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MONITORING AND SPEED CONTROL OF INDUCTION MOTOR USING ARDUINO

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ABSTRACT

Speed control of induction motor is a new technique. It has high-efficiency which drives ac induction motor with PWM modulated sinusoidal voltage and design of a low cost.Circuit operation is controlled by using Arduino family microcontroller. The circuit is capable of supplying single phase induction motor with varying ac voltage.The mains ac voltage is directly modulated. It requires a lower number of active and passive components which compared with costly converter. This proposed control technique is use in consumer and industrial products like washing machine, dishwashers, ventilators, compressor

1. INTRODUCTION

Induction motor are widely used in industrial ,commercial ,utility application, residential application. It is used in various applications because the motor have low cost, high efficiency, wide speed range and robustness[1].In the present time, in the most of the applications, AC machines are useful than DC machines due to their simple and most robust construction without any mechanical commutators. Motor control applications span everything from residential washing machines, fans, and automotive window lift, traction control systems and various industrial drives. In many industrial applications in which induction motor are fed by static frequency inverters is growing fast. Thus electric motor is most important component. A complete production unit have three basic component driven (working) machine, transmitting device and electric motor. An electric motor is source of power. Power from electric motor to driven is delivered by transmitting device. The electric motor is classified as

AC motor is connected to AC line. Speed is calculated by: Ns =120*f/p-slip Ns= motor speed, f=frequency, p= number of poles. It is same as in TRIAC control, the voltage applied to load can be varied from zero to maximum value. On the other side, a pulse width modulation technique (PWM) is used and it is compared with the phase angle control and used for TRIAC, it produces much lower high order harmonics. Because the circuit is aimed at low-cost, medium-power applications, to produce the output voltage waveform it does not use a conventional converter topology[5]. It modulates the mains AC voltage. As compared with costly converter, it requires minimum number of active and passive power components. The device attempted here takes advantage of both the low cost of the phase angle control and the minimum harmonic content and greater efficiency which get standard converter topology. The drive uses a PWM controlled MOSFET then the load in series with a bridge rectifier. This drive based on this proposed control technique is used in consumer and industrial products like fan, washing machine, dishwashers, ventilators etc.. The input terminals of the rectifying bridge are connected in series with load. The output terminals (rectified side) has power transistor (IGBT, MOSFET or bipolar) connected across them. Current cannot flow through the rectifying bridge whenthe power transistor is off then the load which is in series and remains in an offstate. The bridge output terminals are short-circuited, when the power transistor is on and then current can flow through the rectifying bridge and thus through the load.

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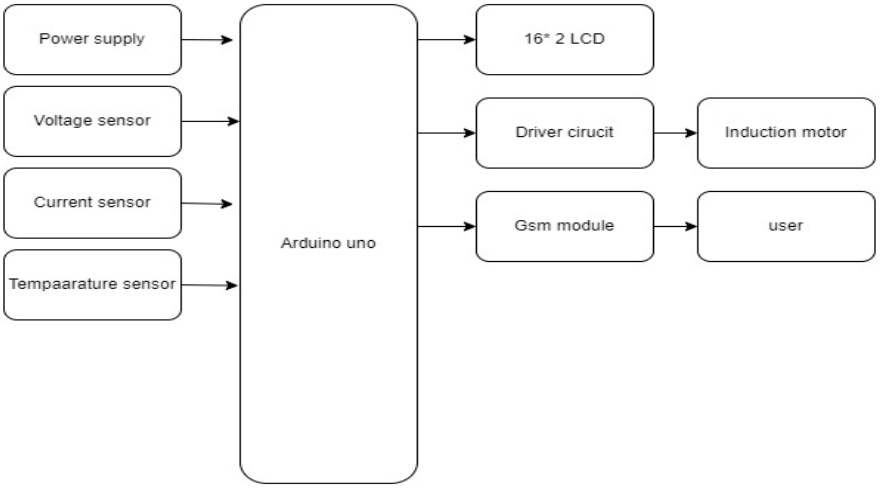


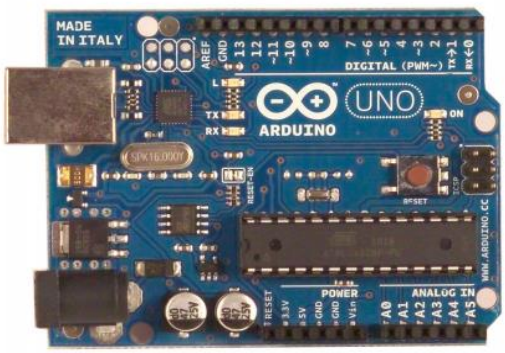
FIG:1- Proposed Syetem Block Diagram

2. COMPONENTS

Component	Specification	Quantity
Aurdino		1
Power supply	6-20V	1
Memory	ATmega328 , 32KB	1
Input output	14 Digit pin , 5v	1
LCD	16x2 pin	1
Buzzer	6v	1
Temparature sensor	DHT11 , 3.5v – 5.5v	1
GSM module	GSM-900	1
Voltage sensor	5v	1
Motor	INDUCTION MOTOR 230V	1

ARDUINO UNO:

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduno, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform;



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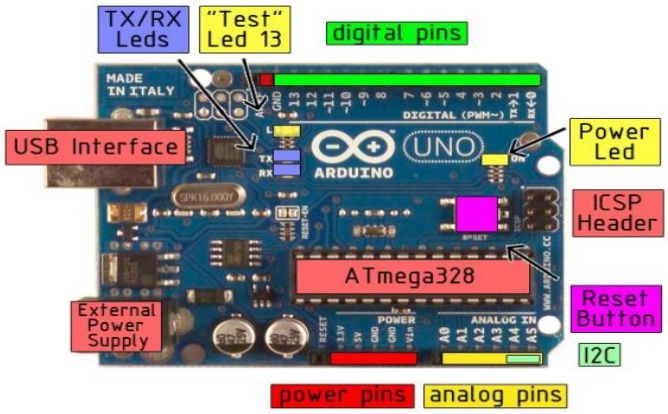
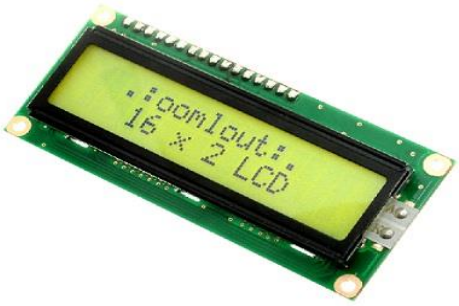


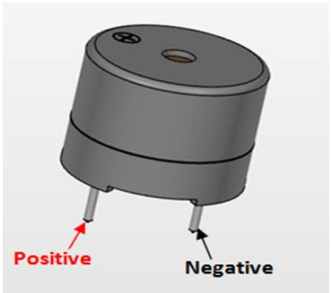
LCD:

LCD is an abbreviation for liquid crystal display. This particular type of electronic display module is utilized in a wide range of circuits and gadgets, including TV sets, computers, calculators, cell phones, and more. Seven segments and multi-segment light-emitting diodes are the major applications for these displays. The primary advantages of utilizing this module are its low cost, easy programming, animations, and limitless display options for unique characters, special effects, and animations, among other things.



BUZZER:

A buzzer is a little yet effective part that gives our project or system sound capabilities. This component is commonly used in most electronic applications due to its small and compact 2-pin structure, which allows for easy use on PCBs, Perf Boards, and breadboards. There are two varieties of buzzers that are frequently seen. The buzzer displayed here is a basic kind that emits a continuous beep when powered on. Another variety is referred to as a ready-made buzzer, which has a larger appearance and also produces a beep. Beep. Beep. Because of the internal oscillating circuit, it makes sound.



Active Passive Buzzer

Buzzer Features and Specifications

- Rated Voltage: 6V DC
- Operating Voltage: 4-8V DC
- Rated current: <30mA
- Sound Type: Continuous Beep
- Resonant Frequency: ~2300 Hz
- Small and neat sealed package
- Breadboard and Perf board friendly

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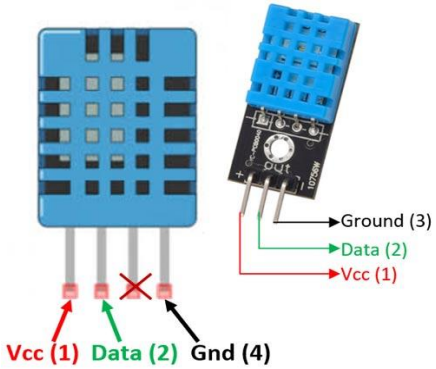

DHT11 Temparature and Humidity sensor:

The **DHT11** is a commonly used **Temperature and humidity sensor that** comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data.

DHT11 Specifications

Operating Voltage: 3.5V to 5.5V Operating current: 0.3mA (measuring) 60uA (standby) Output: Serial data Temperature Range: 0°C to 50°C Humidity Range: 20% to 90% Resolution: Temperature and Humidity both are 16-bit Accuracy: ±1°C and ±1%

LED(LIGHT EMITTING DIODE)

A light-emitting diode (LED) is a semiconductor diode that emits light when an electrical current is applied in the forward direction of the device, as in the simple LED circuit. The effect is a form of electroluminescence. where incoherent and narrow-spectrum light is emitted from the p-n junction..

LEDs are widely used as indicator lights on electronic devices and increasingly in higher power applications such as flashlights and area lighting. An LED is usually a small area (less than 1 mm^2) light source, often with optics added to the chip to shape its radiation pattern and assist in reflection · The color of the emitted light depends on the composition and condition of the semi conducting material used, and can be infrared, visible, or ultraviolet. Besides lighting, interesting applications include using UV-LEDs for sterilization of water and disinfection of devices , and as a grow light to enhance photosynthesis in plants·

GSM (Global System for Mobile communications)

Introduction:

GSM (Global System for Mobile communications) is a cellular network, which means that mobile phones connect to it by searching for cells in the immediate vicinity. GSM networks operate in four different frequency ranges. Most GSM networks operate in the 900 MHz or 1800 MHz bands. Some countries in the Americas use the 850 MHz and 1900 MHz bands because the 900 and 1800 MHz frequency bands were already allocated.The rarer 400 and 450 MHz frequency bands are assigned in some countries, where these frequencies were previously used for first-generation systems.GSM-900 uses 890–915 MHz to send information from the mobile station to the base station (uplink) and 935–960 MHz for the other direction (downlink), providing 124 RF channels (channel numbers 1 to 124) spaced at 200 kHz. Duplex spacing of 45 MHz is used. In some countries the GSM-900 band has been extended to cover a larger frequency range.

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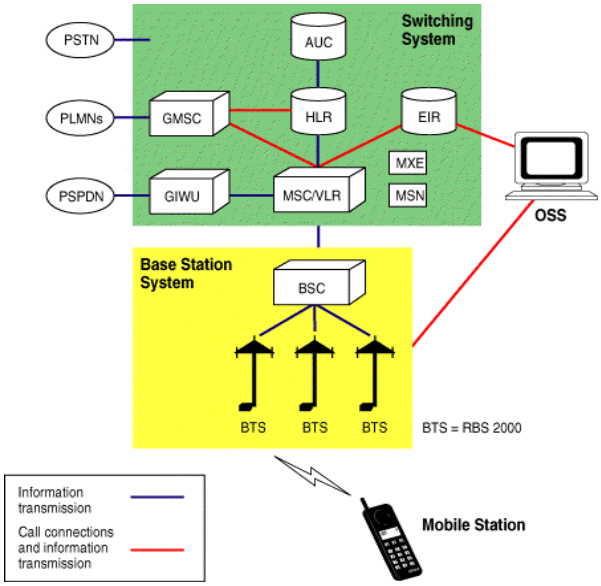
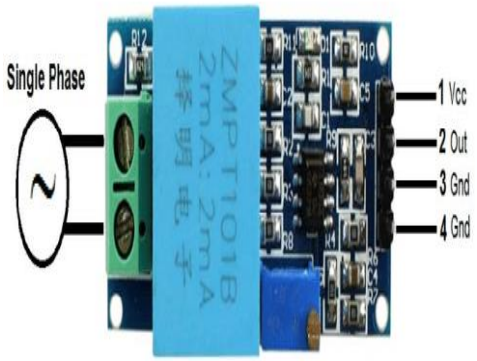
This 'extended GSM', E-GSM, uses 880–915 MHz (uplink) and 925–960 MHz (downlink), adding 50 channels (channel numbers 975 to 1023 and 0) to the original GSM-900 band. Time division multiplexing is used to allow eight full-rate or sixteen half-rate speech channels per radio frequency channel. There are eight radio timeslots (giving eight burst periods) grouped into what is called a TDMA frame. Half rate channels use alternate frames in the same timeslot. The channel data rate is 270.833 kbit/s, and the frame duration is 4.615 ms.

The GSM Network:

GSM provides recommendations, not requirements. The GSM specifications define the functions and interface requirements in detail but do not address the hardware. The GSM network is divided into three major systems: the switching system (SS), the base station system (BSS), and the operation and support system (OSS).



ZMP Voltage sensor:



AC Voltage Sensor Module ZMPT101B (Single Phase) is the best for the purpose of the DIY project, where we need to measure the accurate AC voltage with a voltage transformer. This is an ideal choice to measure the AC voltage using Arduino/ESP8266/Raspberry Pi like an opensource platform. In many electrical projects, engineer directly deals with measurements with few basic requirements like High galvanic isolation, Wide Range, High accuracy, Good Consistency. Onboard precision miniature voltage transformer, The active phase AC output voltage transformer module. Onboard precision op-amp circuit, the signal sampling and appropriate compensation for precise functions. Modules can be measured within 250V AC voltage, the corresponding analog output can be adjusted. It is brand new, good quality high performance.

Features:

1. Low price
2. Small size and lightweight
3. Easy PCB mounting
4. Good consistency
5. Widely acclaimed

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3. WORKING PRINCIPLE

As per the code coded in the Arduino uno, we can control the speed of an induction motor. The speeds are adjusted as per the requirement. The code is written in such a way that we can adjust the speed of an induction motor by using IoT platform because the induction motor is widely used in variable speed applications now a days due to the low cost and energy efficient of the induction motor compared to any other traditional motors used in earlier. The Arduino based speed control is used because of then low energy wastage compared to the traditional speed control methods.

4. SOFTWARE DESCRIPTION

The Arduino Software (IDE) is also known as the Arduino Integrated Development Environment. It includes a text editor for writing code, a message box, a text console, a toolbar with buttons for frequently used tasks, and other menus. In order to upload programs and interact with the Arduino and Genuino hardware, it connects to them. Sketches are programs created with the Arduino Software (IDE). These drawings are saved as files with the.ino extension and are created using a text editor. The editor offers tools for searching through and replacing text as well as cutting and pasting. In addition to displaying faults, the message box provides feedback during exporting and saving. Complete error warnings and other text output from the Arduino Software (IDE) are displayed in the console. The configured board and serial port are shown in the window's lower right corner. You can create, open, save, and verify programs with the toolbar buttons. You can also open the serial monitor and create, open, and validate drawings.

5. CONCLUSION AND FUTURE SCOPE

Conclusion:

Microcontroller based system can be efficiently used for speed control of induction motor along with pulse width modulation technique. By using PWM technique user can control speed of induction motor according to users requirement

Future Scope of Speed Control of Induction Motor Using Arduino: Enhanced Control Algorithms: Implementing more advanced control algorithms such as field-oriented control (FOC) or direct torque control (DTC) to achieve better efficiency, smoother operation, and precise speed control. Sensorless Control: Researching and developing sensorless control techniques to eliminate the need for speed sensors, reducing cost and complexity while improving reliability.

Closed-Loop Control: Expanding the system to incorporate closed-loop control mechanisms by integrating feedback from additional sensors such as current sensors or encoders for improved accuracy and stability. Variable Speed Operation: Extending the system's capabilities to support variable speed operation over a wider range, enabling the motor to adapt to varying load conditions and optimize energy consumption. Fault Detection and Diagnosis: Implementing fault detection and diagnosis algorithms to identify and mitigate issues such as stator faults, rotor faults, or bearing failures, improving reliability and minimizing downtime. Multi-Motor Control: Expanding the system to control multiple induction motors simultaneously, coordinating their operation for applications requiring coordination or synchronization. By pursuing these avenues of development, the speed control of induction motors using Arduino can evolve into a sophisticated and versatile system capable of meeting the demands of diverse industrial, commercial, and residential applications while contributing to energy efficiency and sustainability goals.

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