IOT Based Sensorless Speed Control of Induction Motor

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Abstract

Speed sensors are required for the control of induction motors and temperature sensors are required to find excessive thermal stress.These sensors reduces the studiness of the system and make it expensive.Therefore a drive system without sensors is required.It is usual to find single phase induction motor(SPIM) in several house,office,farm and industry uses,which are become each time more refined and requiring variable speed drives.This project presents a tender for sensorless variable speed SPIM drive based on IOT. A Spectator based on two independent linear closed-loop control systems provides the assessment to the rotor flux and speed from the measurements of the stator currents and voltages.Variable transformation is not used in this project in order to eliminate the asymmetry of the stator windings of the SPIM.The performance of the proposed sensorless speed control andparameters monitoring is satisfactorily verified from computer simulations.

Keywords - *Microcontroller, GPRS, IOT, Induction motor, Speed, MPLAB and etc.*

I.INTRODUCTION

General purpose of motors are increasing widely in our surrounding from household equipments to machine tools in industrial applications.It is a necessary and indispensable source of power in many industries.In many applications the speed control plays a vital role which can be done using many control strategies

The purpose speed controller of a motor is to take signal representing the demanded speed and to drive a motor at that speed.Generally speed control of the motor can be can be done by varying the motor parameters of the induction motor such as current,voltage,frequency etc.,this can be achieved by different methods such as field control method,armature control method etc.

In this project speed control is done by PWM (Pulse Width Modulation) technique and the parameters are monitored and displayed in LCD by PIC microcontroller and shared to mobile using IOT through GPRS which makes the whole system flexible and user friendly.

With the help of IOT through GPRS the required speed is given as input to PWM through PIC microcontroller thus varying the speed of induction motor.

Present industry is increasingly shifting towards automation. Two principle components of today's industrial automations are programmable controllers and robots. In order to aid the tedious work and to serve the mankind, today there is a general tendency to develop an intelligent operation.

The objective of this project is to monitor and protect if the induction motor parameters such as voltage , current, temperature and speed are exceed above the normal value without using any sensor.

Thus the proposed method has the advantage of requiring a low level monitoring signal which reduces the motor torque perturbations and additional power losses are negligible.PIC microcontroller is the heart of the device which handles all the sub devices connected across it. It has flash type reprogrammable memory. It has some peripheral devices to play this project perform. It also provides the sufficient power to inbuilt peripheral devices. We need not give individually to all devices. The peripheral devices also activities as low power operation mode. These are advantages that appear here.

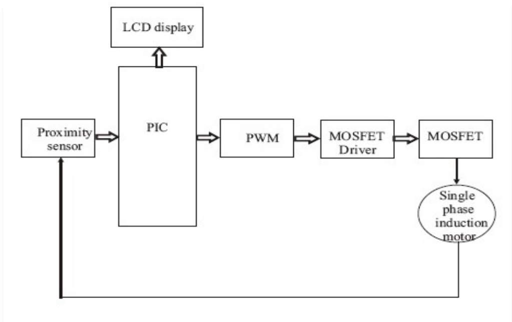


Fig 2.1. Block diagram of existing system

II.EXISTING SYSTEM

The objective of this project is to generate PWM frequency in PIC microcontroller to control the speed of the single phase induction motor.In this project we are generating frequency to control speed of single phase induction motor. By using the software instruction we are generating frequency for PWM wave in the PIC microcontroller. It is the flash type microcontroller in which we have already programmed

The PWM pulse is given to driver circuit. Then AC voltage is given to setup transform in order to step up into 230V. So the output of the transformer is 230V AC 50Hz frequency voltage and given to motor. The speed is monitored by proximity sensor. It detects the metals and generates the voltage pulse. We fixed the metal plate in the motor shaft. So whenever metal plate is crossed, the proximity sensor generates the pulse. The corresponding pulse signal is given to the microcontroller.

Now the microcontrollers display the pulse rate on the LCD display which is equal to speed of the motor. The microcontroller compares the monitored and set speed to regulate the speed. Here by we used the keypad to give the set value to microcontroller.

III. PROPOSED METHOD

From 230V AC line PT is connected in parallel to measure voltage. Precision rectifier converts AC to DC. This is done as the PIC microcontroller works only on DC not on AC. CT is connected in series to measure current and shunt resistor is used to limit the starting current and also current can be calculated by measuring voltage drop. Since we know the value of resistor with the measured value of voltage current can be calculated. Precision rectifier converts AC to DC. PIC microcontroller receives the values of the parameters voltage and from CT to PT and displays it in LCD. When current increases, torque increases and speed decreases and similarly when current decreases, torque and speed increases.

With the knowledge of speed can be calculated using the relation,

Speed in rpm = HP *5250/Torque

A SIM is inserted in the GPRS. The monitored parameters from PIC is sent to the mobile through GPRS. IoT app in mobile receives the parameter and hence we can monitor the induction motor easily whenever and whenever we want. From IOT we can also send the required speed to control the induction motor through GPRS to PIC microcontroller.

This value of speed is given as input to PWM which varies the outputaccordingly which in turn drives the control circuit (which consists of thyristor) to vary the speed of the induction motor.

The induction motor sped is varied by varying the Pulse Width or Pulse Duration (frequency) can be achieved by using relation,

Speed = 120*frequency/No. of poles

The project is designed to monitor and control the speed of induction motor. Speed control is achieved by PWM technique and also the system will be connected web server using Wi-Fi module. The system is designed in such a way to accept commands from a web server. This commands are the various speed. The system responds to this commands by changing the motors run speed as per the command received.

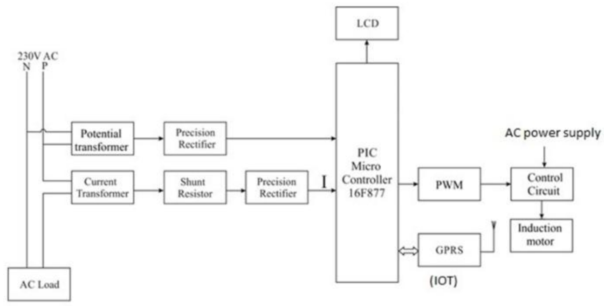


Fig.3.1 Block diagram of proposed system

IV. INTERNET OF THINGS

Internet of things(IOT) is the network of physical devices, software, sensors, actuators connectivity which enables these things to connect, collect an exchange data.

The definition of internet of things has evolved due to convergence of multiple technologies, real time analytics, machine learning and embedded systems.The concept of a network of smart devices was discussed as early as 1982, with a modified coke machine at Carriage Mellon University becoming the first internet connected appliance, able to report its inventory and whether newly loaded drinks were cold. Radio frequency identification is as essential to the internet of things, which would allow computers to manage all individual things.

Fig.4.1. Internet of things

V. SINGLEPHASE MOTOR

However it will not self start. It may be hand started in either direction, coming up to speed in a few seconds.It will only develop 2/3 of the 3-phase power rating because one winding is not used.

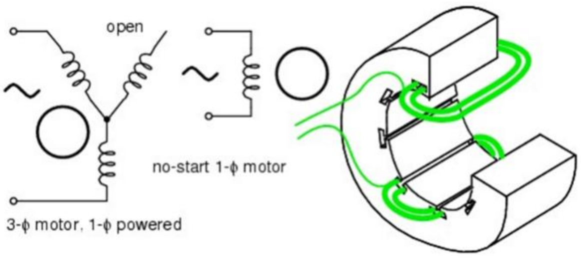


Fig.5.1. 3-phase motor from 1-phasepower

Types of single phase induction motor:

Permanent-split capacitor motor.

Capacitor-start induction motor.

Capacitor-run induction motor.

Resistance split phase motor.

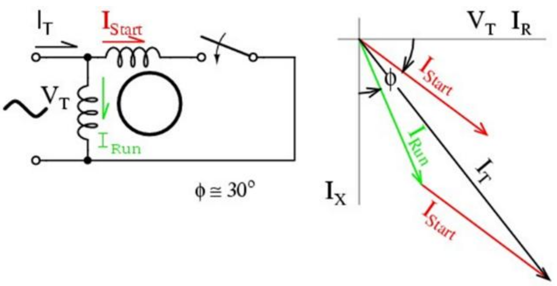


Fig.5.2.Resistance split-phase induction motor

VI. INTRODUCTION TO PIC

The microcontroller that has been used for this project is from PIC microcontroller is the first fabricatedinCMOS(Complementary Metal-Oxide Semiconductor) that uses separate bus for instruction and data allowing simultaneous access of program and data memory.

The main advantage of combination of CMOS and RISC is low power consumption resulting in a very small chip size with a small pin count. The another advantage of CMOS is that it has immunity to noise than other fabrication techniques.

PIC (16F877):

Various microcontrollers offer different kinds of memories. EEPROM, EPROM, FLASH etc., are some of the memories of which FLASH is the most recently developed. Technology that used in pic 16F877 is flash technology, so that data of retained even when the power is switched off. Easy programming and Erasing are other features of PIC 16F877.

DEVICE	PROGRAM FLASH	DATA MEMORY	DATA EEPROM
PIC 16F877	8K	368 Bytes	256 Bytes

Table No. 6.1a. Specifications of PIC 16F877

I/O PORTS:

Some pin for these I/O ports are multiplexed with an alternate function for the peripheral features on the device. In general, when a peripheral is enabled, that pin may not be used as a general purpose I/O pin. Additional information on I/O ports may be found in the micro™ Mid-range Reference Manual.

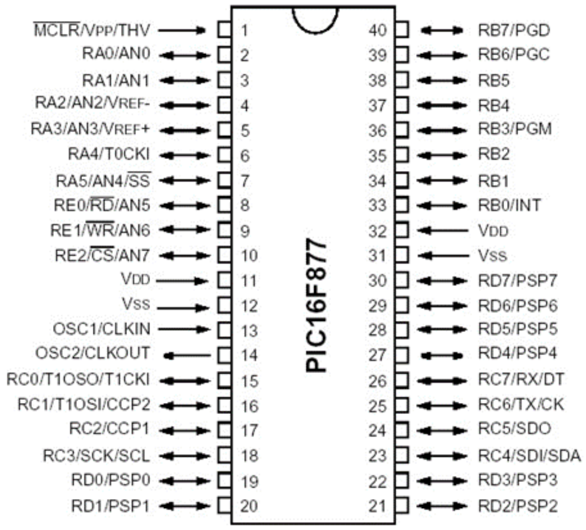


Fig.6.1. Pin diagram of PIC 16F887

PORT A is 16- bit wide bi-directional port. The corresponding data direction register is TRIS A. Setting a bit(=1) will make the corresponding PORT A pin an input, put the corresponding output driver in a Hi-impedance mode. Clearing a TRIS A bit (=0) will make the corresponding PORT A pin an output,i.e., put the contents of the output latch on the selected pin.

Name	Bit#	Buffer	Function
RA0/AN0	bit0	TTL	Input/output or analog input
RA1/AN1	bit1	TTL	Input/output or analog input
RA2/AN2	bit2	TTL	Input/output or analog input
RA3/AN3/VREF	bit3	TTL	Input/output or analog input or VREF
RA4/T0CKI	bit4	ST	Input/output or external clock input for Timer0 Output is open drain type
RA5/SS/AN4	bit5	TTL	Input/output or slave select input for synchronous serial port or analog input

Table No.6.1b. Functions of PORT A

PORT B is an 8-bit wide bi-directional port. The corresponding data direction register is TRIS B. Setting a TRIS B bit (=1) will make the corresponding PORT B pin an input, put the corresponding output driver in a Hi- impedance mode. Clearing a TRIS B bit (=0) will make the corresponding PORT B pin an output, i, e., put the content of the output latch of the selected pin. Similarly PORT C and PORT D are operated.

Program memory

The PIC 16F877 devices have 13-bit program counter capable of addressing 8K *14words of FLASH program memory. Accessing a location above the physically implemented address will cause a wraparound. The RESET vector is at 0000h and the interrupt vector is at 0004h.

Data memory

The data memory is partitioned into multiple banks which contain the General Purpose Registers and the special functions registers. Bits RP1(STSTUS<6) and RP0(STATUS>5)are the bank selected bits.

Instruction set

All instructions are executed within the one single instruction cycle, unless a conditional test is true or the program counter is changed as a result of an instruction. In this case, the execution takes two instruction cycles with the second cycle executed as a NOP. One instruction cycle consists of four oscillator periods. Thus, for an oscillator frequency of 4 MHz, the normal instruction execution time is 1ms. If a conditional test is true or the program counter is changed as a result of an instruction, then the instruction execution time is 2ms.

The instruction set is highly orthogonal and is grouped into three basic categories are Byte oriented, Bit oriented, Literal and control operations.

VII. PULSE WIDTH MODULATION (PWM)

Pulse Width Modulation (PWM) or Pulse Duration Modulation (PDM), is a commonly used technique for controlling power to inertial electrical devices, made practical by modern electronic power switches. The average value of voltage (and current) fed to the load is controlled by turning the switch between supply and load on and at fast pace. The longer switch is on compared to the off periods, the higher the power supplied to the load is. The PWM switching frequency has to be much faster than what would affect the load, which is to say device that uses the power. Typically switches have to be done several times a minute in an electric stove, 120Hz in a lamp dimmer, from few kilohertz(KHz) to tens of kilohertz for a motor drive and well into the tens or hundreds of K Hz in audio amplifiers and computer power supplies. The term duty cycle describes the proportion of 'on' time to the regular interval or 'period' of time; a low duty cycle corresponds to low power, because the power is off for most of the time. Duty cycle is expressed in percent, 100% being fully on. The main advantage of PWM is that power is that power loss in the switching devices is very low. When a switch off there is practically no current, and when it is on, there is almost no voltage drop across the switch. Power loss, being the product o voltage and current, is thus in both cases close to zero. PWM also works well with digital controls, which because of their on/off nature, can easily set the needed duty cycle. PWM has also been used in certain communication systems where its duty cycle has been used to convey information over a communications channel.

VIII. GPRS

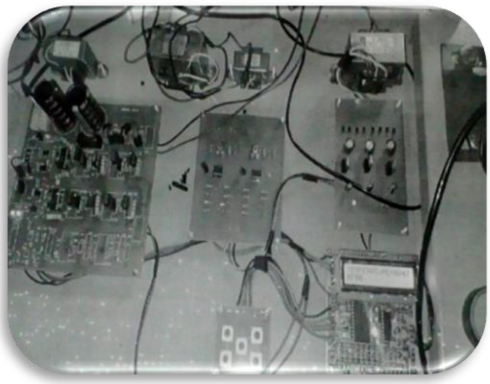
General Packet Radio Service (GPRS) is a packet oriented mobile data service on the 2Gad 3G cellular communication system's global system for mobile communications (GSM).

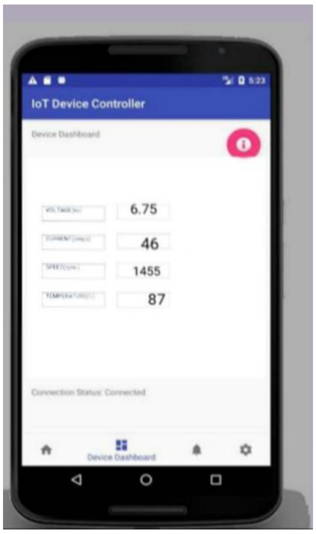
GPRS is a packet-based wireless data communication service designed to replace the current circuit-switched services available on the second generation global system for mobile communications (GSM) and time division multiple access (TDMA) IS-136 networks.

The GPRS core network is the central part of the GPRS which allows 2G, 3G and WCDMA mobile networks to transmit IP packets to external networks such as the internet. The GPRS system is an integrated part of the GSM network switching sub-system.

IX. PCB DESIGNING

Printed Circuit Boards are form the core of electronic equipment domestic and industrial. The software used in our project to obtain the schematic layout is MICROSIM. Software tools are used in tis project such as MPLAB IDE is an integrated development environment that provides development engineers with the flexibility to develop and debug firmware for various microchip devices. MPLAB IDE is a windows based integrated development environment for the microchip technology incorporated PIC microcontroller (MCU) and digital signal microcontroller (DSC) families.





X. CONCLUSION

The progress in science and technology is a non-stop process. New things and new technology are being invented. As the technology grows day by day, we can imagine about the future in which thing we may occupy every place.

The proposed system based on PIC microcontroller is found to be more compact, user friendly and less complex, which can readily be used in order to perform. Several tedious and repetitive task. Though it is designed keeping in mind about the need for industry, it can extended for other purposes such as commercial and research applications. Due to the probability of high technology used this "IOT BASED SENSORLESS SPEED CONTROL OF INDUCTION MOTOR" is fully software controlled with less hardware circuit. The feature makes this system is the base for future systems.

The principle of the development if science is that "nothing is impossible". So we all look forward to a bright and sophisticated world.

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