

AUTOMATED COVID PREVENTION SYSTEM FOR INDOOR SAFETY

Submitted in partial fulfilment of the requirements for the award of Bachelor of
Engineering degree in Electronics and Communication Engineering

By

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SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade "A" by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

APRIL – 2021



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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **ANKIT KUMAR TIWARY (37130027)** and **AYUSH ANAND (37130041)** who have done the Project work as a team who carried out the project entitled "**AUTOMATED COVID PREVENTION SYSTEM FOR INDOOR SAFETY**" under my supervision from September 2020 to April 2021.

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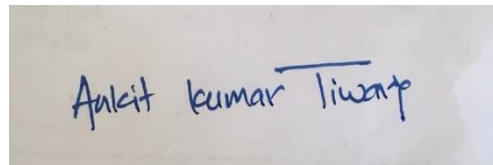
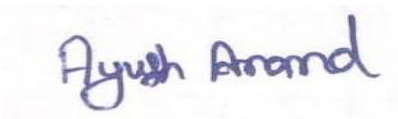
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DECLARATION

We, **Ankit Kumar Tiwary (37130027)** and **Ayush Anand (37130041)** hereby declare that the Project Report entitled “**AUTOMATED COVID PREVENTION SYSTEM FOR INDOOR SAFETY**” done by us under the guidance of **MS.L.Magthelin Therase M.E.**, at Sathyabama Institute of Science and Technology is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication Engineering.

DATE:19-04-2021

PLACE:CHENNAI

A photograph of a handwritten signature in blue ink on a light-colored surface. The signature reads "Ankit kumar Tiwary".A photograph of a handwritten signature in blue ink on a light-colored surface. The signature reads "Ayush Anand".

SIGNATURE OF THE CANDIDATE

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We are pleased to acknowledge our sincere thanks to Board of Management of **SATHYABAMA** for their kind encouragement in doing this project and for completing it successfully. We are grateful to them.

We convey our thanks to **Dr. N. M. Nandhitha, M.E., Ph.D.**, Dean, School of Electrical and Electronics and **Dr. T Ravi, M.E., Ph.D.**, Head of the Department, Dept. of Electronics and Communication Engineering for providingus necessary support and details at the right time during the progressive reviews.

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ABSTRACT

In today's scenario of COVID 19, prevention is a major issue. Since as for now no vaccines are available, precaution and prevention is the only hope. Since the last days of the previous year, the occurrence of novel infectious flu-alike respiratory disease COVID-19 caused by SARS-Cov-2 virus (also known as coronavirus) has affected almost every aspect of people's lives globally. First, it was discovered in China, but spread quickly to other continents in just a few weeks. Common symptoms of coronavirus disease include fever, tiredness, sore throat, nasal congestion, loss of taste and smell. In most cases, it is transmitted directly (person to person) through respiratory droplets, but also indirectly via surfaces. Incubation period could be quite long and varies (between 14 and 27 days in extreme cases). Furthermore, even asymptomatic persons (almost 45% of cases) can spread the disease making the situation even worse. Due to these facts, many protection and safety measures were taken by governments in order to reduce the disease spread, such as obligatory indoor mask wearing, social distancing, quarantine, self-isolation, limiting citizens' movement within country borders and abroad, often together with prohibition and cancellation of huge public events and gatherings. Even though the pandemic seemed weaker at some points, most of safety regulations are still applied due to an unstable situation.

This problem can be tackled by the recent technologies using which these norms can be mandated. Being more specific on technology, EMBEDDED SYSTEMS, has a huge potential to meet this demand. For the safety of the people inside a room or office, people coming from outside environment can be stopped at the entrance and bid to follow certain procedures like body temperature checking, sanitizing hand and body, sanitizing the belongings if any. All this can be done by using microcontrollers like Arduino, Raspberry pie or MSP430 and various sensors like IR sensor, temperature sensor. This project setup will result in abiding people to follow the norms and will ensure safety of people indoors. This project has a high future scope as COVID has not only affected the human body but also the lifestyle and to ensure complete safety following the norms must be a part of it.

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CHAPTER 1

INTRODUCTION

1.1 OVERVIEW

On December 31 On December 31st, 2020, reports of the first case of Covid-19 had surfaced the city of Wuhan, China. Since then, the outbreak was declared a public health emergency of international concern and reached almost all corners of the world and in a short time it became a pandemic resulting for lots of countries to raise up their walls declaring lockdowns, travel ban, and to practice social distancing. This had lead for the World health Organization (WHO) to work 24/7 to analyse data related to this new type of coronavirus, provide necessary advice, coordinate with different sectors and partners in an international scale, help countries prepare, increase supplies, and manage expert networks. Now, as of April 18th, 2020, there are almost 2 million coronavirus cases, 150 thousand deaths, and 580 thousand recovered across the globe and counting. According to latest evidence, the new novel corona virus is mainly transmitted between people through respiratory droplets and contact routes such us through a person's nose or mouth. In a recent analysis conducted by the WHO 75,465 COVID-19 cases in China, airborne transmission was not documented. In defence, Airborne transmission is different from droplet transmission, a common misconception by people, as its presence of microbes within the particle emitted by a carrier. But still, experts and scientist across the world is still studying and analysing whether the new type of corona virus scan be transmitted airborne though conducting research from air sampling from symptomatic COVID-19 patients however there are no Covid-19 RNA was detected in air samples. A good thing that technology and modernization had helped us through safe and faster communication especially the WHO to become fully aware of other studies which are related on the evaluation of the presence of COVID-19 RNA in air samples, but which are not yet published in peer-reviewed journals for the primary reason that these initial findings need to be interpreted more carefully, technically, and systematically which are in accordance with proper procedures and scientific application. According to what I know, as a student and a graduate of science school, it is crucial to put in mind that the detection of RNA in air samples and in environmental samples based on PCR-based assays will not stipulate that a possible virus could be transmissible. Still, necessary guidelines could still be implemented when studies like this is proven true. As evidence arises, it is in deep need to know whether a feasible virus is found and on what role it plays in transmission. Now government efforts are emerging in a national scale to help those in need of food, shelter, medication, and to those people who are in need

financially. Test kits are being mass produced and thanks to technology this type of production is accomplished faster and easier unlike before. International help is also evident in every country especially to the 3rd

world countries such as the Philippines and Thailand supplying medical tools, equipment, and in special intercountry relationship even medical health workers. Countries who are in lockdown are encouraged to do self-quarantine or stay at home as much as possible to help prevent further spread of the pandemic virus resulting to cancellation of labour, public transportation, postponing of international events such as celebrity concerts and athletic events, and

closing of schools and other mass gatherings. This had forced people to change how they normally live and reminisce their fun memories and life when there

's still no virus lurking around. The society that we live right now had changed drastically, we even become conscious on our health even the simplest cough makes us question if we really are okay or had the misfortune of acquiring the so called COVID-19. Personally, I miss having a good and better life where I have inner peace that myself and my family, relatives, friends, and love ones is safe and free from sickness that could possibly end our lives in a painful way. This present situation also makes me realize that having a good life is not only having inner peace or having a good mental health but also knowing the value of money and prioritizing on which decisions and actions you should make when situations change. I swear, If I were to lead a local or national government or a non-government organization I address the situation by education my scope of influence what they should do in crisis like this and on how to prevent having and spreading this kind of virus through different broadcast system such as the radio, TV, and even social-media platforms because I believe we can change and overcome any problems with proper knowledge, strategy, application, and also with the full commitment, obedience, and discipline of the countrymen.

CHAPTER 2

LITERATURE SURVEY

From the invention of microcontroller in 1970s to the large-scale use of various kinds of embedded microprocessors, embedded systems have a history of more than forty years. The first high-volume production of an embedded system is the D-17 automatic navigation control computer system in the Minuteman 1 missile which was launched in 1961. It can reprogram the guidance algorithms, so that the missile could obtain higher accuracy. Another significance of embedded systems is that, it made the price of intergraded chips drop from 1000 dollar to 3 dollar each. Intergraded chip commercial became possible¹. In 1976, Intel launched its first single chip 8048. After that in the early 1980s, Intel improved its 8048. The company launched its new single chip 8051. It was the most famous single chip in the world¹. In 1990s, the performance of embedded systems has been further improved. The real-time conception appeared. Embedded systems began to support multitask. Many companies began to develop their own embedded systems. In 2000s, with the development of the embedded technologies, embedded systems had a considerable improvement in reliability, power consumption and performance. They could be packed into a very small device but with high performances, you can use it for more than two or three weeks without changing. Ipad is a good example. Its success could prove the importance of a good embedded system. Nowadays the multi-core technology is coming into our life. It could support multi-task better. It is also the direction of the future technology.

The Arduino project was first developed in Italy in 2005. As defined on their website² “Arduino is an open-source electronics platform based on easy-to-use hardware and software”. The Arduino platforms were built to address several issues in other microcontroller products making it more appealing for hobbyists, students, and teachers. It has the advantages of low cost, cross-platform, simplicity of programming, and open-source extendable software and hardware. Arduino products are based on the 8-bit ATmega microcontrollers. Boards are equipped with a large number of digital and analog IO pins, serial communication modules, USB connection, and ICSP capability. Arduino boards are easily interfaced with external components for data

acquisition and control applications. All Arduino boards could be connected to a number of shields developed for different applications. As a measure of the popularity of Arduino, Fig. 2 illustrates the results extracted by Google Trends regarding searches for three keywords, namely: Arduino, Raspberry Pi, and the PIC microcontroller. An interesting behavior to note is the general continuous increase of the number of searches for Arduino and Raspberry Pi with Arduino having a higher number. On the other hand, the number of searches for the PIC microcontroller is gradually decreasing over the past five years. Moreover, as Arduino became more and more popular among academics, the number of publications involving the Arduino platform has considerably increased over the years. Fig. 3 illustrates the number of Arduino-related publications in the following engineering education conferences: American Society for Engineering Education (ASEE), Frontiers in Education (FIE), IEEE Teaching, Assessment, and Learning for Engineering (TALE), and IEEE Global Engineering Education Conference (EDUCON). These publications either report using Arduino in education (in primary schools, high schools and universities), introducing new Arduino educational boards, recommending its use, or just acknowledging the technology. Some programs offer complete courses for learning Arduino. For example, two courses are dedicated for learning Arduino and its programming environment, and interfacing principles at the University of California, Irvine³ in an Internet-of-Things (IoT) specialization. Arduino is gaining interest from the industry as well. Referring to an embedded systems market study carried by UBM⁴ in 2014, 19% of the surveyed professionals are considering the use of Arduino in their next embedded project.

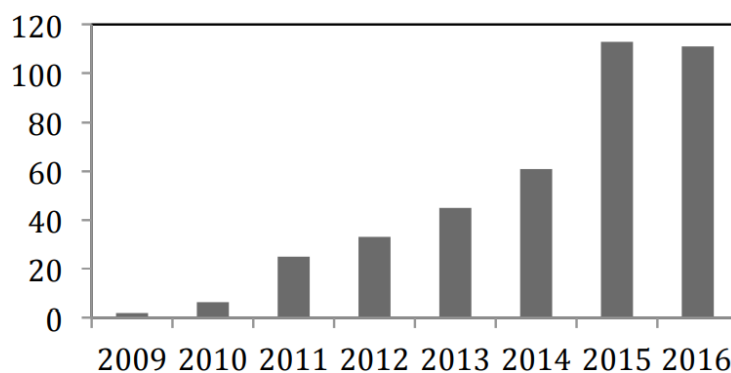


Fig. 3. Number of Arduino-related publications per year.

CHAPTER 3

AIM AND SCOPE

In this system, we are using Embedded System consisting of Arduino microcontroller, Sensors

Audio interfaces. Arduino acts as the brain of the systems as it stores all the information of instructions and tasks to be performed. The sensors used will detect the human presence and ask to follow

the norms as stored in codes. These instructions will be commanded by speakers.

Aim is to make it mandatory to follow the Covid norms.

As corona cases are increasing day by day instead of having vaccines and all sort of medicines it will become a new normal to follow the covid norms. This increases the importance of this product built exponentially. Scope of success of this product if marketed is very high as it is the need of the time.

CHAPTER 4

MATERIALS AND METHODS

4.1 EXISTING SYSTEM

The existing systems that are being used in the market are task specific.

Each system does a certain task. For eg. We have a separate system for temperature measurement, separate for hand sanitization but instead of this affected person can get into the premises of offices, banks, malls etc. These are manual systems, and it depends on a person's wish to use it or not.

Moreover, these systems do not generate any kind of warning if protocol is broken. It just gives a information and does not act accordingly. i.e Temperature measurement machine can not stop a person from entering the premises if he is having high temp. So, at a certain point these existing methods are failing in providing complete safety.

4.2 BLOCK DIAGRAM OF EXISTING SYSTEM

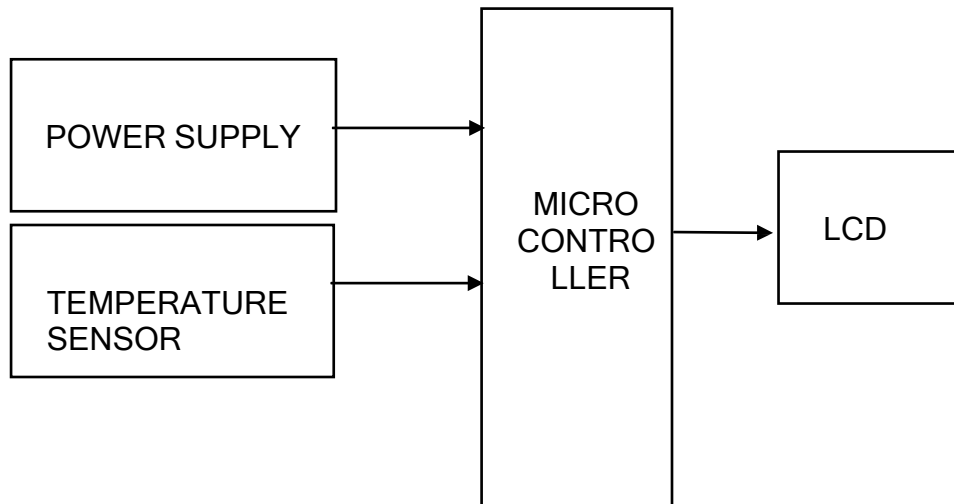


Fig 4.1 Block Diagram of Existing System

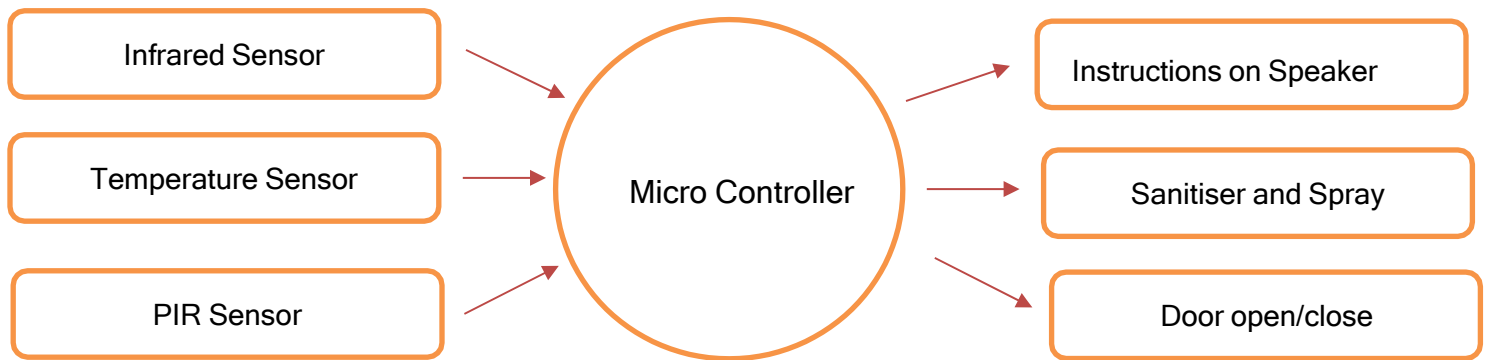
4.3 PROPOSED SYSTEM

The proposed system is complex combination of all the individually required systems In such a manner that it performs all the tasks alone. From detecting a person to

measuring its temperature and hand sanitization all the tasks are done by the same system.

Moreover, if the required temperature of a person is more than normal range it will not allow him to enter into the premises. Similarly, if temperature is normal but person is not sanitizing hands, it won't allow him to enter. This way it makes it mandatory to follow the norms suggested by the government.

4.5 PROPOSED SYSTEM BLOCK DIAGRAM



CHAPTER 5

HARDWARE DESCRIPTION

1. ARDUINO

The Arduino hardware is a so-called micro controlling board (Following called “board”). Basically, it is a circuit board with many electronic parts around the actual microcontroller. On the edge of the board are many pins with whom it is possible to connect different components. Some of them are for example: Switches, LED's, Ultrasonic sensors, temperature sensors, displays, stepper, etc., There are different kind of boards, that can be used with the Arduino software. Different sized “official” boards, with the official “Arduino” name on it, but also many, mostly cheaper, but equivalent Arduino “fitting” boards. Typical official boards are called Arduino UNO, Arduino MEGA, Arduino Mini, etc. Arduino compatible boards are for example Funduino UNO, Funduino MEGA, Freeduino, Seeduino, Sainsmart UNO etc.

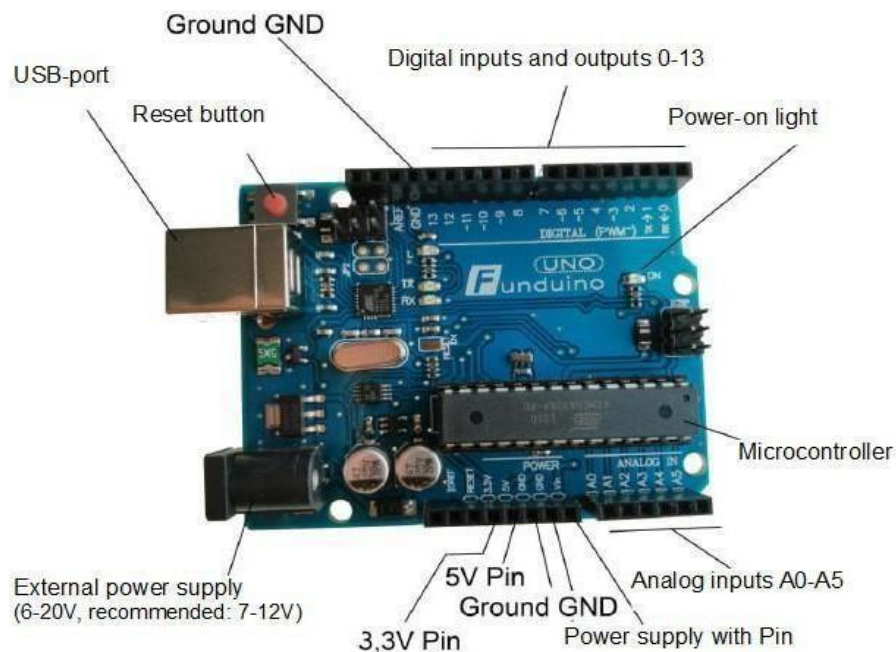


Fig 5.1 Arduino Board

Arduino boards sense the environment by receiving inputs from many sensors, and affect their surroundings by controlling lights, motors, and other actuators. Arduino boards are the microcontroller development platform that will be at the heart of your projects. When making something you will be building the circuits and interfaces for interaction and telling the

microcontroller how to interface with other components.

Here the anatomy of Arduino Uno.

5.1.1 PIN DETAILS

- **Digital pins** Use these pins with `digitalRead()`, `digitalWrite()`, and `analogWrite()`. `analogWrite()` works only on the pins with the PWM symbol.
- **Pin 13 LED** The only actuator built-in to your board. Besides being a handy target for your first blink sketch, this LED is very useful for debugging.
- **Power LED** Indicates that your Arduino is receiving power. Useful for debugging.
- **ATmega microcontroller** The heart of your board.
- **Analog in** Use these pins with `analogRead()`.
- **GND and 5V pins** Use these pins to provide +5V power and ground to your circuits.
- **Power connector** This is how you power your Arduino when it's not plugged into a USB port for power. Can accept voltages between 7-12V.
- **TX and RX LEDs** These LEDs indicate communication between your Arduino and your computer. Expect them to flicker rapidly during sketch upload as well as during serial communication. Useful for debugging.

- **USB port** Used for powering your Arduino Uno, uploading your sketches to your Arduino, and for communicating with your Arduino sketch (via Serial. println() etc.).
- **Reset button** Resets the ATmega microcontroller.

The software that is used to program the microcontroller, is open-source- software and can be downloaded for free on www.arduino.cc. With this "Arduino software" you can write little programs with the microcontroller should perform. This program is called "Sketch". In the end the sketches are transferred to the microcontroller by USB cable. More on that later on the subject "programming"

5.1.2 INSTALLATION

Now one after another the Arduino software and the USB driver for the board must be installed.

Installation and Set Up of the Arduino Software

1. Download the Arduino software on www.arduino.cc and install it on the computer (The microcontroller NOT connected to the PC). After that you open the software file and start the program named arduino.exe.

Two set ups on the program are important and should be considered.

- a) The board that you want to connect, has to be selected on the Arduino software.

You have to choose the right "Serial-Port", to let the Computer know the board has been connected. That is only possible if the USB driver has been installed correctly. It can be checked this way: At the moment the Arduino isn't connected to the PC. If you now choose "Port", under the field "Tool",

you will already see one or more ports here (COM1/ COM2/ COM3...). The quantity of the shown ports doesn't depend on the quantity of the USB port on the computer.



Installation of the USB Driver

How it should be:

2. You connect the board to the computer.
3. The Computer recognizes the board and suggests to install a driver automatically.

ATTENTION: Wait a second! Most of the time the computer can't find the driver automatically to install it. You might choose the driver by your own to install it. It can be found in the Arduino file under "Drivers".

Control: At the control panel of the Computer you can find the "Device manager". If the board has been installed successfully, it should appear here. When the installation has failed, there is either nothing special to find or you will find an unknown USB device with a yellow exclamation mark. In this case: Click on the unknown device and choose "update USB driver". Now you can start over with the manual installation

5.2 RELAY AND DRIVER

5.2.1 Relay

The first relay was invented by Joseph Henry in 1835. The name relay is derived from the French noun *relais* that indicates the horse exchange place of the postman. Generally, a relay is an electrical hardware device having an input and output gate. The output gate consists in one or more electrical contacts that switch when the input gate is electrically excited. It can implement a decouple, a router or breaker for the electrical power, a negation, and, on the base of the wiring, complicated logical functions containing *and*, *or*, *flip-flop*. In the past relays had a wide use, for instance the telephone switching or the railway routing and crossing systems. In spite of electronic progresses, relays are still used in applications where ruggedness, simplicity, long life and high reliability are important factors.

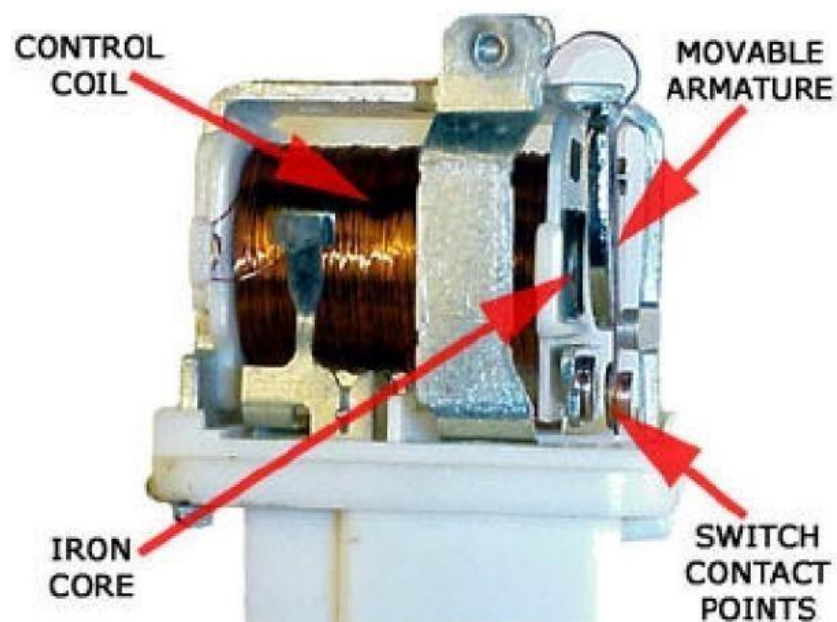


Fig 5.2 Relay

5.2.2 Operation

When a current flows through the coil, the resulting magnetic field attracts an armature that is mechanically linked to a moving contact. The movement either makes or breaks a connection with a fixed contact. When the current to the coil is switched off, the armature is returned by a force approximately half as strong as the magnetic force to its relaxed position. Usually this is a spring, but gravity is also used commonly in industrial motor starters. Most relays are manufactured to operate quickly. In a low voltage application, this is to reduce noise. In a high voltage or high current application, this is to reduce arcing.

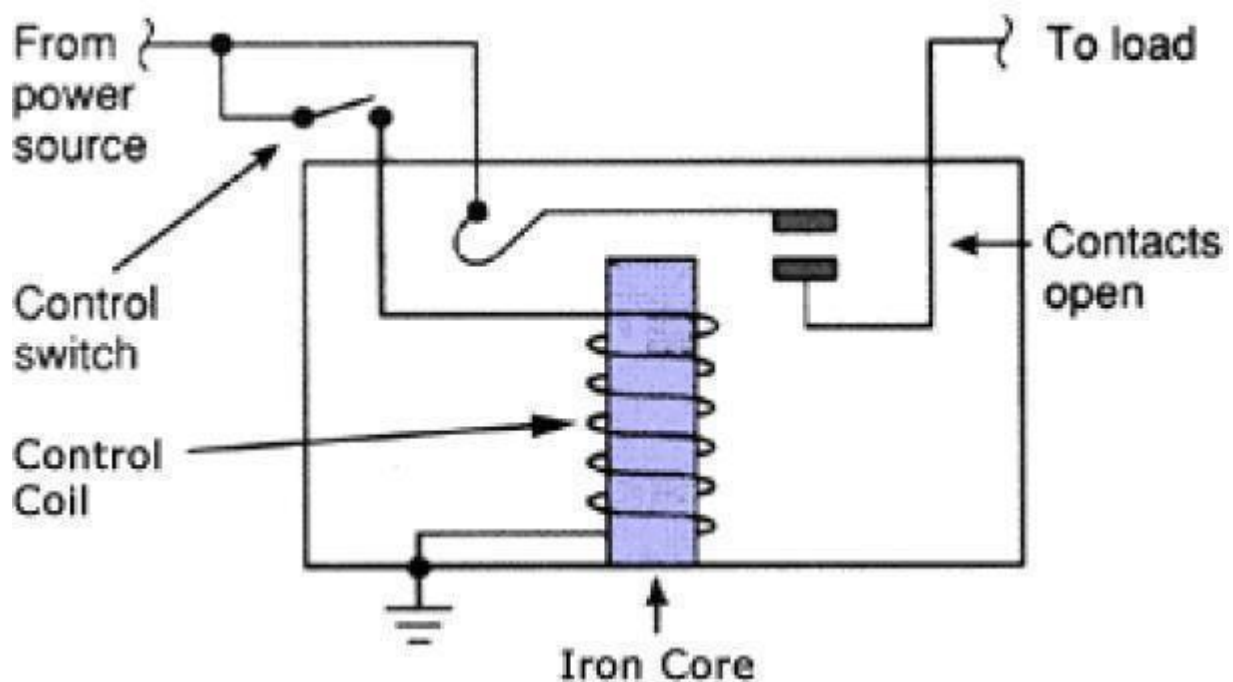


Fig 4.6 Magnetic Field

If the coil is energized with DC, a diode is frequently installed across the coil, to dissipate the energy from the collapsing magnetic field at deactivation, which would otherwise generate a spike of voltage and might cause damage to circuit components. If the coil is designed to be energized with AC, a small copper ring can be crimped to the end of the solenoid. This “shading ring” creates a small out-of-phase current, which increases the minimum pull on the armature during the AC cycle.

5.2.3 Electromechanical Relay:

It consists in a fixed coil, mechanically linked to a moving contact. Feeding the coil by means of electrical current a magnetic field arises. Then the moving armature is attracted to the coil and, consequently the contact can be moved. The movement of the contact either makes or breaks an electrical connection with a fixed contact. When the feeding current of the coil is removed, the armature and the feed contact return to their relaxed position by means of a spring or of the elasticity of the contact. An electromechanical relay has galvanic insulation between the input and output gate and between the terminals of the contacts when they are in break position.

USES

- To control a high -voltage circuit with a low-voltage signal, as in some types of modems.
- To control a high-current circuit with a low-current signal, as in the starter solenoid of an automobile.
- To detect and isolate faults on transmission and distribution lines by opening and closing circuit breakers.
- To isolate the controlling circuit from the controlled circuit when the two are at different potentials, for example when controlling a mains-powered device from a low voltage wires are easily installed in partitions, which may be often moved as needs change. They may also be controlled by room occupancy detectors in an effort to conserve energy.

5.3 MOTORS

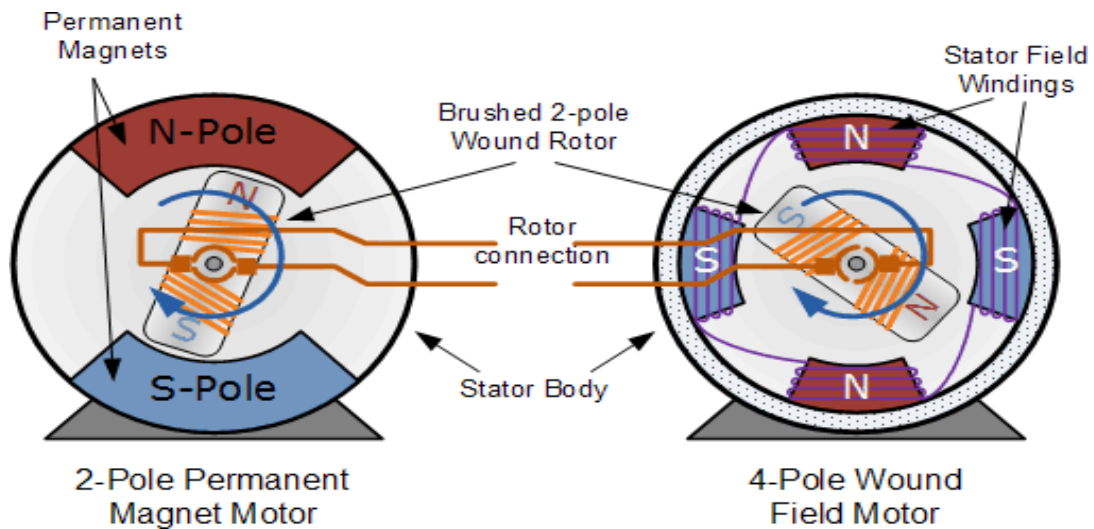


Fig 4.16 Motors

5.3.1 Electrical DC Motors

Continuous actuators that convert electrical energy into mechanical energy. The DC motor achieves this by producing a continuous angular rotation that can be used to rotate pumps, fans, compressors, wheels, etc.

As well as conventional rotary DC motors, linear motors are also available which are capable of producing a continuous linear movement. There are basically three types of conventional electrical motor available: AC type Motors, DC type Motors and Stepper motor.



Fig 4.17 Typical Small DC Motor

5.3.2 AC Motors

These are generally used in high power single or multi-phase industrial applications where a constant rotational torque and speed is required to control large loads such as fans or pumps.

In this tutorial on electrical motors we will look only at simple light duty **DC Motors** and **Stepper Motors** which are used in many different types of electronic, positional control, microprocessor, PIC and robotic type circuits.

5.3.3 The Basic DC Motor

The **DC Motor** or **Direct Current Motor** to give it its full title, is the most commonly used actuator for producing continuous movement and whose speed of rotation can easily be controlled, making them ideal for use in applications where speed control, servo type control, and/or positioning is required. A DC motor consists of two parts, a “Stator” which is the stationary part and a “Rotor” which is the rotating part. The result is that there are basically three types of DC Motor available.

- **Brushed Motor** - This type of motor produces a magnetic field in a wound rotor (the part that rotates) by passing an electrical current through a commutator and carbon brush assembly, hence the term “Brushed”. The stators (the stationary part) magnetic field is produced by using either a wound stator field winding or by permanent magnets. Generally brushed DC motors are cheap, small and easily controlled.
- **Brushless Motor** - This type of motor produces a magnetic field in the rotor by using permanent magnets attached to it and commutation is achieved electronically. They are generally smaller but more expensive than conventional brushed type DC motors because they use “Hall effect” switches in the stator to produce the required stator field rotational sequence but they have better torque/speed characteristics, are more efficient and have a longer operating life than equivalent brushed types.
- **Servo Motor** - This type of motor is basically a brushed DC motor with some form of positional feedback control connected to the rotor shaft. They are connected to and controlled by a PWM type controller and are mainly used in

positional control systems and radio-controlled models.

Normal DC motors have almost linear characteristics with their speed of rotation being determined by the applied DC voltage and their output torque being determined by the current flowing through the motor windings. The speed of rotation of any DC motor can be varied from a few revolutions per minute (rpm) to many thousands of revolutions per minute making them suitable for electronic, automotive or robotic applications. By connecting them to gearboxes or gear-trains their output speed can be decreased while at the same time increasing the torque output of the motor at a high speed.

The “Brushed” DC Motor

A conventional brushed DC Motor consist basically of two parts, the stationary body of the motor called the **Stator** and the inner part which rotates producing the movement called the **Rotor** or “**Armature**” for DC machines. connected together in a circular configuration to produce the required North-pole then a South-pole then a North-pole etc, type stationary magnetic field system for rotation, unlike AC machines whose stator field continually rotates with the applied frequency. The current which flows within these field coils is known as the motor field current.

These electromagnetic coils which form the stator field can be electrically connected in series, parallel or both together (compound) with the motors armature. A series wound DC motor has its stator field windings connected in *series* with the armature. Likewise, a shunt wound DC motor has its stator field windings connected in *parallel* with the armature as shown.

5.3.4 Series and Shunt Connected DC Motor

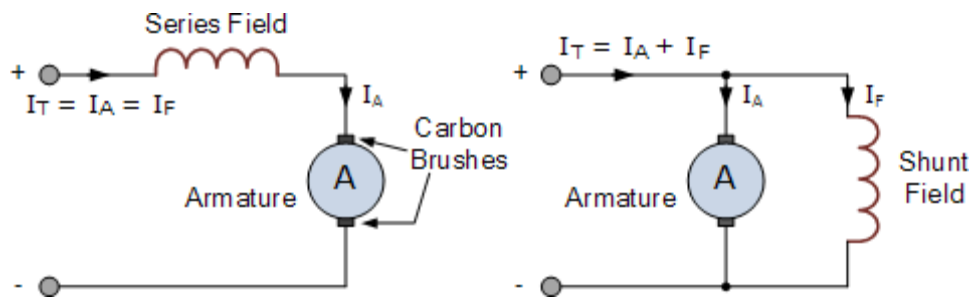


Fig 4.18 Series and Shunt Connected DC Motor

The rotor or armature of a DC machine consists of current carrying conductors connected together at one end to electrically isolated copper segments called the **commutator**. The commutator allows an electrical connection to be made via carbon brushes (hence the name “Brushed” motor) to an external power supply as the armature rotates.

The magnetic field setup by the rotor tries to align itself with the stationary stator field causing the rotor to rotate on its axis, but cannot align itself due to commutation delays. The rotational speed of the motor is dependent on the strength of the rotors magnetic field and the more voltage that is applied to the motor the faster the rotor will rotate. By varying this applied DC voltage, the rotational speed of the motor can also be varied.

5.3.5 Conventional (Brushed) DC Motor

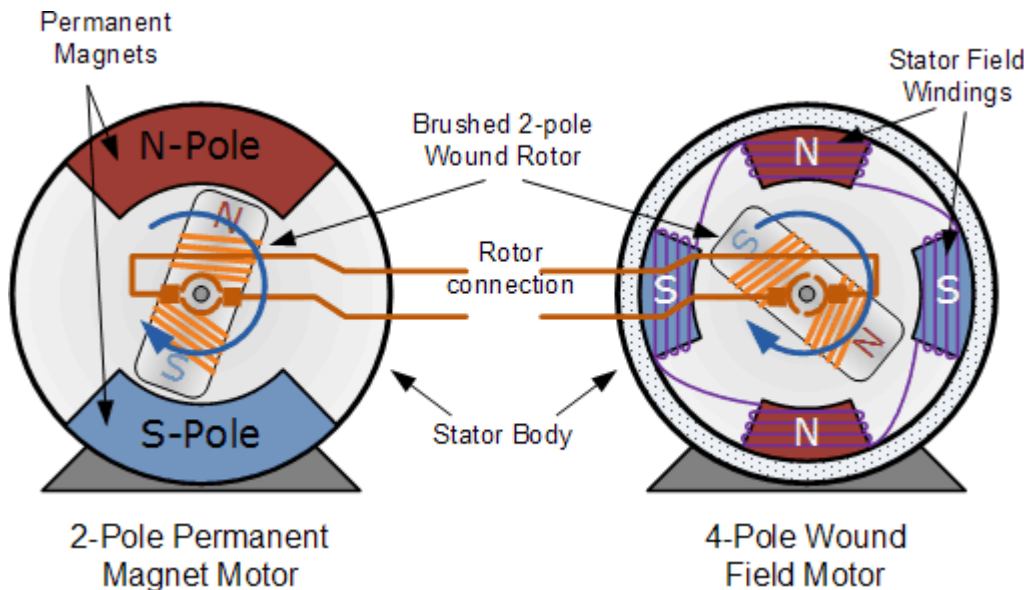


Fig 4.19 Conventional (Brushed) DC Motor

The Permanent magnet (PMDC) brushed DC motor is generally much smaller and cheaper than its equivalent wound stator type DC motor cousins as they have no field winding. In permanent magnet DC (PMDC) motors these field coils are replaced with strong rare earth (i.e. Samarium Cobalt, or Neodymium Iron Boron) type magnets which have very high magnetic energy fields.

The use of permanent magnets gives the DC motor a much better linear speed/torque characteristic than the equivalent wound motors because of the permanent and sometimes very strong magnetic field, making them more suitable for use in models, robotics and servos.

Although DC brushed motors are very efficient and cheap, problems associated with the brushed DC motor is that sparking occurs under heavy load conditions between the two surfaces of the commutator and carbon brushes resulting in self generating heat, short life span and electrical noise due to sparking, which can damage any semiconductor switching device such as a MOSFET or transistor. To overcome these

disadvantages, **Brushless DC Motors** were developed.

5.3.6 The “Brushless” DC Motor

The brushless DC motor (BDCM) is very similar to a permanent magnet DC motor, but does not have any brushes to replace or wear out due to commutator sparking. Therefore, little heat is generated in the rotor increasing the motors life. The design of the brushless motor eliminates the need for brushes by using a more complex drive circuit where the rotor magnetic field is a permanent magnet which is always in synchronization with the stator field allows for a more precise speed and torque control.

Then the construction of a brushless DC motor is very similar to the AC motor making it a true synchronous motor but one disadvantage is that it is more expensive than an equivalent “brushed” motor design.

The control of the brushless DC motors is very different from the normal brushed DC motor, in that this type of motor incorporates some means to detect the rotors angular position (or magnetic poles) required to produce the feedback signals required to control the semiconductor switching devices. The most common position/pole sensor is the “Hall Effect Sensor”, but some motors also use optical sensors.

Using Hall effect sensors, the polarity of the electromagnets is switched by the motor control drive circuitry. Then the motor can be easily synchronized to a digital clock signal, providing precise speed control. Brushless DC motors can be constructed to have, an external permanent magnet rotor and an internal electromagnet stator or an internal permanent magnet rotor and an external electromagnet stator.

Advantages of the **Brushless DC Motor** compared to its “brushed” cousin is higher efficiencies, high reliability, low electrical noise, good speed control and more importantly, no brushes or commutator to wear out producing a much higher speed. However, their disadvantage is that they are more expensive and more complicated to control.

5.3.7 The DC Servo Motor

DC Servo motors are used in closed loop type applications where the position of the output motor shaft is fed back to the motor control circuit. Typical positional “Feedback” devices include Resolvers, Encoders and Potentiometers as used in radio control models such as aero planes and boats etc.

A servo motor generally includes a built-in gearbox for speed reduction and is capable of delivering high torques directly. The output shaft of a servo motor does not rotate freely as do the shafts of DC motors because of the gearbox and feedback devices attached.

DC Servo Motor Block Diagram

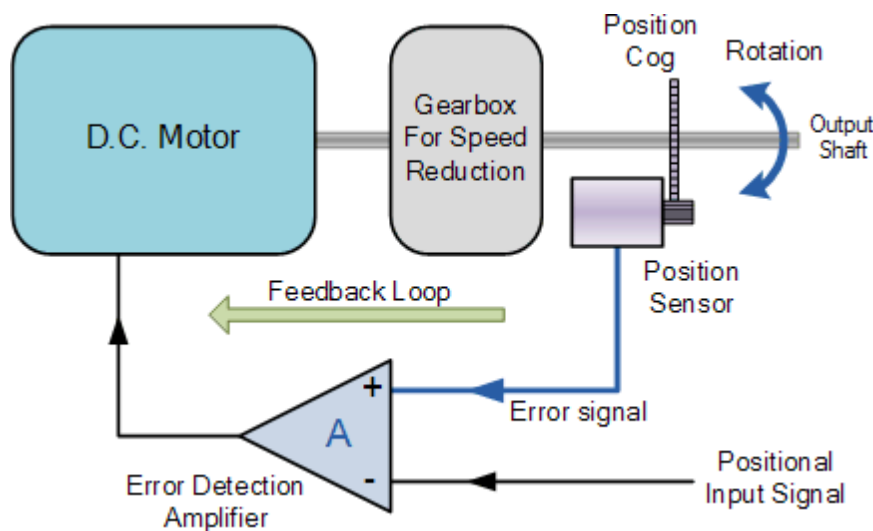


Fig 4.20 DC Servo Motor

A servo motor consists of a DC motor, reduction gearbox, positional feedback device and some form of error correction. The speed or position is controlled in relation to a positional input signal or reference signal applied to the device.

RC Servo Motor

The error detection amplifier looks at this input signal and compares it with the feedback signal from the motor's output shaft and determines if the motor output shaft

is in an error condition and, if so, the controller makes appropriate corrections either speeding up the motor or slowing it down. This response to the positional feedback device means that the servo motor operates within a “Closed Loop System”.

As well as large industrial applications, servo motors are also used in small remote-control models and robotics, with most servo motors being able to rotate up to about 180 degrees in both directions making them ideal for accurate angular positioning. However, these RC type servos are unable to continually rotate at high speed like conventional DC motors unless specially modified.

A servo motor consist of several devices in one package, the motor, gearbox, feedback device and error correction for controlling position, direction or speed. They are widely used in robotics and small models as they are easily controlled using just three wires, *Power, Ground and Signal Control*.

DC Motor Switching and Control

Small DC motors can be switched “On” or “Off” by means of switches, relays, transistors or MOSFET circuits with the simplest form of motor control being “Linear” control. This type of circuit uses a bipolar Transistor as a Switch (A Darlington transistor may also be used were a higher current rating is required) to control the motor from a single power supply.

By varying the amount of base current flowing into the transistor the speed of the motor can be controlled for example, if the transistor is turned on “half way”, then only half of the supply voltage goes to the motor. If the transistor is turned “fully ON” (saturated), then all of the supply voltage goes to the motor and it rotates faster. Then for this linear type of control, power is delivered constantly to the motor as shown below.

Motor Speed Control

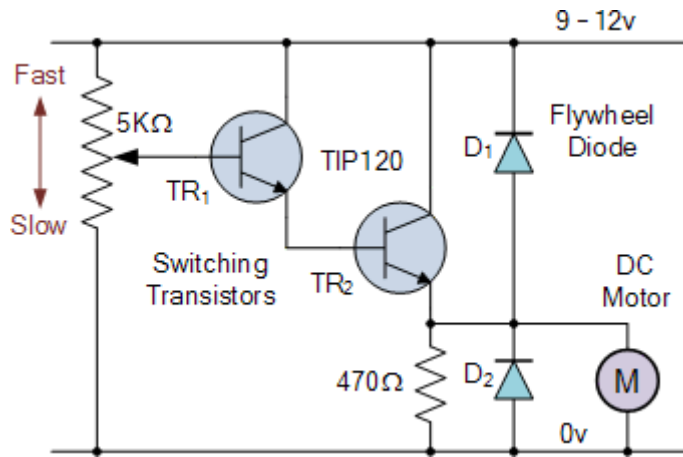


Fig 4.21 Motor Speed Control

The simple switching circuit above shows the circuit for a **Uni-directional** (one direction only) motor speed control circuit. As the rotational speed of a DC motor is proportional to the voltage across its terminals, we can regulate this terminal voltage using a transistor.

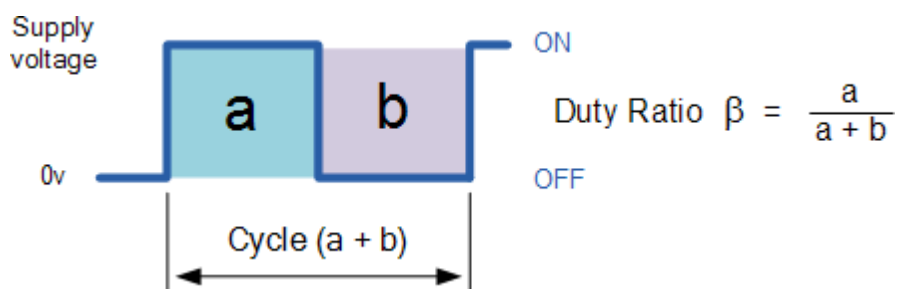
The two transistors are connected as a Darlington pair to control the main armature current of the motor. A 5kΩ potentiometer is used to control the amount of base drive to the first pilot transistor TR₁, which in turn controls the main switching transistor, TR₂ allowing the motor's DC voltage to be varied from zero to V_{cc}, in this example 9 to 12 volts.

Optional flywheel diodes are connected across the switching transistor, TR₂ and the motor terminals for protection from any back emf generated by the motor as it rotates. The adjustable potentiometer could be replaced with continuous logic "1" or logic "0" signal applied directly to the input of the circuit to switch the motor "fully-ON" (saturation) or "fully-OFF" (cut-off) respectively from the port of a micro-controller or PIC.

As well as this basic speed control, the same circuit can also be used to control the motors rotational speed. By repeatedly switching the motor current "ON" and "OFF" at a high enough frequency, the speed of the motor can be varied between stand still (0 rpm) and full speed (100%) by varying the mark-space ratio of its supply. This is achieved by varying the proportion of "ON" time (t_{ON}) to the "OFF" time (t_{OFF}) and this can be achieved using a process known as Pulse Width Modulation.

Pulse Width Speed Control

We said previously that the rotational speed of a DC motor is directly proportional to the mean (average) voltage value on its terminals and the higher this value, up to maximum allowed motor volts, the faster the motor will rotate. In other words more voltage more speed. By varying the ratio between the “ON” (t_{ON}) time and the “OFF” (t_{OFF}) time durations, called the “Duty Ratio”, “Mark/Space Ratio” or “Duty Cycle”, the average value of the motor voltage and hence its rotational speed can be varied. For simple unipolar drives the duty ratio β is given as:



and the mean DC output voltage fed to the motor is given as: $V_{\text{mean}} = \beta \times V_{\text{supply}}$. Then by varying the width of pulse a , the motor voltage and hence the power applied to the motor can be controlled and this type of control is called **Pulse Width Modulation** or **PWM**.

Another way of controlling the rotational speed of the motor is to vary the frequency (and hence the time period of the controlling voltage) while the “ON” and “OFF” duty ratio times are kept constant. This type of control is called **Pulse Frequency Modulation** or **PFM**.

With pulse frequency modulation, the motor voltage is controlled by applying pulses of variable frequency for example, at a low frequency or with very few pulses the average voltage applied to the motor is low, and therefore the motor speed is slow. At a higher frequency or with many pulses, the average motor terminal voltage is increased and the motor speed will also increase.

Then, Transistors can be used to control the amount of power applied to a DC motor with the mode of operation being either “Linear” (varying motor voltage), “Pulse Width

Modulation” (varying the width of the pulse) or “Pulse Frequency Modulation” (varying the frequency of the pulse).

Reversing the Direction of A DC Motor

While controlling the speed of a DC motor with a single transistor has many advantages it also has one main disadvantage, the direction of rotation is always the same, it's a “Uni-directional” circuit. In many applications we need to operate the motor in both directions forward and back.

To control the direction of a DC motor, the polarity of the DC power applied to the motor's connections must be reversed allowing its shaft to rotate in the opposite direction. One very simple and cheap way to control the rotational direction of a DC motor is to use different switches arranged in the following manner:

DC Motor Directional Control

The first circuit uses a single double-pole, double-throw (DPDT) switch to control the polarity of the motor's connections. By changing over the contacts, the supply to the motor's terminals is reversed and the motor reverses direction. The second circuit is slightly more complicated and uses four single-pole, single-throw (SPST) switches arranged in an “H” configuration.

The mechanical switches are arranged in switching pairs and must be operated in a specific combination to operate or stop the DC motor. For example, switch combination A + D controls the forward rotation while switches B + C control the reverse rotation as shown. Switch combinations A + B or C + D shorts out the motor terminals causing it to brake quickly. However, using switches in this manner has its dangers as operating switches A + C or B + D together would short out the power supply.

While the two circuits above would work very well for most small DC motor applications, do we really want to operate different combinations of mechanical switches just to reverse the direction of the motor, NO!. We could change the manual

switches for set of Electromechanical Relays and have a single forward-reverse button or switch or even use a solid state CMOS 4066B quad bilateral switch.

But another very good way of achieving bi-directional control of a motor (as well as its speed) is to connect the motor into a **Transistor H-bridge** type circuit arrangements as shown below.

Basic Bi-directional H-bridge Circuit

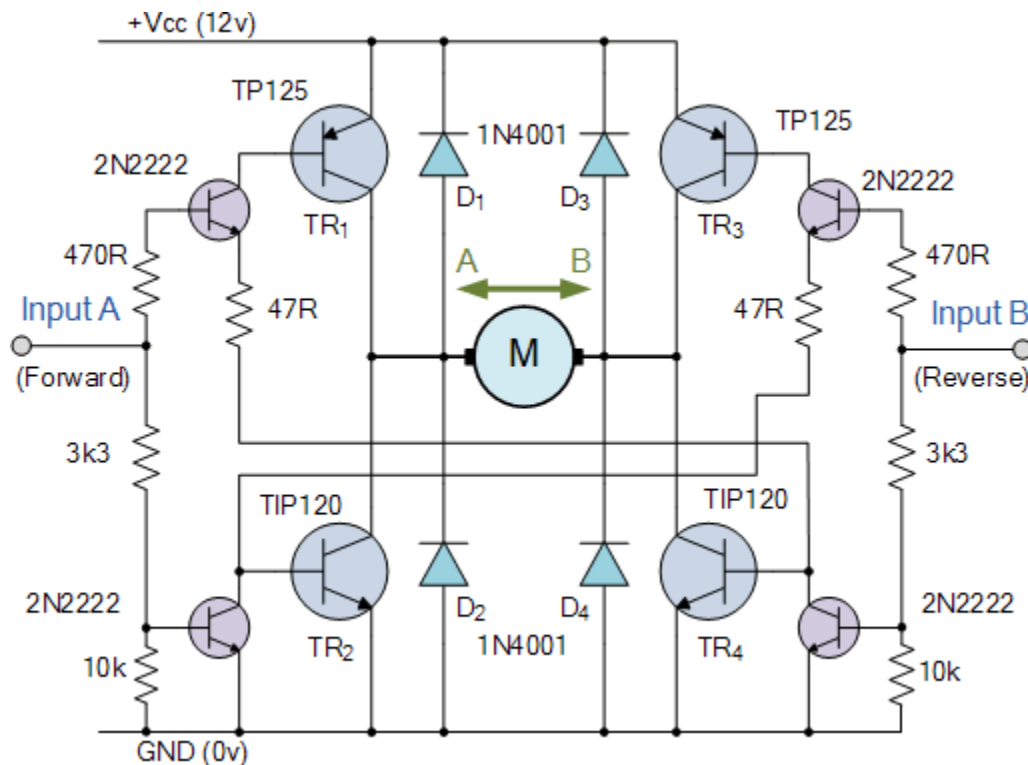


Fig 4.22 Basic Bi-directional H-bridge Circuit

The **H-bridge circuit** above, is so named because the basic configuration of the four switches, either electro-mechanical relays or transistors resembles that of the letter "H" with the motor positioned on the centre bar. The Transistor or MOSFET H-bridge is probably one of the most commonly used type of bi-directional DC motor control circuits. It uses "complementary transistor pairs" both NPN and PNP in each branch with the transistors being switched together in pairs to control the motor.

Control input A operates the motor in one direction ie, Forward rotation while input B operates the motor in the other direction ie, Reverse rotation. Then by switching the transistors “ON” or “OFF” in their “diagonal pairs” results in directional control of the motor.

For example, when transistor TR1 is “ON” and transistor TR2 is “OFF”, point A is connected to the supply voltage (+Vcc) and if transistor TR3 is “OFF” and transistor TR4 is “ON” point B is connected to 0 volts (GND). Then the motor will rotate in one direction corresponding to motor terminal A being positive and motor terminal B being negative.

If the switching states are reversed so that TR1 is “OFF”, TR2 is “ON”, TR3 is “ON” and TR4 is “OFF”, the motor current will now flow in the opposite direction causing the motor to rotate in the opposite direction.

Then, by applying opposite logic levels “1” or “0” to the inputs A and B the motors rotational direction can be controlled as follows.

4.10.9 H-bridge Truth Table

Table 4.1 H -Bridge

Input A	Input B	Motor Function
TR1 and TR4	TR2 and TR3	
0	0	Motor Stopped (OFF)
1	0	Motor Rotates Forward

0	1	Motor Rotates Reverse
1	1	NOT ALLOWED

It is important that no other combination of inputs are allowed as this may cause the power supply to be shorted out, ie both transistors, TR1 and TR2 switched “ON” at the same time, (fuse = bang!).

As with uni-directional DC motor control as seen above, the rotational speed of the motor can also be controlled using Pulse Width Modulation or PWM. Then by combining H-bridge switching with PWM control, both the direction and the speed of the motor can be accurately controlled.

Commercial off the shelf decoder IC's such as the SN754410 Quad Half H-Bridge IC or the L298N which has 2 H-Bridges are available with all the necessary control and safety logic built in are specially designed for H-bridge bi-directional motor control circuits.

The DC Stepper Motor

Like the DC motor above, **Stepper Motors** are also electromechanical actuators that convert a pulsed digital input signal into a discrete (incremental) mechanical movement are used widely in industrial control applications. A stepper motor is a type of synchronous brushless motor in that it does not have an armature with a commutator and carbon brushes but has a rotor made up of many, some types have hundreds of permanent magnetic teeth and a stator with individual windings.

Stepper Motor

As its name implies, the stepper motor does not rotate in a continuous fashion like a

conventional DC motor but moves in discrete “Steps” or “Increments”, with the angle of each rotational movement or step dependent upon the number of stator poles and rotor teeth the stepper motor has.

Because of their discrete step operation, stepper motors can easily be rotated a finite fraction of a rotation at a time, such as 1.8, 3.6, 7.5 degrees etc. So for example, let's assume that a stepper motor completes one full revolution (360°) in exactly 100 steps.

Then the step angle for the motor is given as $360 \text{ degrees}/100 \text{ steps} = 3.6 \text{ degrees per step}$. This value is commonly known as the stepper motors **Step Angle**.

There are three basic types of stepper motor, **Variable Reluctance**, **Permanent Magnet** and **Hybrid** (a sort of combination of both). A **Stepper Motor** is particularly well suited to applications that require accurate positioning and repeatability with a fast response to starting, stopping, reversing and speed control and another key feature of the stepper motor, is its ability to hold the load steady once the required position is achieved.

Generally, stepper motors have an internal rotor with a large number of permanent magnet “teeth” with a number of electromagnet “teeth” mounted on to the stator. The stator's electromagnets are polarized and depolarized sequentially, causing the rotor to rotate one “step” at a time.

Modern multi-pole, multi-teeth stepper motors are capable of accuracies of less than 0.9 degs per step (400 Pulses per Revolution) and are mainly used for highly accurate positioning systems like those used for magnetic-heads in floppy/hard disc drives, printers/plotters or robotic applications. The most commonly used stepper motor being the 200 step per revolution stepper motor. It has a 50 teeth rotor, 4-phase stator and a step angle of 1.8 degrees ($360 \text{ degs}/(50 \times 4)$).

Stepper Motor Construction and Control

In our simple example of a variable reluctance stepper motor above, the motor consists of a central rotor surrounded by four electromagnetic field coils labelled A, B, C and D. All the coils with the same letter are connected together so

that energizing, say coils marked A will cause the magnetic rotor to align itself with that set of coils.

By applying power to each set of coils in turn the rotor can be made to rotate or "step" from one position to the next by an angle determined by its step angle construction, and by energizing the coils in sequence the rotor will produce a rotary motion.

The stepper motor driver controls both the step angle and speed of the motor by energizing the field coils in a set sequence for example, "ADCB, ADCB, ADCB, A..." etc., the rotor will rotate in one direction (forward) and by reversing the pulse sequence to "ABCD, ABCD, ABCD, A..." etc., the rotor will rotate in the opposite direction (reverse).

So in our simple example above, the stepper motor has four coils, making it a 4- phase motor, with the number of poles on the stator being eight (2×4) which are spaced at 45 degree intervals. The number of teeth on the rotor is six which are spaced 60 degrees apart.

Then there are 24 (6 teeth $\times$ 4 coils) possible positions or "steps" for the rotor to complete one full revolution. Therefore, the step angle above is given as: $360^\circ/24 = 15^\circ$.

Obviously, the more rotor teeth and or stator coils would result in more control and a finer step angle. Also, by connecting the electrical coils of the motor in different configurations, Full, Half and micro-step angles are possible. However, to achieve micro-stepping, the stepper motor must be driven by a (quasi) sinusoidal current that is expensive to implement.

It is also possible to control the speed of rotation of a stepper motor by altering the time delay between the digital pulses applied to the coils (the frequency), the longer the delay the slower the speed for one complete revolution. By applying a fixed number of pulses to the motor, the motor shaft will rotate through a given angle.

The advantage of using time delayed pulse is that there would be no need for any form of additional feedback because by counting the number of pulses given to the motor the final position of the rotor will be exactly known. This response to a set

number of digital input pulses allows the stepper motor to operate in an “Open Loop System” making it both easier and cheaper to control.

For example, let's assume that our stepper motor above has a step angle of 3.6 degs per step. To rotate the motor through an angle of say 216 degrees and then stop again at the require position would only need a total of: $216 \text{ degrees} / (3.6 \text{ degs/step}) = 80 \text{ pulses}$ applied to the stator coils.

There are many stepper motor controller IC's available which can control the step speed, speed of rotation and motors direction. One such controller IC is the SAA1027 which has all the necessary counter and code conversion built-in, and can automatically drive the 4 fully controlled bridge outputs to the motor in the correct sequence.

The direction of rotation can also be selected along with single step mode or continuous (stepless) rotation in the selected direction, but this puts some burden on the controller. When using an 8-bit digital controller, 256 micro steps per step are also possible

SAA1027 Stepper Motor Control Chip

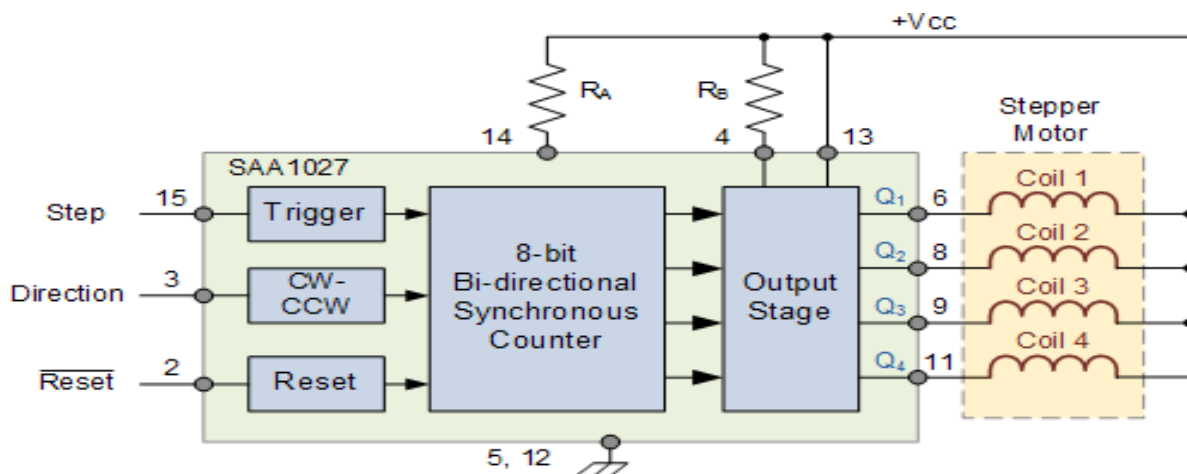
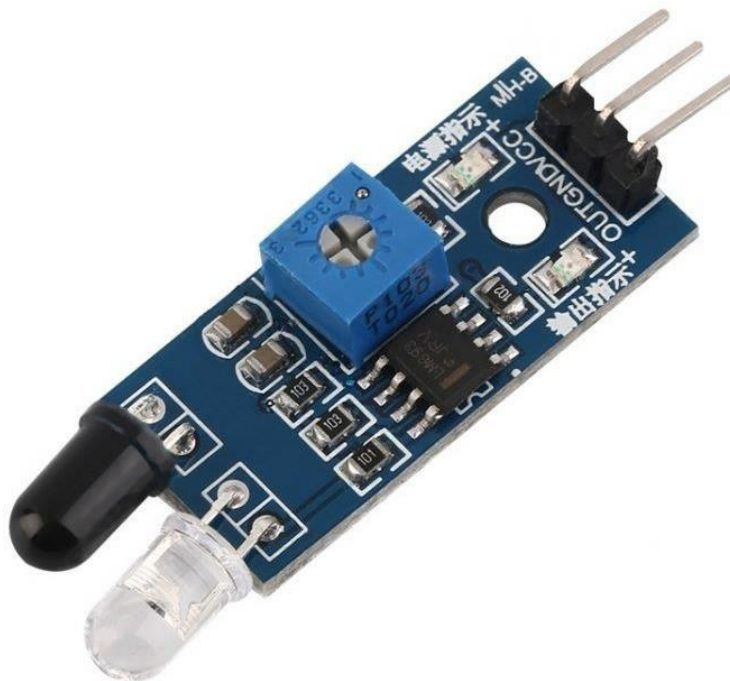


Fig 4.23 SAA1027 Stepper Motor Control Chip

5.4 IR Sensor

5.4.1 What is an IR Sensor?

IR sensor is an electronic device, that emits the light in order to sense some object of the surroundings. An Ir sensor can measure the heat of an object as well as detects the motion. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. These types of radiations are invisible to our eyes, but infrared sensor can detect these radiations.



The emitter is simply an IR LED and the detector is simply an IR photodiode . Photodiode is sensitive to IR light of the same wavelength which is emitted by the IR LED. When IR light falls on the photodiode, the resistances and the output voltages will change in proportion to the magnitude of the IR light received.

There are five basic elements used in a typical infrared detection system: an infrared source, a transmission medium, optical component, infrared detectors or receivers and signal processing. Infrared lasers and Infrared LED's of specific

wavelength used as infrared sources.

The three main types of media used for infrared transmission are vacuum, atmosphere and optical fibers. Optical components are used to focus the infrared radiation or to limit the spectral response. Watch this video if you wish to skip the rest of the blog.

5.4.2 Types of IR Sensor

There are two types of IR sensors are available and they are, Active Infrared Sensor
Passive Infrared Sensor

5.4.2.1 Active Infrared Sensor

Active infrared sensors consist of two elements: infrared source and infrared detector. Infrared sources include the LED or infrared laser diode. Infrared detectors include photodiodes or phototransistors. The energy emitted by the infrared source is reflected by an object and falls on the infrared detector.

5.4.2.2 Passive Infrared Sensor

Passive infrared sensor are basically Infrared detectors. Passive infrared sensors do not use any infrared source and detector. They are of two types: quantum and thermal. Thermal infrared sensors use infrared energy as the source of heat. thermocouple, pyroelectric detectors and bolometers are the common types of thermal infrared detectors. Quantum type infrared sensors offer higher detection performance. It is faster than thermal type infrared detectors. The photo sensitivity of quantum type detectors is wavelength dependent.

5.4.3 IR Sensor Working Principle

There are different types of infrared transmitters depending on their wavelengths, output power and response time. An IR sensor consists of an IR LED and an IR Photodiode, together they are called as PhotoCoupler or OptoCouplers.

IR Transmitter or IR LED

Infrared Transmitter is a light emitting diode (LED) which emits infrared radiations called as IR LED's. Even though an IR LED looks like a normal LED, the radiation emitted by it is invisible to the human eye.

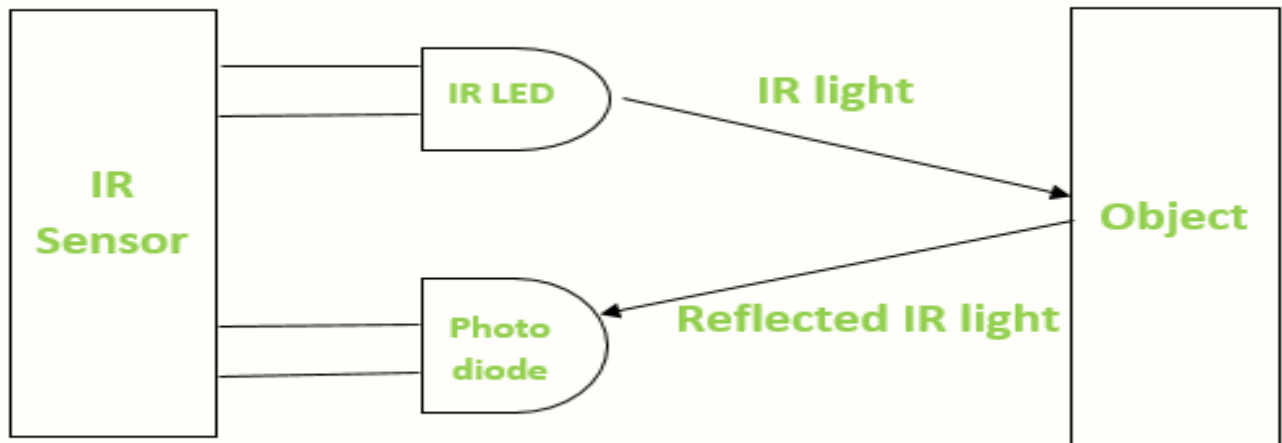
IR Receiver or Photodiode

Infrared receivers or infrared sensors detect the radiation from an IR transmitter. IR receivers come in the form of photodiodes and phototransistors. Infrared Photodiodes are different from normal photo diodes as they detect only infrared radiation. Below image shows the picture of an IR receiver or a photodiode,



Different types of IR receivers exist based on the wavelength, voltage, package, etc. When used in an infrared transmitter - receiver combination, the wavelength of the receiver should match with that of the transmitter.

The emitter is an IR LED and the detector is an IR photodiode. The IR photodiode is sensitive to the IR light emitted by an IR LED. The photo-diode's resistance and output voltage change in proportion to the IR light received. This is the underlying working principle of the IR sensor.



back to the IR receiver. Based on the intensity of the reception by the IR receiver, the output of the sensor defines.

5.4.4 Applications of IR Sensor

IR sensors are used in various projects and also in various electronic devices. They are as follows,
Night Vision Devices



An Infrared technology is implemented in night vision equipment if there is not enough visible light available to see unaided. Night vision devices convert ambient photons of light into electrons and then amplify them using a chemical and electrical process before finally converting them back into visible light.

Radiation Thermometers



IR sensors used in radiation thermometers to measure the temperature depend upon the temperature and the material of the object and these thermometers have some of the following features

- Measurement without direct contact with the object
- Faster response
- Easy pattern measurements

Infrared Tracking

An Infrared tracking or Infrared homing, is a missile guidance system which operates using the infrared [electromagnetic radiation](#) emitted from a target to track it.

IR Imaging Devices



IR image device is one of the major applications of IR waves, primarily by virtue of its property that

Is for thermal imagers, [night vision devices](#) etc.

Other Key Application Areas

Other key application areas that use infrared sensors include:

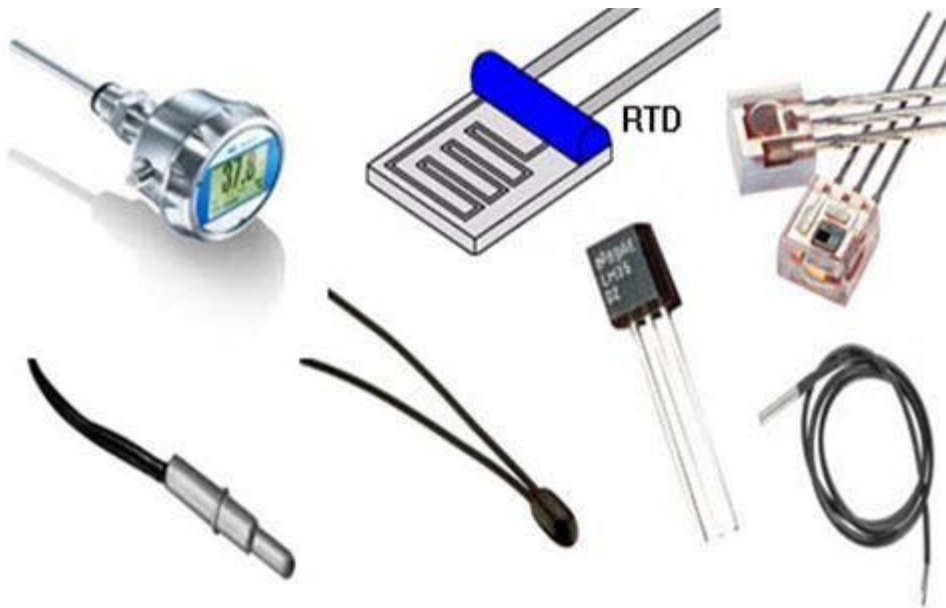
- Climatology
- Meteorology
- Photobiomodulation
- Flame Monitors
- Gas detectors
- Water analysis
- Moisture Analyzers
- Anesthesiology testing
- Petroleum exploration
- Rail safety
- Gas Analyzers

5.5 Temperature Sensors

5.5.1 DEFINITION

A temperature sensor is an electronic device that measures the temperature of its environment and converts the input data into electronic data to record, monitor, or signal temperature changes.

Temperature sensors are among the most commonly used sensors. All types of equipment USE TEMPERATURE SENSOR, ranging from computers, cars, kitchen appliances, air conditioners, and (of course) home thermostats.



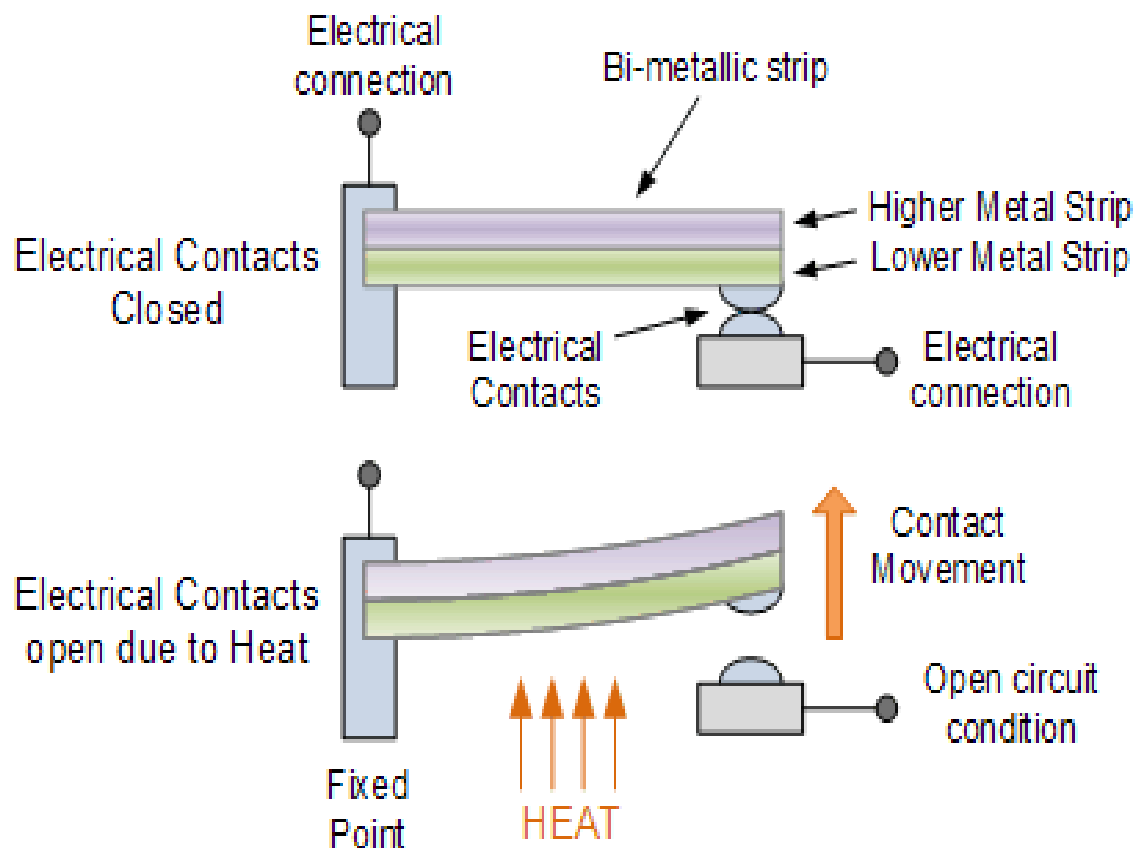
5.5.2 WHAT ARE THE TYPES OF TEMPERATUER SENSORS?

- **The five most common types of temperature sensors include:-**
 - Thermistor
 - Thermocouple
 - RTDs (resistive temperature detectors)
 - Digital thermometer ICs
 - Analog thermometer ICs

5.5.3 How do temperature sensors work?

How do [Temperature sensors](#) work? They are devices to measure temperature readings through electrical signals. The sensor is made up of two metals, which generate electrical voltage or resistance once it notices a change in temperature. The temperature sensor plays a critical role in maintaining a specific temperature within any equipment used to make anything from medicine to beer. To produce these types of content, the accuracy and responsiveness of the temperature and temperature control are critical to ensuring the end product is perfect. Temperature is the most common physical measurement type in industrial applications. Accurate measurements are vital in ensuring the success of these processes. There are many applications that are not-so-obvious, which use temperature sensors. Melting chocolate, using a blast furnace, controlling a hot air balloon, freezing substances in a lab, running a motor vehicle, and firing a kiln.

Temperature sensors come in different forms, which are used for different methods of temperature management. There are two categories of temperature sensors which are contact and non-contact. Contact sensors are used mainly in hazardous areas.



5.6 Pumps

One of the first pieces of powered machinery to be invented at the dawn of the industrial age was a crude form of pump. The pump has since evolved into an endless variety of types, sizes, and applications. This article will give an overview of the general types of pumps that are in common use in process plants. A functional understanding of pumps, their use, and application is essential to understand how most processes are handled in process plants today.

5.6.1 Introduction

Pump is a machine or mechanical equipment which is required to lift liquid from low level to high level or to flow liquid from low pressure area to high pressure area or as a booster in a piping network system.

Principally, pump converts mechanical energy of motor into fluid flow energy.

Pump also can be used in process operations that requires a high hydraulic pressure. This can be seen in heavy duty equipment's. Often heavy duty equipment's requires a high discharge pressure and a low suction pressure. Due to low pressure at suction side of pump, fluid will lift from certain depth, whereas due to high pressure at discharge side of pump, it will push fluid to lift until reach desired height.



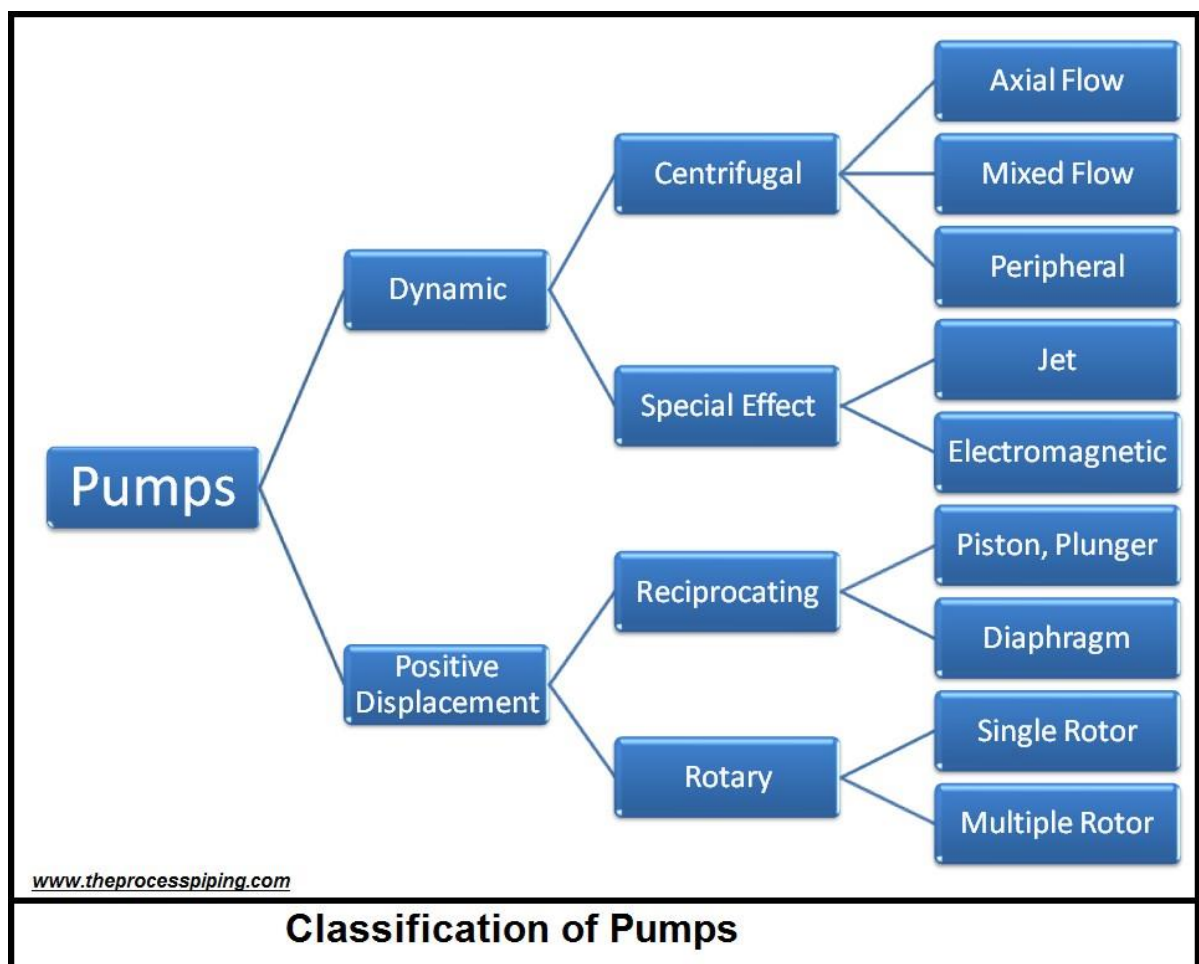
5.6.2 Classification of Pumps

Pumps may be classified on the basis of the applications they serve, the materials from which they are constructed, the liquids they handle, and All such classifications, however, are limited in scope and tend to substantially

overlap each other. A more basic system of pump classification is based on the principle by which energy is added to the fluid. Under this system, all pump types generally fall into two main categories -

Dynamic (Centrifugal) Pumps – Energy is continuously added to increase the fluid velocities within the machine.

Positive Displacement Pumps – Energy is periodically added by application of force to one or more movable boundaries of enclosed, fluid-containing volumes. These are further divided into many forms. For simplification of article we will discuss these many forms separately in separate articles.



5.6.3 Working Principle of Pump

The working principle of a pump is, it enhances the fluid's pressure to provide the driving strength which is necessary for flow. Usually, the pressure filter supply pump is a centrifugal type pump, and the working principle is that slurry penetrates the pump during the rotating impeller's eye which informs a circular motion

5.7 SPEAKER

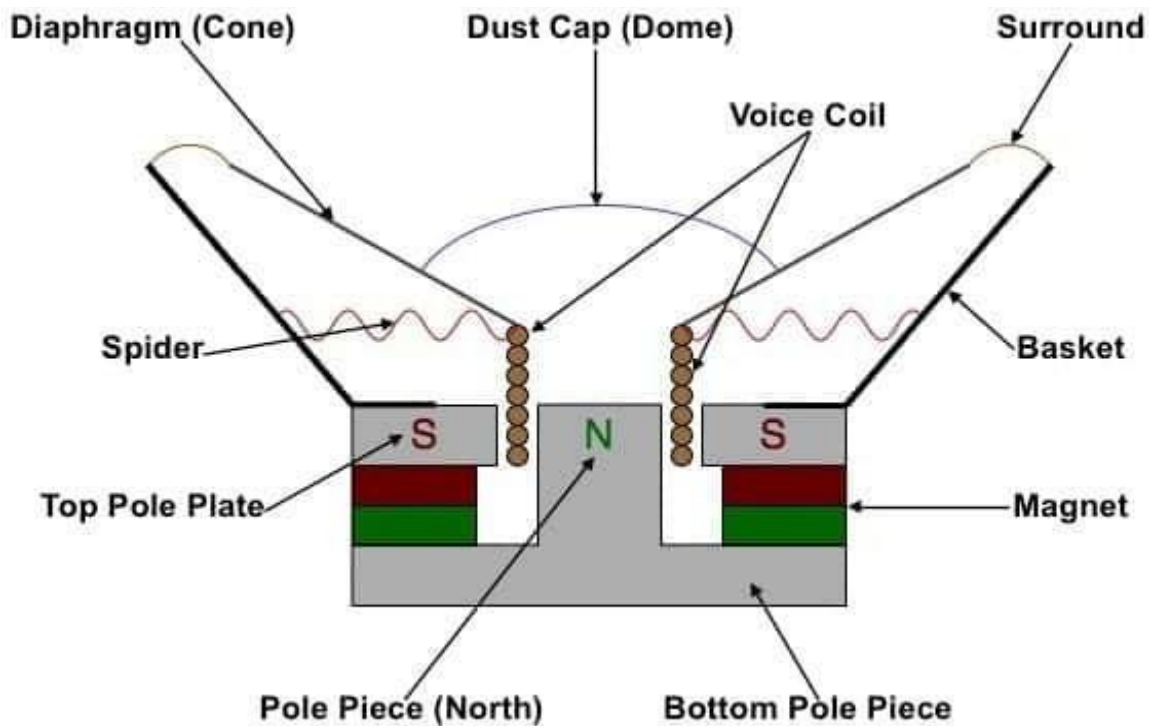
5.7.1 Definition

Loudspeakers are electro-mechanical-acoustic systems. Another word for speaker is transducer. A transducer is a device that converts one type of energy or signal into another. While there are many types of transducers the ones most common to music lovers are the microphone and the speaker. The microphone is at the beginning of the process and converts sound waves into electrical impulses. A speaker is at the end of the process and converts electrical impulses from the amp into acoustic energy (sound.) A loudspeaker typically accomplishes this conversion by causing a diaphragm to vibrate and send vibrations through the air, thereby propagating acoustic waves.



Speakers Are Transducers

- Basically, speakers are transducers that convert electrical energy (audio signals) into mechanical energy (sound waves).
- In most cases, this is done via electromagnetism. The audio signal passes through a conductive voice coil, inducing a magnetic field that reacts with a permanent magnet to cause diaphragm movement.
- Essentially, the alternating current of the audio signal causes a varying voltage across the conductive voice coil which, in turn, causes the diaphragm (attached to the voice coil) to move in accordance with the electrical signal.



Electr
odyna
mic

Speaker Driver/Transducer Illustration

5.7.2 What are the different types of speaker?

The four main types of speaker found in the home these days are traditional loudspeakers, in-wall/ceiling speakers, soundbars and subwoofers. Each type of speaker serves a different purpose and is useful for different applications.

CHAPTER-6

WORKING MECHANISM

6.1 ARDUINO SET UP

The Arduino hardware is a so-called micro controlling board (Following called “board”). Basically, it is a circuit board with many electronic parts around the actual microcontroller. On the edge of the board are many pins with whom it is possible to connect different components. Some of them are for example: Switches, LED's, Ultrasonic sensors, temperature sensors, displays, stepper, etc., There are different kind of boards, that can be used with the Arduino software. Different sized “official” boards, with the official “Arduino” name on it, but also many, mostly cheaper, but equiva.

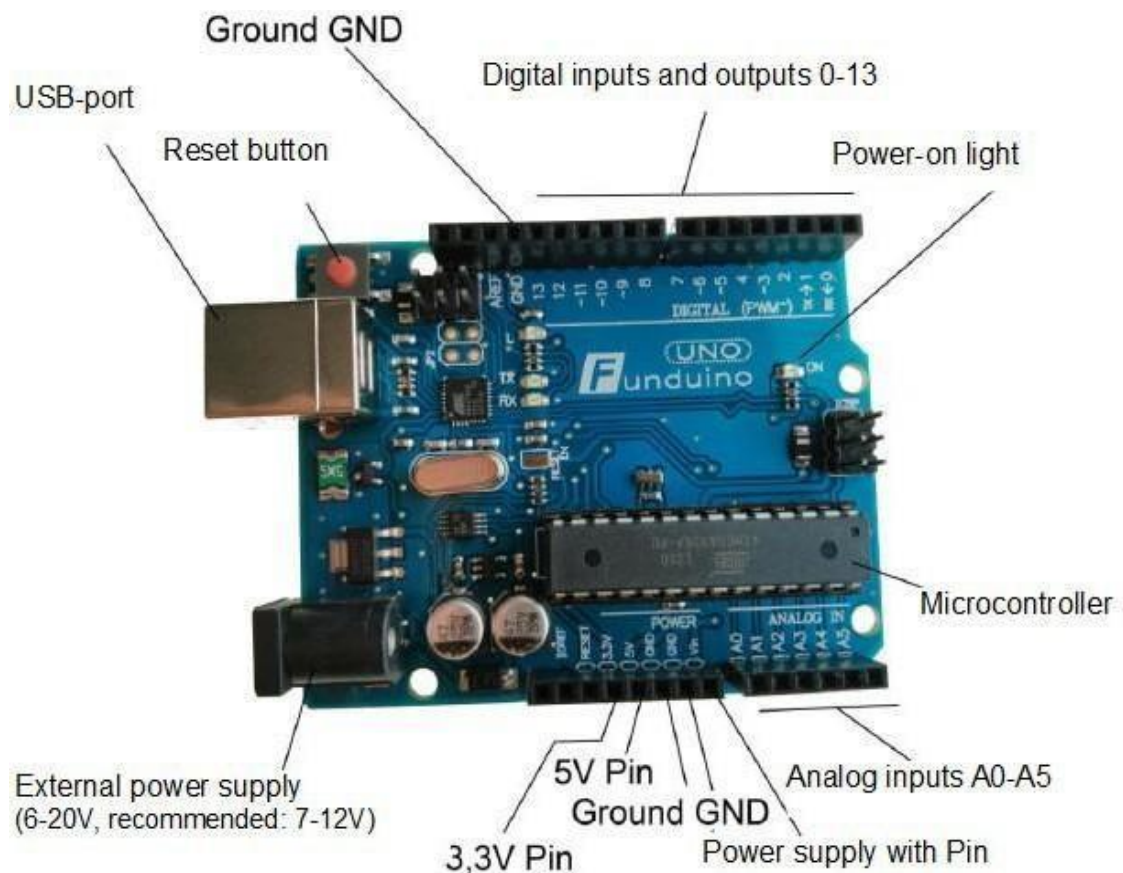


Fig 4.28 Arduino UNO

lent Arduino “fitting” boards. Typical official boards are called Arduino UNO, Arduino MEGA, Arduino Mini, etc. Arduino compatible boards are for example Funduino UNO, Funduino MEGA, Freeduino, Seeduino, Sainsmart UNO etc.,

Step 1 – Download Arduino IDE Software.

You can get different versions of Arduino IDE from the [Download page](#) on the Arduino Official website. You must select your software, which is compatible with your operating system (Windows, IOS, or Linux). After your file download is complete, unzip the file.

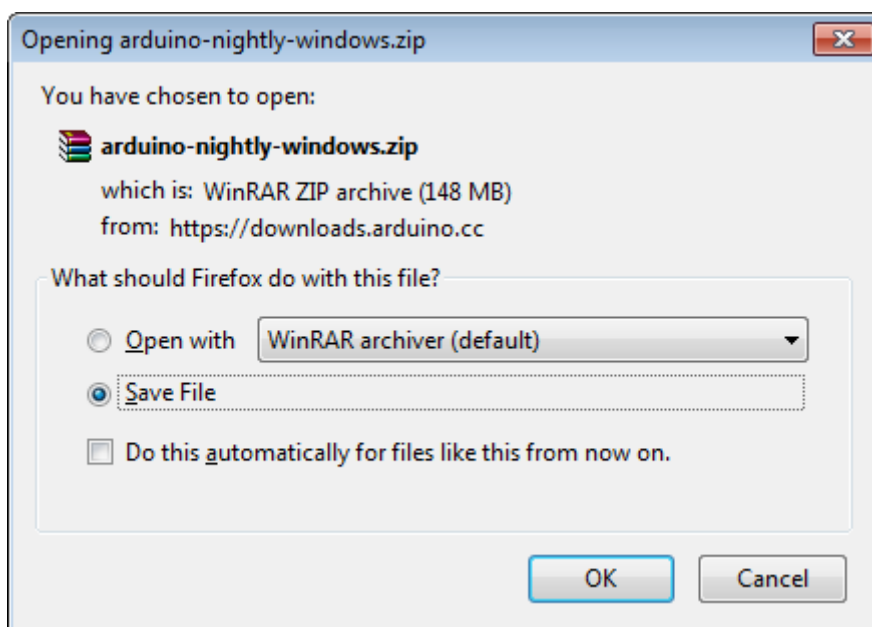


Fig 4.29 software

Step 2 – Power up your board.

The Arduino Uno, Mega, and Arduino Nano automatically draw power from either, the USB connection to the computer or an external power supply. If you are using an Arduino Decimal, you have to make sure that the board is configured to

draw power from the USB connection. The power source is selected with a jumper, a small piece of plastic that fits onto two of the three pins between the USB and power jacks. Check that it is on the two pins closest to the USB port.

Connect the Arduino board to your computer using the USB cable. The green power LED (labeled PWR) should glow.

Step 3 – Launch Arduino IDE.

After your Arduino IDE software is downloaded, you need to unzip the folder. Inside the folder, you can find the application icon with an infinity label (application.exe). Double-click the icon to start the IDE.

Step 4 – Open your first project.

Once the software starts, you have two options –

- Create a new project.
- Open an existing project example.

To create a new project, select File → **New**.

To open an existing project example, select File → Example → Basics → Blink.

Here, we are selecting just one of the examples with the name **Blink**. It turns the LED on and off with some time delay. You can select any other example from the list.

Step 5 – Select your Arduino board.

To avoid any error while uploading your program to the board, you must select the correct Arduino board name, which matches with the board connected to your computer.

Go to Tools → Board and select your board.

Step 6 – Select your serial port.

Select the serial device of the Arduino board. Go to **Tools** → **Serial Port** menu. This is likely to be COM3 or higher (COM1 and COM2 are usually

reserved for hardware serial ports). To find out, you can disconnect your Arduino board and re-open the menu, the entry that disappears should be of the Arduino board. Reconnect the board and select that serial port.

Step 7 – Upload the program to your board.

Before explaining how we can upload our program to the board, we must demonstrate the function of each symbol appearing in the Arduino IDE toolbar.

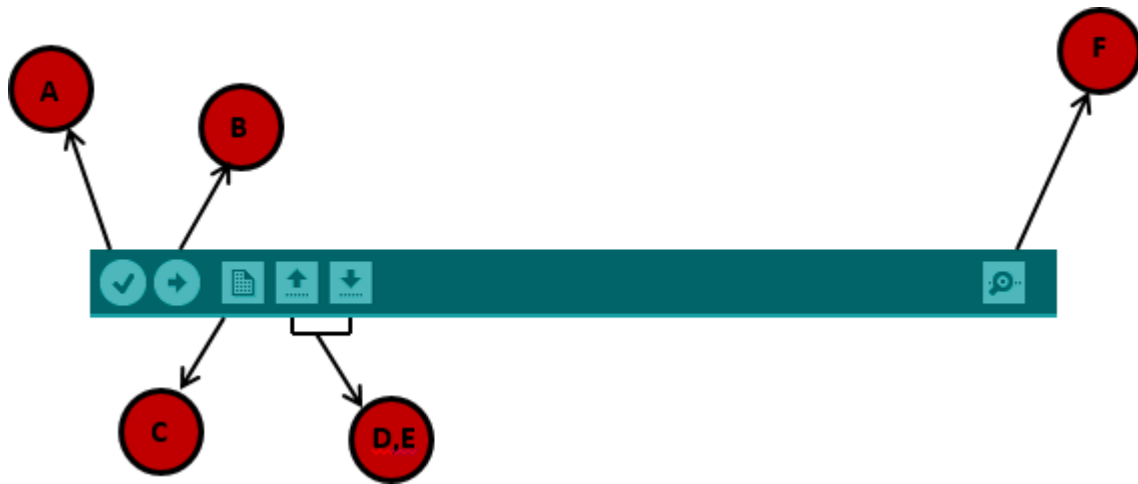


Fig 4.30 Arduino Program Upload Tool

A – Used to check if there is any compilation error.

B – Used to upload a program to the Arduino board.

C – Shortcut used to create a new sketch.

D – Used to directly open one of the example sketch.

E – Used to save your sketch.

F – Serial monitor used to receive serial data from the board and send the serial data to the board.

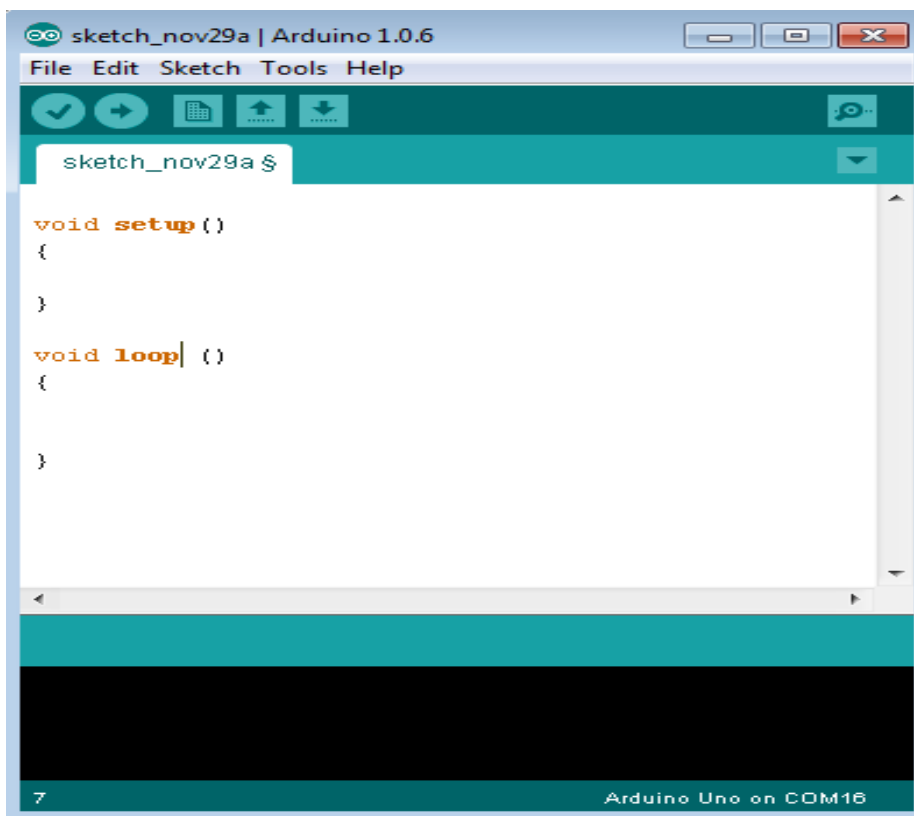
Now, simply click the "Upload" button in the environment. Wait a few seconds; you will see the RX and TX LEDs on the board, flashing. If the upload is successful, the message "Done uploading" will appear in the status bar.⁶

6.1.2 Structure of Programming

Arduino programs can be divided in three main parts: **Structure**, **Values** (variables and constants), and **Functions**. In this tutorial, we will learn about the Arduino software program, step by step, and how we can write the program without any syntax or compilation error.

Let us start with the **Structure**. Software structure consist of two main functions –

- Setup () function
- Loop () function



6.2 DETECTION OF PERSON

As soon as the person come in the range of 2 meters IR sensors detects the presence and send the information to central processing unit, i.e, Arduino. Arduino then receives the info and activate temperaturesensor (MLX 90614).

6.2.1 Code for detection

```

// Define pins for infrared and tempsensor
int const trigPin = 10;
int const echoPin = 9;
int const tempPin = 2;

void setup()
{
    pinMode(trigPin, OUTPUT); // trig pin will have pulses output
    pinMode(echoPin, INPUT); // echo pin should be input to get pulse width
    pinMode(tempPin, OUTPUT); // buzz pin is output to control buzzing
}

void loop()
{
    // Duration will be the input pulse width and distance will be the distance to the obstacle in
    // centimeters
    int duration, distance;
    // Output pulse with 1ms width on trigPin
    digitalWrite(trigPin, HIGH);
    delay(1);
    digitalWrite(trigPin, LOW);
    // Measure the pulse input in echo pin
    duration = pulseIn(echoPin, HIGH);
    // Distance is half the duration divided by 29.1 (from datasheet)
    distance = (duration/2) / 29.1;
    // if distance less than 0.5 meter and more than 0 (0 or less means over range)
    if (distance <= 50 && distance >= 0) {
        // temp
        digitalWrite(tempPin, HIGH);
    } else {
        // Don't sense
        digitalWrite(tempPin, LOW);
    }
    // Waiting 100 ms won't hurt any one
    delay(100);

```

6.3 Temperature measurement

Once processor gets the detection information it activates temperature sensor and code for the sensor gets deployed. Temperature is measured and if its in the normal range instruction for hand sanitisation is given and if it is not in normal range instruction for check up is given.

```
#include <Wire.h>
#include <Adafruit_MLX90614.h>
Adafruit_MLX90614 mlx = Adafruit_MLX90614();

void setup() {
  Serial.begin(9600);
  Serial.println("Adafruit MLX90614 test");
  mlx.begin();
}

void loop() {
  Serial.print("Ambient = ");
  Serial.print(mlx.readAmbientTempC());
  Serial.print("*C\tObject = ");
  Serial.print(mlx.readObjectTempC()); Serial.println("*C");
  Serial.print("Ambient = ");
  Serial.print(mlx.readAmbientTempF());
  Serial.print("*F\tObject = ");
  Serial.print(mlx.readObjectTempF()); Serial.println("*F");
  Serial.println();
  delay(500);
}
```

6.3 Hand Sanitization

In this process after the temperature is verified person is instructed to sanitize his hand. Once the person put his hand below sanitizer it gets detected by IR sensor and sanitizer sprays on the person's hand. If hand is detected and sanitized, then the door is opened and person can enter.

```
#include <Servo.h>

// HC-SR04 Echo Pin & Trigger Pin connect to the Arduino Uno Digital Pins
#define echo_pin 2
#define trigger_pin 3

// Servo PWM
#define servo_pin 5

Servo servo_motor;

void setup() {
  pinMode(trigger_pin, OUTPUT);
  pinMode(echo_pin, INPUT);

  Serial.begin(9600);

  servo_motor.attach(servo_pin);
}

void loop() {

  digitalWrite(trigger_pin, LOW);
  delayMicroseconds(2);

  digitalWrite(trigger_pin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigger_pin, LOW);

  long duration = pulseIn(echo_pin, HIGH);
  double distance = duration * 0.034 / 2;

  Serial.print(distance);

  // If the distance read by the sensor is less than 10 cm and more than the minimum 3 cm, then it is
  // assumed that there is a hand under the sanitizer
  if ((distance > 3) && (distance < 10)) {
    servo_motor.write(90);
    delay(100);
  }
  servo_motor.write(0);
}
```

6.5 Full Body Sanitization

After hand sanitization is done its time for full body sanitization. Door will be unlocked And at a delay of 2 seconds disinfectant will be sprayed. The person waling into the inner Environment will be completely safe for others inside.

CHAPTER 7

RESULT AND CONCLUSION

After successful execution of code all the components of the system work as whole. starting with the temperature measurement to hand sanitization and full body sanitization.

A person coming from an outer environment will be completely safe for others inside. System functions fully automatically and there is no in person contact. The need for a Person to check the body temperature is removed. There's no need to touch the door orSanitizer. Making the system contactless. It will make sure the person entering to the premises is harmless to everyone.

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