SPEED CONTROL OF THREE-PHASE INDUCTION MOTOR USING ARDUINO UNO

SHAIK FEROZ AHMED

Department of Electronics & Communication Engg

Jawaharlal Nehru Technological University, Hyderabad

DR. K. H PHANISHREE

Department of Electrical & Electronics Engg

Jawaharlal Nehru Technological University, Hyderabad

ABSTRACT

This paper presents the speed control of induction motor using Arduino Uno, to design a system which provides smooth control along with energy saving. The induction motors are widely used in the industrial drives due to its advantages such as low cost and versatility yet controlling of speed using stator control is of short range. This problem can be solved by using power electronic devices and controlling of firing angle. The objective is to control the speed of induction motor using stator control. This hardware gives input signal to microcontroller, which in turns controls the input of power electronic devices. By controlling the firing angle of semiconductor power device with the help of Arduino Uno, the terminal voltage across the stator winding of the motor can be varied to achieve the speed control of three phase induction motor. These are easy to operate and can be controlled using smartphone.

Keywords: Arduino Uno, Three Phase Induction Motor, TRIAC, WIFI

• INTRODUCTION

Many motors are being used for general purposes. The electric motor is now a necessary source of power in many domestic and industrial applications. It comes from fractional horsepower to thousands of horsepower. The functions and the performance required for these motors are wide-ranging. As the variation of speed is a necessary, the induction motor speed is controlled with an external resistor or DC voltage. To save the wasting slip power of induction motor through slip recovery scheme, to provide optimal speed variations beyond energy saving.

An Embedded system is a combination of PC equipment, programming and mechanical parts with real-time computing constraints. It is designed to perform several tasks like to access and control the data in various electronics based systems, In many electrical and electronic circuits and kits embedded technology is used. It is used in wide range of applications like hybrid vehicles to maximize efficiency and reduce pollution, example anti lock braking system, traction control etc.

II. THE PROPOSED MODEL BLOCK DIAGRAM

RX:

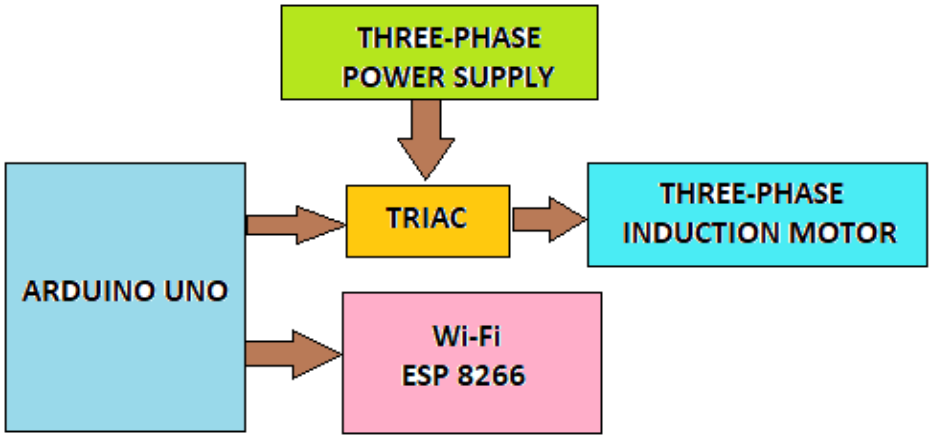


Figure -1 Block diagram of proposed model

In this undertaking one should utilize one receiver and one transmitter to control three phase induction motor speed.

The Receiver module:

- Three-phase Induction motor
- TRIAC
- WiFi (ESP8266)
- Arduino Uno

The transmitter is android application just like given

TX: TELNET APP

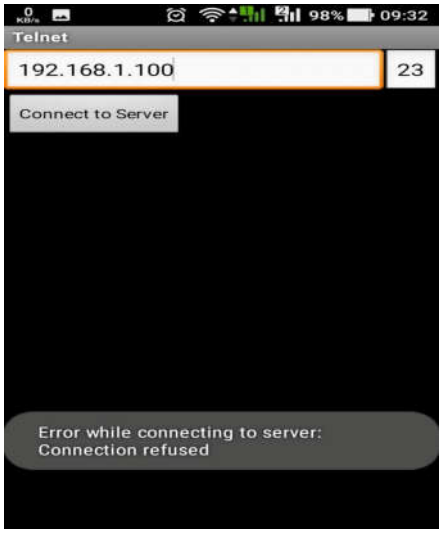


Figure-2 TELNET Application

- **Working of the Three-Phase Induction Motor:**

Nowadays controlling the induction motor speed with wireless communication is fundamental, In this paper controlling the three phase induction motor with android or iOS application by giving the commands in telnet application. To exercise this task use Arduino to control the WI-FI module. WI-FI will get the information from the application it will provide for the controller, TRIAC will give expected voltage to motor. Commands as input motor will run at various speeds

- **HARDWARE AND SOFTWARE REQUIREMENTS**

Hardware devices: In this undertaking, the equipment necessities are as following:

ARDUINO uno microcontroller is an open source, PC equipment and programming organization and customer assemble that designs and makes single-board microcontrollers and its units for building computerized gadgets and intelligent articles that can detect and control challenges in the physical world. It contains everything needed to support the microcontroller. The framework items are divided as open-source equipment and programming, which are approved under the GNU Lesser General Public License (LGPL), or the GNU General Public License (GPL), [1] allowing fabricate of Arduino sheets and programming transport communication by anybody. Arduino sheets are accessible industrially in pre-assembled outline, or as do-it-without anybody's assistance. The main consequence of the design is the programming of the Arduino. The programming is totally based how to change the frequency to get the desired speed of induction motor. Generate two pulses at 5 and 6 pins of Arduino and send these pulses to the input.

Figure-3 Arduino Uno

WI-FI MODULE (ESP8266):

Portrayal: The ESP8266 Wi-Fi Module is a free SOC with joined TCP/IP tradition stack that can give any microcontroller access to Wi-Fi. The ESP8266 can do either encouraging an application or offloading all Wi-Fi arranging limits from another application processor. Each ESP8266 module comes pre-modified with an AT summon set firmware, which means, you can fundamentally connect this to an Arduino gadget and get about as much Wi-Fi-limit as a Wi-Fi Shield offers. The ESP8266 module is a degree practical board.

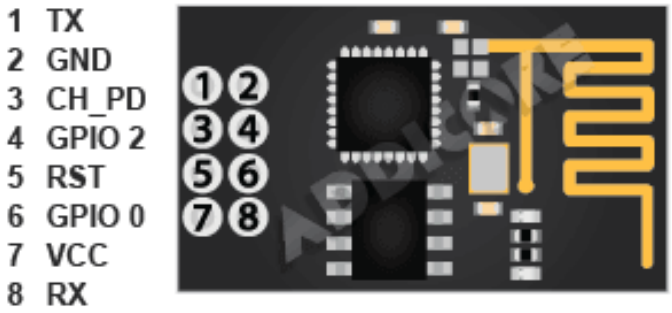


Figure-4 WI-FI Module

This module is capable on-load up handling and limits capacity that enables it to be facilitated with the sensors and other application specific gadgets through its GPIOs with negligible improvement and insignificant stacking in the runtime. Its high level of on-chip joining takes into outside equipment, including the front-end module, is expected to include irrelevant PCB zone.

A Hard Product of ESP8266:

ESP8266 Schematic:

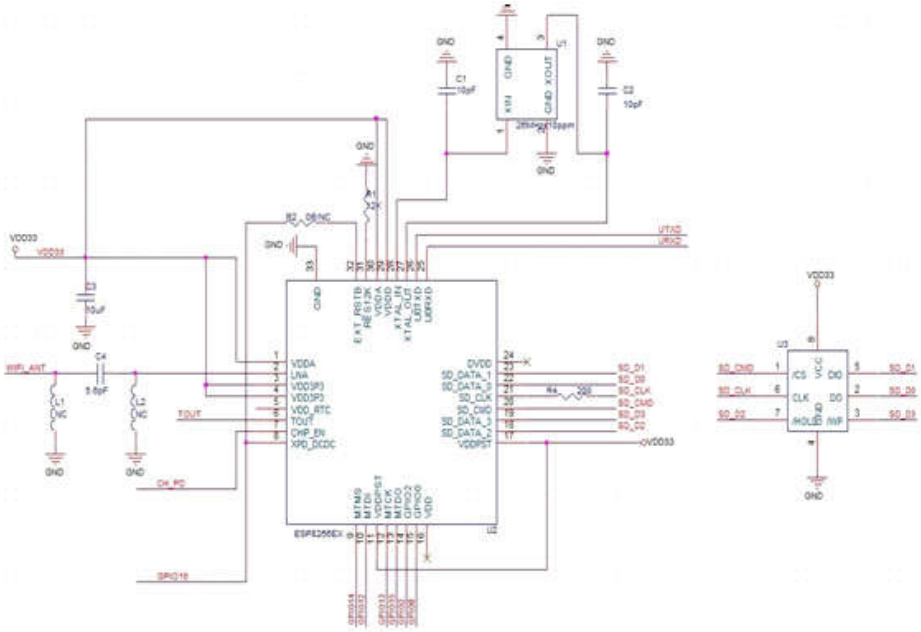


Figure-5 ESP8266 Scheme

Utilization of ESP8266:

Smart power plugs Home automation Mesh network Industrial wireless control, Wearable gadgets Wi-Fi location-aware gadgets Security ID labels Wi-Fi position system beacons.

ESP8266 module as follows

- Vcc = 3.3V (needs around 300-400mA peak)
- Gnd = - ve ground
- CH_PD = Chip enable so always +ve
- RST = ground to reset
- GPIO0 = normally floating; however, this should be grounded when you start the update.
- GPIO2 = abnormal state
- UTXD = Tx information associate with RX on FTDI/Serial interface
- URXD = Rx information associate with TX of FTDI/Serial interface

Electronic Characteristics

Current Consumption: The going with current usage relies upon 3.3V supply, and 25℃ surrounding, using inward controllers. Estimations are done at radio wire port without SAW channel. All the transmitter's estimations rely upon 90% commitment cycle, persistent transmit mode.

Three Phase Induction Motor

A Three-Phase Induction motor is basically a consistent speed motor which makes it difficult to control its speed. The speed control of induction motor is achieved by reducing the efficiency and low power factor. Interface section includes stepup transformer and motor, AC is fed to step-up transformer which converts 12 Volts to 220 Volts which drives motor. Generate two pulses at 5 and 6 pins of Arduino and send these two pulses to the input. The change in delay between the pulses is in user's hand.

FIGURE-6 Three-Phase Induction Motor Setup

Synchronous Speed

N= 120F/P

Where, f = recurrence and P is the quantity of shafts

The speed of acceptance engine is given by,

$N = N_S (1-S)$

Where, N is the speed of the rotor of an acceptance engine, N_s is the synchronous speed, S is the slip. The torque created by three phase induction motor is given by,

$T = (3/2P_1 N_S)$

$X (SE_2R_2/R_2 + (SX_2))$

The Speed of Induction Motor is changed from both Stator and Rotor Side. The speed control of three phase induction motor from stator side is as follows:

- V/f control or recurrence control.
- Changing the quantity of stator posts.
- Controlling supply voltage.
- Adding rheostat in the stator circuit.

The speed controls of three phase induction motor from rotor side are additionally named:

- Adding outer protection on rotor side.
- Cascade control technique.
- Injecting slip recurrence emf into rotor side.

TRIAC

SCRs are uni-directional current gadgets, making them helpful for controlling DC as it were. If two SCRs participating consecutive parallel design simply like two Shockley diodes were consolidated to frame a DIAC, and another gadget known as the TRIAC

Since individual SCRs was more adaptable to use in cutting edge control frameworks, these are all the more ordinarily found in circuits like engine drives; TRIACs are normally found in basic, low-control applications like family dimmer switches. A basic light dimmer circuit is appeared in Figure beneath, entire with the stage moving resistor-capacitor arrange fundamental for after-top terminating.

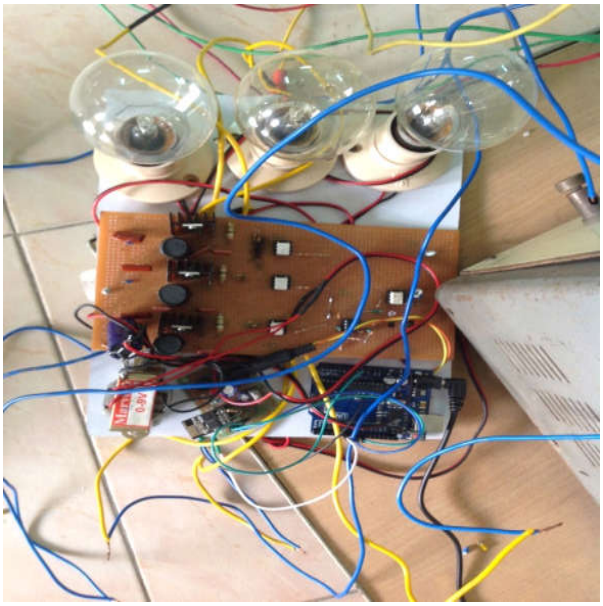


Figure-7 TRIAC Setup

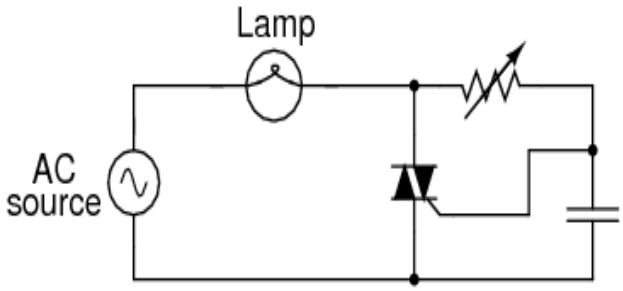
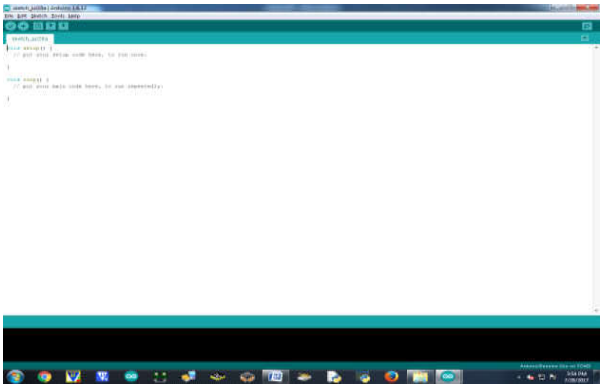


Figure-8 TRIAC phase-control of power

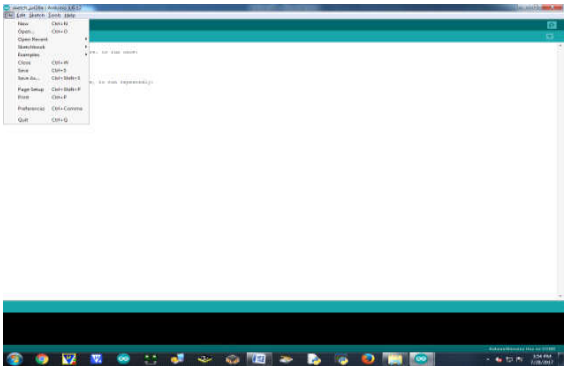
TRIACs are infamous for not terminating symmetrically. This implies for the most part won't trigger at the same voltage level for one extremity with respect to the next. As a rule, this is unwanted, on the grounds that unsymmetrical terminating brings about a present waveform with a more mess of consonant frequencies. Waveforms that are symmetrical above and below their normal centerlines are involved just odd-numbered music. Unsymmetrical waveforms, then again, contain even-numbered sounds (which might be joined by odd-numbered music too).

- **PROGRAMMING REQUIREMENTS:**

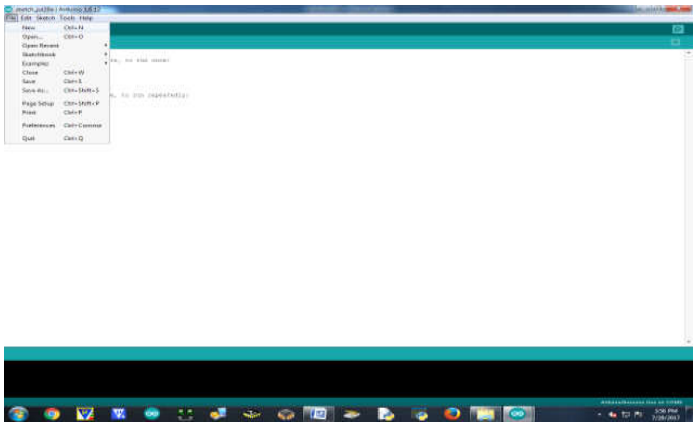
The products utilized for this paper are:
Arduino IDE
Dialect: C/C++
Arduino uno r3 ide (coordinated improvement board)



Step-1: Open Arduino IDE

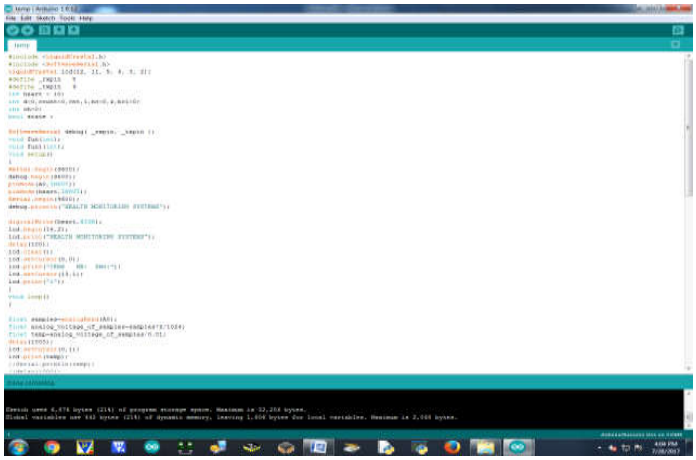


Step-2: Select a File Menu option.

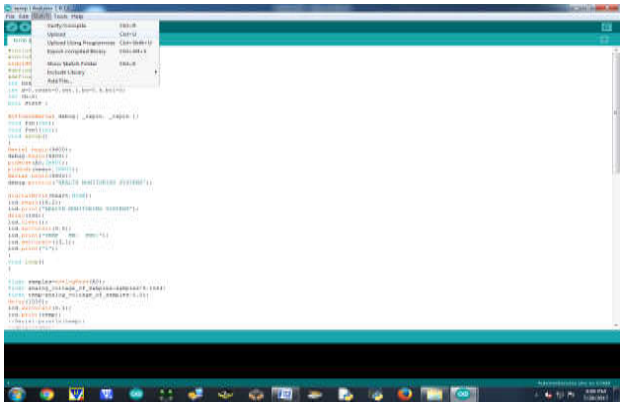


Step-3: and Select new File and begin composing the code for venture in that record

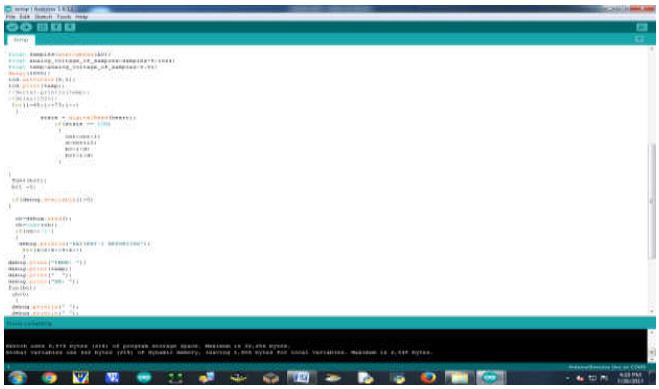
Step-4: After composing code for assemblage select the Sketch alternative on menu bar and select confirm/order (Ctrl+r)



Step-5: After composing code for arrangement select the Sketch choice on menu bar and select confirm/compile (Ctrl+r) and it appears underneath any blunders if there Wise Done assembling Underneath the Arduino IDE



Step-6: After effectively gather code for transferring the code into Arduino board select the draw and upload (Ctrl+U)



Step-7: After effectively transferring code IDE appears beneath done transferring

RESULT:

The Speed Control of Three Phase induction motor by using Arduino board with the help of telnet client terminal iOS application by using smartphones in following steps:

1. Establish the connection between module and mobile through a WiFi connection by entering IP address and port number.

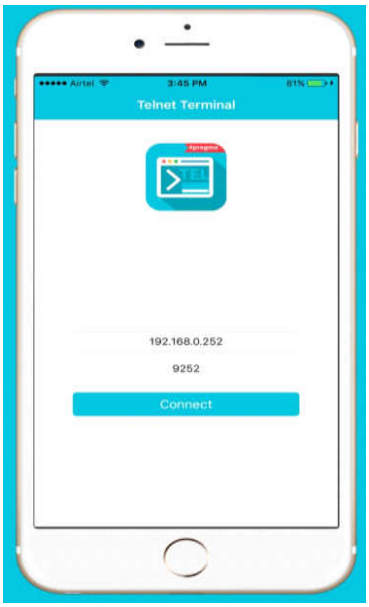


Figure-9 TELNET iOS Application

2. Speed variations can be done by giving following commands as input:

'&' is used to increase the speed to 100% (ON).

'@' is used to reduce the speed to 75%.

'#' is used to reduce the speed to 50%.

'$' is used to reduce the speed to 25%.

'*' is used to reduce the speed to 0% (OFF).

Figure-10 Input Commands

5. CONCLUSION

Three-Phase Induction motor gives an essential and minimal effort alternative for speed control, and the start of Three-Phase Induction motor acknowledgement. It can provide efficient speed control in emergency ccases. Humaeffort can be reduced. Acknowledgement motors are incredible machines for application requiring extensive speed control. The ordinary working extent of a regular selection motor is bound to less than 5% slip, so the prerequisite for different speed controls rises. Torque-Speed attributes for different procedures for speed control of a Three-Phase Induction motor can be achieved and inspected by making MATLAB codes.

In factor rotor protection, the most extraordinary electromagnetic torque is self-sufficient of rotor protection, thusly, when the rotor security is extended, the best electromagnetic torque is unaffected yet the speed at which it happens can be particularly controlled. In factor stator protection, increase in a repeat grow the torque-speed relation a decrease in repeat reduces the torque-speed relation of the motor, In factor stator voltage, fluctuating the terminal voltage will change the working speed yet with additionally a variety of working torque. To the extent as far as extension of speed variations, it is not critical therefore this strategy is suitable for small motors. In steady volts/hertz control, the supply voltage and the supply repeat can be changed with the ultimate goal that the proportion remains consistent the transition stays steady as well.

In this way, special working zones for different paces and torques can be obtained and further varied synchronous speed can be obtained with relatively same significant torque, In this way the motor is completely utilized, likewise, there is a better way than the

average extent of speed control. To achieve higher speed and torque, a lesser number of shafts is required and to achieve lower speed and torque, the number of shafts should be extended, Finally, it is prescribed that any of the speed control procedure be completed in a model. Energy can be saved and reduce energy crisis in the country.

6. REFERENCES

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