

Controlling Devices by IoT



Vikas Rao Vadi, Shafiqul Abidin

Abstract: Internet of Things (IoT) is an emerging technology not only is being used in computer applications but also in controlling electronic devices. In this paper IoT is being employed to control a single-phase induction motor. By implementing this technique and using a wireless speed controller a single-phase induction can be controlled from any location across the world. Demonstration setup included a single-phase induction motor of 230 volts and 50 Hertz is interfaced with the microcontroller (PIC16F877A). Interfacing is done through opto coupler (MOC3021) and triac (BT136) and Speed for various PWM scheme was determined.

Keywords : Induction Motor, Internet of Things, IoT, Android; PIC – Microcontroller, PWM Technique, Opto-coupler, Triac.

I. INTRODUCTION

Majority of the load of the electricity is inductive in nature mainly motors for example -fan, motor in air conditioner, motor for pumping and various motion related work in industry. Utilizing these kinds of device in efficient manner can save a lot of electrical energy. According to a research done in an IEEE paper of Power Electronics if we save one unit of electricity at the consumer end then it will save the fuel equivalent to the 6 unit at the generation end [1]. When induction motor start it quickly attain its full speed that is nearly equal to synchronous speed ($n=120f/p$) [2], so it is difficult attain a controlled speed below the maximum speed just by simple mechanism. It's an interesting problem as many a time we do not need maximum speed and at many a places people have used gears in case of controlled motion, valve for the flow related control in pumping [3,4].

In computer science the study of Wireless Sensor network and IoT play very important roles. Wireless Sensor Networks and IoT make a huge impact on the economics which also affects the industries. IoT and wireless sensor network may contain sensors from few tens or hundreds to more than thousands and the fact that these sensors can communicate with each other and transmit data over large distances, they

play a very crucial role in some highly classified fields such as military [5].

During the past years, Internet of Things and Wireless Sensor Network have found a huge number of applications in various fields that can have a significant impact on the society [6].

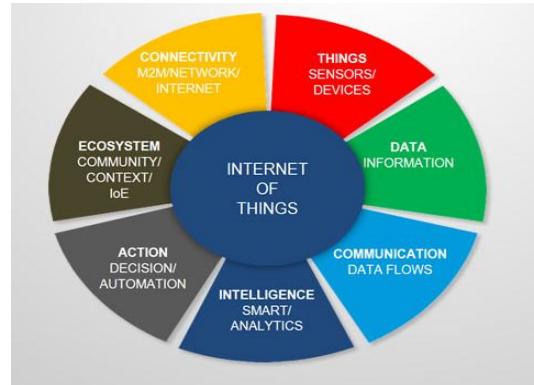


Fig. 1. Characteristics Features of IoT.

In both the above-mentioned cases the aim of the controlled output was attained but the electrical energy consumed was still same [1]. Another method of decreasing speed is decreasing speed is to reduce the terminal voltage across the induction motor by the introduction of resistance into the series of the supply voltage but in this case too the electrical energy consumed is still same. This paper provide the solution only for the electrical energy only for single phase induction motor. The main ideas of this paper are as listed below.

A. Advanced Technology IoT

It introduces a very advanced technology that is Internet of Things and making the control of the motor globally access with any Internet device.

B. Applicable Solution

This paper provides the applicable solution for the speed control of single-phase induction motor in an electrically efficient manner.

II. LITERATURE SURVEY

The surrounding buzz, which is an upcoming development of the internet that has been much focused on machine to machine (M2M) communication, serving as a network of physical objects, having a cloud based environment. The IOT allows the objects or the things to be controlled and sensed remotely, making them to behave as: devices talking to devices, without requiring human-to-human or human-to-computer interaction. It consists of two main things:

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A. Any Physical or Virtual Thing

It is the actual object or device collectively called the “THING” that consists of the on board sensors and other related hardware and software, allowing it to be accessed onto the cloud.

B. Associated IP Address

It provides a unique identifier to each THING, making it distinguished from others. IOT is supposed to use IPv6 for locating and addressing to a particular object for M2M communication.

III. OPERATING QUADRANTS OF TRIAC

There are the four quadrants of operation of triac but here we will use first and fourth quadrant only [4].

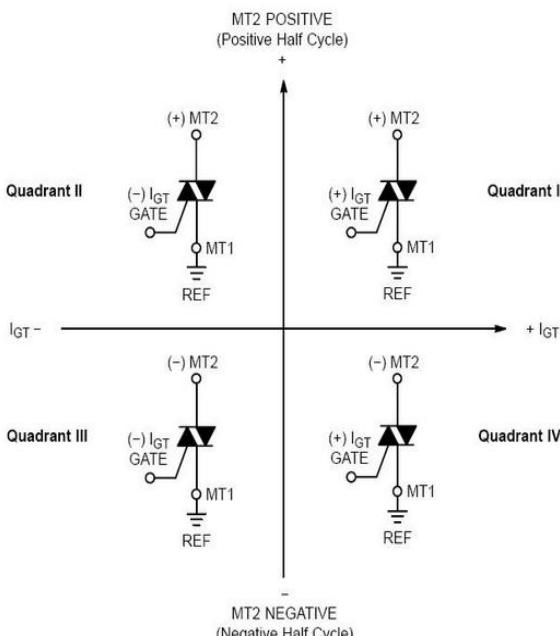


Fig. 2.Operations of Triac.

IV. METHODOLOGY

Our project falls under ‘Home Automation Gateways’ and ‘Consumer Electronics & Automotive’ with respect to the figure 1 and figure 2.

A. Home Automation Gateway

It refers to automated electronic control of household features, appliances and activities. We have a centralized server based single phase motor controlling tool and monitoring tool that can be accessed globally over an IP-Address. This motor can be controlled on the principle of PWM using a microcontroller fetched using dedicated centralized server remotely.

B. Consumer Electronics & Automotive

In this paper we demonstrate the controlling of the speed of the single phase induction motor, as an application from washing machines, fans to hand held power tools and automotive window lift, traction control systems and various industrial drives.

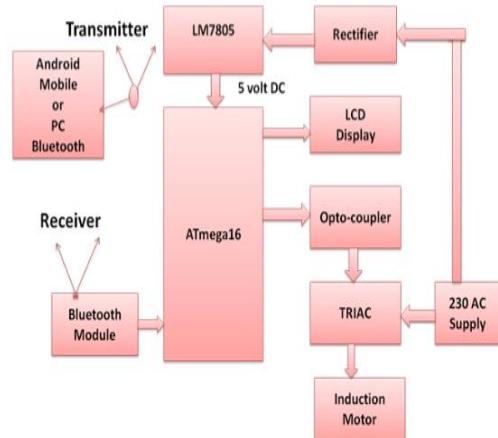


Fig. 3.Block Diagram of System.

C. Working

Here the NOIP server [7] is the cloud server that has a dynamic IP-Ankitja27.ddns.net, allowing it to be accessed from any user device capable of having Internet facility. First, the user uses his device to connect to the NOIP server, and a dedicated command is passed over the cloud. It is received by the WI-FI module(esp8266) that is interfaced with the PIC-microcontroller, now PIC microcontroller controls the motor speed according to the signal received by the WI-FI through cloud.

D. Speed Control Mechanism

Speed of single-phase induction motor is controlled by phase angle control method. Phase angle control is a method of varying the ON and OFF time of the applied in each cycle of sinusoidal wave (AC source).

The power device, which we have used in phase angle controllers, is a Triac. The power flow that controls the speed of the induction motor is controlled by delaying the firing angle (firing time each half-cycle) to the power device [4]. Firing angle is dependent upon the PWM sequence obtained by the PIC microcontroller.

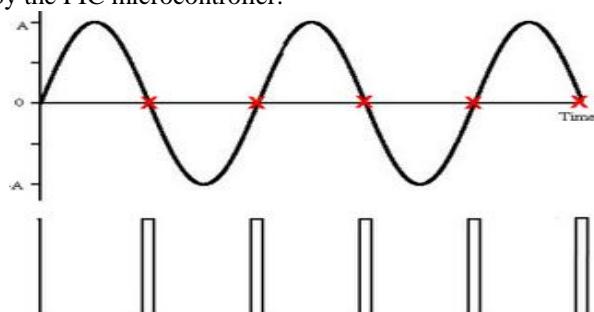
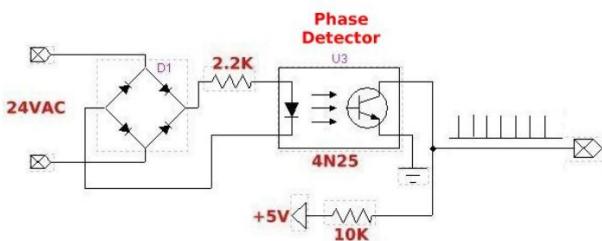


Fig. 4.Zero Crossing.

A zero crossing detection is very necessary in power control circuits.

**Fig. 5.**Zero Crossing Circuit with Opto-coupler.

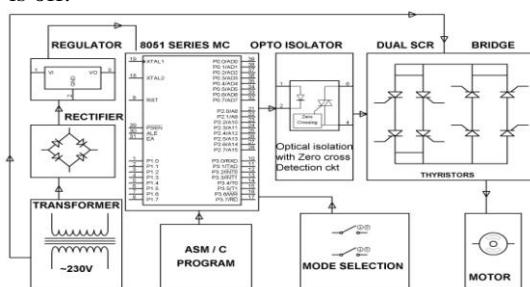
Usually photo transistor is low , when the voltage approaches to zero collector goes high [8]. The LED emitters of the optocoupler assure both half-cycles are utilized. The output of this optocoupler is then connected to a pin of the microcontroller and the input of this pin is checked in the microcontroller's program to maintain a sync between the firing angle of the triac and ac mains supply.

E. Phase Angel Control and Electrical Efficiency

No current is flows when triac is off , right after zero crossing. The gating signal is given to triac and it turns, it happens after some delay. The process continues till current passing through gets neutralized [4].

By delaying signal, voltage and power can be adjusted by PWM sequence [8].

The voltage is supplied till the triac is on. Duration of triac remains on depends upon delay time between gating signal and zero crossing. In this case the electric energy consumed only for the on cycle and consumption of electricity when Triac is off.

**Fig. 6.**Circuit for Speed Control for Single Phase Induction Motor.

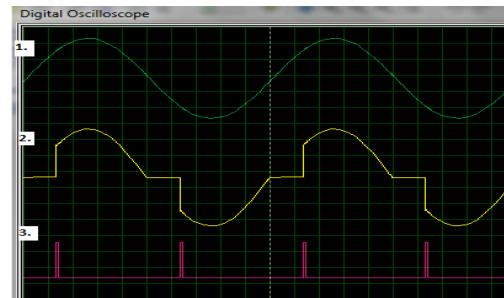
F. PIC Microcontroller and Opto-Coupler (3021)

PIC stand for Peripheral Interface Controller, in this paper we have used PIC16F877A a very popular version of PIC.PIC is the brain of our system it receive the data from the cloud, it process the received data and generates the PWM accordingly which direct the fire angle of the Triac.

MOC 3021 is the driver. This is called random phase optically isolated triac output driver. Triac remains on when the LED is on within MOC 3021. This is basically works as a bridge to separate power from main circuit.

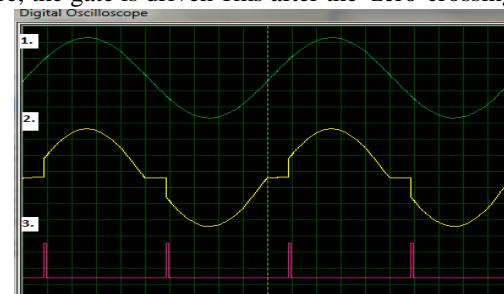
V. OUTPUT WAVEFORMS

The waveforms are generated by using varying input and under various conditions.

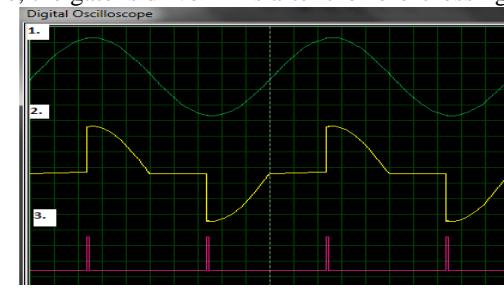
**Fig. 7.**Triac firing with 2 ms delay.

Input AC, AC Output after phase angle control and Gate Drive signal have been implemented.

Here, the gate is driven 1ms after the zero-crossing:

**Fig. 8.**Triac firing with 1 ms delay.

Here, the gate is driven 4ms after the zero-crossing:

**Fig. 9.**Triac firing with 4 ms delay.

VI. APPLICATIONS AND LIMITATIONS

Internet of Things (IoT) have a wide range of applications from small industry to aviation.

Few of the potential applications are as follows: - The speed of fan can be controlled remotely by employing IoT; Adjustable and smooth power supply is mandatory in industrial applications to produce quality product; Internet device can also be used to regulate light intensity; Blower, pumps and small conveyors applications can implement; High pressure equipments, air compressor water pumps, vacuum pumps and high torque applications. Few of the advantages are: -Remote operation is achieved by any smart-phone /tablet etc. with the help of Internet; Technically expert controller is not required; IOT service is a free service and easily accessible from nay where in the globe; Programming code is not always required to change for different input parameters; It does not require any specific device or any specification application; any Internet device can operate it; It is secure as it has a log in system as like the Gmail service; It is more useful for the patient and disabled person.

The employed technique and setup has few of the limitations :- User must have Internet to access the device; Circuit of the microcontroller must have Internet connectivity always; High complexity i.e. device and application impact; Only there are few websites like noip.com provides the free cloud service.

VII. CONCLUSION AND FUTURE SCOPE

The primary objective of the proposed paper was to control the single phase induction motor. The proposed paper has been verified and results are achieved as per the expectation. The results have been possible by developing the hardware and software for controlling speed of induction motor using Internet of Things. It has been found that now days demands for wireless operating devices are exponentially increasing over wired devices. Internet of Things (IoT) is being used here for controlling induction motor wirelessly.

An effort would be made and implemented to control 3-phase induction motor just like single phase induction motor in future. We can develop sophisticated and automated office and home by controlling appliances and devices with speed control of motor with Internet of things.

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Prof. (Dr.) Vikas Rao Vadi having around 20 years of experience, is currently working as Director at Bosco Technical Training Society, Don Bosco Technical School, an affiliated institution of Guru Gobind Singh Indraprastha University, New Delhi, India. Earlier he had worked as Professor and Director at Trinity Institute of Professional Studies, affiliated to Guru Gobind Singh Indraprastha University, Dwarka, New Delhi, India. As Faculty at Saudi Electronic University in Dammam, Kingdom of Saudi Arabia, As Professor and Principal at Comm-IT an affiliated College of Guru Gobind Singh Indraprastha University, As Dean Academics at Satya College of Engineering and Technology, an affiliated college of MDU, Rohatka. As Head of Department(Computer Applications) at Kalka Institute for Research and Advanced Studies, an affiliated college of Guru Gobind Singh Indraprastha University. He is Sr. Life Member of ISTE and Sr. Life Member of Computer Society of India, He has authored four books, reviewed one

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Dr. Shafiqul Abidin - M Tech (IT), Ph. D (IT), possesses more than 22 year experience in academic, research and administration. Dr. Abidin has published more than 50 research papers in national / international journals of repute and conferences. He is associated with various national / international journals as reviewer and advisory board member such as WASET Italy; IJOART, USA; International Union of Engineering & Technology, USA; InderScience; IEEE and Springer. He has visited various countries for teaching and research purpose in their institutions for a period of more than five years. Dr. Abidin has successfully completed two international certification programmes ICDL from Dubai, UAE and Project Assessment from Cambridge University, London, United Kingdom. He is life member of Indian Society for Technical Education (ISTE), Computer Society of India (CSI), International Association of Computer Science and Information Technology (IACSIT), Singapore and International Association of Engineers (IAENG), Hong Kong. He has evaluated number of Ph. D thesis and dissertations. Two of his research scholars have submitted their Ph. D thesis for final examination. His research areas include – WSN, RFID, Network Security and e-learning.