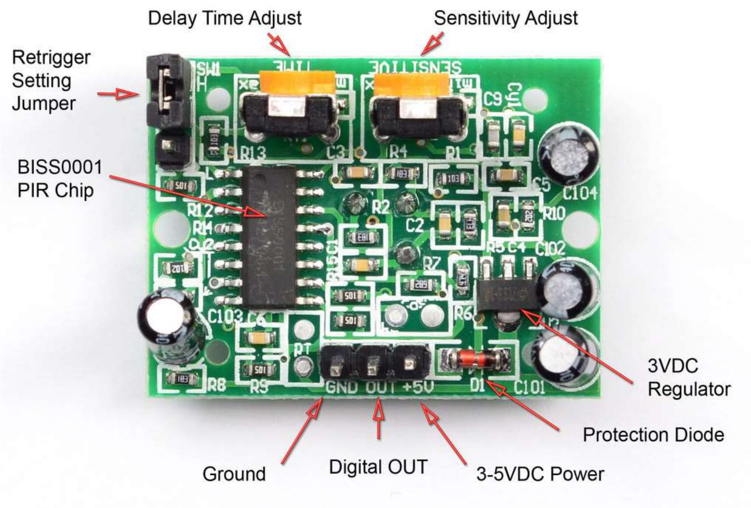
13.PIR

PIR sensors allow you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range. They are small, inexpensive, low-power, easy to use and don't wear out. For that reason, they are commonly found in appliances and gadgets used in homes or businesses. They are often referred to as PIR, "Passive Infrared", "Pyroelectric", or "IR motion" sensors.

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



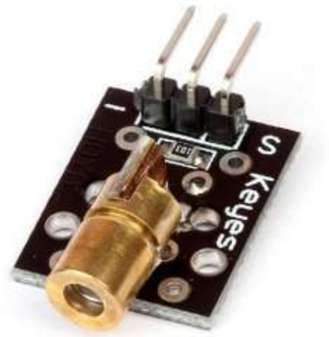
Along with the pyroelectric sensor is a bunch of supporting circuitry, resistors and capacitors. It seems that most small hobbyist sensors use the BISS0001 ("Micro Power PIR Motion Detector IC"), undoubtedly a very inexpensive chip. This chip takes the output of the sensor and does some minor processing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



For many basic projects or products that need to detect when a person has left or entered the area, or has approached, PIR sensors are great. They are low power and low cost, pretty rugged, have a wide lens range, and are easy to interface with. Note that PIRs won't tell you how many people are around or how close they are to the sensor, the lens is often fixed to a certain sweep and distance (although it can be hacked somewhere) and they are also sometimes set off by house pets. Experimentation is key!

LASER (Light Amplification by Stimulated Emission of Radiation)

laser, a device that stimulates atoms or molecules to emit light at particular wavelengths and amplifies that light, typically producing a very narrow beam of radiation. The emission generally covers an extremely limited range of visible, infrared, or ultraviolet wavelengths. Many different types of lasers have been developed, with highly varied characteristics. *Laser* is an acronym for “light amplification by the stimulated emission of radiation.”



14.1LASER BEAM CHARACTERISTICS

Laser light generally differs from other light in being focused in a narrow beam, limited to a narrow range of wavelengths (often called “monochromatic”), and consisting of waves that are in phase with each other. These properties arise from interactions between the process of stimulated emission, the resonant cavity, and the laser medium.

Stimulated emission produces a second photon identical to the one that stimulated the emission, so the new photon has the same phase, wavelength, and direction—that is, the two are coherent with respect to each other, with peaks and valleys in phase. Both the original and the new photon can then stimulate the emission of other identical photons. Passing the light back and forth through a resonant cavity enhances this uniformity, with the degree of coherence and the narrowness of the beam depending on the laser design.

Although a visible laser produces what looks like a point of light on the opposite wall of a room, the alignment, or collimation, of the beam is not perfect. The extent of beam spreading depends on both the distance between the laser mirrors and diffraction, which scatters light at the edge of an aperture. Diffraction is proportional to the laser wavelength divided by the size of the emitting aperture; the larger the aperture is, the more slowly the beam spreads. A red helium-neon laser emits from a one-millimetre aperture at a wavelength of 0.633 micrometre, generating a beam that diverges at an angle of about 0.057 degree, or one milliradian. Such a small angle of divergence will produce a one-metre spot at a distance of one kilometre. In contrast, a typical flashlight beam produces a similar one-metre spot within a few metres. Not all lasers produce tight beams, however. Semiconductor lasers emit light near one micrometre wavelength from an aperture of comparable size, so their divergence is 20 degrees or more, and external optics are needed to focus their beams.

The output wavelength depends on the laser material, the process of stimulated emission, and the optics of the laser resonator. For each transition between energy levels, a material can support stimulated emission over a limited range of wavelengths; the extent of that range varies with the nature of the material and the transition. The probability of stimulated emission varies with wavelength, and the process concentrates emission at wavelengths where that probability is the highest.

Resonant cavities support laser oscillation at wavelengths that meet a resonant condition—an integral number N of wavelengths λ must equal the distance light travels during a round trip between the mirrors. If the cavity length is L and the refractive index of the material in the laser cavity is n, the round-trip distance $2L$ must equal $N\lambda/n$, or $2L = N\lambda/n$. Each resonance is called a longitudinal mode. Except in semiconductor lasers, cavities are thousands of wavelengths long, so the wavelengths of adjacent modes are closely spaced—and usually the laser simultaneously emits light on two or more wavelengths within 0.1 percent of each other. These beams are monochromatic for most practical applications; other optics can be added to limit laser oscillation to a single longitudinal mode and an even narrower range of wavelengths. The best laboratory lasers emit a range of wavelengths that differ by less than 0.0000001 percent.

The narrower the range of wavelengths, the more coherent the beam—meaning the more precisely every light wave in the beam is in exact synchronization with every other one. This is measured by a quantity called coherence length. If the centre of the range of wavelengths emitted is λ and the range of wavelengths emitted is $\Delta\lambda$, this coherence length equals $\lambda^2/2\Delta\lambda$. Typical coherence lengths range from millimetres to metres. Such long coherence lengths are essential, for instance, to record holograms of three-dimensional objects.

Lasers can generate pulsed or continuous beams, with average powers ranging from microwatts to over a million watts in the most powerful experimental lasers. A laser is called continuous-wave if its output is nominally constant over an interval of seconds or longer; one example is the steady red beam from a laser pointer. Pulsed lasers concentrate their output energy into brief high-power bursts. These lasers can fire single pulses or a series of pulses at regular intervals. Instantaneous power can be extremely high at the peak of a very short pulse. Laboratory lasers have generated peak power exceeding 10^{15} watts for intervals of about 10^{-12} second.

Pulses can be compressed to extremely short duration, about 5 femtoseconds (5×10^{-15} second) in laboratory experiments, in order to "freeze" the action during events that occur very rapidly, such as stages in chemical reactions. Laser pulses also can be focused to concentrate high powers on small spots, much as a magnifier focuses sunlight onto a small spot to ignite a piece of paper.

14.2 TYPES OF LASERS

Crystals, glasses, semiconductors, gases, liquids, beams of high-energy electrons, and even gelatine doped with suitable materials can generate laser beams. In nature, hot gases near bright stars can generate strong stimulated emission at microwave frequencies, although these gas clouds lack resonant cavities, so they do not produce beams.

In crystal and glass lasers, such as Maiman's first ruby laser, light from an external source excites atoms, known as dopants, that have been added to a host material at low concentrations. Important examples include glasses and crystals doped with the rare-earth element neodymium and glasses doped with erbium or ytterbium, which can be drawn into fibres for use as fibre-optic lasers or amplifiers. Titanium atoms doped into synthetic sapphire can generate stimulated emission across an exceptionally broad range and are used in wavelength-tunable lasers.

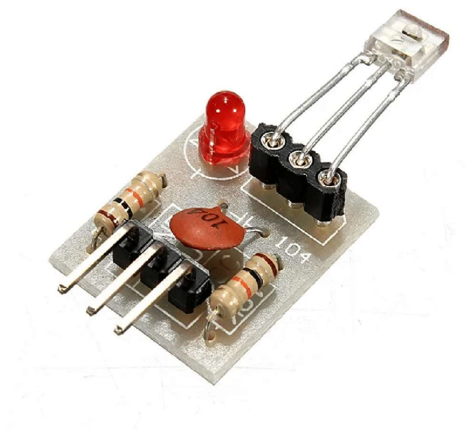
Many different gases can function as laser media. The common helium-neon laser contains a small amount of neon and a much larger amount of helium. The helium atoms capture energy from electrons passing through the gas and transfer it to the neon atoms, which emit light. The best-known helium-neon lasers emit red light, but they also can be made to emit yellow, orange, green, or infrared light; typical powers are in the milliwatt range. Argon and krypton atoms that have been stripped of one or two electrons can generate milliwatts to watts of laser light at visible and ultraviolet wavelengths. The most powerful commercial gas laser is the carbon-dioxide laser, which can generate kilowatts of continuous power.

The most widely used lasers today are semiconductor diode lasers, which emit visible or infrared light when an electric current passes through them. The emission occurs at the interface (*see p-n* junction) between two regions doped with different materials. The *p-n* junction can act as a laser medium, generating stimulated emission and providing lasing action if it is inside a suitable cavity. Conventional edge-emitting semiconductor lasers have mirrors on opposite edges of the *p-n* junction, so light oscillates in the junction plane. Vertical-cavity surface-emitting lasers (VCSELs) have mirrors above and below the *p-n* junction, so light resonates perpendicular to the junction. The wavelength depends on the semiconductor compound.

A few other types of lasers are used in research. In dye lasers the laser medium is a liquid containing organic dye molecules that can emit light over a range of wavelengths; adjusting the laser cavity changes, or tunes, the output wavelength. Chemical lasers are gas lasers in which a chemical reaction generates the excited molecules that produce stimulated emission. In free-electron lasers stimulated emission comes from electrons passing through a magnetic field that periodically varies in direction and intensity, causing the electrons to accelerate and release light energy. Because the electrons do not transition between well-defined energy levels, some specialists question whether a free-electron laser should be called a laser, but the label has stuck. Depending on the energy of the electron beam and variations in the magnetic field, free-electron lasers can be tuned across a wide range of wavelengths. Both

14.3LASER SENSORS

A laser sensor is a measurement value recorder working with laser technology and turning the physical measured value into an analogue electrical signal. This means that the laser sensor is conceived for contactless measurement. The laser sensor works based on the triangulation principle. With a laser sensor you can measure the length of a road, a distance's length and positions, without any contact. This happens at a very high resolution. Laser sensors also dispose of various linearities, in addition to the various resolutions.



There are laser sensors that are especially designed for tarnished and metallic surfaces or for black surfaces. Thank to the integrated intelligent signal analysis, the laser sensor can deliver an exact result. And this irrespective of the colour of the respective surface. Thank to the emitted laser beam that is extremely focused, the laser sensor is able to perform finer measurements than devices based on light diodes.

These sensors are integrated in a point laser or a line laser. The line laser is different from a point laser in the sense that the former projects one resp. two fixed lines. The lines are produced with integrated fixed lens. Point lasers produce one or several points. Thank to the compact and very robust design of a laser sensor, it is possible to integrate it in very small devices or e.g. to include it as a component of industrial robots.

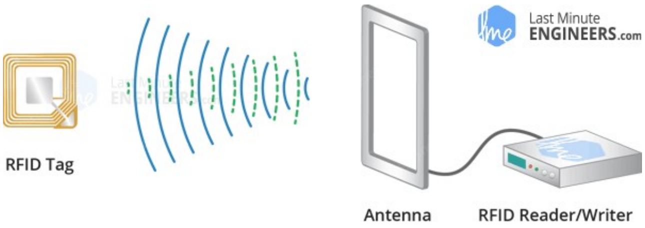
RFID module

RFID or Radio Frequency Identification system consists of two main components, a transponder/tag attached to an object to be identified, and a Transceiver also known as interrogator/Reader.

A Reader consists of a Radio Frequency module and an antenna which generates high frequency electromagnetic field. On the other hand, the tag is usually a passive device, meaning it doesn't contain a battery. Instead it contains a microchip that stores and processes information, and an antenna to receive and transmit a signal.

15.1HOW RFID WORS

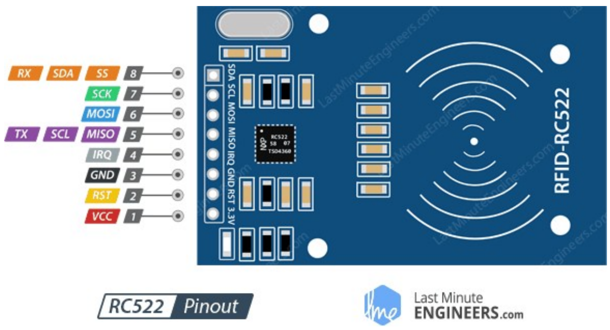
To read the information encoded on a tag, it is placed in close proximity to the Reader (does not need to be within direct line-of-sight of the reader). A Reader generates an electromagnetic field which causes electrons to move through the tag's antenna and subsequently power the chip.



The powered chip inside the tag then responds by sending its stored information back to the reader in the form of another radio signal. This is called backscatter. The backscatter, or change in the electromagnetic/RF wave, is detected and interpreted by the reader which then sends the data out to a computer or microcontroller.

15.2RC522 RFID MODULE PINOUT

The RC522 module has total 8 pins that interface it to the outside world. The connections are as follows:



VCC supplies power for the module. This can be anywhere from 2.5 to 3.3 volts. You can connect it to 3.3V output from your Arduino. Remember connecting it to 5V pin will likely destroy your module!

RST is an input for Reset and power-down. When this pin goes low, hard power-down is enabled. This turns off all internal current sinks including the oscillator and the input pins are disconnected from the outside world. On the rising edge, the module is reset.

GND is the Ground Pin and needs to be connected to GND pin on the Arduino.

IRQ is an interrupt pin that can alert the microcontroller when RFID tag comes into its vicinity.

MISO / SCL / Tx pin acts as Master-In-Slave-Out when SPI interface is enabled, acts as serial clock when I2C interface is enabled and acts as serial data output when UART interface is enabled.

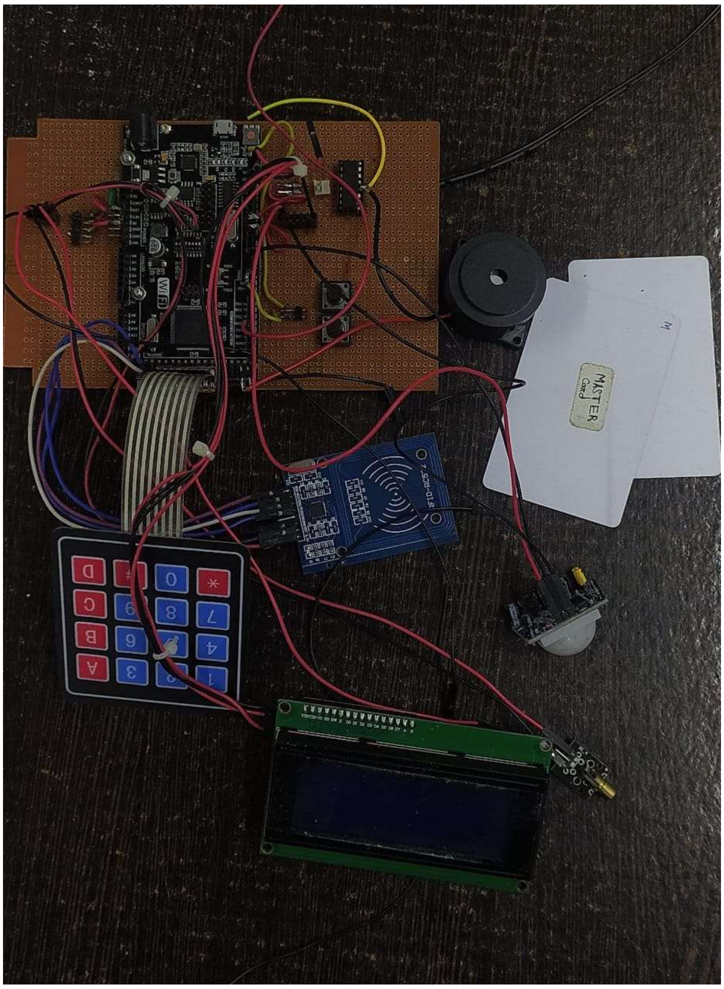
MOSI (Master Out Slave In) is SPI input to the RC522 module.

SCK (Serial Clock) accepts clock pulses provided by the SPI bus Master i.e. Arduino.

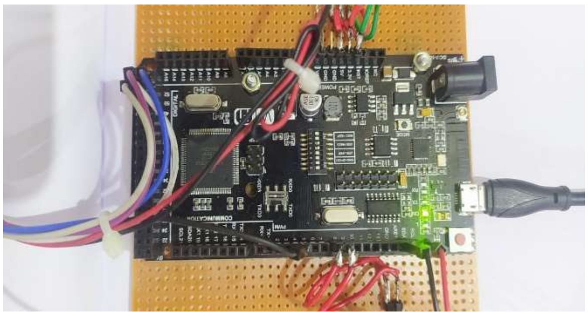
SS / SDA / Rx pin acts as Signal input when SPI interface is enabled, acts as serial data when I2C interface is enabled and acts as serial data input when UART interface is enabled. This pin is usually marked by encasing the pin in a square so it can be used as a reference for identifying the other pins.

PHOTOGRAPHS

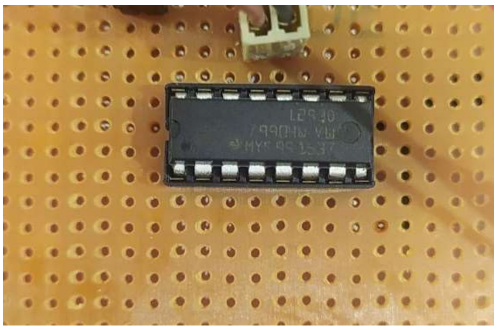
16.1 EXPERIMENTAL PROTOTYPE

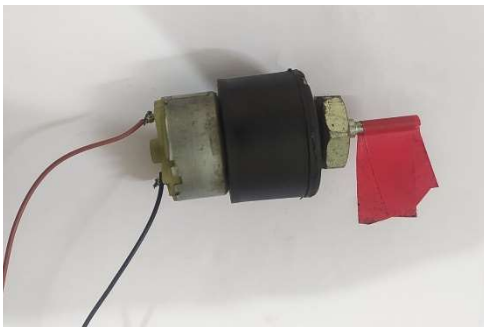


16.2 INDIVIDUAL COMPONENTS

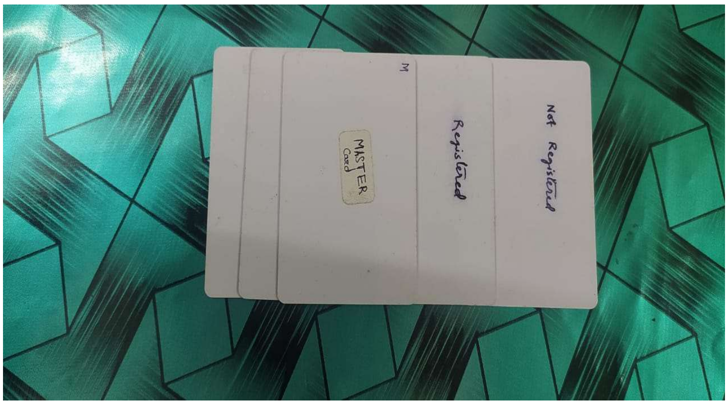


ATMEGA2560 **LCD**

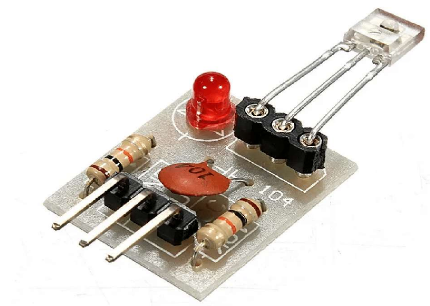


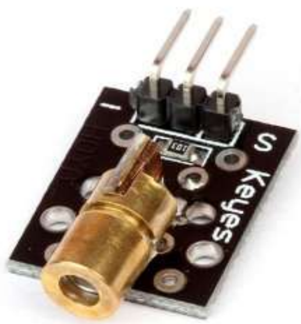


L293D **DC GEARED MOTOR**



RFID R/W **RFID CARD**





LASER SENSOR **LASER SOURCE**

PIR SENSOR **BUZZER (alarm system**

CONCLUSION

In the circuit we have done the RFID system implementation, LCD interfacing and we have connected the DC geared motor circuit for the door opening and closing system of the garage. System can accept new user as well as can remove user from the EPROM. Moreover, PIR sensor is used to detect any intruder activity ,To be more precise on detection of intruder; LASER is implemented too and connected with a buzzer .The moment PIR or LASER detects any intruder activity abruptly alarm system activates.

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