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GSM Based Automatic Motor Control and Protection System

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ABSTRACT

Some wise scientist once said that control system is a system where we can shut down the machine whenever we want. That's the difference between controlled and uncontrolled machine. Our project is about make this control system efficient and dynamic. As the name suggested the automatic control is for controlling the motor from remote place, look over it's operating conditions, get feedback from the motor itself. Our target is to control the motor from distant place by mobile DTMF tone and also get feedback by SMS while it is in ON or OFF condition. We also ensure the safe operation of the motor by detecting the voltage of the source and ensure feedback from system while it is over or under voltage. Again we also get these feedbacks by SMS as well. GSM network is everywhere in our country that's why we choose GSM network to operate our motor also transfer feedback information through it. We also use GSM network because if we use it then we don't need to establish extra equipment for networking. To transmit feedback signals we use GSM modem at the motor end also generate control signal by mobile DTMF because it is very easy to generate DTMF by mobile station and send feedback SMS by Modem as well. In industrial sector we hope our project is become handy and cost effective to operate motor and give it's protection

Keywords : DTMF Decoder, Hand Shaking Device, AT Command, Rectifier Circuit, GSM Modem, Microcontroller.

1 INTRODUCTION

Some wise scientist once said that control system is a system where we can shut down the machine whenever we want. That's the difference between controlled and uncontrolled machine. Our project is about make this control system efficient and dynamic.

Today in Bangladesh for industrial sector motors are too much important. But high rating motors required safe operation. Equipment necessary for automatic motor control and safety system requires more foreign currency to import. Although maximum systems are consist of wires which increase complexity of the system. That's why we are willing to make a device which is dynamic, cheap and wireless in the field of motor controlling. Again safety of a motor is also a major concern because malfunctioning of a huge motor can cause a huge loss in production also increase maintenance cost of the motor itself. That's why we include safety function in our project. Mentioning that safety system is also wireless makes it dynamic and one can observe motor's operation from a remote place and control it.

We use GSM system here to increase reliability of the network and save the cost of networking equipments.

2 METHODOLOGY

2.1 Project Objective

The main objective of this project is to control the motor. Control means ability to shut down a machine whenever we want to and in this project it is done with wireless signal transmission. Our objective is to give the motor proper protection. We give over voltage and under voltage protection by fetching feedback signals from the load end.

2.2 Project Overview

There are three functions in this project:

- motor control
- on-off state detection
- motor safety

2.2.1 Motor Control

In this portion the motor can be turned on or turned off. Precisely there have been used two mobile stations: a receiver and a transmitter. The receiver mobile is always in auto receiving mode. When a call is made by the transmitter mobile then the call is automatically received by the receiver cell phone. Then the transmitter mobile gives a command to the receiver mobile phone. The command is then transferred to a DTMF decoder.

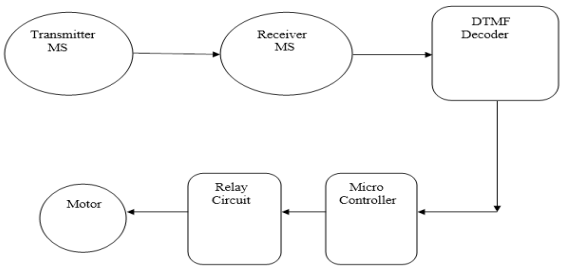

Fig. 1. Magnetization as a function of applied field

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2.2.2 On-Off State Detection

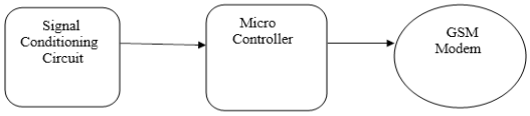

Fig. 2. Block diagram of on-off stste detection for motor

It is seen from the above potion that the microcontroller receiving signal from the signal conditioning circuit operates the relay. Same time the microcontroller sends a command to a signal sending MS to send a signal to the transmitter mobile station whether the motor is in on or off state.

2.2.3 Motor Safety

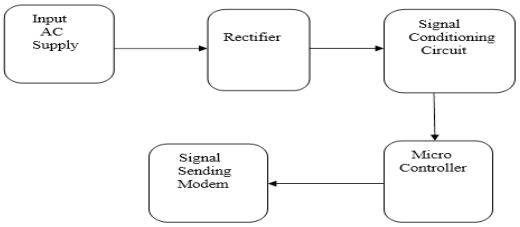

Fig. 3. Block diagram for motor voltage safety process

In this portion motor safety is provided. At first the AC input supply which drives the motor is rectified by a rectifier and then it is send to a signal conditioning circuit then sends to a micro controller. Microcontroller has a threshold value for 220V AC supply. Hence if the AC input supply reaches to a over voltage or under voltage then the microcontroller commands the signal sending modem to send a message to the controller mobile station. By this way one can be alerted to take necessary steps to save the motor.

3 ADOPTED TECHNIQUE

3.1 DTMF decoder circuit

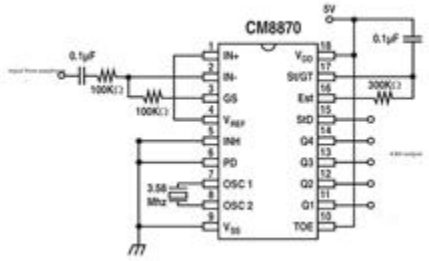

Fig. 4. DTMF Decoder circuit [2]

This circuit detects the dial tone from a telephone line and decodes the keypad pressed on the remote telephone. The dial tone we heard when we pick up the phone set is call Dual Tone Multi-Frequency, DTMF in short.

3.2 Transistor Switching of Motor

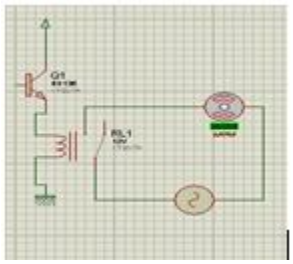

Fig. 5. Relay Circuit to operate motor

The circuit looks that of the *Common Emitter* circuit we know. The difference this time is that to operate the transistor as a switch the transistor needs to be turned either fully "OFF" (cut-off) or fully "ON" (saturated).

3.3 Over voltage and under voltage detection circuit

Here bridge rectifier is used to make AC voltage into DC. Using bridge rectifier cause .14 volt voltage drop here but produce less ripple.

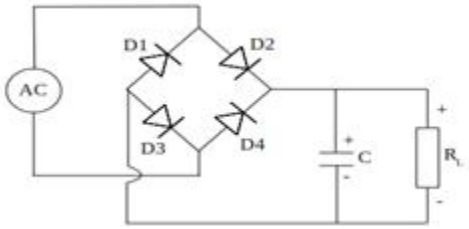

Fig. 6. Rectifier circuit used in voltage detection [1]

3.4 Hand Shaking Device

When communicating with various micro processors one needs to convert the RS232 levels down to lower levels, typically 3.3 or 5.0 Volts. Serial RS-232 (V.24) communication works with voltages -15V to +15V for high and low

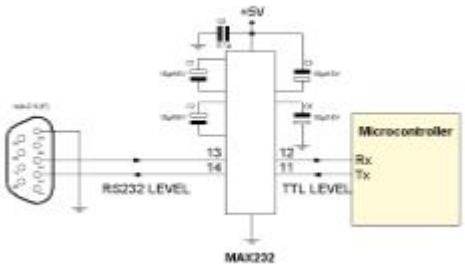

Fig. 7. Connection of Hand Shaking device [3]

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On the other hand, TTL logic operates between 0V and +5V. Thus the RS-232 signal levels are far too high TTL electronics, and the negative RS-232 voltage for high can't be handled at all by computer logic. To receive serial data from an RS-232 interface the voltage has to be reduced. Also the low and high voltage level has to be inverted. Modern low power consumption logic operates in the range of 0V and +3.3V or even lower. In our project PIC microcontroller works with 5 volt and 0 volt logic but to send AT command to Modem this signal should converted to a level of serial RS232. That's why we need a handshaking device. Here we use MAX232 as a handshaking device. This is a cheap and simple way to do that.

4 Design and Hardware Implementation

4.1 Overall Circuit Diagram

In the simulation design we can see the overall circuit diagram of this prototype project.

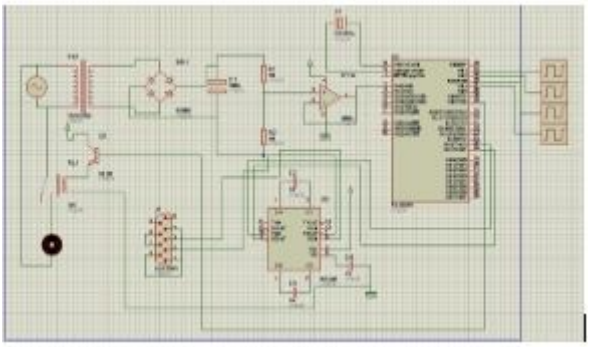

Fig. 8. Complete Circuit diagram of motor control and protection system

4.2 DTMF Decoder and Motor Drive Unit

DTMF decoder grab the tone signal from receiver mobile station and generates 4 digit binary codes. This 4 digit binary code sends to a microcontroller input. Micro controller checks the inputs and if the program logic satisfies the input logic then it turns on either off the motor. At the same time micro controller sends a sms to the controller through Modem which is operated by the micro controller itself.

In order drive the mootor Base current to flow, the Base input terminal must be made more positive than the Emitter by increasing it above the 0.7 volts needed for a silicon device. By varying this Base-Emitter voltage V_{BE}, the Base current is also altered and which in turn controls the amount of Collector current flowing through the transistor. When maximum Collector current flows the transistor is said to be Saturated. The value of the Base resistor determines how much input voltage is required and corresponding Base current to switch the transistor fully "ON". This transistor switching circuit operate the motor to be ON either OFF.

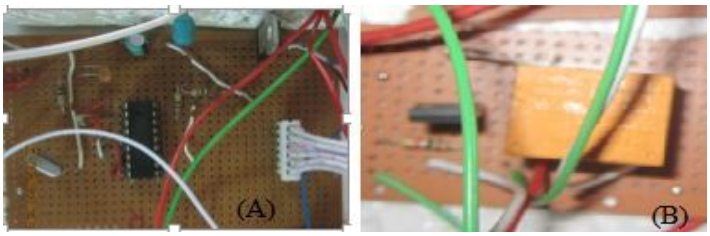

Fig. 9. (A) DTMF Decoder circuit, (B) Relay circuit to drive the motor

4.3 Confirmation Sending Unit

This unite consist of a microcontroller interfaced with a GSM modem named MOD 9001 by a hand shaking device consisting MAX232. [4]

For confirmation of the motor state also give over voltage and under voltage detection massages, preferred signals are provided to the microcontroller mother board by signal conditioning circuit**.**

PIC microcontroller is interfaced with Modem by hand shaking device. Modem works with AT command send by microcontroller. When microcontroller found proper logic of over voltage occur either under voltage then it gives signals (AT commands) to modem to send a SMS to the controller mobile phone number which is defined at the program. This process also happened when motor become ON either OFF. Modem also send SMS to controller mobile phone number.

Fig. 10. (A) Signal conditioning circuit for voltage dtection, (B) Modem connection with microcontroller by handshaking device.

5 Testing and Results

Motor is controlled in a predefined manner as theory. DTMF is responding fast as also microcontroller but notification goes in a delay about several seconds because of fluency of program also because of the slowness of the auxiliary interfacing device.

Overvoltage and under voltage can be notified by sms. But because of reducing a value of 220 volt ac into 3 volt dc the error margin is quite small here.

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Fig. 11. ON state of the load

Fig. 12. OFF state of the load

6 CONCLUSION

Design such a project and implement it, we gather great practical experience. We tried to implement our theoretical knowledge successfully. This course teaches us about the far difference between theoretical and practical knowledge.
This project increases our ability to work as a group and it helps us in future life.
But we face several problems because of unavailability of quality goods, technical support and inexperience. Despite that we enjoyed our work very much and successfully finished that work in perfection.
In this dynamic world motor is the most convenient and useful tool in industry. Large rated motor required flexible control and protection. We hope our project can bring dynamic change in our industrial level motor controlling system.

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