Speed control for AC motor using Arduino platform

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***Abstract*- Some of the necessary characteristics needed for field-oriented AC drives square measure a quick run-stop capability and sensible speed regulation in spite of explosive load amendment. once connected to main power provide, induction motors run at their rated speed, but there square measure several applications wherever variable speed operations square measure needed. though a variety of induction control techniques square measure accessible, generating variable frequency provide may be a widespread management technique, having a continuing voltage to frequency quantitative relation so as to realize constant (maximum) force throughout the in operation amount. This management technique is named as variable frequency management. the most aim of this academic degree project paper emphasizes on the event of a general purpose universal board that's capable of dominant the speed of single or 3 part induction motor with minor package and hardware modifications. absolutely the system consists of the management, driver and therefore the power circuits. The negative feedback circuit includes the ability provide circuit and therefore the microcontroller. the ability circuit includes the full-bridge single-phase Pulse breadth Modulation electrical converter.**

I. INTRODUCTION

AC Motors have been used widely in different fields ranging from domestic appliances to industrial machinery. This necessitates a speed control mechanism that is efficient and is also safe to use. AC Motor Speed Control Project serves this purpose of controlling the speed of the induction motor.AC motor runs through direct AC line the amount of power given to it decides to what RPM it does rotates. We can modulate the power of the AC line to vary the speed of the induction motor through AC driver circuitry. The circuit regulates the AC power supplied to any load like an electric bulb, motor, amplifiers etc.

Single phase Induction motor is widely used in many industry application. It comes from Fractional horse power upto thousands of horse power. Variation of speed is necessary, this can be done by various methods such as

By changing applied voltage
By variable Frequency method
Pole changing method
Stator frequency control

A variable frequency drive (VFD) is a type of motor controller that drive an electric motor by varying the frequency and voltage applied to the motor. A variable frequency drive is an adjustable speed drive. VFD's are available in a number of different low and medium voltage AC-AC and DC-AC Topologies.

II. LITRETURE REVIEW

AC provide plays vital roles in electrical usage as a result of it's normally used for general purpose electrical purpose in domestic or business applications wherever 3 part power provide isn't obtainable. supported this provide, AC Motors become one in all the foremost wide used for various domestic and industrial applications like home appliances, industrial system, and automation as a result of there it provide lower maintenance, reliable and smaller motor size. AC Motor has been coated most servo application in AI, machine tools and positioning devices. Normally, it's 2 winding, main and auxiliary whereas auxiliary winding has a lot of turns than winding has. ancient AC motor run directly from AC voltage at one speed solely. the advance in ac control alter to be run on variable speed, which might cut back power consumption, acoustic noise and mechanical vibration. The vital side in AC motor business is that the role of the researcher/ engineer to manage the speed of Associate in Nursing AC motor that getting used. historically, the AC motor is controlled by 2 classical ways, vector management and torsion management. Vector management and direct torsion management square measure the 2 classical ways to manage synchronization and asynchronous of induction motor [1].

The development and applications of power natural philosophy in business has directly exaggerated the employment of electrical energy (AC) machine. Nowadays, their uses isn't restricted to the automobile application (electrics vehicle), however additionally realize applications in weak power mistreatment battery system (motor of toy) and for the electrical traction within the multi-machine systems. The speed of AC motor may be adjusted or controlled simply to an excellent reach offer straightforward controllability and high performance. There square measure 3 ways of dominant the speed of the shunt and singly excited AC motor, coil voltage speed management, field flux speed management and coil resistance speed management. during this work, coil voltage and field flux management ways were applied severally and eventually combined along on one singly excited AC motor. Completely different management may be wont to control the speed of a AC motor, like inflammatory disease Controller, [2]

Standard AC Motors & Gear Motors operate by merely connecting a capacitance and provision power from an ad power provide. customary AC Motors & Gear Motors embrace the fundamental induction motor and reversible motor. additionally, Oriental Motor offers magnetic attraction brake motors, synchronous motors, torsion motors and watertight, dust-resistant motors to fulfill specific application needs.

Standard AC Motor & Gear Motor summary - Associate in Nursing introduction to AC motor technology

AC Motor Fundamentals - AC motors square measure electrical motors that rotate by mistreatment power from an ad AC power provide. they're straightforward to handle and have options which will be configured at a coffee value.

Features and management Technologies of the DSC Series Motor and Speed Controller Package - Associate in Nursing "AC motor and speed controller package" may be a unit product composed of a strong, single-phase induction motor, and a coffee noise, long life speed controller. The DSC Series may be a new AC Speed management product. so as to enhance easy use, this product is provided with Associate in Nursing operation panel for observance varied functions, yet as for digital settings. The new DSC management technology additionally accomplishes 2 functions that typical product cannot; instant reversal of single part induction motors, and vertical drive by fastness management (electromagnetic brake sort only).

Hypoid vs. cogwheel - there's another to cogwheel sets: the hypoid gear. generally employed in automotive applications, gearmotor corporations have begun group action hypoid geartrain into right-angle gearmotors to unravel the issues that arise with worm reducers.

Using a torsion Motor for Winding and unreeling sort Applications - A torsion motor is a superb product for winding and unreeling sort applications. thanks to the look of the motor, it reaches full torsion at zero output speed, or barred rotor condition. A torsion motor will act as a brake once back driven, or a straightforward device to produce tension. counting on the torsion setting, the motor can offer tension to the fabric whereas taking over slack within the line mechanically, primarily matching the road speed. informatics Ratings - Degree of Protection - The dust-resistance and waterproofing degrees of protection for the instrumentality square measure classified in step with nut 60529 (Specification Degrees of Protection Provided by Enclosures (IP Code)) (=IEC 60529), nut 60034-5 (Rotating Electrical Machines - half 5: Degrees of Protection Provided by The Integral style of Rotating Electrical

Speed management of AC motors evolved terribly apace with advances in power natural philosophy technology. Applications that were dominated by DC motors became most suited to AC motors as a a lot of economical various. The part motors, however, were the prime candidates for initial developments for his or her a lot of important impact on high power industrial applications. With the maturing of 3part motor drives, technologies began to realize their thanks to single part motor application that represent the most important proportion of electrical power consumption in business Associate in Nursing residential applications. AC single – part Induction Motors square measure standard for his or her low value and flexibility. For application with varied hundreds, a variable speed drive may be a should since it can do upto five hundredth in energy savings. The principle usually applies to machines that require to be perpetually beginning. By suggests that of variable speed drives, it's attainable to control the beginning current of such machines and, therefore,

save a lot of energy. There square measure 3 normally legendary techniques for AC motor drives; namesly, variable frequency, voltage management, and variable rotor resistance. many studies are conducted to investigate the performance of the various drives.[4]

Single part induction motors square measure extensively employed in appliances and industrial controls. Its simple, rugged construction prices comparatively very little to manufacture. Associate in Nursing induction motor runs around its rated speed once it's connected on to the most provide. However, several applications just like the induction motor based mostly pump, a speed reduction of two hundredth ends up in Associate in Nursing energy savings of roughly five hundredth. Driving and dominant the induction motor with efficiency square measure prime issues in today's energy aware world. With the advancement within the semiconductor fabrication technology, each the dimensions and also the value of semiconductors have gone down drastically. this implies that motor user will replace Associate in Nursing energy inefficient mechanical motor drive and system with type of control drive.[5]

III.METHODOLOGY

LMT 7085 Voltage Regulator Rating

- Input voltage range – 7V- 35V
- Current rating – 1A
- Output Voltage Range – Vmax = 5.2V
- Vmin = 4.8 V

Selection of Transformer.

- Current Rating of Transformer depends on Current required for Load to be driven.
- Input voltage of 7805 IC should be greater than 7V as it drops 2V across itself.
- So we use 9V transformer with current rating 1A.

Peak voltage is

$9\sqrt{2}=12.7V$

Selection of Rectifying circuit

1N4007 diodes are used as they are capable of withstanding a higher reverse voltage of 1000V whereas 1N4001 is 50V.

Selection of Capacitor:

Capacitor is selected based on ripple factor

It is given by,

$\gamma=\frac{1}{4\sqrt{3}fRC}$

where,

1.f=frequency of AC[50Hz]

2.R=resistance calculated

$R=\frac{V}{Ic}$

where,

V=Secondary voltage of transformer

$V=9\sqrt{2}=12.7V$

$R=\frac{12.7V}{1000mA}=12.7$

So, we choose standard value 15Ω

3.C=filtering capacitor

Now we have to determine this capacitance for filtering

We know that,

$\gamma=\frac{Vac-rms}{Vdc}$

where,

$V_{ac(rms)}=\frac{Vr}{2\sqrt{3}}$ ------(1)

$V_{dc}=V_{max}-(\frac{Vr}{2})$ ----(2)

Therefore,

$V_r=V_{max}-V_{min}$

$V_r=5.2-4.8=0.4V$

Putting value of $V_r$in equation (1) &(2)

We get,

$V_{ac(rms)}=0.3464V$ -----(3)

$V_{dc}=5V$ -----(4)

Putting values(3)&(4) in the given equation

$\gamma=\frac{Vac(rms)}{Vdc}$

$\gamma=0.06928$

Now put values of Y,f,R in given equation

$\gamma=\frac{1}{4\sqrt{3}fRC}$

So we get,

2.777×10^{-3} farad

i.e,2777μF

So, standard Value we chose 2200μF.

Selection of Ceramic Capacitor

Datasheet of 7805 prescribes to use a 0.01 microfarad capacitor at output side to avoid transient changes in voltages due to change in load and 0.33 microfarad at input side of the regulator to avoid ripples if the filtering is far away from regulator.

In this project ATmega 328 arduino is used which needs 5V dc supply and 7805 Regulator IC is used to provide 5V dc supply to the arduino. The input of

Regulator has around 12 V provided by the Transformer. The Transformer has Primary winding of 230V and secondary winding 12V AC. Now this input is given to the bridge circuit which converts AC into DC and thus around 12V is obtained at the input side of the Regulator and output of 5V is thus fed to the controller.

When power supply is ON, LED glows

According to the ohm's law

V = IR

V= 5V

I =20Ma

Thus R= 250 ohms

but we generally use 20-30% high Resistance. Hence here R = 330V is taken.

The 16MHz Crystal Oscillator is used in this model which generates frequency of 16MHz. The pulse is generated by the crystal oscillator which is fed to the oscillator. when the positive pulse is given to the controller the first command is executed and thus sequence wise commands gets executed in receiving the positive pulse.

The driver circuit used here is TRIAC. Triac Firing angle feedback loop is meant to manage flow of AC power from input offer to load by dynamic the common voltage showing across load. during this project triac firing angle is controlled to manage quantity of power flow to load. Firing angle feedback loop is meant victimization analog physical science parts like operational electronic equipment, resistance and condenser. Zero crossing detection, step down electrical device, rectifier, comparator and ramp generator square measure the fundamental parts of firing angle feedback loop for triac. Triac have several applications in power physical science particularly in AC voltage controller circuits.

It is accustomed sight zero crossing of wave, once AC wave cross zero reference voltage. Zero reference voltage is employed to work out firing angle time period for positive and negative cycle of wave. For zero reference detection circuit, step electrical device of rating 220-12 potential unit is employed to step down voltage and rectifier bridge is absolutely rectify this step down voltage. when full bridge, comparator is employed. Full bridge output is connected with inverting input of comparator and diode is connected with non-inverting input of comparator. thus once voltage at non inverting pin become greater than inverting output of comparator becomes high and pulse is manufacture at output of comparator for each zero crossing detection.

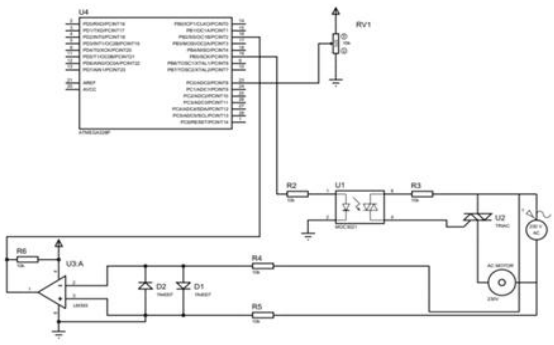
When the Firing angle is a smaller amount, the ON period is a smaller amount and therefore the output is dim. Thus once the voltage is high and therefore the gate pulse is high and Ton is additional and the speed so will increase. we tend to vary voltage through the pot and Speed varies consequently.

IV CONCLUSION

More than five hundredth of power consumption goes to AC motor that is serving to industries and it's familiar that potency is drastically reduced in these motors at part-load operation. The part-load operation of AC motors can't be avoided in several industrial applications like pumping, fans, compressed gas systems, conveyers, elevators, transportation and in all types of process industries. The half load potency and power issue of the AC motor are often improved by adapting the magnetizing level within the motor in accordance with load and speed and, hence, motor ought to either be fed through AN electrical converter or redesigned with improvement algorithms. moreover, atiny low increment within the potency of those motors by providing higher management or optimum style may end up in substantial saving within the long amount. The analysis within the gift work was disbursed to attain most potency of motor driven systems.

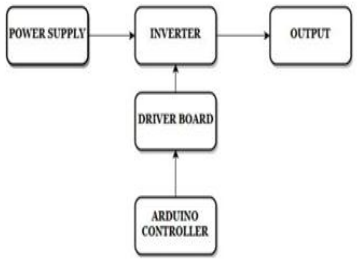
The projected design may be wont to management different plants consisting of electrical motors. This paper studies and proposes a few technique of performance improvement of AC motor once it works in a very variable speed and disturbance surroundings by selecting an acceptable sturdy speed controller.

IV.CIRCUIT DIAGRAM



V. BLOCK DIAGRAM

BLOCK DIAGRAM



VI. RESULTS AND ANALYSIS

RPM: 2214

RPM: 3924

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