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Research Paper

PROTECTION OF ADJUSTABLE SPEED DRIVES USING FUZZY LOGIC

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ASDs are ideal on loads where torque increases with speed, such as fans, blowers, centrifugal pumps, and most kinds of compressors. Constant-torque loads require the same torque regardless of speed such as reciprocating compressors, positive-displacement pumps, conveyers, center winders, and drilling/milling machines. In this project a motor's speed, Temperature, voltage and current are measured and maintained under preferred value for the motor protection purpose using fuzzy logic.

Keywords: Adjustable speed drive, Constant-torque loads, Fuzzy logic

INTRODUCTION

The uniqueness of the electrical environment on the output of ASDs requires special consideration to be given to the motor protection. ASDs have been widely used in industry for many years, such as blowers, centrifugal pumps, compressors. The operation of those applications must be continuous irrespec-tive of speed of the system. The motor characteristics such as temperature, voltage, current, and speed are measured. Those characteristics are maintained under preferred level using the fuzzy logic. Fuzzy logic is a form of many-valued logic that deals with approximate, rather than fixed and exact reasoning Compared to traditional binary logic (where variables may take on true or false values), fuzzy logic variables may have a truth value that ranges in degree between 0 and 1. Fuzzy logic has been extended to handle the concept of partial truth, where the truth value may range between completely true and completely false. The Working Group has investigated and addressed these concerns. This paper announces the report on the findings of this activity and the recommendations made to the motor protection.

FUZZY LOGIC

Fuzzy logic is widely used in a machine control. The term "fuzzy" refers to the fact that the logic

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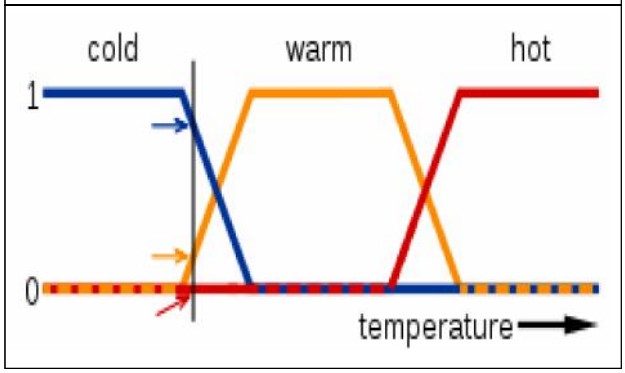
involved can deal with concepts that cannot be expressed as the "true" or "false" but rather as "partially true". Although alternative approaches such as genetic algorithms and neural networks can perform just as well as fuzzy logic in many cases, fuzzy logic has the advantage that the solution to the problem can be cast in terms that human operators can understand, so that their experience can be used in the design of the controller. This makes it easier to mechanize tasks. Fuzzy logic variables may have a truth value that ranges in degree between 0 and 1. Fuzzy logic has been extended to handle the concept of partial truth, where the truth value may range between completely true and completely false.

Figure 1: Fuzzy Logic Temperature



In this image, the meanings of the expressions cold, warm, and hot are represented by functions mapping a temperature scale. A point on that scale has three "truth values"—one for each of the three functions. The vertical line in the image represents a particular temperature that the three arrows (truth values) gauge. Since the red arrow points to zero, this temperature may be interpreted as "not hot". The orange arrow (pointing at 0.2) may describe it as "slightly warm" and the blue arrow (pointing at 0.8) "fairly cold

IF temperature IS very cold THEN stop fan

IF temperature IS cold THEN turn down fan

IF temperature IS normal THEN maintain fan

IF temperature IS hot THEN speed up fan

There is no "ELSE"—all of the rules are evaluated, because the temperature might be "cold" and "normal" at the same time to different degrees.

The AND, OR, and NOT operators of Boolean exist in fuzzy logic, usually defined as the minimum, maximum, and complement;

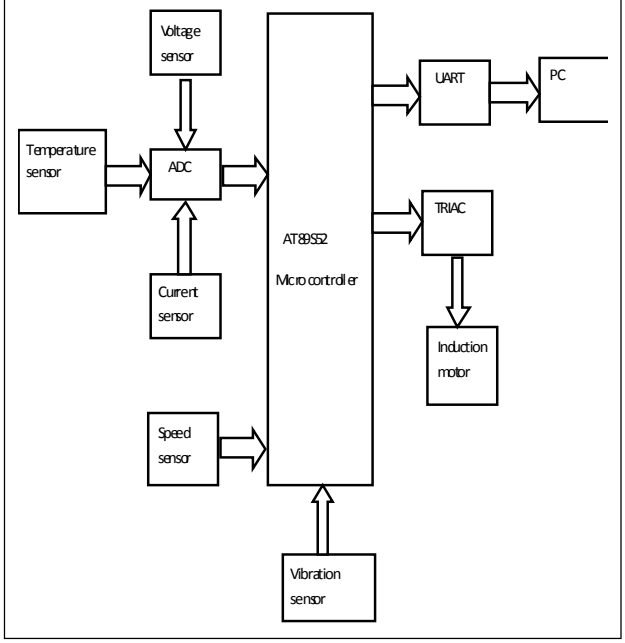
The fuzzy variables x and y:

NOT x = (1 - truth(x))

x AND y = minimum(truth(x), truth(y))

x OR y = maximum(truth(x), truth(y))

Figure 2: Block Diagram



The block diagram shows the proposed method which consists the system components.

HARDWARE DETAILS

AT89s52 Microcontroller

The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8 K bytes of in-system programmable Flash memory. The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the Industry standard 80C51 instruction set and pin out.

Features

- 4.0 V to 5.5 V Operating Range.
- 8 K Bytes of In-System Programmable (ISP)
- Flash Memory Endurance: 1000 Read/ Write Cycles
- Fully Static Operation: 0 Hz to 33 MHz
- 256 x 8-bit Internal RAM,
- 32 Programmable I/O Lines
- Three 16-bit Timer/Counters

ADC 0808/0809

The ADC0808, ADC0809 data acquisition component is a monolithic CMOS device with an 8-bit analog-to-digital converter, 8-channel multiplexer and microprocessor compatible control logic. The 8-bit A/D converter uses successive approximation as the conversion technique. The device eliminates the need for external zero and full-scale adjustments.

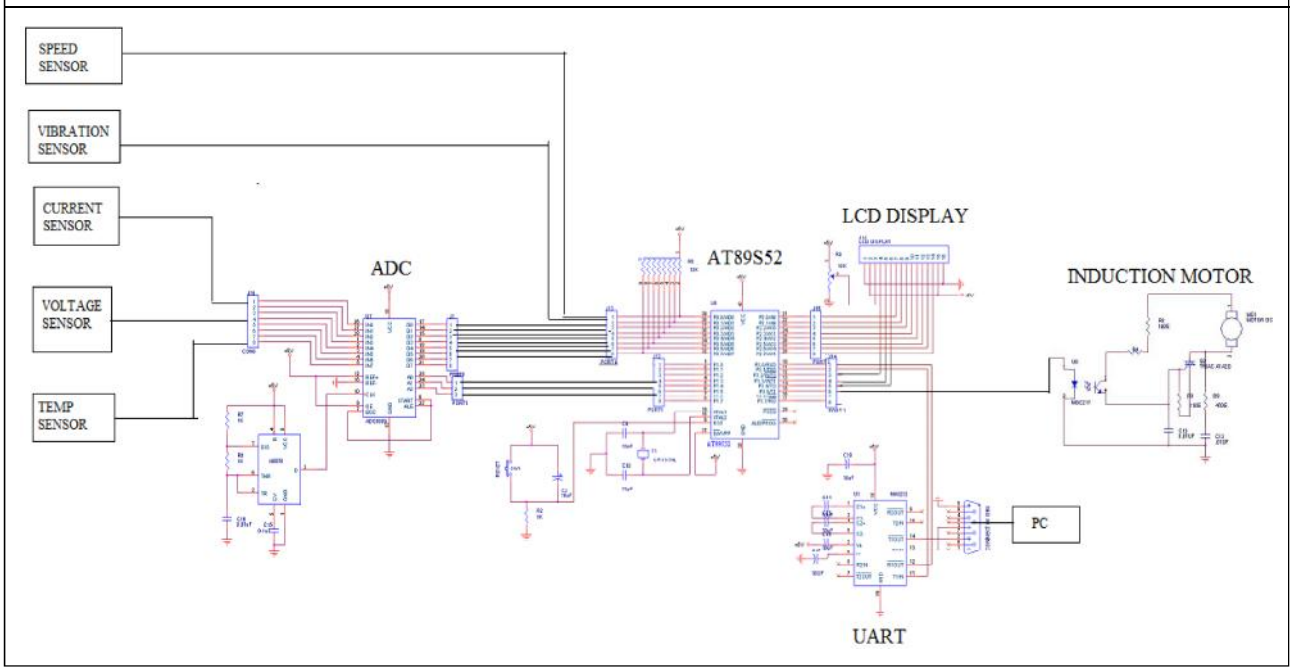
UART

A universal asynchronous receiver/transmitter (MAX232) is a type of "asynchronous receiver/ transmitter", a piece of computer hardware that translates data in parallel and serial forms between controller and PC.

SENSORS

The system uses current sensor, voltage sensor, speed sensor, temperature sensor and vibration sensor. The analog quantities obtained from those sensor are fed to the ADC which gives digital input to the controller to make operations.

Figure 3: Circuit Diagram



TRIAC

TRIAC, from Triode for Alternating Current, is a generalized trade name for an electronic component which can conduct current in either direction when it is triggered (turned on), and is formally called a bidirectional triode thyristor or bilateral triode thyristor.

A TRIAC is approximately equivalent to two complementary unilateral thyristors (one is anode triggered and another is cathode triggered SCR) joined in inverse parallel (paralleled but with the polarity reversed) and with their gates connected together. It can be triggered by either a positive or a negative voltage being applied to its gate electrode (with respect to A1, otherwise known as MT1). applying a trigger pulse at a controllable point in an AC cycle allows one to control the percentage of current that flows through the TRIAC.

POWER SUPPLY

Power supply is a reference to a source of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU.

A 230 v, 50 Hz Single phase AC power supply is given to a step down transformer to get 12 v supply. This voltage is converted to DC voltage using a Bridge Rectifier. The converted pulsating DC voltage is filtered by a 2200 uf capacitor and then given to 7805 voltage regulator to obtain constant 5v supply. This 5 v supply is given to all the components in the circuit. A RC time constant circuit is added to discharge all the capacitors quickly. To ensure the power supply a LED is connected for indication purpose.

Table 1: Hardware Result

Voltage (volts)	Current (Amps)	Temperature (Celsius)	Speed (RPM)
214	2.6	49	467

Figure 4: Power Supply Circuit Diagram

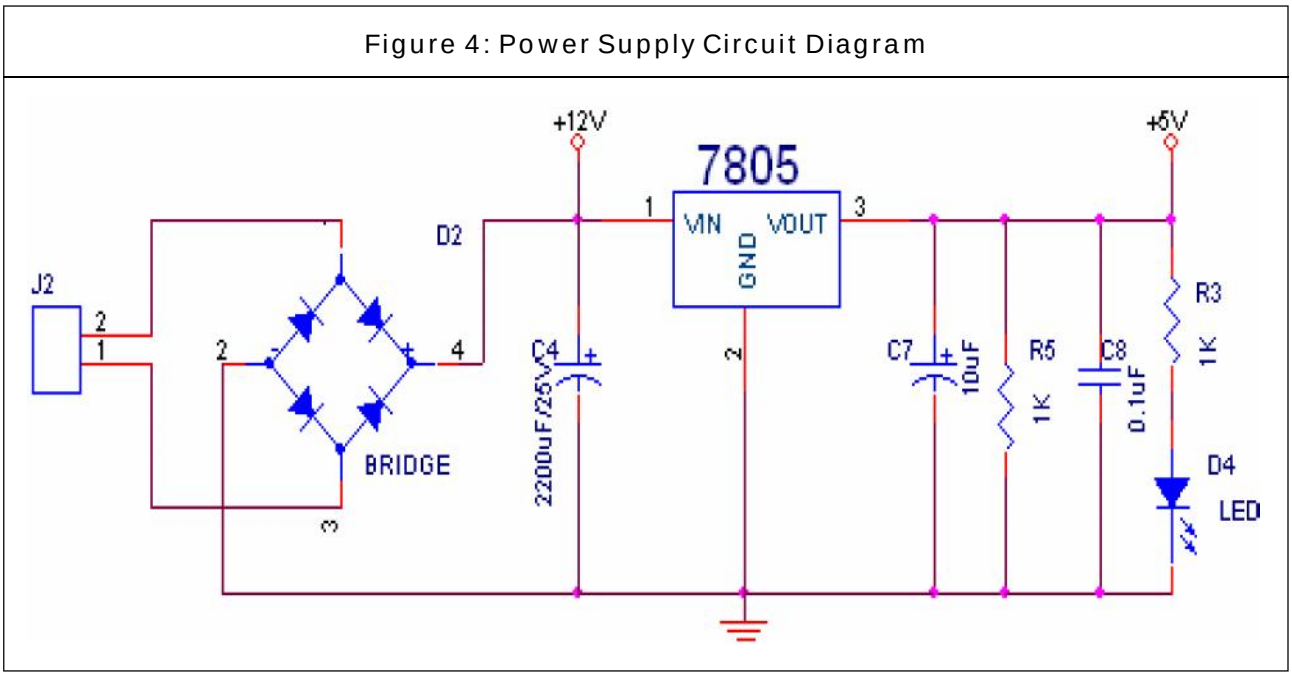
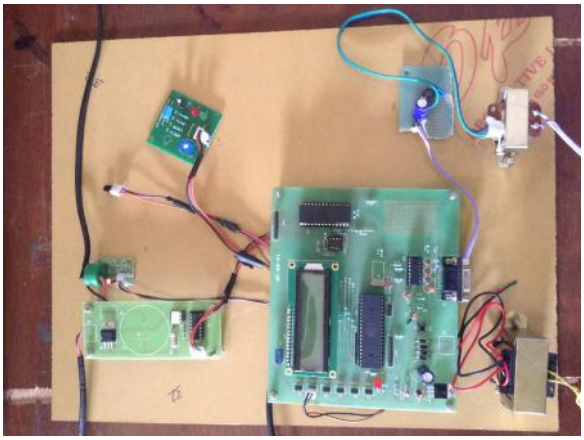


Figure 5



CONCLUSION

ASDs of particular importance is the inclusion of the specific protective function, not necessarily its physical location either in an external protection system or internal to the drive controls. The system is made to operate and verified for satisfactory operation using fuzzy logic.

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