MEASURING ALTERNATING CURRENT MOTOR SPEED WITH GSM MODEM

[#1]BOORLA SANTHOSH, ***Associate Professor,***
Department of Electronics and Communications Engineering,
[#2]Dr. THODUPUNURI SRINIVAS, ***Professor,***
Department of Electronics and Communications Engineering,
MOTHER THERESA COLLEGE OF ENGINEERING AND TECHNOLOGY, PEDDAPALLY, TS.

ABSTRACT: The proliferation of mobile devices has led to the emergence of wireless tracking and control as a novel approach that is increasingly being adopted worldwide. Cellular devices have the capability to modify the speed of air conditioning systems in both industrial and office settings. A cellular device has the capability to monitor a wide range of electrical and mechanical components. The underlying principle of this approach revolves around the utilization of an electric switch that may be programmed and integrated into the circuitry of the motor's receiving end. This gadget has the capability to turn a wireless signal into a functional signal. The Short Message Service (SMS), which is a functionality available on mobile phones, is utilized for transmitting information. The system comprises many components such as the Arduino board, the GSM board, resistors, diodes, switches, SCRs, transformers, and converters. This strategy is exclusively applicable to mobile networks and does not extend to internet connectivity. The ability to operate remotely from any location on the planet is facilitated by the widespread availability and accessibility of mobile networks. Additional technologies, such as Bluetooth, Wi-Fi, line link, and remote infrared, exhibit restricted operational distances. The primary objective of this study is to examine the GSM technology and the hardware circuits necessary for regulating the speed of AC motors.

***KeyWords*:** Cyclo-converter, Arduino, Opto-coupler, Zero Crossing Detector, Relay.

1. INTRODUCTION

Over the course of time, advancements in science and technology have witnessed significant improvement, rendering them increasingly advantageous across a broader spectrum of circumstances. AC motors are typically favored for commercial applications. The utilization of this material extends to various industries, including automotive manufacturing, machine tool production, printing press fabrication, heavy metal rolling mill operations, elevator construction, and electric train assembly, among other applications. The importance of motor speed management grows significantly in tandem with advancements in machinery.

Additionally, a significant number of customers necessitate the capability to remotely monitor and adjust velocity. The ability of a direct current (DC) motor to modify its rotational speeds is of utmost importance in numerous applications. In addition, it is imperative to continuously monitor the speed control mechanism of the AC motor. In the past, manual mechanical controls were employed to regulate the operation of hand-operated electrical tools. In the aforementioned areas, those engaged in the manipulation of mechanical switches may be subjected to electric shocks, while the act of switching these devices on or off may result in the emission of sparks. This could have negative consequences for the entities involved. Despite their ability to provide electricity to electrical devices, these technologies exhibit rigidity.

The Global System for Mobile Communications (GSM) is a wireless device that facilitates long-distance communication between users. A digital radio transmission device has the capability to transmit voice conversations, multimedia content,

and data.

The GSM technology, which is undergoing continuous advancements, presently offers a wide range of applications. The optimal approach for monitoring and regulating an alternating current (AC) motor involves the utilization of Global System for Mobile Communications (GSM) technology.

The speed of an AC motor can be adjusted remotely from any location worldwide, provided that the GSM network is operational. The exemplary characteristic of GSM technology is its superior quality.A microcontroller is responsible for the management of an embedded program. Microcontrollers find application in diverse areas like as electricity, medical electronics, automation, and automotive, enabling the development of self-contained goods and systems. A cycloconverter is capable of altering the input frequency in order to adjust the rotational speed of an AC motor. When designing these components, the individual responsible for formatting must comply with these requirements.

2. BLOCK DIAGRAM

The block diagram depicted in Figure 1 illustrates the methodology employed for the purpose of regulating the speed of an AC motor through the utilization of a GSM modem. The service provider transmits messages to GSM recipients using mobile phones. Arduino 1 is the recipient of communication. The Arduino device processes the received message and utilizes the provided instructions to identify the subsequent actions to be taken. This is exemplified by providing a response to the one who initiated the initial communication.

In the event that the instruction is given to Arduino2 to alter the speed of the motor, the transmission of the motor speed occurs via a serial link. Subsequently, Arduino2 provides control signals to the cyclo converter based on the specified speed.

In the given case, the activation of the switch initiates the flow of alternating current electricity within the machine. The process of establishing a connection between the Arduino microcontroller and additional peripheral components to the power source.

The power and control wires are separated. The opto coupler's output is linked to the cyclo converter. The liquid crystal display (LCD) screen provides visual representation of the motor's speed and operational condition.

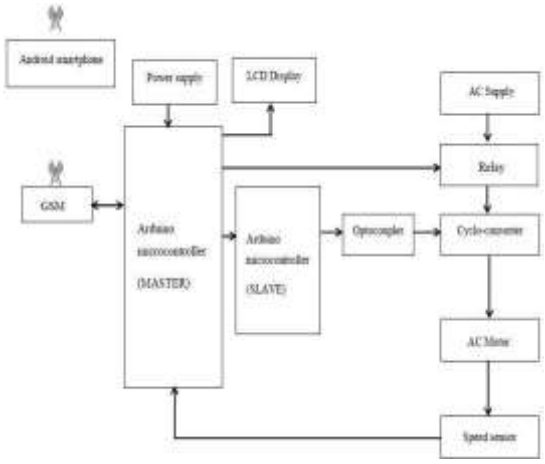

Fig-1: A diagram illustrating the fundamental components

Zero Crossing Detector

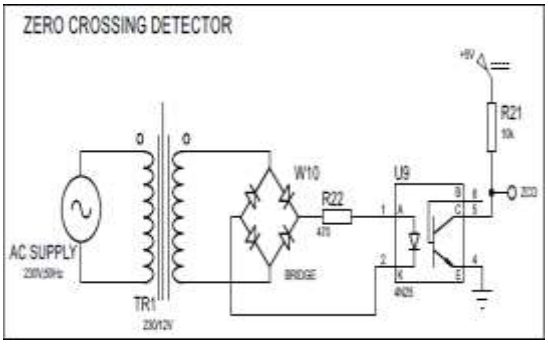

Fig-2: One approach to identifying zero crossings.

In order to successfully create a zero connection, an optocoupler is required to be utilized. When the alternating current (AC) wave at the input goes above zero, the ensuing output pattern always registers as HIGH. This is because AC waves have a sinusoidal shape. The electronic component sends out a high zero-crossing pulse at regular intervals of 0 degrees, 180 degrees, 360 degrees, or every 180 degrees.

The frequency of the alternating current can be slowed down thanks to the transformer that is contained within this circuit. Alternating current needs to be converted into pulsating direct current, and the bridge converter is the component responsible for making that transformation.

After it has been rectified, the output of the bridge rectifier is then delivered in the direction of the

optocoupler. It is necessary for the light-emitting diode (LED) in the opto-coupler to receive a minimum voltage of 1V in order for it to illuminate whenever the alternating current (AC) waveform approaches the zero crossing line. In the event that the voltage falls below 1V, the LED will no longer light up. After that, the voltage of the output transistor is raised to 5 volts, and it is then turned off.

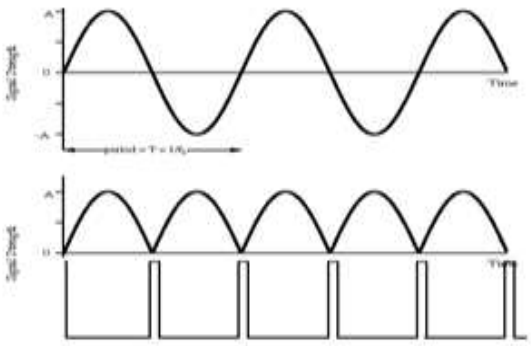

Fig-3: The manner in which waves reach and depart from the zero-crossing detection (ZCD) point.

CYCLO CONVERTER

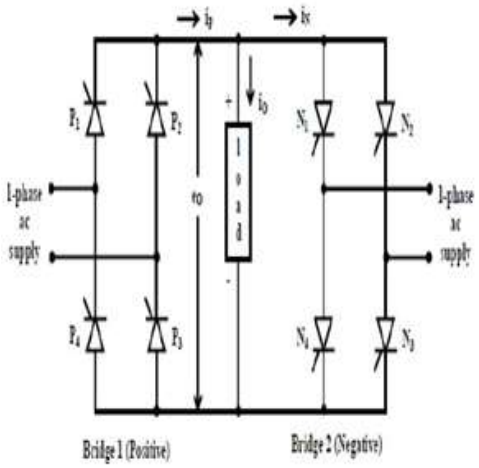

Fig-4: Alter the trajectory of the tempest.

A cyclo-converter is an apparatus utilized for the conversion of alternating current energy from one frequency to another, typically resulting in a lower frequency output.It alters the frequency without need a direct current source. The output voltage and frequency of a cyclo-converter can be altered at any given time through the utilization of an autonomous control circuit. One distinguishing characteristic of this converter is its ability to modify frequencies in a singular, immediate action, setting it apart from other converters.

Cyclo-converters refer to a type of thyristors that possess the capability to regulate the electrical current in bidirectional manner, while also exhibiting inherent switching behavior between the on and off states. These bridges may exist between different phases, such as the transition from phase 1 to phase 3, or they may manifest as events occurring during the interphase.

GSM TECHNOLOGY

Creating a Global Strategy in Preparation for International Development Digital radio transmission is a common technology used in mobile communication. It enables the data, multimedia messages, and phone calls to be transmitted over wide geographical areas. The Global System for Mobile Communications (GSM) makes it easier for mobile stations, base stations, and switching systems to communicate with one another.

Mobile stations, which are also sometimes referred to as "cell sites," are linked to base stations, which are often referred to as "mobile stations," which are linked to switching systems. Mobile stations (MS), base station subsystems (BSS), network and switching subsystems (NSS), and operation and support subsystems (OSS) are the four primary elements that make up a GSM network. The mobile station (MS) is the first element in this list. Mobile stations have the ability to facilitate connections between cellular devices that have Subscriber Identity Module (SIM) cards installed in them and the services that are offered by mobile stations.

The Network Switching Subsystem (NSS) is connected to the mobile station through the base station, which acts as an intermediate between the two systems. It is essential for the system to both send and receive signals in order for it to function properly. Radio components are included within a base station. The National Security Service (NSS) is in charge of regulating the communication protocols that are utilized by mobile users in order to interact with one another.

The system is equipped with the databases that are required for the purpose of monitoring user information and keeping track of the activities of individual users. Radio frequency waves are utilized by a GSM device in order to transmit and receive data over a considerable geographical

range. SIM cards, which are typically found in mobile phones, are an indispensable component from a practical standpoint. The Arduino device receives the text message that was sent over the Short Message Service (SMS) thanks to the GSM connection. At the moment, the AT commands are being used by the Arduino in order to manage the modem. When using GSM technology, additional networking equipment is not required in order to function properly. Individuals located in any part of the world are now able to connect with one another thanks to the Global System for Mobile Communications, or GSM.

Design

The highest voltage that can be supplied across the silicon-controlled rectifier (SCR) for a 1 horsepower (HP) load is 340 volts, obtained by multiplying 240 volts by a factor of 2. What types of loads can the 1 horsepower silicon-controlled rectifier (SCR) effectively manage?

$$\frac{1HP}{(\sqrt{2} \times V \times cos\emptyset)}$$

$$= \frac{746}{(\sqrt{2} \times 240 \times 0.8)} = 2.8A$$

Upon the initiation of the motor, the electrical current undergoes a substantial amplification, reaching a magnitude that is fivefold more than its maximum threshold.

This implies that the maximum current for the silicon-controlled rectifier (SCR) is 5 = 14A.

The TYN616 silicon-controlled rectifier (SCR) has a current rating of 16A and an anode-cathode voltage of 600V, rendering it suitable for implementation inside a cyclo-converter circuit. Two of the scores have an exceptionally elevated magnitude.

Based on the provided documentation, it is recommended that the gate current of the TYN616 silicon-controlled rectifier (SCR) falls within the range of 2 to 25 mA.

The power circuit consists of diodes, specifically 1N4007 components, which have a current rating of 1A and a voltage rating of 1000V.

As per the specifications provided for the optocoupler MOC 3021, it is stated that each silicon-controlled rectifier (SCR) necessitates the presence of 470 resistors with a power rating of 1 watt. The input of the opto-coupler should be connected to the 220-ohm, 1-watt resistor. The present design is based on simulation methodologies.

Simulation circuit

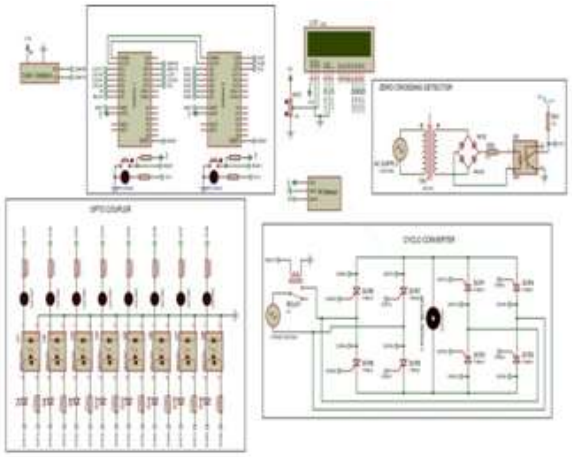

Fig-5: The concept of the modeling circuit.

3. OUTPUT

The presented values in this illustration represent the many output frequency options that can be generated using the Proteus software. The present software application provides a simulation of the utilization of a Subscriber Identity Module (SIM) card for the purpose of monitoring the rotational speed of an alternating current (AC) motor.

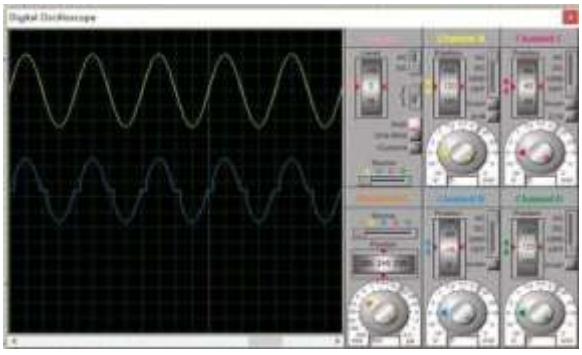

Fig-6: The 50 Hz frequency can be altered by employing a cyclo-converter.

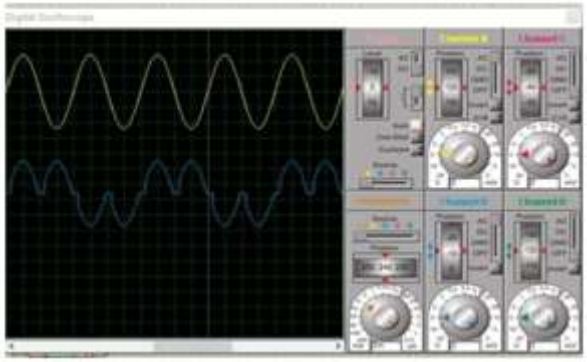

Fig-7: The cycloconverter is responsible for altering the frequency to a value of 16 Hz.

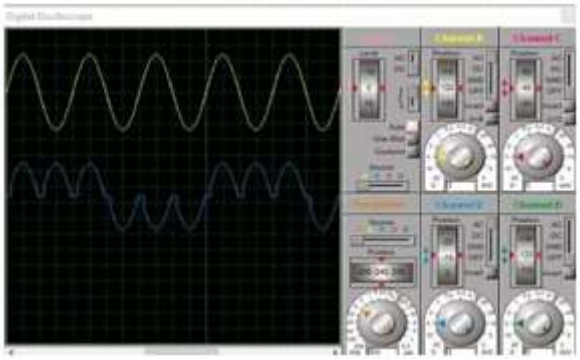

Fig-8: The utilization of a cyclo-converter for the purpose of altering the frequency from 25 Hz.

Table-1: Each discharge frequency exhibits a discernible rhythm.

Output frequency	Speed of motor
16 HZ	480 RPM
25HZ	750 RPM
50 HZ	1500 RPM

The output frequency of a cyclo-converter can also be adjusted to any desired value. The frequency of the alternating current motor is subject to variation in accordance with the output of the cyclo-converter.

The chart presents a comprehensive overview of the different speeds attainable at different frequencies.

4. CONCLUSION

The gear is equipped with a cyclo-converter, enabling the alteration of the output frequency of the AC motor. This exemplifies the capability of a cyclo-converter to generate a frequency of a predetermined value. In order to monitor the speed of an AC motor, it is necessary for a user to transmit a message via a GSM network. In order for the system to operate well, it is imperative that the IR monitor possesses the capability to accurately measure the motor's velocity. The speed control regulator (SCR) autonomously adjusts the control signal in response to the speed mistake. When the rotational velocity of an alternating current (AC) motor aligns with the velocity designated by the user, it is referred to as operating at such velocity.

REFERENCES

1. Damini Gharat, Chetna Patil, Harshal Ghude3, SandeepGaikwad,“SpeedControlofACMotorUsingFrequencyControlMethod”,IJRESMVolume-1,Issue-10,October-2018
2. “DevelopmentofLightControlandMotorSpeed ControlbySmartPhone”ElectricalandElectronicsEngineering,
3. UniversityofSabah,KotaKinabalu,Malaysia
4. VirenPatel,DipakMakawana,VishalRangpara,JaydipsinhZala,“ActoAcstepdowncycloconverter”IJRESM,
5. Volume: 04,Issue:03,Mar-2017
6. Mr.BuraliY.N.,AssistantProf.PatilR.T.,“Speed ControlandMonitoringofanACMotorbyWirelessCommunicationUsing DTMF Decoder Technique”, IJRESM, Vol. 1, Issue 7(November2012),PP10-18
7. T. Mathurri Sai, S. Keerthi Kumar, “Speed control of dc motor using voice commands”, ICCPEIC, St.Joseph's College of Engineering, Chennai, India.