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Li-Fi (Light Fidelity) Based Induction Motor Failure Detection and Analysis the Life Span of Motor

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ABSTRACT: The main advantage of induction motors is their robust and simple construction. It can work in any environmental conditions and the cost is cheap. Remote monitoring in industries is the most important criterion for increasing production, profitability, plant availability and for protecting machine health. Industries need more manpower to monitor, in some occasions remote from technicians may be abnormal condition. So, in this project we designed LIFI light fidelity wireless communication system to monitor induction motor parameters like temperature, vibration, voltage and current of induction motor continuously in all parts of industrial complex to avoid catastrophic failure. Li-Fi uses LED lamps equipped with a transceiver that can transmit and receive information. Li-Fi can transfer more data in a very short time and can instantly. If any abnormal condition in the motor is detected based on the sensor data, it will automatically transmit the message to the central station using LIFI (light fidelity) technology and receive the motor information displayed in the terminal software. It reduces the labor required in all industries for continuous monitoring of overall parameters using a light fidelity application (LIFI) sensor. It also provides an industrial application that makes the system faster and more user-friendly.

I. INTRODUCTION

1.1 OVERVIEW

Three-phase induction motors are very popular in industrial applications due to their simple and safe construction. Therefore, several control methods have been proposed to obtain a better control system for them. In recent years, traditional control systems have been abandoned and adaptive and intelligent control systems have been used instead. Towards the end of the 20th century, the development of electronics, power electronics and computer technology started new advances in control technology and automation. Control of electric motors used in various systems and process control, especially asynchronous motors, has become very important for its suitability in designing systems in industry and for many other advantages such as energy, time and sensitivity. The electrical parameters of the motor are used both in the mathematical model of the motor and in the calculation of the torque and flux components. Induction motor parameters can be measured by some experiments such as locked rotor, no load experiments. Current, voltage, temperature and vibration of induction motors are very important for the drive system. The performance of the induction motor is directly affected by all the basic characteristics. This project represents work that is part of efforts to build a composite and automatic induction motor condition monitoring system, where an intelligent system will constantly analyze machine parameters and display relevant health conditions in real time using LIFI equipment. The presented work focuses on determining the health status of a three-phase induction motor using the analysis of voltage and current and vibration signals, temperature status in a unique and relatively simpler way.

1.2 OBJECTIVES

- The main goal of this project is the monitoring of induction motor parameters and wireless data transmission based on LIFI communication.
- Induction motor parameters such as temperature changes, vibration, voltage and current values can be continuously monitored using sensors.



II. LITERATURE SURVEY

However, in order to achieve reliable and robust diagnosis of induction motor faults and to realize the detection of multiple faults at the same time, including stator faults, rotor faults and bearing faults, different types of sensor signals should be used together. This is because each type of sensor signal contains specific information related to certain operating conditions. Thus, combining these signals and analyzing them together can be an effective way to realize multi-fault diagnostics under complex conditions. Feature extraction from sensor signals is actually a crucial step, and the performance of the fault diagnosis method depends on how accurately the extracted features can represent the fault signature of the monitored induction motor. However, the performance of conventional feature-based fault diagnosis depends on the quality of the extracted features and their suitability for a particular task. This requires expertise and human intervention, which in turn introduces uncertainty into the overall performance. [1]. Machine learning represents an effective solution to the above problems. Successful applications including Support Vector Machine (SVM), Bayesian Networks (BN), Artificial Neural Networks (ANN), fuzzy inference and deep learning (DL) have been seen in various fault diagnosis scenarios. Among these techniques, deep learning represents an attractive feature learning option that benefits from its strong ability to learn from massive data in a much deeper network structure. Deep learning architectures refer to neural networks that have multiple hidden layers that are able to learn hierarchical representations from raw data. With the improvement of computing power and advanced network training techniques, deep learning has succeeded in various applications such as speech recognition, natural language processing [2]. When diagnosing machine faults, the deep architecture can automatically learn useful representations from massive sensor data and recognize certain failure patterns. Compared to traditional ways in fault diagnosis, where features are extracted and selected manually, which requires prior knowledge and great effort during analysis, the deep learning method can learn representations and patterns hierarchically from the input data and select those that can best represent the working conditions machine by gradually adjusting. attached weights. This reduces the impact caused by human intervention and increases efficiency. By using a deep architecture and massive training data, the deep learning method has the ability to model complex working conditions and provide accurate predictions. There are several typical deep architectures that have been successfully applied to machine fault diagnosis.[3]

III. EXISTING SYSTEM

- The existing system is a condition monitoring system that includes operational condition monitoring (OCM) and failure diagnostic analysis (FDA).
- A simple built-in system is used for condition monitoring and fault diagnosis of induction motors.
- The system evaluates the current state of the engine using vibration detection. When an abnormality is detected, electrical detection is used in conjunction with vibration detection to determine the possible type of malfunction.
- This system uses a three-axis accelerometer to measure motor vibrations, non-contact sensing of voltage and current signals using Hall sensors.
- Laboratory results indicate that OCM can successfully diagnose the healthy state of induction motors, and FDA can classify various damage, stator failure, rotor failure, bearing failure and eccentric failure.
- In this existing system, only the vibration of the induction motor and the electrical condition are monitored.
- There is no data about the temperature state of the motor and there is a correct communication about the parameters of the motor.

3.1.1 DISADVANTAGES

- Time-consuming
- Delay in process
- Consumption of man-power and money
- Inefficiency in locating the faults

3.1 PROPOSED SYSTEM

- The proposed system represents an alternative approach for monitoring induction motor parameters based on sensors and wirelessly transmitted information based on wireless communication with optical fidelity.
- This system obtains information about the induction motor continuously by monitoring parameters such as changes in temperature, vibration, voltage and current values continuously in all parts of the industrial complex to prevent catastrophic failure and can immediately transmit the information to the central station using Light Fidelity (LIFI) Technology.



- The sensor unit detects the corresponding motor parameter, the temperature status can be monitored using the DHT11 temperature sensor.
- The engine vibration condition can be monitored using a vibration sensor.
- The voltage and current values of an induction motor can be monitored using a voltage and current sensor.
- The microcontroller reads the data from various sensors and analyzes according to the given instructions, then displays the information on the LCD, and the information can be sent wirelessly using the LIFI module.
- High-speed data is transmitted using a light beam from an LED lamp to a photodetector. The receiver detects the change in the intensity of the light beam and converts the data.
- This converted data is transmitted to the receiver side. received information can be viewed in the terminal software.
- If the temperature condition of the induction motor is abnormal or overheated, it means to automatically shut down the motor by electromechanical relay.

IV. SYSTEM FUNCTION

BLOCK DIAGRAM

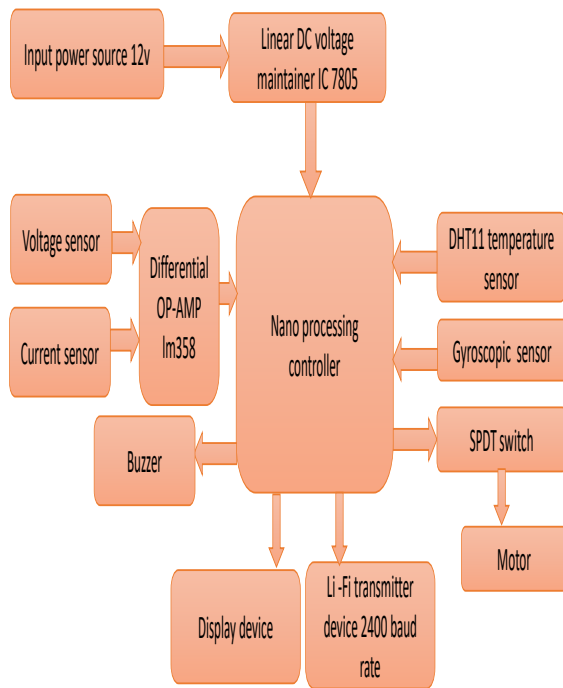


Fig no 1: transmitter block diagram

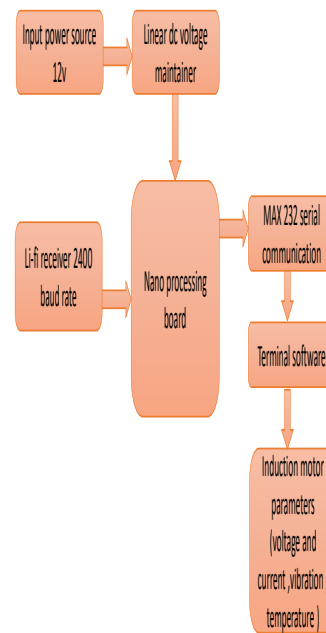


Fig no 2: receiver block diagram

4.1.1 BLOCK DIAGRAM EXPLANATION

The above block diagram consists of transmitter and receiver side. The block diagram presents the concept of induction motor parameters and wireless data transmission based on LIFI communication. The transmitter block consists of a Nano controller, li-fi transmitter and sensors. the sensor unit detects the corresponding motor parameter, the temperature status can be monitored using the DHT11 temperature sensor. The vibration condition of the motor can be monitored using the vibration sensor, the voltage and current values of the induction motor can be monitored using the voltage and current sensor. The microcontroller reads the data from various sensors and analyzes according to the given instructions, then displays the information on the LCD, and the information can be sent wirelessly using the LIFI module. High-speed data is transmitted using a light beam from an LED lamp to a photodetector. The receiver detects the change in the intensity of the light beam and converts the data. This converted data is transmitted to the receiver side. received information can be viewed in the terminal software.



4.2 CIRCUIT DIAGRAM

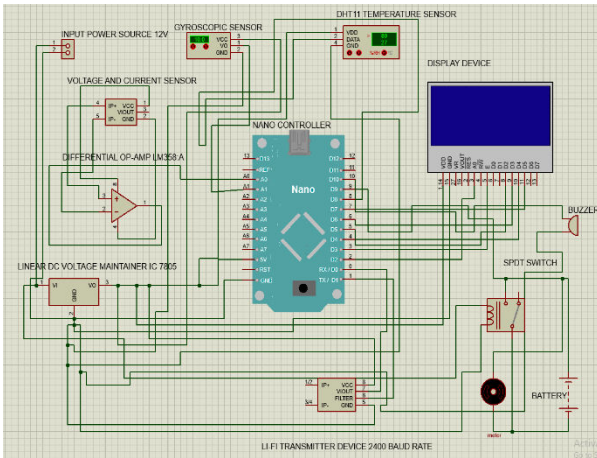


Fig no 3: Transmitter circuit diagram

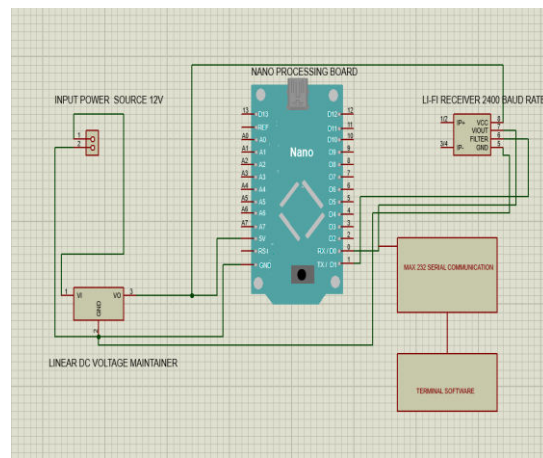


Fig no 4: Receiver circuit diagram

4.2.1 CIRCUIT DESCRIPTION

- The transmitter wiring diagram consists of Nano microcontroller components, LCD display, LI-FI Tx device, voltage and current sensor,
- DHT11 temperature sensor, gyro sensor power supply, SPDT switch, motor, buzzer and controller. The input source is intended for a regulator for voltage regulation of 12V to 5V.
- Li-fi Tx device has 4 pins VCC pin is connected to 5v.
- The GND pin is connected to ground. Two pins connected to the TX and RX pin of the controller. The voltage sensor has 3 pins.
- VCC pin is connected to 5V supply, GND pin is connected to ground. the output pin is connected to the analog pin of the controller. The DHT11 temperature sensor has 3 pins.
- The VDD pin is connected to the 5V supply, the GND pin is connected to ground. The DATA pin is connected to the digital pin of the controller. The gyro sensor has 3 pins.
- VCC pin is connected to 5V supply, GND pin is connected to ground. Vo is connected to the analog pin of the controller.
- An SPDT switch is connected to the controller to connect the motor. LCD display connected to Nano microcontroller. VDD connected to positive and GND connected to negative and data pins are connected to D2, D3, D4, D5, D6, D7 are connected to digital pins of the controller.
- The buzzer has 2 pins, the positive pin is connected to the digital controller and the negative pin is connected to ground.
- The receiver circuit consists of Nano regulator, LI-FI Rx device, power source, regulator, max 232. Li-FI Rx has 4 pins Pin VCC is connected to 5v.
- The GND pin is connected to ground. Two pins connected to the TX and RX pin of the controller.
- The Max232 is connected to the controller for serial communication.

V. HARDWARE REQUIERMENTS

1. LCD DISPLAY

An LCD is a display device that uses a liquid material to display images and values in the form of pixels. The LCD also contains points that it knows as pixels. Pixels are backlit. When the backlight is activated, it projects light onto pixels to create an image. A pixel that appears clean thanks to a layer of polarizing glass placed between the LCD. When both layers are polarized, the backlight can shine through the liquid pixels and out of the top layer of the LCD.



Fig no: 5 LCD display

2.LIGHT FIDELITY TRANSMITTER& RECEIVER

The Li-Fi transmitter circuit is used to transmit music data from your mobile phone to the speaker using LED light waves and without wires. LED light can also illuminate your room. stream music from your cell phone to a speaker system...that uses the same light to seamlessly do two things together. Light Fidelity (Li-Fi) is an innovative paradigm in wireless transmission. The proposed strategy is an improved version for a wired audio system that plays audio signals obtained using light.

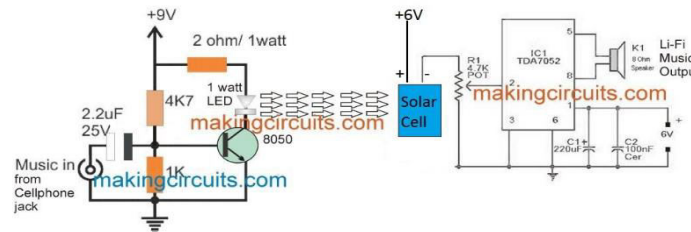


Fig no 6: LI-FI transmitter and receiver

3.ELECTROMECHANICAL RELAY (SPDT SWITCH)

This is a 4-channel high-level trigger relay, applicable, The relays are suitable for controlling high-power electronic devices such as lights, electric fans and air conditioners, There are two solder points in the relay, one is 5V and the other is GND to the two ends of the relay module. If you want to disconnect the device with the module after the experiment, just disconnect the connectors and you don't have to unscrew the wires in the socket. Reminder: Be careful with your fingers when disconnecting the heads.

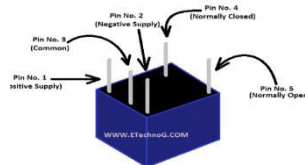


Fig no 7: relay

4. VOLTAGE SENSOR

In this article we can discuss about voltage and current sensor in detail. A voltage and current sensor can actually detect, monitor and measure the voltage supply. It can measure AC and/or DC voltage level. The input to a voltage and current sensor is the voltage itself, and the output can be analog voltage signals, switches, audio signals, analog current level, frequency, or even frequency modulated outputs. This means that some voltage and current sensors can provide sine or pulse trains as output, and others can produce amplitude-modulated, pulse-width-modulated, or frequency-modulated outputs.



Fig no 8: voltage sensor

DHT11 TEMPERATURE SENSOR

To measure temperature, this sensor uses a thermistor with a negative temperature coefficient, which causes its resistance value to decrease as temperature increases. The temperature range of the DHT11 is from 0 to 50 degrees Celsius with an accuracy of 2 degrees. The humidity range of this sensor is from 20 to 80% with an accuracy of 5%.



The sampling frequency of this sensor is 1Hz, i.e., it gives one reading every second. The DHT11 is small in size with an operating voltage of 3 to 5 volts.

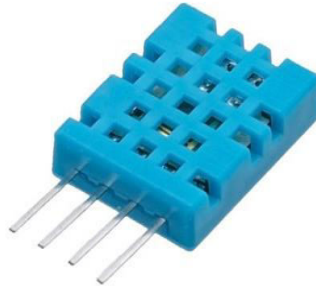


Fig no 9: temperature sensor

GYROSCOPIC SENSOR (TILT SENSOR)

Accelerometer sensors are devices that produce an electrical signal that changes with angular movement. These sensors are used to measure tilt and accelerometer in a limited range of motion. Sometimes accelerometer sensors are referred to as inclinometers because the sensors only generate a signal, but inclinometers generate both data and signal.

Accelerometer Sensor Working Principle

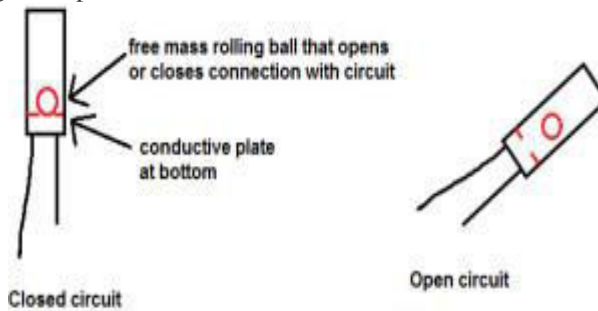


Fig no 10: Accelerometer Sensor working

DC INDUCTION MOTOR

DC geared motors are complete propulsion systems consisting of an electric motor and reduction gearing integrated into one easy-to-install and configurable package. This greatly reduces the complexity and cost of designing and building power tools, machines and equipment requiring high torque at relatively low shaft speeds or revolutions per minute. Geared motors allow the use of low-power, fuel-efficient motors that provide high propulsive power at low speed, such as elevators, winches, medical tables, hoists, and robotics.

VI. RESULTS

In final results we have successfully predicted induction motor failure by monitoring over voltage, temperature rises and vibration changes in induction motor. The main cause for induction motor failure is temperature rising, over voltage and vibration changes in motor to avoid this type of failure we have developed a device which can predict this type of failure at a very earlier stage.

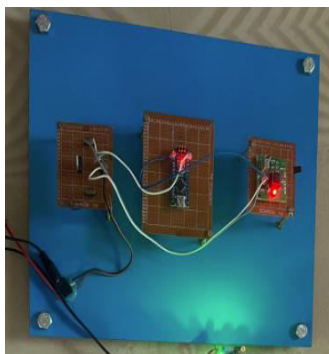


Fig no 11: Receiver

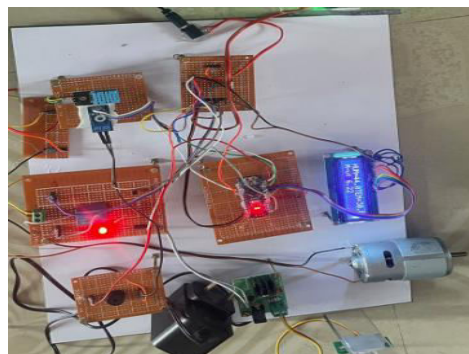


Fig no 12: Transmitter



VII. CONCLUSION

In this project, a parameter monitoring system for induction motors based on a new technology called LIFI is achieved and successfully tested, which provides uninterrupted output related to a maintenance worker located anywhere, anytime. The developed system is capable of performing such operations as operating the motor through LIFI, monitoring and controlling most of the motor parameters such as currents and voltages, temperature, vibration. All these values can be transferred to the computer, displayed on the interface, using the terminal software. According to this project, some industrial parameters can be continuously monitored at regular time intervals.

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