

# Control Strategy of Induction Motor Drive by using Arduino UNO Controller and its Control an Analysis in MATLAB

Miss. Anuradha I. Goradwar<sup>1</sup>, Prof. Prajakta Kasulkar<sup>2</sup>

<sup>1</sup>M.Tech Student, Department of EE, BIT, Bamni, (M.H.), India

<sup>2</sup>Professor, Department of EE, BIT, Bamni, (M.H.), India

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**Abstract** - the planning and implementation of MATLAB Simulink interfacing with Arduino Uno Micro-Controller to performed an impact speed of single phase Ac motor. This controller has been selected due to the ability of the block diagrams that are often inbuilt the Matrix Laboratory (MATLAB) Simulink. The MATLAB Simulink block are going to be used as an interface between the planning controllers which will be downloaded to the Arduino laboratory function in MATLAB Simulink. The gating signal generation of the Arduino microcontroller are going to be observed. This microcontroller is chosen thanks to low cost and straightforward market availability. Single phase AC motor may be a machine that widely used thanks to excellence speed control for acceleration and utilized in heavy application. The Simulink block of MATLAB to regulate and observed the only phase Ac supply, AC motor to the scope of MATLAB. The modelling, control and simulation of this research has been implemented by using MATLAB Simulink Software version 2016a. The Pulse Width Modulation (PWM) signals which generated from MATLAB Simulink model will be burn into Arduino microcontroller.

**Key Words:** Induction Motor, PWM, Arduino UNO, Zero Crossing Detector, Potentiometer

## 1. INTRODUCTION

An induction motor (IM) may be a sort of asynchronous AC motor where power is Supplied to the rotating device by means of electromagnetic induction. Single phase induction motor is a machine that converts electrical energy into mechanical energy. It's a mechanically commutated motor which powered from AC Supply. Two main parts of AC motor are rotor and stator. Stator may be a stationary part while rotor may be a rotating part. Nowadays, AC motor plays a crucial role in research and laboratory experiments thanks to its simplicity. Thus, fine speed control is one among the explanations for the strong competitive position of AC motors within the modern industrial applications. The speed of the AC motor are often controlled by changing the voltage applied to the armature (voltage control method) or by changing the sector current (flux control method). The introduction of variable resistance within the armature circuit or field circuit allowed speed control. Modern AC motors are often controlled by power electronics systems which called AC drives.

## 2. SOFTWARE PART

### Simulink

This research is to develop Simulink model for Ac voltage control for the aim to regulate the speed of an AC motor. The most contribution is that the simple algorithm of control blocks. Control blocks are going to be developed in MATLAB Simulink. An Arduino board is as an interfacing between MATLAB Simulink and out of doors world (gate driver, AC motor, feedback loop and AC voltage measurement). This project is split into two parts that consists of controller development in MATLAB Simulink and hardware development for verification. The works include designing, modelling, simulation and verification. Single phase supply AND circuit driver are designed by using Proteus software. Modelling and simulation were conducted by using MATLAB Simulink software.

## 3. HARDWARE PART

### a. Induction Motor

In synchronous AC motors, the rotor turns at precisely the same speed because the rotating magnetic field; in an induction motor, the rotor always turns at a lower speed than the sector, making it an example of what is called an asynchronous AC motor. The theoretical speed of the rotor in an induction motor depends on the frequency of the AC supply and therefore the number of coils that structure the stator and, with no load on the motor, comes on the brink of the speed of the rotating magnetic flux. In practice, the load on the motor (whatever it's driving) also plays a part—tending to slow the rotor down. The greater the load, the greater the "slip" between the speed of the rotating magnetic flux and therefore the actual speed of the rotor.

The induction motor consists of a two magnetically connected systems namely, Stator and rotor. This is often almost like a transformer that also has two magnetically connected systems namely primary and secondary windings. Also, the induction motor operates on an equivalent principle because the transformer. Hence, the induction motor is additionally called as rotating transformer

The difference between the speed of the rotor and speed of the rotating magnetic flux within the stator is named slip.

☐ The relationship between the availability frequency,  $f$ , the amount of poles,  $p$ , and therefore the Synchronous speed (speed of rotating field),  $n_s$  is given by

$$n_s = 120f/p$$

☐ As the amount of poles aren't variable, varying the availability frequency would end in the variation in speed of the induction motor.

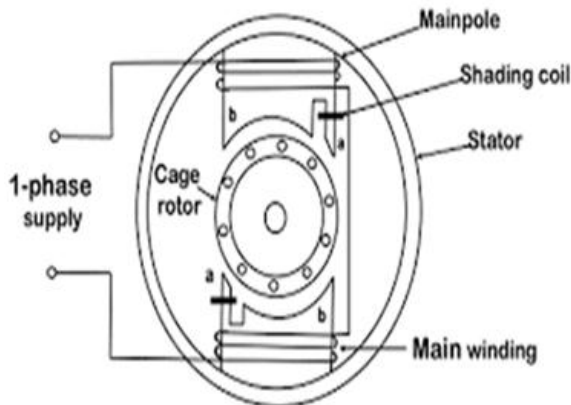


Fig. Induction Motor

The stator is supplied by a balanced three-phase voltage that drives a three-phase

Current through the winding. This current induces a voltage within the rotor. The applied

Voltage ( $V_1$ ) across phase A is adequate to the sum of the – induced voltage ( $E_1$ ). –voltage drop across the stator resistance ( $I_1 R_1$ ). –voltage drop across the stator leakage reactance ( $I_1 j X_1$ ).

Let

$I_1$  = stator current/phase

$R_1$  = stator winding resistance/phase

$X_1$  = stator winding reactance/phase

$R_2$  = rotor winding resistance/phase

$X_2$  = rotor winding reactance/phase

$I_r$  = rotor current

$V_1$  = applied voltage to the stator/phase

$I_o = I_w + I_m$  ( $I_m$ -magnetising component,  $I_w$ -core loss component)

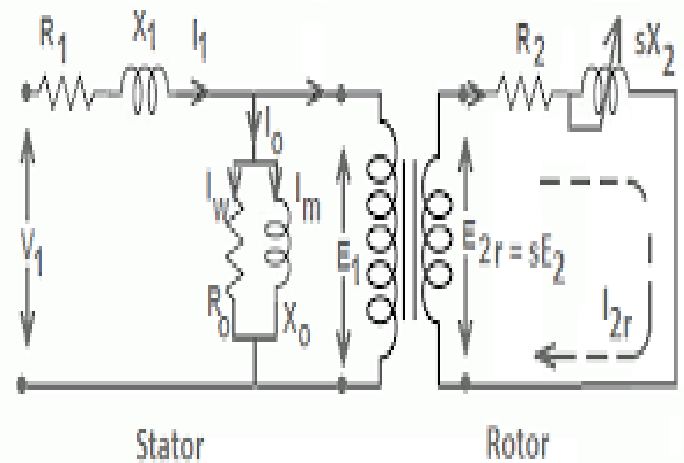


Fig. Equivalent Circuit of I.M.

### b. TRIAC

This clip technology TRIAC has very high thermal cycling performance, and therefore the design structure presents a better ITSM. The 150 °C maximum junction temperature of this device offers easier thermal management. Its 10 mA gate current offers direct drive from a microcontroller, mainly for resistive load control.

### C. Arduino UNO

Arduino the Arduino Uno may be a microcontroller board supported the ATmega328 (datasheet). it's 14 digital input/output pins (of which 6 are often used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, an influence jack, an ICSP header, and a push button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to urge started.

The Uno differs from all preceding boards therein it doesn't use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

### 4. METHODOLOGY

The diagram of this project is shown in Figure. Single phase supply are given to the only phase AC motor through the gate driver in between the gate driver circuit and ac motor the voltage sensor are placed for measuring the voltage flow between ac motor. Single phase gate driver may be a power amplifier that accepts a coffee power input from Arduino and produces a high current drive input for the gate of a high power transistor. In essence, a gate driver consists of a level shifter together with an amplifier. Arduino board is an interfacing between software development and hardware

development. Voltage sensor can detect the input voltage to the AC motor. Arduino can sense the environment by receiving input from sensor and may affect its surrounding by controlling motor. The chip on Arduino board is programmed by using MATLAB. For software development, Control blocks simple algorithm is developed by using MATLAB Simulink. The effectiveness of controlling the speed is by changing the worth of proportional gain and integral gain.

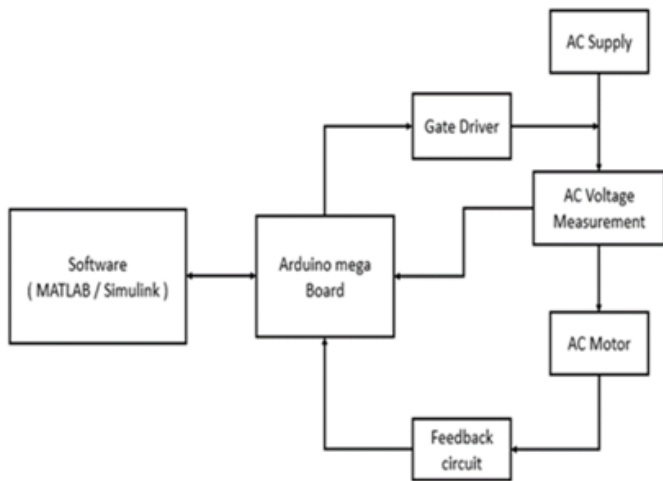


Fig. diagram of Drive Circuit

From the diagram below, Single phase AC supply voltage given to AC motor. SPWM signals from gate driver are going to be used for triggering gate. The aim of gate driver is to power up PWM signal that produced from Arduino from 5V to 15V. Modelling and simulation were wiped out MATLAB Simulink part. During this control system, control blocks using the voltage control technique. The controller will compare to the motor voltage with the reference voltage. If there's a mistake, the controller will generate the heart beat width modulation (PWM) to feed into the only phase controlled supply. This process will continuous until the error nearly zero to offer high performance of the AC motor.

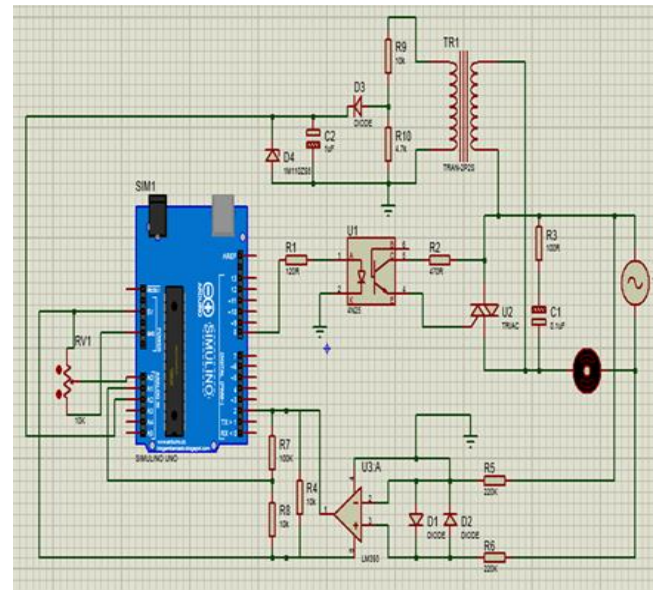


Fig. Circuit Diagram of Drive Circuit

### Controller Development in MATLAB

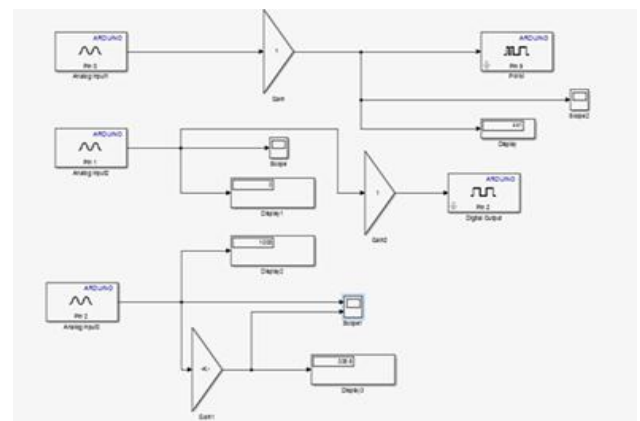


Fig. Simulink Diagram of Speed Control

For controller part, MATLAB Software are going to be used as a medium for communication of Arduino Uno to MATLAB Simulink can build, download and run the model on Arduino Uno. In MATLAB Simulink Library Browser, the

Simulink support package are often added. The Control block is out there under continuous in Simulink. This control blocks functions are enough to the foremost control processes. The control blocks is especially to regulate an appropriate

Proportional gain, integral gain, and differential gain to realize the optimal control performance.

### Working of AC fan control using Arduino

The working are often divided into four different parts. They're as follows

1. Zero-Crossing Detector
2. Phase controlling circuit
3. Potentiometer to regulate the Fan speed amount
4. PWM signal Generation circuit

**RESULT**

The results of ac motor speed control by using the potentiometer in interfacing with matlab simulink and arduino uno controller, within the show of graph are varying the potentiometer to extend or decrease the speed of ac single phase motor.

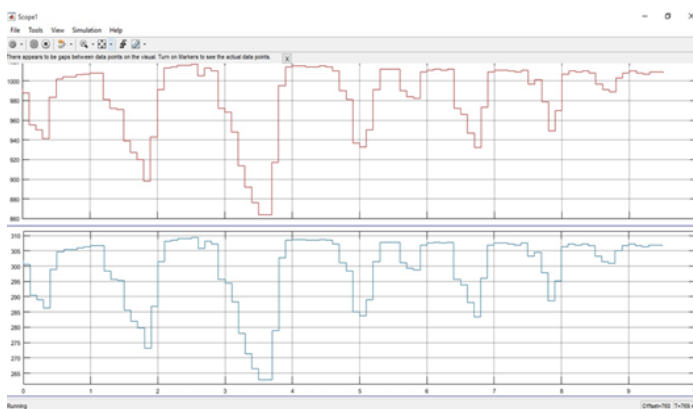


Fig. 9.1 variation of ac motor

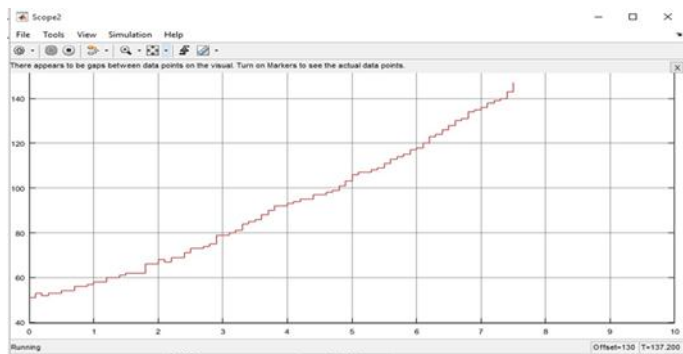


Fig. Waveform of potentiometer

**Experimental setup**

The experimental setup are shown in the figure. The amount of component are require for that setup AC supply are directly connected to the motor through TRIAC. It's some complex type circuitry.

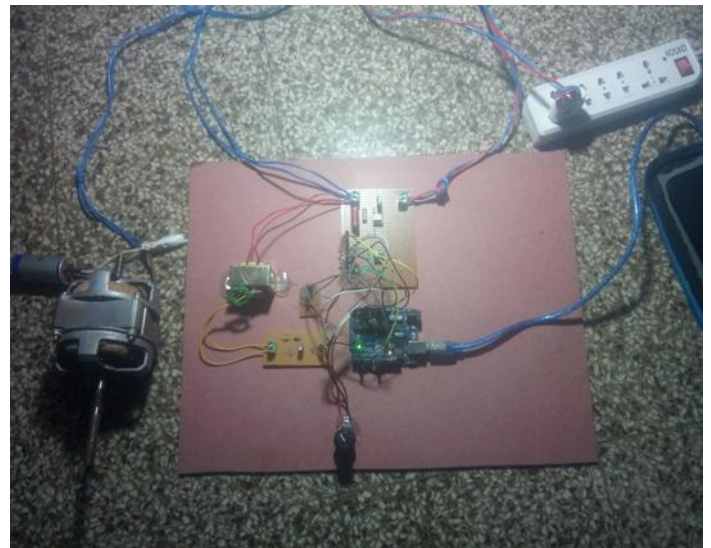


Fig. Final experiment setup

**CONCLUSION**

The objective of a project has been achieved which has been developing the hardware and software for controlling speed of induction motor using android application. The demand for wireless operating device increases, it's more preferable over wired devices. Here we are controlling speed of induction motor Arduino and Simulink.

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