Motor Protection Using the ATmega328P and the Blynk Phone Application

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Abstract

In this project, the motor protection system is designed using the ATmega328P microcontroller which checks for unsafe conditions including overvoltage, undervoltage, overcurrent, overtemperature, and incorrect rotor speed. Information is sent through the Blynk application for easy user notification.

Background

Electric motors are now an integral part of modern living and can be found almost anywhere. Motors can degrade over time or be quickly damaged by entering unsafe operating conditions. To avoid the high costs of motor replacement or motor repair, it is beneficial to provide a protection system to ensure motor safety if unsafe motor conditions are encountered. There are currently high-quality motor protection systems available on the market, but these can oftentimes be very expensive. The goal of this project is to create an affordable protection system for small industrial motors while easily providing updates on the state of the motor to the user's phone using the Blynk phone application.

Method

The three phases provided to the motor are first run through current transformers. The current transformers provide a small voltage to the MCU which relates to the current flowing through the phases to the motor. Theses phases are then tapped by 120V to 24V voltage transformers. The secondary side of the voltage transformers are rectified, filtered and divided to provide a voltage between 0V-5V which can be read by the MCU. The motor is separated from power by a three-phase solid-state relay. The solid-state relay is controlled using a DC voltage provided by the MCU. If any unsafe conditions are met, the solid-state relay will disconnect the power provided to the motor. A speed sensor and temperature sensor are placed near the shaft and windings of the motor. The temperature sensor is run to an amplifier to more accurately read small changes in temperature. If any unsafe conditions are read from any of these components, the solid-state relay is turned off and the Blynk application notifies the user.


Current Transformer

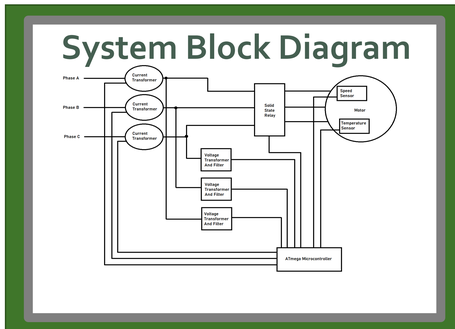

Temperature Sensor

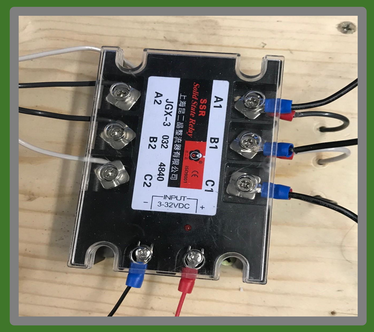

Voltage Transformer


Speed Sensor


Solid-State Relay

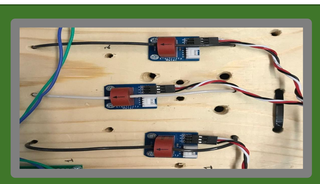

MCU

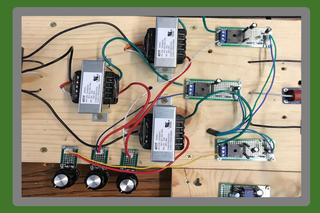


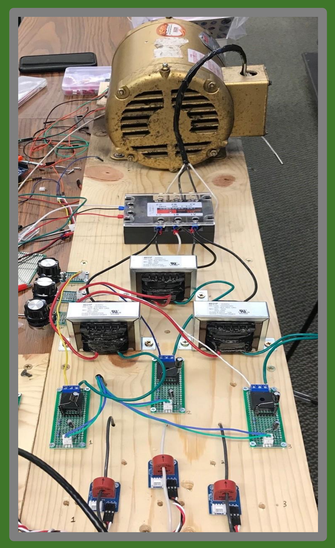

Solid-State Relay

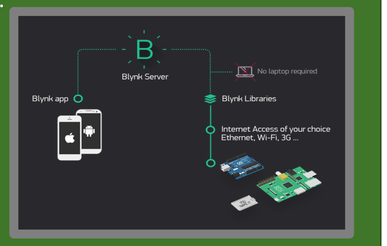
Blynk

The Blynk application sets this motor protection system apart from others by providing motor updates and warnings directly to one's phone. Updates on the voltage and current of each of the three phases are displayed on the app. When the motor enters any unsafe condition, the solid-state relay is turned off and a notification is sent to the Blynk app. This can be set up to inform the user of the reason the motor was shut off instead of just saying that the motor was turned off. The Blynk application offers easy setup and modification. Using the wide variety of widgets offered in the app, the values read by the MCU can be displayed in what the user deems the most effective setup. The readings are updated regularly to ensure that what the user sees is accurate. Overall, this app is easy to use and effective.


Current Transformer Setup


Voltage Transformers with Filters And Potentiometers


Component Setup with Motor



Blynk Application

Testing

The system is tested to see how it will react to certain unsafe motor conditions. Over and under voltage conditions are tested using a potentiometer on the secondary side of each of the voltage transformers. By choosing an arbitrary voltage value, the microcontroller can be set to turn off the solid-state relay when the voltage goes too high or too low. The current transformers are tested by running another conductor through the center hole and drawing current through both conductors running through the center tap. If the current is too high, then the MCU shuts off the microcontroller. The temperature sensor is tested by setting an arbitrary value and then changing the environment around the temperature sensor. As the temperature enters an unsafe level, the MCU shuts off the solid-state relay. The same concept is applied to the speed sensor. An arbitrary value is chosen. When that value is exceeded the MCU shuts off the solid- state relay. To ensure motor protection, the parameters for each of these monitoring devices need to the tailored to the specific needs of the motor.

Conclusion

This motor protection system simplifies the safeguarding of small industrial motors. The system can be built and installed on a small budget and can be designed to fit the specific needs of individual motors. The Blynk application creates a simple and effective user experience, offering quick motor updates right to one's personal phone. Further development is needed to create an improved system designed to handle large motors and larger power consumption. The user experience can be greatly improved by providing an LCD display for user input regarding motor parameters.

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