Three Phase Sequence Indicator Using Arduino Programming

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***Abstract*: During present age i.e. the age of industrialization and growing manufacturing sector/facilities, the machines used in the industries depend on the input three phase supply. Since we are aware that in three phase supply, correct connections of phase sequence is very much necessary otherwise it could lead to serious damages in the machines. The operator who is the in charge of monitoring the machines must know about the phase sequence connection and its adverse effects also. This paper provides the simple arduino programming model based 'three phase sequence indicator' which is helpful in many industrial applications.**

***Keywords*: phase sequence, voltage divider circuit, step down transformer, arduino.**

I. Introduction

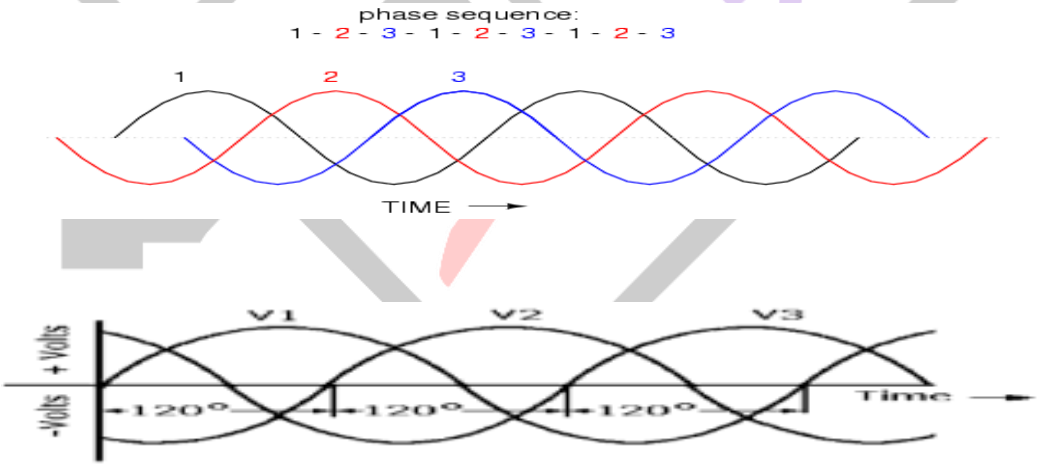
The order in which the individual phase voltages attain their respective maximum values in a three phase system is called phase sequence. A three phase supply system needs three single phase EMFS provided they must have same voltage magnitude and frequency but with different phase displacement, usually by 120 degrees.

Types of phase sequence

1. Positive phase sequence (RYB)

2. Negative phase sequence (RBY)

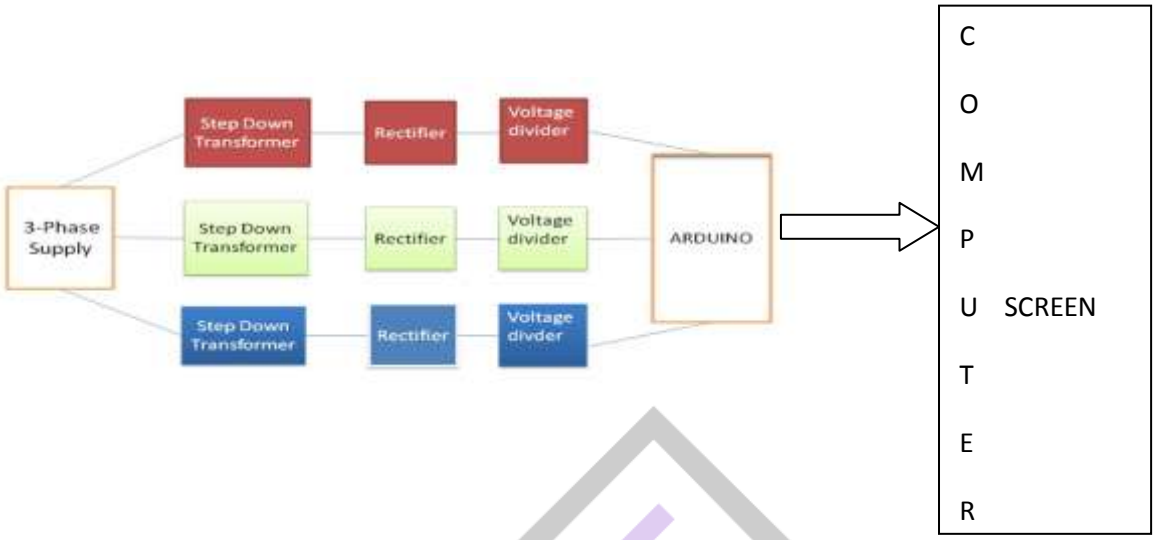
Now a days, various types of phase sequence indicator are used in the industry for the detection of correct phase sequence. Such as static, non static, rotating, non rotating, micro controller based etc. but finally the logic remains the same.



II. Scope of Work

- It is used to detect the phase sequence.
- It is widely used in industries to check the phase sequence, so that the correct phase sequence supply is given to machines and the chance of damage of induction machines gets reduced.
- The direction of rotation of three phase electric motors can be changed by changing the phase sequence of supply.
- It is used for tracking the electrical connection during both, the installation and the maintenance of the electrical connection.
- It is also used for wiring switchboards when three phase supply is a matter of concern.

III.BLOCK DIAGRAM



IV.SYSTEM IMPLEMENTATION AND METHODOLOGY

From three phase supply, each phase is stepped down to 12V-0-12V using step-down.transformer and then it is given to half wave rectifier and the output of the half wave rectifier is fed to the voltage divider circuit which is 12V.Here,we are eliminating the negative half of the supply. From the voltage divider circuit approximately 1.17 volts is tapped. As in arduino the maximum voltage we can feed is 5Volts. This is the logic behind giving the output of rectifier to voltage divider circuit,so that we can trap voltage less than /equal to 5V. The output of the voltage divider circuit is given to the analog pins of arduino i.e. A0,A1 and A2 and by programming in arduino (using basic C and arduino IDE) we are able to detect the phase sequence by the concept of zero crossing and the output is displayed on computer screen.

In arduino there is 10 bit-ADC ($2^{10=1024}$). The ADC on the Arduino is a 10-bit ADC, meaning it has the ability to detect 1,024 (2^{10}) discrete analog levels. The way an ADC works is fairly complex. The microcontroller monitors the number of clock cycles that pass before the capacitor is discharged. This number of cycles is the number that is returned once the ADC is complete.

Relating ADC Value to Voltage

The ADC reports a *ratio metric value*. This means that the ADC assumes 5V is 1023 and anything less than 5V will be a ratio between 5V and 1023.

$$\frac{Resolution\ of\ the\ ADC}{System\ Voltage} = \frac{ADC\ Reading}{Analog\ Voltage\ Measured}$$

Analog to digital conversions are dependant on the system voltage**.** Because we are predominantly use the 10 bit ADC of the Arduino on a 5V system, we can simplify this equation slightly:

$$\frac{1023}{5} = \frac{ADC\ Reading}{Analog\ Voltage\ Measured}$$

:

1023/5 = **x/1.7V**

1023/5 = 204.6~ 205

So,x = 205* 1.7 = 348.5

The voltage divider formula is $V_{out} = V_s*(R2/(R1+R2)$

So, Vout = 12*(1/10+1) ~ 1.7 V

V. System Requirements and its Operation

Developing an arduino based programming model of three phase sequence indicator has enabled us to analyze and survey about the necessity of the requirement to make unique and based on the latest techniques and features to make it cheap and easily available for the consumers.

The required components are listed below

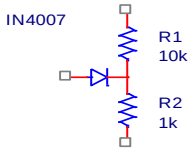
- Step down transformers
- Diodes
- Resistors
- Arduino

VI. System Description

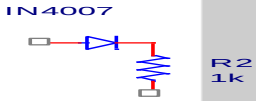
1. Step Down transformer: The rating of the transformer is 230V/12-0-12V, 500mA, 6VA

2. Resistor:10K and 1K resistors are used to build the voltage divider circuit.

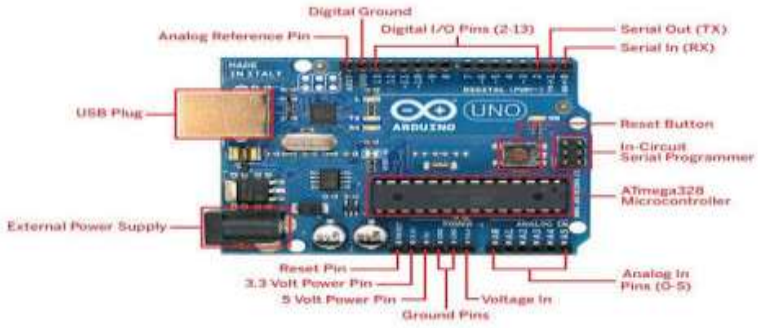
The formula of the Voltage divider circuit is Vout= Vs*[R2/(R1+R2)]



3. Diode: IN4007 is used to build half wave rectifier.



VII.Arduino:



It is the board to get started with electronics and coding.The description of the components of the arduino are as follows:

a) Power Usb:- Arduino board can be powered by using the USB cable from the computer. All we need to do is connect the USB cable to the USB.

b) Power barrel jack:- Arduino boards can be powered directly from the AC mains power supply by connecting it to the Barrel Jack.

c) Voltage Regulator:- The function of the voltage regulator is to control the voltage given to the Arduino board and stabilize the DC voltages used by the processor and other element.

d) Crystal Oscillator:- The crystal oscillator helps Arduino in dealing with time issues. How does Arduino calculate time? It is by using the crystal oscillator. The number printed on top of the Arduino crystal is 16.000H9H. It tells us that the frequency is 16,000,000 Hertz or 16 MHz

e) Arduino Reset:- We can reset our Arduino board, i.e., start your program from the beginning. You can reset the UNO board in two ways. First, by using the reset button (17) on the board. Second, we can connect an external reset button to the Arduino pin labelled RESET (5).

f) Pins:- 3.3V (6) − Supply 3.3 output volt

5V (7) − Supply 5 output volt

Most of the components used with Arduino board works fine with 3.3 volt and 5 volt.

GND (8)(Ground) − There are several GND pins on the Arduino, any of which can be used to ground your circuit.

g) Analog pins:- The Arduino UNO board has five analog input pins A0 through A5. These pins can read the signal from an analog sensor like the humidity sensor or temperature sensor and convert it into a digital value that can be read by the microprocessor.

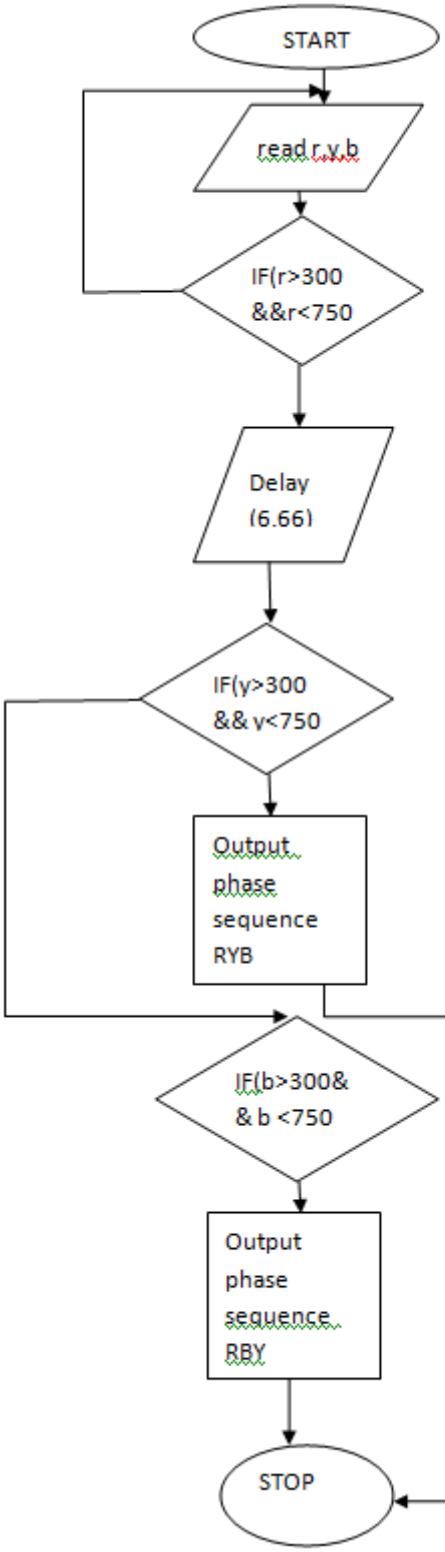
h) Main microcontroller:- Each Arduino board has its own microcontroller (11). We can assume it as the brain of your board. The main IC (integrated circuit) on the Arduino is slightly different from board to board. The microcontrollers are usually of the ATMEL Company. You must know what IC your board has before loading up a new program from the Arduino IDE. This information is available on the top of the IC. For more details about the IC construction and functions, you can refer to the data sheet.

IX. Arduino Programming

```
        int a = A0;
        int b = A1;
        int c = A2;
        int i = 0
void setup()
{
        serial.begin(9600);
        pinMode(a,INPUT);
        pinMode(b,INPUT);
        pinMode(c,INPUT);
}
void loop()
{
double r =analogRead(A0);
        double y=analogRead(A1);
        double b =analogRead(A2);
        if(r>300 && r<750)
        {
                delay (6.66666666);
                if((y>300 && y<750) && (i==0))
                {
                        Serial.println("RYB");
                        i=1;
                }
                if((b>300 && b<750) && (i==0))
                {
                        Serial.println("RBY");
```

```
                    i=1;
                }
            }
}
```

X. Flowchart



XI. Algorithm of Programming

1.Start

2.Read r,y,b.

3.If r is in the range of 300 to 750

4.Delay 6.66

5.If y is in the range of 300 to 750

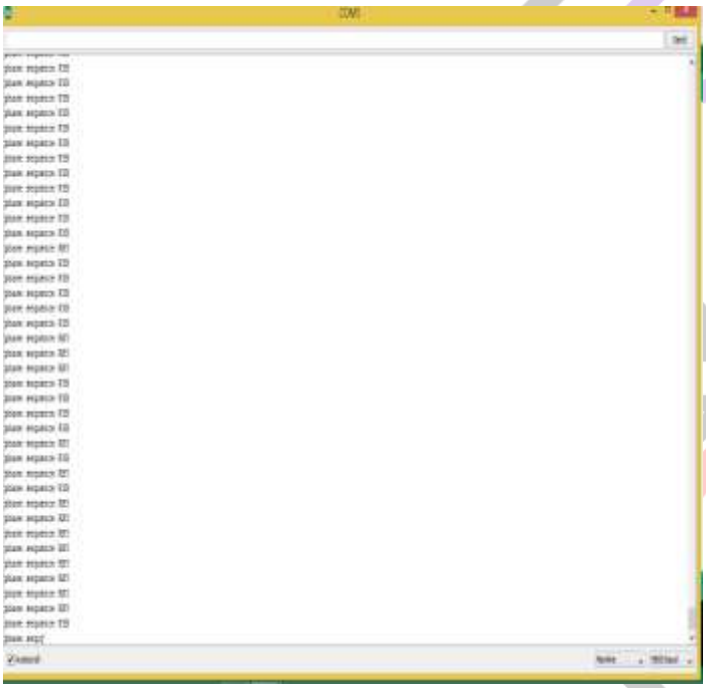
6.Print the output 'phase sequence' RYB

7.If b is in the range of 300 to 750

8.Print the output 'phase sequence' RBY

9.Stop

XII. Output of the program on the computer screen



XIII. Conclusion

By programming through arduino we are able to display the sequence RYB or RBY. Hence the project is successfully implemented.

The project can also be implemented for future purpose for detecting the phase sequence through latest computerized technique. Similar concept can be also used for detecting the fault in transformer through the implementation of programming .We can also send the message to the operator/technician through the GSM module or can programme a relay to trip the circuit breaker in case of any fault. This device can be connected to number of rotating machine for the protection of machine. The project proposed by us is cost effective and reliable.

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