Controlling of Star Delta Starter Using Bluetooth

Sonargaon University (Su)

Supervised By

Tabassum Alam

Lecturer

Department of EEE

Sonargaon University (SU)

Submitted By

Md. Didarul Islam	ID: EEE1803015105
Polash Chandro Roy	ID: EEE1901016152
Nayeem Hossain	ID: EEE1901016160
Md. Shamim Hossain	ID: EEE1901016159
Monirul Islam Dulu	ID: EEE1901016067

Department of Electrical & Electronic Engineering (EEE)

Sonargaon University (SU)

147/I, Panthapath,

Dhaka-1215, Bangladesh

Date of Submission: 25-09-2022

Declaration

It is declared hereby that this thesis paper or any part of it has not been submitted to anywhere else for the award of any degree.

.....	….....
Md. Didarul Islam	Polash Chandro Roy
.....	….....
Nayeem Hossain	Md. Shamim Hossain
…….	
Monirul Islam Dulu	

Under Supervision of

.....

Tabassum Alam
Lecturer

Department of EEE

Sonargaon University (SU)

Certification

This is to certify that this project entitled “Star Delta Starter using Bluetooth” is done by the following students under my direct supervision. This project work has been carried out by them in the laboratories of the Department of Electrical and Electronic Engineering under the Faculty of Engineering, Sonargaon University (SU) in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering.

Supervisor

.....

Tabassum Alam
Lecturer

Department of Electrical and Electronic Engineer (EEE)

Sonargaon University (SU)

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We are, indeed, grateful to all those from whom we got sincere cooperation and help for the preparation of this report.

Dedicated To Our Parent

With

Love & Respect

Abstract:

Star or Delta starters are the most common reduced voltage starters in the 50 Hz industrial motors. They are used in an attempt to reduce the starting current applied to the motor during start. The Star/Delta starter is generally manufactured using three contactors, a timer and a thermal overload for operating a 3-phase motor at 440 volt at AC mains supply of 50 Hz. However, in our project we have taken up the same to operate a 3-phase motor at 440 volt AC mains supply 50 Hz with a set of 12 volt DC relays an electronically adjustable timer provided through arduino and a set of miniature circuit breakers. The interlocking arrangement of the relay coils and the electronic arduino is all wired in lowvoltage DC of 12 Volt fed from an in-built DC power supply for safe handling of the starter during the study, still retaining its application for a 3-phase motor starting with a single phasing prevention. The timer comprises of Arduino the output of which is fed to a relay for changing the mains supply from 3-phase star to delta. The project also has the provision of single phase protection, since the 3-phase motors may get burnt if any one phase goes missing during operation. The output to the lamps shall be completely cut off in the event of any phase failure. Furthermore, the project can be enhanced by using thyristors in a firing angle control principle for soft start of the induction motor that would overcome all the drawbacks of the star delta starter.

List Of Contents

Declaration ii

Certification iii

ACKNOWLEDGEMENT iv

Abstract: vi

List Of Contents vii

Chapter-1 1

INTRODUCTION 1

1.1 Introduction 1

1.2 OBJECTIVE 2

1.3 METHODOLOGY 2

1.4 EXISTING AND RELATED WORKS 2

Chapter-2 3

Design And Implementations 3

2.1 Introduction 3

2.2 Block Diagram 4

2.3 Circuit Diagram 5

2.4 Working Principle 5

Chapter-3 7

Hardwire Descriptions 7

3.1 Introduction 7

3.2 List of Components 7
3.2 RESISTORS 8
3.2.1 Wire Wound Resistors: 8
3.2.2 Carbon Resistors: 9
3.2.3 Metal Film Resistors: 9
3.2.3 Variable Resistors: 9
3.2.4 RESISTOR COLOR CODE 9
3.3 Function of Arduino NANO 11
3.3.1 Defining Arduino 11
3.3.2 Arduino Architecture: 11
3.3.3 Arduino Pin Diagram: 12
3.3.4 How to program an Arduino? 14
3.3.5 Five Steps to program an Arduino 15
3.5.6 A basic sketch consists of 3 parts: 15
3.3.7 Few of basic Adruino functions are: 15
3.3.8 How to Design your own Arduino? 16
3.3.9 Seven Reasons why Arduino is being preferred these days 16
3.4 Bluetooth Module: 17
3.4.1 Technical Specifications: 18
3.5 LCD Display: 18
3.5.1 Technical Specifications: 21
3.6 Power Supply 21
3.6.1 Transformer 22
3.6.2 Working of this Transformer 22
3.7 Diode 23

3.7.1 Characteristics 24
3.7.3 Full-Wave Rectifiers 25
3.7.4 Working of a Bridge Rectifier 25
3.7.5 Capacitor 27
3.7.6 Theory of Operation 28
3.8 Voltage Regulator 29
3.8.1 Voltage Regulators Output Voltages 29
3.9 Connecting Wires 30
3.10 Vero Board Copper DIL Strip Board 30
Chapter -4 32
Result and Discussion 32
4.1 Introduction 32
4.2 Advantages 32
4.3 Disadvantages 32
4.4 Future Scope 33
4.5 Limitations 33
4.6 Future Works 33
4.7 Applications 33
4.8 Result 34
Chapter-5 35
Conclusions 35
5.1 Conclusions 35
Appendix 36
References 41

Chapter-1

INTRODUCTION

1.1 Introduction

Due to the wide variety characteristics of the induction motor, it plays the premier role in the industrial sector. Some of those are self-starting, rugged construction, high efficiency, good power factor and ease of control, etc. Squirrel cage type of induction motors are mostly used widely than the other types. When the motor is at idle, it just look like short circuited transformer at secondary side because all the rotor bars are connected together to form a closed path. This will turn a large current flow through the rotor bars. So when the motor is started, stator draws the high current which is 8-10 times that of the motor rated current. Before staring the motor, it is necessary reduce the voltage applied to the motor. The project is designed to provide low voltage start to induction motors. This is achieved by using star to delta conversion. Star/Delta starters are probably the most common reduced voltage starters in the 50Hz industrial motor world. Star delta is used in an attempt to reduce the start current applied to the motor then after sometime full load current is applied to the motor. Since in star connection current is same in different phases while line voltage is the root three times the phase voltage. So the voltage is reduced (results to reduce current) if motor is started as star. And also in delta connection the voltage is same as that of phase voltage so full voltage is applied if we run the motor as delta connection. The Star/Delta starter is generally obtained from three contractors; arduino and a thermal overload for operating a 3 phase motor at 440 volt at ac mains supply 50 Hz. The interlocking arrangement of all the contactor coils is traditionally wired in 440 volt AC. The project is designed to start a 3 phase motor at 440 volt AC mains supply 50 Hz with a set of 12 volt DC relays in star mode and then to delta mode by an electronically adjustable timer. A set of relays are used to shift the motor connections from star to delta with a time delay. The project is supplied with six lamps in a 3 phase motor i.e., 3 lamps will work when motor is in star connection and when it will get converted to star to delta all 6 lamps will operate.

1.2 OBJECTIVE

The main aim of our project is given bellow,

- Make a Arduino and Bluetooth bade star-delta Starter using relay.
- To developed automation using arduino for reduce current demand during motor startup.
- It is often used for starting three-phase induction motors,
- To implement the designed system
- Learn about microcontroller programming.
- Learn about Bluetooth communications.

1.3 METHODOLOGY

- First of all we collect some data related our project from Google, youtube and reference books.
- Requirements of the project was carefully analyzed to design the home automation system.
- The methodology of this project design can be divided into two sections; hardware and software implementations.
- Information's were collected from references books and websites to find out the possible improvement.
- Required components have been purchased from local market.

1.4 EXISTING AND RELATED WORKS

The existing star delta starter has many types like manual switch over and automatic switch over using timers, there are many disadvantages in the existing system. In manual switch over star delta starter the connection between the star and delta switch is changed by manual operation by the SPDT (Single Pole Double Throw) switch. In this case the switching between the connection should be when the motor reaches the 35% of the rated speed. But to attain the required speed

the timing delay is must. So, it is not possible for manual switch over for changing in precision of time. In the automatic star delta switches the timers are used for accurate switch over between the connection. But the main drawback back of this starter is it cannot handle the load control of the motor, i.e. breaking of the motor supply under overloading or during specific load current condition. This drawback is reduced in he proposed system using microcontrollers. Also, the present starters do not have any temperature and speed monitor in the on-board starter.

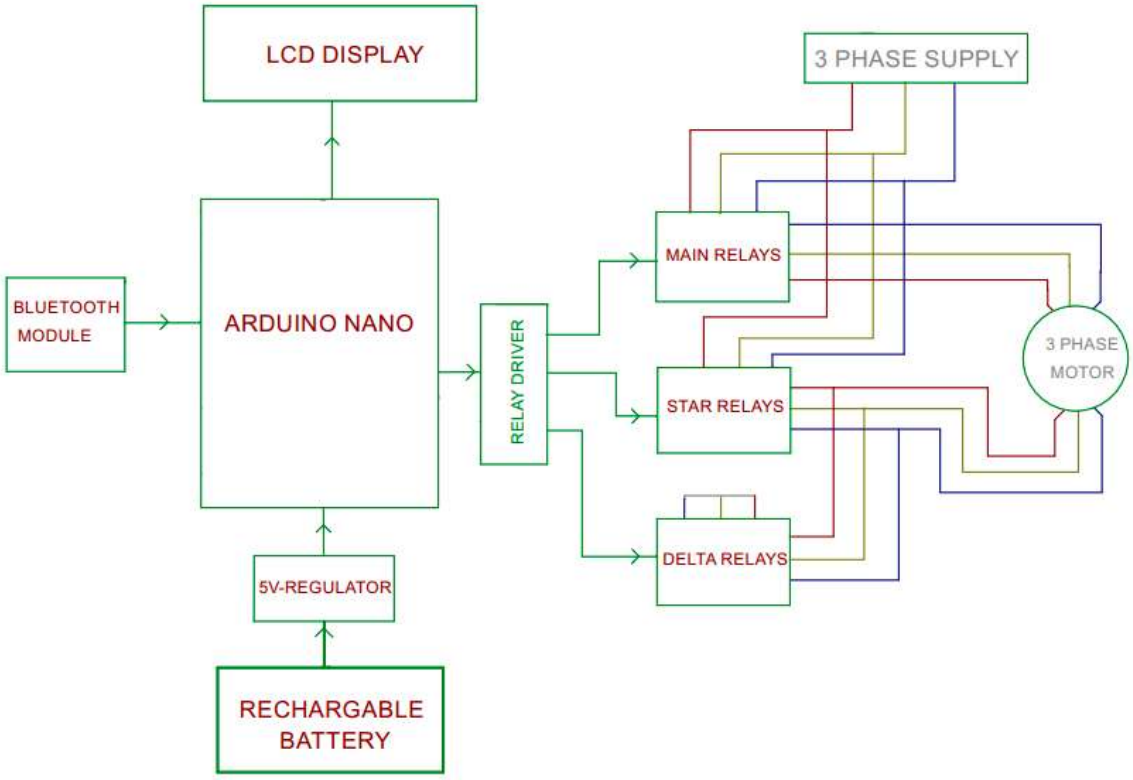
Chapter-2

Design And Implementations

2.1 Introduction

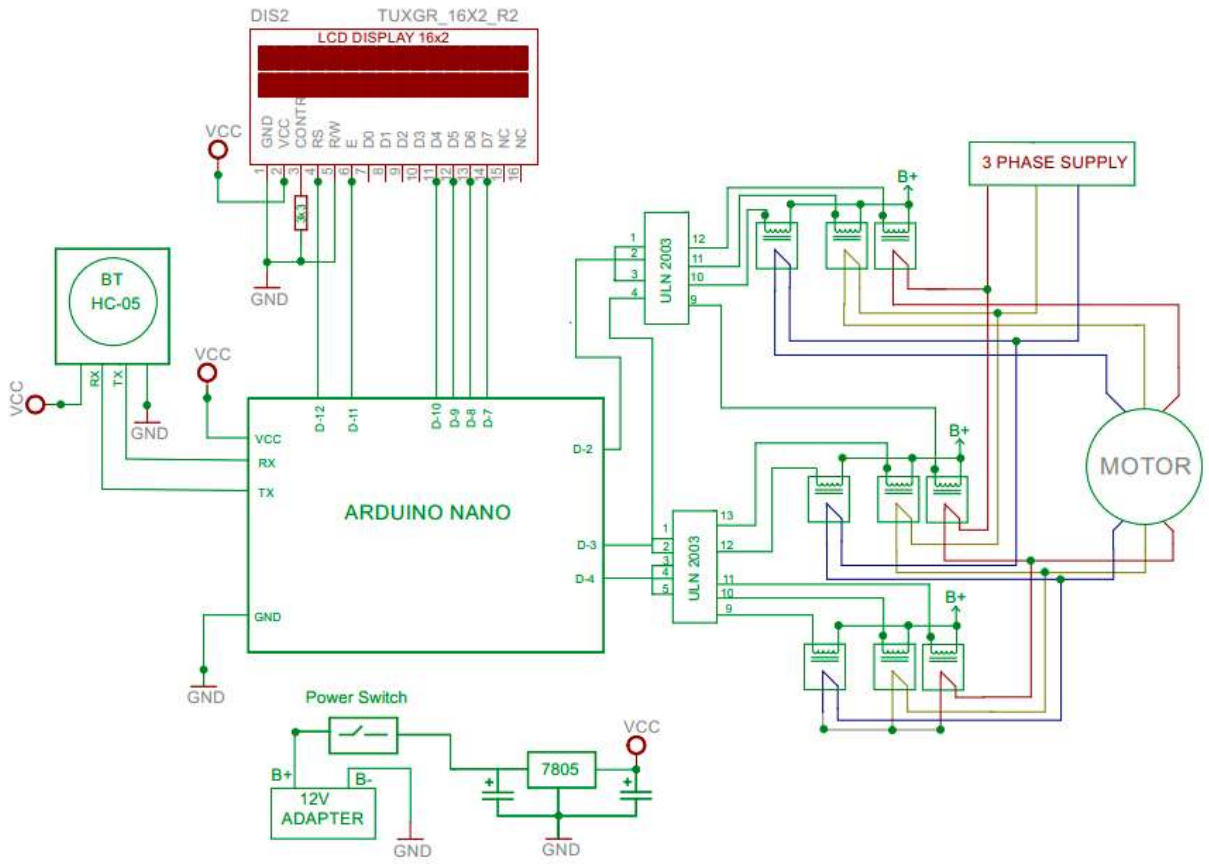
In this modern world electrical appliances are going very fast, each and every day the technology updates are changed. One of the important appliances used in today life is motor. There are so many types of motor used in our daily life's. Each motor needs some type of starting methods, some motor does not need any starting method. The induction motor requires starter for the motor starting. Some induction motors require DOL (direct On Line) starter. DOL starter are used for low power induction motor. Whereas high power induction motor cannot be started by DOL starter because the high-power induction motor requires high starting torque. So we must go other starter which can able deliver high starting torque. In this case we using star – delta starter, which starts the motor using star connection and runs in the delta connection. The reason behind choosing the star delta starter is to provide high starting current during the start condition and runs in delta connection.

2.2 Block Diagram



Block Diagram of Star Delta Starter Using Arduino and Bluetooth

2.3 Circuit Diagram



Circuit Diagram of Star Delta Starter Using Arduino and Bluetooth

2.4 Working Principle

The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards

(shields) and other circuits. The board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable. It can be powered by a USB cable or by an external 9 volt battery, though it accepts voltages between 7 and 20 volts. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0.The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform. The ATmega328 on the Arduino Uno comes pre-programmed with a boot loader that allows uploading new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol. An arduino is used as a timer in this project "automatic star delta starter using relay for three phase induction motor", where pin number 2 is used for start and pin number 3 for stop. Pin number 8 is used for star and 9 for delta connection. The pin number 2 starts the timer with starting of motor in star connection and after 30 seconds the motor changes to delta connection which is stopped by pin number In given above circuit diagram firstly Three phase supply 415V AC is given to the three single phase transformer 230/12 Volts output from one of these transformers is supplied to the Printed Circuit Board through three sets of bridge rectifiers to operate the 12 Volt DC relays. It is also used to run the microcontroller through the 7809 Voltage regulator which gives an output of 9 volt DC output which is given to the arduino supply from other two transformers are used to operate the star and delta connected relays which operate with a time delay of 3 second set by the microcontroller. This changes the operation of motor from star mode in the starting to delta mode after the fixed time delay. It operates the motor windings from the high inrush current during starting of the motor and allows only $1/\sqrt{3}$ of the rated current. After the fixed time delay the motor is switched to delta mode of operation allowing full load current.

Chapter-3

Hardwire Descriptions

3.1 Introduction

The project is designed to provide low voltage start to induction motors. This is achieved by using star to delta conversion. Star/Delta starters are probably the most common reduced voltage starters in the 50Hz industrial motor world. Star delta is used in an attempt to reduce the start current applied to the motor. Thereafter, full load current is applied to the motor. The Star/Delta starter is generally manufactured from three contactors; and electromechanical timer and a thermal overload for operating a 3-phase motor at 440 volts at ac mains supply 50Hz.

3.2 List of Components

Name	**Quantity**
Arduino Nano	01
Bluetooth module HC-05	01
12v relay	6
3.7V rechargeable battery	3
CONNECTOR	01
12v DC Adapter	01

SOME WIRES	01
SAMPLE PCB	01
7805 voltage regulator	04
Diode, Resistor, Capacitor	some

3.2 RESISTORS

The flow of charge (or current) through any material, encounters an opposing force similar in many respect to mechanical friction. This opposing force is called resistance of the material. It is measured in ohms. In some electric circuits resistance is deliberately introduced in the form of the resistor.

Resistors are of following types:



1. Wire wound resistors. 2. Carbon resistors. 3. Metal film resistors. Resistor

3.2.1 Wire Wound Resistors:

Wire wound resistors are made from a long (usually Ni-Chromium) wound on a ceramic core. Longer the length of the wire, higher is the resistance. So depending on the value of resistor required in a circuit, the wire is cut and wound on a ceramic core. This entire assembly is coated with a ceramic metal. Such resistors are generally available in power of 2 watts to several

hundred watts and resistance values from 1ohm to 100k ohms. Thus wire wound resistors are used for high currents.

3.2.2 Carbon Resistors:

Carbon resistors are divided into three types:

a. Carbon composition resistors are made by mixing carbon grains with binding material (glue) and moduled in the form of rods. Wire leads are inserted at the two ends. After this an insulating material seals the resistor. Resistors are available in power ratings of 1/10, 1/8, 1/4 , 1/2 , 1.2 watts and values from 1 ohm to 20 ohms. b. Carbon film resistors are made by deposition carbon film on a ceramic rod. They are cheaper than carbon composition resistors. c. Cement film resistors are made of thin carbon coating fired onto a solid ceramic substrate. The main purpose is to have more precise resistance values and greater stability with heat. They are made in a small square with leads.

3.2.3 Metal Film Resistors:

They are also called thin film resistors. They are made of a thin metal coating deposited on a cylindrical insulating support. The high resistance values are not precise in value; however, such resistors are free of inductance effect that is common in wire wound resistors at high frequency.

3.2.3 Variable Resistors:

Potentiometer is a resistor where values can be set depending on the requirement. Potentiometer is widely used in electronics systems. Examples are volume control, tons control, brightness and contrast control of radio or T.V. sets.

3.2.4 RESISTOR COLOR CODE

Colour

1st band

2nd band

3rd band (multiplier) 4th band (tolerance) Temp. Coefficient

Black 0 0 ×100

Brown 1 1 ×101 ±1% (F) 100 ppm

Red 2 2 ×102 ±2% (G) 50 ppm

Orange 3 3 ×103

15 ppm

Yellow 4 4 ×104

25 ppm

Green 5 5 ×105 ±0.5% (D)

Blue 6 6 ×106 ±0.25% (C)

Violet 7 7 ×107 ±0.1% (B)

Gray 8 8 ×108 ±0.05% (A)

White 9 9 ×109

Gold

×10−1 ±5% (J)

Silver

×10−2 ±10% (K)

None

±20% (M)

Example: 1k or 1000 ohms

Band1

Band 2

Band 3

Band 4

3.3 Function of Arduino NANO

3.3.1 Defining Arduino

An Arduino is actually a microcontroller based kit which can be either used directly by purchasing from the vendor or can be made at home using the components, owing to its open source hardware feature. It is basically used in communications and in controlling or operating many devices. It was founded by Massimo Banzi and David Cuartielles in 2005.

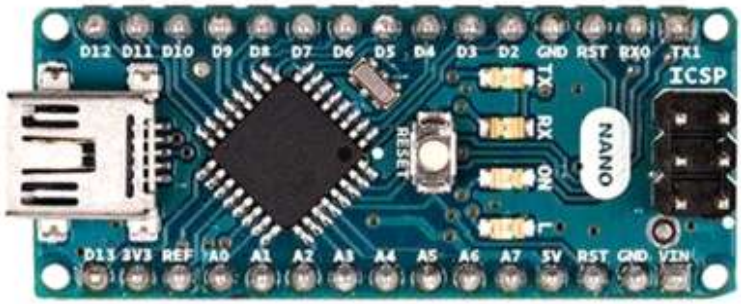


Figure 3. 1Arduino NANO

3.3.2 Arduino Architecture:

Arduino's processor basically uses the Harvard architecture where the program code and program data have separate memory. It consists of two memories- Program memory and the data memory. The code is stored in the flash program memory, whereas the data is stored in the data memory. The Atmega328 has 32 KB of flash memory for storing code (of which 0.5 KB is used

for the bootloader), 2 KB of SRAM and 1 KB of EEPROM and operates with a clock speed of 16MHz.

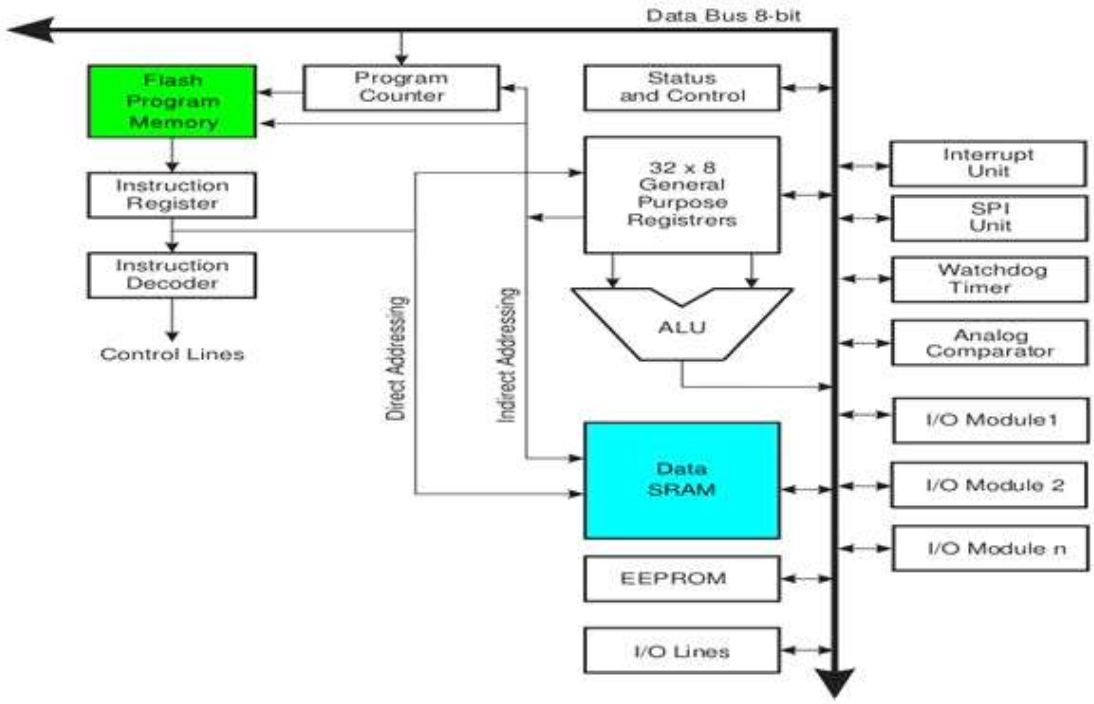


Figure 3. 2Block Diagram of Arduino Architecture

3.3.3 Arduino Pin Diagram:

A typical example of Arduino board is Arduino Uno. It consists of ATmega328- a 28 pin microcontroller.

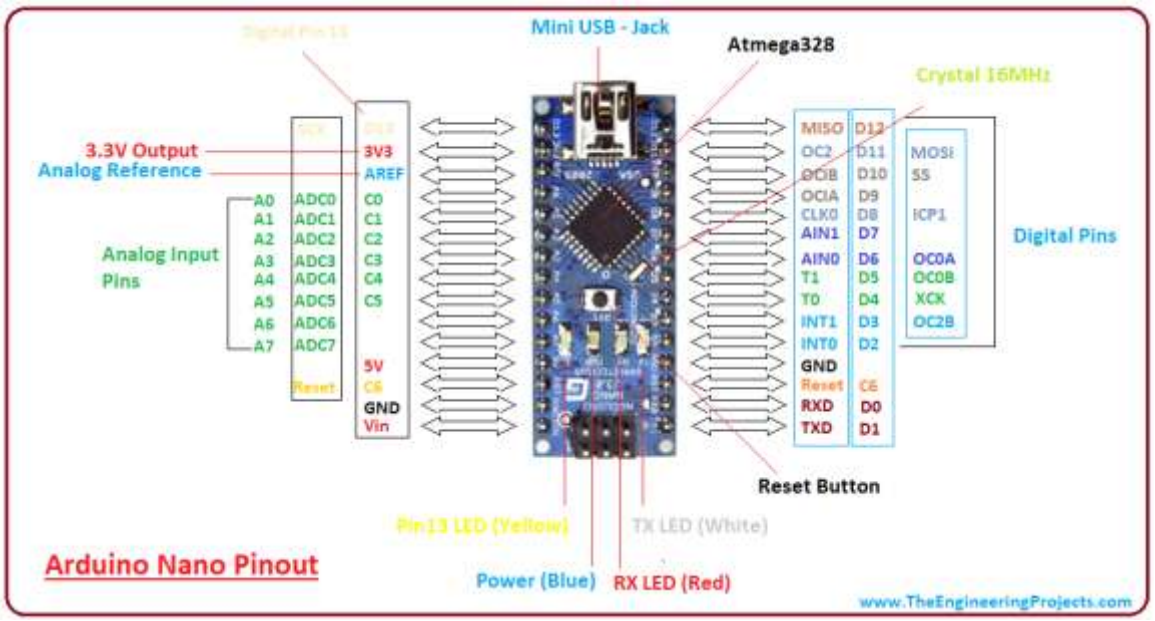


Figure 3. 3Pin Diagram of Arduino

Power Jack: Arduino can be power either from the pc through a USB or through external source like adaptor or a battery. It can operate on a external supply of 7 to 12V. Power can be applied externally through the pin Vin or by giving voltage reference through the IORef pin.

Digital Inputs: It consists of 14 digital inputs/output pins, each of which provide or take up 40mA current. Some of them have special functions like pins 0 and 1, which act as Rx and Tx respectively , for serial communication, pins 2 and 3-which are external interrupts, pins 3,5,6,9,11 which provides pwm output and pin 13 where LED is connected.

Analog inputs: It has 6 analog input/output pins, each providing a resolution of 10 bits.

ARef: It provides reference to the analog inputs

Reset: It resets the microcontroller when low.

3.3.4 How to program an Arduino?

The most important advantage with Arduino is the programs can be directly loaded to the device without requiring any hardware programmer to burn the program.

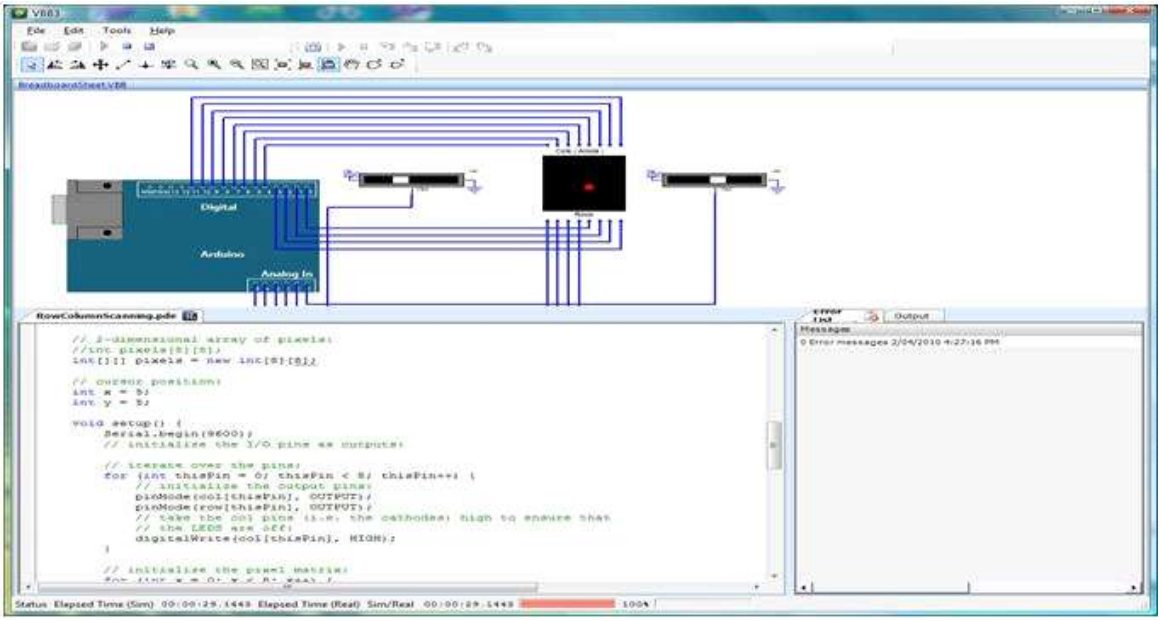


Figure 3. 4Program file of Arduino

This is done because of the presence of the 0.5KB of Bootloader which allows the program to be burned into the circuit. All we have to do is to download the Arduino software and writing the code.

The Arduino tool window consists of the toolbar with the buttons like verify, upload, new, open, save, serial monitor. It also consists of a text editor to write the code, a message area which displays the feedback like showing the errors, the text console which displays the output and a series of menus like the File, Edit, and Tools.

3.3.5 Five Steps to program an Arduino

1. Programs written in Arduino are known as sketches.

2. The sketch is saved with .ino extension. Any operations like verifying, opening a sketch, saving a sketch can be done using the buttons on the toolbar or using the tool menu.

3. The sketch should be stored in the sketchbook directory

4. Chose the proper board from the tools menu and the serial port numbers.

5. Click on the upload button or chose upload from the tools menu. Thus the code is uploaded by the boot loader onto the microcontroller.

3.5.6 A basic sketch consists of 3 parts:

1. Declaration of Variables

2. Initialization: It is written in the setup () function.

3. Control code: It is written in the loop () function.

3.3.7 Few of basic Adruino functions are:

1. digitalRead(pin): Reads the digital value at the given pin.

2. digitalWrite(pin, value): Writes the digital value to the given pin.

3. pinMode(pin, mode): Sets the pin to input or output mode.

4. analogRead(pin): Reads and returns the value.

5. analogWrite(pin, value): Writes the value to that pin.

6. serial.begin(baud rate): Sets the beginning of serial communication by setting the bit rate.

3.3.8 How to Design your own Arduino?

We can also design our own Arduino by following the schematic given by the Arduino vendor and also available at the websites. All we need are the following components- A breadboard, a led, a power jack, a IC socket, a microcontroller, few resistors, 2 regulators, 2 capacitors. **The procedure as follows**:

1. The IC socket and the power jack are mounted on the board.

2. Add the 5v and 3.3v regulator circuits using the combinations of regulators and capacitors.

3. Add proper power connections to the microcontroller pins.

4. Connect the reset pin of the IC socket to a 10K resistor.

5. Connect the crystal oscillators to pins 9 and 10

6. Connect the led to the appropriate pin.

7. Mount the female headers onto the board and connect them to the respective pins on the chip.

8. Mount the row of 6 male headers, which can be used as an alternative to upload programs.

9. Upload the program on the Microcontroller of the readymade Adruino and then pry it off and place back on the user kit.

3.3.9 Seven Reasons why Arduino is being preferred these days

1. It is inexpensive

2. It comes with an open source hardware feature which enables users to develop their own kit using already available one as a reference source.

3. The Arduino software is compatible with all types of operating systems like Windows, Linux, and Macintosh etc.

4. It also comes with open source software feature which enables experienced software developers to use the Arduino code to merge with the existing programming language libraries and can be extended and modified.

5. It is easy to use for beginners.

6. We can develop an Arduino based project which can be completely stand alone or projects which involve direct communication with the software loaded in the computer.

7. It comes with an easy provision of connecting with the CPU of the computer using serial communication over USB as it contains built in power and reset circuitry.

3.4 Bluetooth Module:

Add Bluetooth to your project with the HC-05 Bluetooth Module and get access to a simple Rx/Tx pipeline through classic Bluetooth protocol. The HC-05 module itself is mounted onto a breakout board which provides easy, breadboard friendly 0.1" headers for Power, Ground, TX, RX, and enable pins. The breakout board also provides a 3.3V regulator so you can power it with 5V from an Arduino or other 5V board.

- **Tx/Rx Pipeline** - The HC-05 is designed to be a transparent TX/RX serial pipeline which allows devices to communicate over serial as they would through a wired connection. This is made possible by the Bluetooth software stack that is onboard the HC-05 module.
- **Range** - With a range of 30ft (~10m) you can send serial data with ease.
- **AT command mode** - You can easily enter the AT command mode using the broken out connection to Pin34 (some models have a button).
- **Baud Rate Range** - Your HC-05 uses a baud rate of 9600 by default but can go higher. To change it, you'll need to use the relevant AT commands.



Figure 3.13: Bluetooth Module

3.4.1 Technical Specifications:

- Bluetooth protocol: Bluetooth Specification v2.0+EDR
- Frequency: 2.4GHz ISM band
- Modulation: GFSK(Gaussian Frequency Shift Keying)
- Emission power: ≤4dBm, Class 2
- Sensitivity: ≤-84dBm at 0.1% BER
- Speed: Asynchronous: 2.1Mbps(Max) / 160 kbps, Synchronous: 1Mbps/1Mbps
- Security: Authentication and encryption
- Profiles: Bluetooth serial port
- Power supply: +3.3VDC 50mA
- Working temperature: -20 ~ +75Centigrade
- 44mm x 16mm x 7mm

3.5 LCD Display:

LCD display is an inevitable part in almost all embedded projects and this article is about interfacing a 16×2 LCD with **microcontroller**. Many guys find it hard to interface LCD module with the **microcontroller** but the fact is that if you learn it properly, it's a very easy job and by knowing it you can easily design embedded projects like digital voltmeter / ammeter, digital clock, home automation displays, status indicator display, **digital code locks**, **digital speedometer/ odometer**, display for music players etc. Thoroughly going through this article will make you able to display any text (including the extended characters) on any part of

the 16×2 display screen. In order to understand the interfacing first you have to know about the 16×2 LCD module.



Figure 3.14: LCD Display

16×2 LCD module is a very common type of LCD module that is used in 8051 based embedded projects. It consists of 16 rows and 2 columns of 5×7 or 5×8 LCD dot matrices. The module are talking about here is type number JHD162A which is a very popular one. It is available in a 16 pin package with back light, contrast adjustment function and each dot matrix has 5×8 dot resolution. The pin numbers, their name and corresponding functions are shown in the table below.

Pin No	Name	Function
1	VSS	This pin must be connected to the ground
2	VCC	Positive supply voltage pin (5V DC)
3	VEE	Contrast adjustment
4	RS	Register selection

5	R/W	Read or write
6	E	Enable
7	DB0	Data
8	DB1	Data
9	DB2	Data
10	DB3	Data
11	DB4	Data
12	DB5	Data
13	DB6	Data
14	DB7	Data
15	LED+	Back light LED+
16	LED-	Back light LED-

VEE pin is meant for adjusting the contrast of the LCD display and the contrast can be adjusted by varying the voltage at this pin. This is done by connecting one end of a POT to the Vcc (5V), other end to the Ground and connecting the center terminal (wiper) of the POT to the VEE pin. See the circuit diagram for better understanding.

The JHD162A has two built in registers namely data register and command register. Data register is for placing the data to be displayed, and the command register is to place the commands. The 16×2 LCD module has a set of commands each meant for doing a particular job with the display. We will discuss in detail about the commands later. High logic at the RS pin will select the data register and Low logic at the RS pin will select the command register. If we make the RS pin high and the put a data in the 8 bit data line (DB0 to DB7), the LCD module will recognize it as a data to be displayed. If we make RS pin low and put a data on the data line, the module will recognize it as a command.

R/W pin is meant for selecting between read and write modes. High level at this pin enables read mode and low level at this pin enables write mode.

E pin is for enabling the module. A high to low transition at this pin will enable the module.

DB0 to DB7 are the data pins. The data to be displayed and the command instructions are placed on these pins.

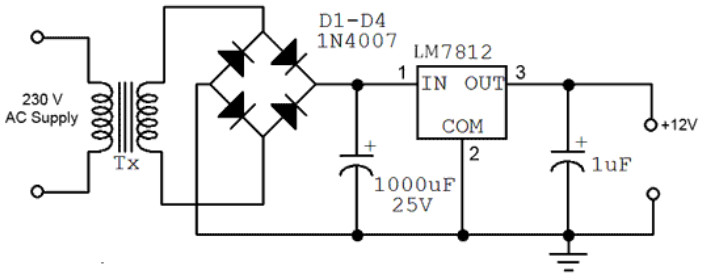
LED+ is the anode of the back light LED and this pin must be connected to Vcc through a suitable series current limiting resistor. LED- is the cathode of the back light LED and this pin must be connected to ground.

3.5.1 Technical Specifications:

- Operating Voltage is 4.7V to 5.3V
- Current consumption is 1mA without backlight
- Alphanumeric LCD display module, meaning can display alphabets and numbers
- Consists of two rows and each row can print 16 characters.
- Each character is built by a 5×8 pixel box
- Can work on both 8-bit and 4-bit mode
- It can also display any custom generated characters
- Available in Green and Blue Backlight

3.6 Power Supply

A power supply is an electronic device that supplies electric energy to an electrical load. The primary function of a power supply is to convert one form of electrical energy to another. As a result, power supplies are sometimes referred to as electric power converters. Some power supplies are discrete, stand-alone devices, whereas others are built into larger devices along with their loads. Examples of the latter include power supplies found in desktop computers and consumer electronics devices. The source of this power can come from different source like the main AC voltage ,a battery or even from a renewable power source like solar panel wind turbine or fuel cell to name just a few. The most common source of power is usually the main AC



AC-DC Power Supply & Circuit Diagram.

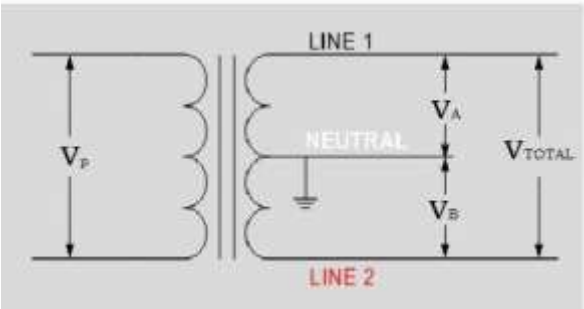
3.6.1 Transformer

A transformer is a device consisting of two closely coupled coils called primary and secondary coils. An AC voltages applied to the primary appears across the secondary with a voltage multiplication proportion to the turn ratio of the transformer and a current multiplication inversely proportional to the turn ratio power is conserved

turn ration = VP/VS=NP/Ns and power out = power in or Vs

3.6.2 Working of this Transformer

The two voltages, between line 1 and neutral and between neutral and line 2 can be named as VA and VB respectively. Then the mathematical relation of these two voltages shows that they are dependent upon the primary voltage as well as the turn ration of the transformer.

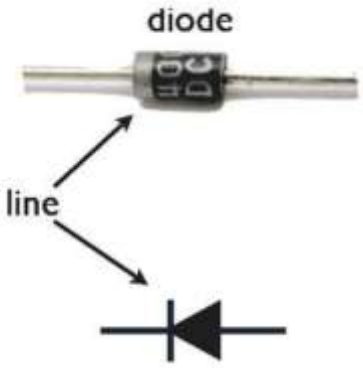


VA = (NA / NP) * VP

VB = (NB / NP) * VP

One thing that should be noted here is that both the outputs VA and VB respectively are equal in magnitude but opposite in direction, which means that they are 180 degrees out of phase with each other. For this purpose, we also use a full wave rectifier with a center tapped transformer, to make both the voltages in phase with each other.

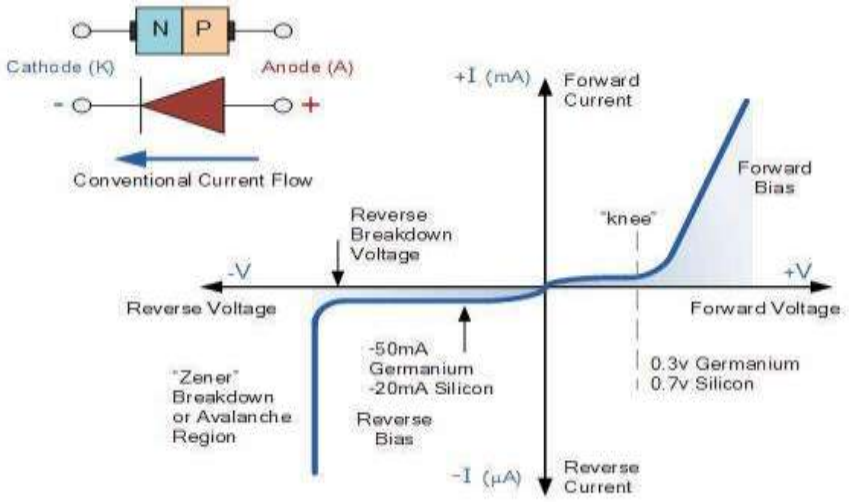
3.7 Diode



Diode and symbol

The term diode usually implies a small signal device with current typically in the milliamp range. A semiconductor diode consists of a PN unction and has two (2) terminals, an anode (+) and cathode (-) current flows from anode to cathode within the diode. Diodes are semiconductor device that might be described as passing current in one direction only. The latter part of that statement applies equally vacuum tube diodes. Diodes however are far more extremely versatile in fact. Diode can be used as rectifier, voltage regulators, turning devices in radio frequency tuned circuit, frequency multiplying device in radio frequency circuit, mixing devices application or can be used to make logic decision in digital circuit.

3.7.1 Characteristics



Junction diode symbol and static I-V characteristics

There are two operating regions and three possible "biasing" conditions for the standard Junction Diode and these are:

1. Zero Bias – No external voltage potential is applied to the PN junction Diode

2. Reverse Bias – The voltage potential is connected negative, (-ve) to the P type material and positive, (+ve) to the N-type material across the diode which has the effect of Increasing the PN junction diode's width.

3. Forward Bias – The voltage potential is connected positive, (+ve) to the P type material and negative, (-ve) to the N-type material across the diode which has the effect of Decreasing the PN junction diodes width.

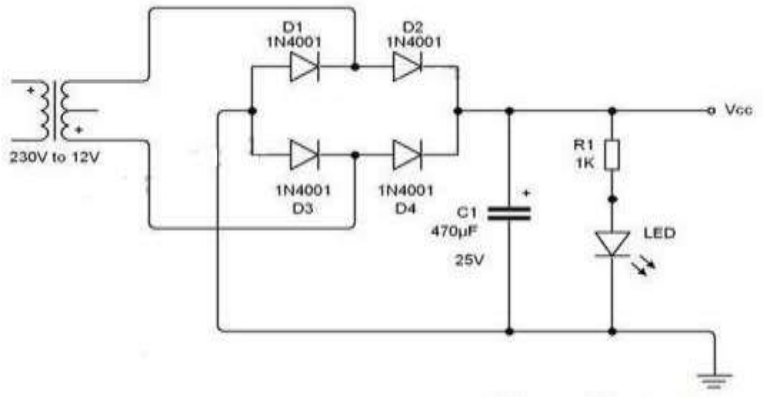
3.7.3 Full-Wave Rectifiers

A rectifier is an electronic circuit that converts AC voltage to DC voltage. It can be implemented using a capacitor diode combination. The unique property of diodes, permitting the current to flow in a single direction is utilized in here. It converts an ac voltage into a pulsating dc voltage using both half cycles of the applied ac voltage. Bridge rectifier is a full wave rectifier circuit using the combination of four diodes to form a bridge. It has the advantage that it converts both the half cycles of AC input into DC output.

Bridge rectifier circuit

3.7.4 Working of a Bridge Rectifier

•During the positive half cycle of secondary voltage, diodes D2 and D3 are forward biased and diodes D1 and D4 are reverse biased. Now the current flows through D2– >Load–>D3.



•During the negative half cycle of the secondary voltage, diodes D1 and D4 are forward biased and rectifier diodes D2 and D3 are reverse biased. Now the current flows through D4–>Load>D1

•In both the cycles, load current flows in the same direction. Hence we get a pulsating DC voltage as shown in fig (3.5,3.6).

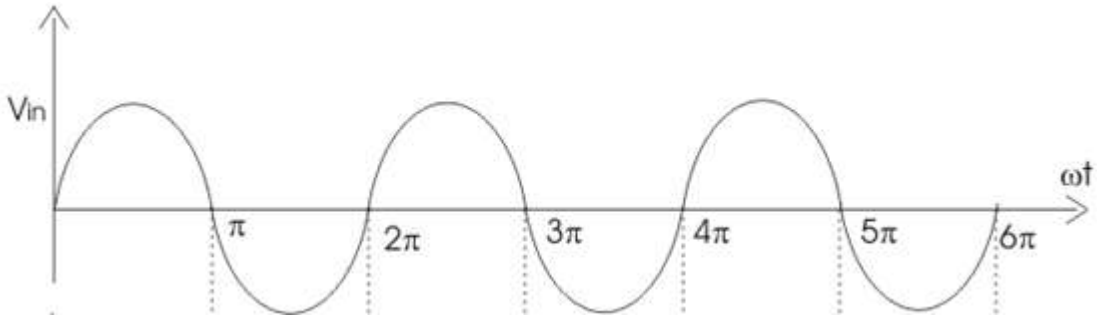
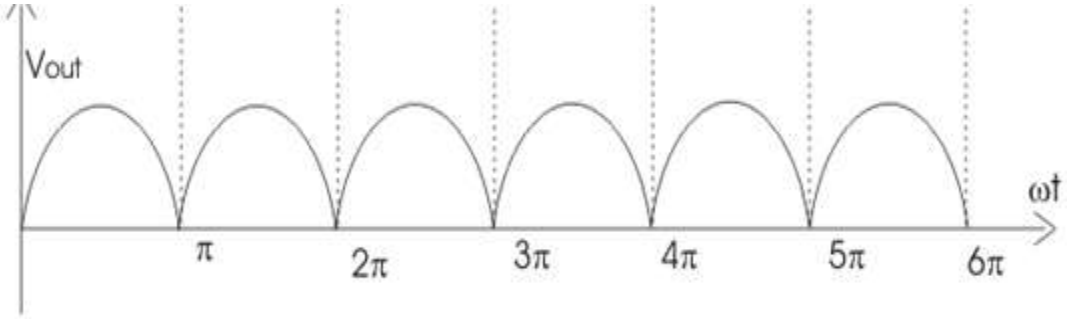


Fig. 3.8 Input sine wave

Pulsating DC output



•Addition of a capacitor at the output converts the pulsating DC voltage to fixed DC voltage.

•Up to a time period of t=1s input voltage is increasing, so the capacitor charges up to peak value of the input. After t=1s input starts to decrease, then the voltage across the capacitor reverse biases the diodes D2 and D4 and therefore it will not conduct. Now capacitor discharges through the load, then voltage across the capacitor decreases.

•When the peak voltage exceeds the capacitor voltage, diodes D2 or D4 forward biases and as aresult capacitor again charges to the peak value. This process continues. Hence we get almost smooth DC voltage as shown in fig (3.7).

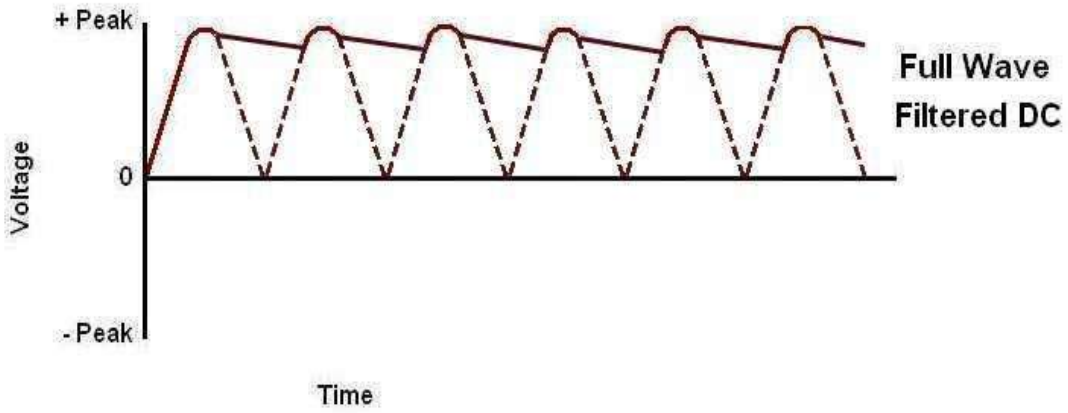
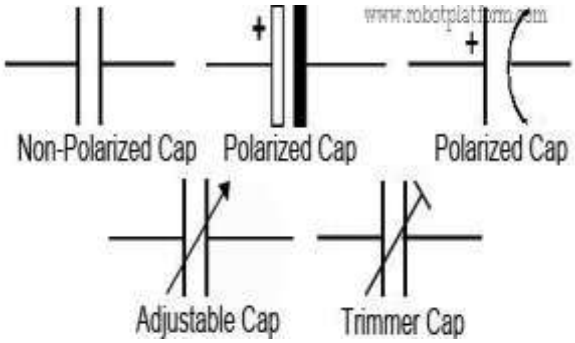


Fig. 3.10 Filtered output

3.7.5 Capacitor

Capacitor is a passive two-terminal electrical component used to store energy in an electric field. The forms of practical capacitors vary widely, but all contain at least two conductors separated by a non-conductor. Capacitors used as parts of electrical systems, for example consist of metal soils separated by a layer of insulating film. A capacitor is passive electronic component consisting of a pair of conductors separated by a dielectric (insulator) when there is a potential difference (voltage) across the detected on one plate and negative charge on the other plate. Energy is stored in the electrostatic field and is measured in farads.





Capacitors & Capacitor symbols.

3.7.6 Theory of Operation

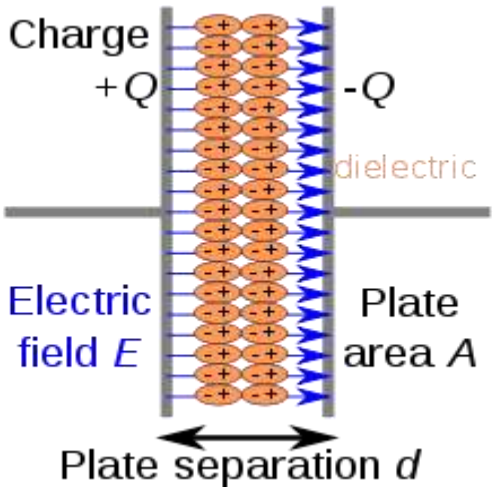


Fig 3.12 Internal constriction of capacitors

A capacitor consists of two conductors separated by a non-conductive region. The non-conductive region is called the dielectric. In simpler terms, the dielectric is just an electrical

insulator. Examples of dielectric media are glass, air, paper, vacuum, and even a semiconductor depletion region chemically identical to the conductors. A capacitor is assumed to be self-contained and isolated, with no net electric charge and no influence from any external electric field. The conductors thus hold equal and opposite charges on their facing surfaces, and the dielectric develops an electric field. In SI units, a capacitance of one farad means that one coulomb of charge on each conductor causes a voltage of one volt across the device.

An ideal capacitor is wholly characterized by a constant capacitance C, defined as the ratio of charge ±Q on each conductor to the voltage V between them:

$$\boldsymbol{C=QV}$$

Because the conductors (or plates) are close together, the opposite charges on the conductors attract one another due to their electric fields, allowing the capacitor to store more charge for a given voltage than if the conductors were separated, giving

the capacitor a large capacitance.

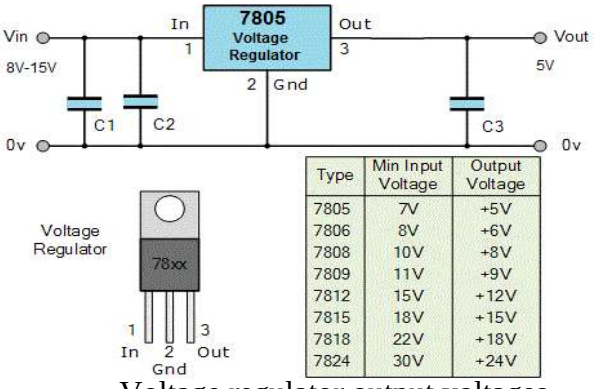
Sometimes charge build-up affects the capacitor mechanically, causing its capacitance to vary. In this case, capacitance is defined in terms of incremental changes:

$$\boldsymbol{C=dQdV}$$

3.8 Voltage Regulator

A voltageregulator is a system designed to automatically maintain a constant voltage level. Avoltage regulator may use a simple feed-forward design or may include negative feedback. It may use an electromechanical mechanism, or electronic components.

3.8.1 Voltage Regulators Output Voltages



Type	Min Input Voltage	Output Voltage
7805	7V	+5V
7806	8V	+6V
7808	10V	+8V
7809	11V	+9V
7812	15V	+12V
7815	18V	+15V
7818	22V	+18V
7824	30V	+24V

Voltage regulator output voltages.

3.9 Connecting Wires

A wire is a single, usually cylindrical, flexible strand or rod of metal. Wires are used to bear mechanical loads or electricity and telecommunications signals. Wire is commonly formed by drawing the metal through a hole in a die or draw plate. Wire gauges come in various standard sizes, as expressed in terms of a gauge number.

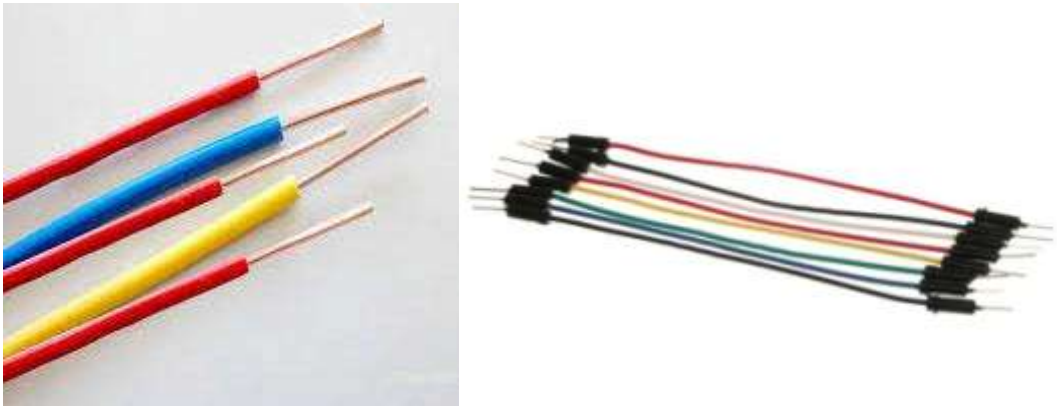
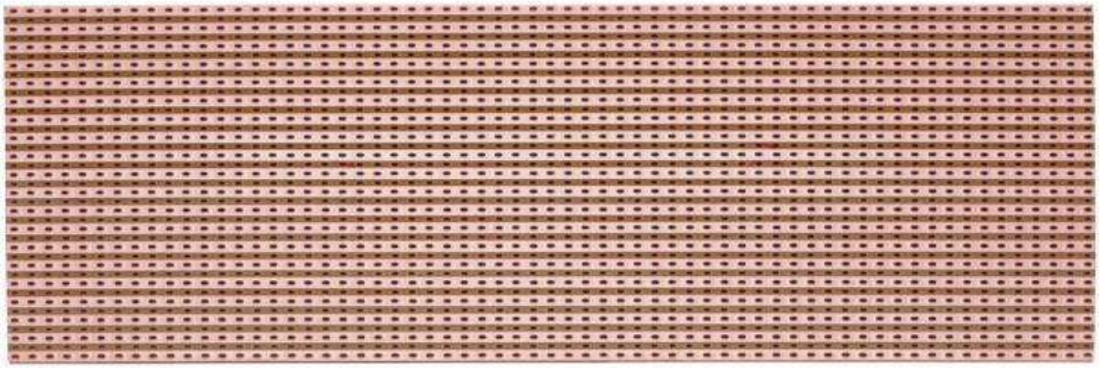


Fig. 3.24 Connecting wire

The term *wire* is also used more loosely to refer to a bundle of such strands, as in 'multi stranded wire', which is more correctly termed a wire rope in mechanics, or a cable in electricity.

3.10 Vero Board Copper DIL Strip Board

Strip board is the generic name for a widely used type of electronics prototyping board characterized by a 0.1 inch (2.54 mm) regular (rectangular) grid of holes, with wide parallel strips of copper cladding running in one direction all the way across one side of the board. It is commonly also known by the name of the original product Vero board, which is a trademark, in the UK, of British company Vero Technologies Ltd and Canadian company Pixel Print Ltd. In using the board, breaks are made in the tracks, usually around holes, to divide the strips into multiple electrical nodes. With care, it is possible to break between holes to allow for components that have two pin rows only one position apart such as twin row headers for IDCs.



Vero board copper DIL strip board

Strip board is not designed for surface-mount components, though it is possible to mount many such components on the track side, particularly if tracks are cut/shaped with a knife or small cutting disc in a rotary tool.

Chapter -4

Result and Discussion

4.1 Introduction

The use of electric motors in the industry, especially in the hotel industry is increasing along with the increasing number of hotels in Bali. The type of motors that generally used are induction motors for pumps, elevator drives or for other purposes. The common starting method for motor induction uses Direct-On Line method. For large capacity of induction motor, a Star-Delta starting method is needed due to a large amount of the starting current. The star stage will reduce the amount of current by 58% and the voltage down to once per square 3 compare to delta stage. The changes between star stage to delta stage is crucial in this operation especially for the time between those two stages. If the change is too fast, the speed of the motor is not enough to produce torque to spin the rotor, on the other hand, if the changeover is to slow, the circuit breaker will identify the current as a fault condition. So, for this purpose it is essential to set the timer in the correct ones. Photo coupler is also used to detect the speed of the rotor. It needs to ensure that the speed of the rotor is not lower than 80% of the normal speed operation of the motor. By setting this condition, it will be adequate to produce a torque to rotate the rotor. One of strategy to produce this result is by using Arduino.

4.2 Advantages

- Main Advantages of this project are bellow,
- reduce current demand during motor startup
- Reduce chance of damage of motor
- Easy to shift star to delta connection
- Easy to control.

4.3 Disadvantages

- In this project we can’t show current rating of motor or
- . In this project we can’t show power rating of motor

4.4 Future Scope

For star delta starter, the basic function is to enable the motor to start and the motor windings are configured in a star formation to the supply voltage. The voltage applied for star delta starter to the individual motor winding is therefore reduced by a factor of 1*sqrt(3) =0.58 this connection amounts to approximately 30% of the delta values.

• Compared to the reduced voltage methods it is the simple and cheapest way of starting the motor

• An automatic voltage fluctuation protector system has been implemented for protection of induction motor

• It can there be easily commercialize

4.5 Limitations

There have some limitations of our projects

- We can’t find any fault during motor run time
- We just can star motor though Bluetooth

4.6 Future Works

- In future we can add many function as like CT/PT SENSOR
- We can add wifi for monitoring data on our computer/ mobile screen.
- And we can add protection system .

4.7 Applications

Following are the main applications of the Surveillance robot:

For very limited applications like small pumps of 7.5 hp small grinding mills, Small Rice mill, Irrigation Pump etc. where the supply system does not allow heavy inrush of current due to poor regulation.

It may be added that the industry is finding a new use of this starter as a power-saving device by choosing between star and delta as per the torque requirement.

4.8 Result

Chapter-5

Conclusions

5.1 Conclusions

A module for the star-delta starting of 3 phase induction motor was built using an Arduino Uno and Arduino Nano. The current sensor section uses a current transformer, while the voltage sensor uses a voltage transformer with added voltage divider circuit. The tacho meter uses the IR obstacle avoidance sensor module which works on the principle of light reflection. This module can handle some various LabVIEW circuit to make it more flexible as a Lab module. In general, this tool can display changes in current when there is a change in the motor coil from the star to delta configuration. Average error in voltage measurement is about 0.39%.

Appendix

```
#include<LiquidCrystal.h>

LiquidCrystal lcd(12,11,10,9,8,7);

#define S1RL 2

#define S2RL 3

#define S3RL 4

#define S4RL 5

#define FFRL 6

#define RPIR A0


char str[15];

int cnt,cnt1,state=0;

int ir;

int rps=0,rpm=0;


void setup()

{

  pinMode(S1RL, OUTPUT);

  pinMode(S2RL, OUTPUT);

  pinMode(S3RL, OUTPUT);

  pinMode(S1RL, OUTPUT);

  pinMode(FFRL, OUTPUT);
```

```
  pinMode(RPIR, INPUT);


  lcd.setCursor(0,0);
  lcd.print("BLUETOOTH MOTOR ");
  lcd.setCursor(0,1);
  lcd.print("SPEED CONTROL   ");
}
////////////////////////////////////////////////////////////////////////////
////////////////////////////////////////////////////////////////////////////
void loop()
{
  CONTROL();
  ////////////////////
  ir = digitalRead(RPIR);
  if (ir == HIGH)
  {
    rps++;
    while(digitalRead(RPIR));
  }


  cnt1++;
  if(cnt1 == 250)
  {
```

```
    rpm = (rps*60);
    DISPLAY1();
    Serial.print(rpm);
    Serial.print("    ");
    cnt1=0;
    rps=0;
    rpm=0;
  }
  ////////////////////
}
////////////////////////////////////////////////////////////////////////////
////////////////////////////////////////////////////////////////////////////
void DISPLAY1()
{
    lcd.setCursor(0,0);
    lcd.print("SPEED:");
    lcd.print(rpm);
    lcd.print(" rpm");
    lcd.setCursor(0,1);
    lcd.print("SPEED:");
    lcd.print(rps);
    lcd.print(" rps");
}
```

```
////////////////////////////////////////////////////////////////////////////

void CONTROL()

{

  if (Serial.available() > 0)

  {

    state = Serial.read();

  }

  if (state == '0')

  {

    digitalWrite(S1RL, LOW);

    digitalWrite(S2RL, LOW);

    digitalWrite(S3RL, LOW);

    digitalWrite(S4RL, LOW);

    digitalWrite(FFRL, LOW);

  }

  else if (state == '1')

  {

    digitalWrite(S1RL, HIGH);

    digitalWrite(S2RL, LOW);

    digitalWrite(S3RL, LOW);

    digitalWrite(S4RL, LOW);

  }

  else if (state == '2')
```

```
{
  digitalWrite(S2RL, HIGH);
  digitalWrite(S1RL, LOW);
  digitalWrite(S3RL, LOW);
  digitalWrite(S4RL, LOW);
}
else if (state == '3')
{
  digitalWrite(S3RL, HIGH);
  digitalWrite(S2RL, LOW);
  digitalWrite(S1RL, LOW);
  digitalWrite(S4RL, LOW);
}
else if (state == '4')
{
  digitalWrite(S4RL, HIGH);
  digitalWrite(S2RL, LOW);
  digitalWrite(S3RL, LOW);
  digitalWrite(S1RL, LOW);
}
else if (state == '6')
{
  digitalWrite(FFRL, HIGH);
```

```
   delay(500);
   state =9;
  }
  else if (state == '7')
  {
   digitalWrite(FFRL, LOW);
    delay(500);
    state =9;
  }
  else if (state == '9')
  {


  }

}
```

References

[1] Elfasi A, Shawesh M A, Shanab W T and Thabet A K 2017 International Conference on Green Energy Conversion Systems (GECS) 1-5

[2] Galadima A A 2014 2014 11th International Conference on Electronics, Computer and Computation (ICECCO) 1-4

[3] Nafeesa K and George S 2011 2011 International Conference on Energy, Automation and Signal 1-5

[4] Aree P 2015 2015 12th International Conference on Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology (ECTI-CON) 1-5

[5] Lin D, Zhou P and Lambert N 2010 The XIX International Conference on Electrical Machines - ICEM 2010 1-6

[6] Wan-ting H, Ya-jie Z, Si-ming R and Hai-yan Z 2011 2011 IEEE 2nd International Conference on Computing, Control and Industrial Engineering 341-344

[7] Pei Y, Liu X, Wang X and Tian M 2016 2016 IEEE 11th Conference on Industrial Electronics and Applications (ICIEA) 2219-2222

[8] Li X, Xu J and Zhang H 2017 2017 IEEE 2nd Information Technology, Networking, Electronic and Automation Control Conference (ITNEC) 1627-1630

Z, Si-ming R and Hai-yan Z 2011 2011 IEEE 2nd International Conference on Computing, Control and Industrial Engineering 341-344

[9] Wijaya F D, Kusumawan S A and Prabowo H 2014 2014 6th International Conference on Information Technology and Electrical Engineering (ICITEE) 1-6

[10] Nafeesa K and George S 2010 2010 Joint International Conference on Power Electronics, Drives and Energy Systems & 2010 Power India 1-5

[11] Run-hao P, Haisen Z, Dongdong Z and Jiaxuan L 2014 2014 17th International Conference on Electrical Machines and Systems (ICEMS) 135-13