IVR System for three phase motor protection, Control and Alert system using GSM

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Abstract- *Control systems have received exceptional attention in the industrial sector as they manage and regulate various systems. This paper is focused on the development of an IVR system for three phase motor control. A new approach is proposed for designing the protection and control unit of the three phase motor using the IVR systems. The main objective is to control the motor from a remote place using the mobile DTMF tone and also to receive the motor status feedback through SMS. GSM is found to be the most convenient, cost efficient network to be used for the transmission of the feedback signals at the motor end along with the generation of control signal by mobile DTMF. This control signal and the feedback SMS is transmitted through the GSM modem. Thus, this paper serves as an introduction to a new control technique of a three phase motor which can be effectively used for industrial purposes along with providing an SMS based alert system.*

Keywords- IVR, DTMF, GSM, Modem, Feedback SMS, three phase motor, control signal

1. Introduction

This Project is a very good example of embedded system as all its operations are controlled by intelligent software inside the microcontroller. The aim of this project is to control i.e. to ON/OFF control of different motors, the electrical or electronic appliances connected to this system from anywhere in the world. For this purpose user can use any type of Mobile. This way it overcomes the limited range of infrared and radio remote controls. Using the convenience of SMS and Phone calls, this project lets you remotely control equipment by sending text messages and all of which can be pre-programmed into the controller and easily remembered later.

Short Message Service (SMS) is defined as a text-based service. That enables up to 160 characters to be sent from one mobile phone to another. In fact, SMS has taken on a life of its own, spawning a whole new shorthand language that's rapidly many industries have been quick to make use of this technology, with millions of handsets currently in use.

Seeing the illiteracy in India we overcome the problem of reading and writing text messages by providing the facility of voice calls with the help of IVR system which would be more helpful and beneficial to rural and uneducated farmers. With this in mind, we've designed the project to work with Quectel M95 GSM modem.

1.1 Problems already existed:

Problems caused due to the existed systems are doesn't provide any power status, motor on/off status. Some of the systems are purely SMS based systems. But many of farmers didn't know about SMS.

1.2 Solutions:

So our intension behind is minimizing the work of farmers, improving the use of irrigation, maintaining optimal usage of electricity to provide an interactive system to farmers .The main aim of this project is to provide flexibility to trigger the motor pumps from any location in an easy way.

1.3 Benefit to user:

- Automatic intimation through calling from System to the Users registered mobile numbers.
- Water pump can be controlled from any location by a mobile phone or landline phone.
- The Motor protection unit continuously scans the faults like Under Voltage, Over Voltage, SPP, Reverse Phase, Voltage Unbalance, Under Load and Over Load.
- User can check the load on/off status by an IVR response simply.
- This unit protects the three-phase motor from getting burn out due to absence or reduction of phase voltages during its operation. It continuously measures and takes the decision accordingly.
- IVR -Voice response available in regional language and remote monitoring for 3 registered numbers.
- Inbuilt phone book for auto reply in case of faults.
- Password protected phonebook registration process.
- Complete protection from electrical unhealthy condition.
- All parameters are password protected.
- All parameters are settable through SMS.
- LED indications for fault occurred.
- User Programmable Timer for Motor ON/OFF.

2. Design Concept

Here we have used power supply to convert 440V to 15V. And similarly we are using Quectel M95 GSM modem. In future we can also use modem having both GSM and GPS facilities for theft control.
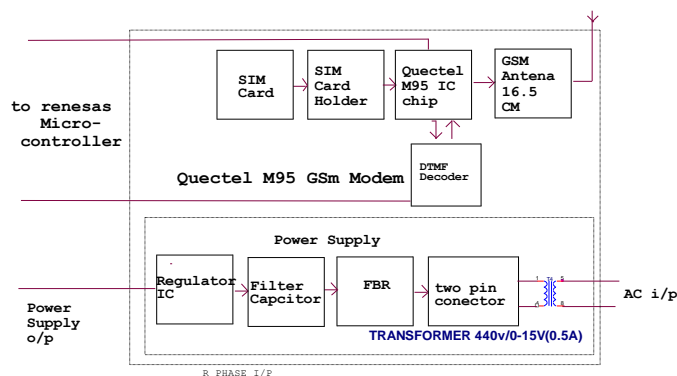

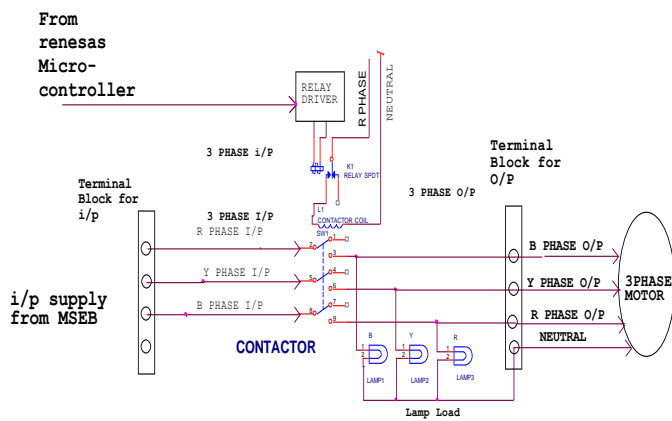Fig2.1 Block diagram Power Supply and GSM Modem

Fig2.2 Representation of connecrtions between Microcontroller and MSEB supply

Here we have used micro-controller for monitoring the different parameters and making decision. The ADC is interfaced with the micro-controller for calculation of respective voltages. The ADC has 8 different channels that can be selected by the micro-controller by giving appropriate select signal.
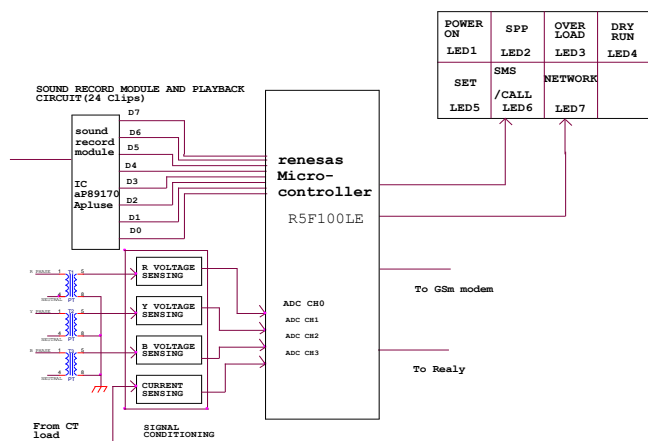

Fig2.3 Renesas Microcontroller with LED connections and Signal conditioning circuit

3. Motor Control via Call:

The GSM CONTROLLER has inbuilt Interactive Voice Response System (IVRS) controlled start/stop and remote monitoring. User can control the motor by voice call to the controller only by entering the password. While the call is on the motor starts if users presses 1 on his mobile, likewise stops if 3 is pressed, SMS of present state is received if 3 is pressed and a present status/condition of the motor can be heard if 9 is pressed. Also the user can change the password by pressing 7 and entering new password when asked from the unit.

4. Motor control via SMS:

The Motor can be Started/Stopped by sending SMS through any mobile with the commands mentioned below having user settable password protection. If any fault occurs to the motor, controller will send SMS to the registered numbers in the unit. If any fault occurs the controller will send an SMS which contains current fault status to 3 mobile numbers stored in the Controller.

4.1 GSM command for Motor operation

Here we are using specific commands for working of motor via SMS and the commands are shown below in the following table:

Action Needed	SMS Command Details	Example Command	Factory Defaults	Setting Range
	Here, XXXX is the 4 digit password	Default Password : 1234		
To Add Registered Mobile Number	*XXXXA<10-Digit Mobile No.>#	*1234A9657016068#	No Number	
To Delete Registered Mobile Number	*XXXXD<10-Digit Mobile No.>#	*1234D9657016068#		
To Get Registered Mobile Number List	*XXXXLST#	*1234LST#		
To Start Motor	*XXXXON#	*1234ON#		
To Stop Motor	*XXXXOFF#	*1234OFF#		
To Set Motor Current	*XXXXSPC#	*1234SPC#		
To Change Password	*XXXXCPWD<4 Digit New Password>#	*1234CPWD5678#	1234	
To Load Factory Setting	*XXXXLFS#	*1234LFS#		
To Get Motor Status on Site	*XXXXSTS#	*1234STS#		
To Check Parameter Settings	*XXXXPSET#	*1234PSET#		
To Check Measurement Values	*XXXXREAD#	*1234READ#		
To Stop Outgoing SMS From Starter Unit	*XXXXDSMS#	*1234DSMS#	Enable	
To Start Outgoing SMS From Starter Unit	*XXXXESMS#	*1234ESMS#		
To Start Password Protection (SMS & CALL)	*XXXXEPWD#	*1234EPWD#	Disable	
To Stop Password Protection (SMS & CALL)	*XXXXDPWD#	*1234DPWD#		
To Reset All Faults Occurred	*XXXXRSTF#	*1234RSTF#		

To Set Power On Time	*XXXXPOT<3 Digit Value>#	*1234POT060#	60 Sec	010Sec - 300Sec
To Set Auto Switch Time	*XXXXAUT<3 Digit Value>#	*1234AUT060#	60 Sec	010Sec - 300Sec
To Set Start To Delta Change Over Time	*XXXXSDT<2 Digit Value>#	*1234SDT08#	10 Sec	08Sec - 30Sec
To Set Under Voltage	*XXXXUV<3 Digit Value>#	*1234UV220#	220V	160V - 380V
To Set Over Voltage	*XXXXOV<3 Digit Value>#	*1234OV470#	470V	420V - 500v
To Set Unbalance Voltage	*XXXXUNBAL<2 Digit Value>#	*1234UNBAL40#	40V	10V - 70V
To Set OL/Dry Reset Time	*XXXXODR<4 Digit HHMM>#	*1234ODR0115#	1 Hour:15Min	00hr:01min - 23hr:59min
To Set Dry Run Trip Percentage	*XXXXDRY<2 Digit Value>#	*1234DRY70#	70%	50% - 90%
To Set Over Load Current Trip Percentage	*XXXXOLC<3 Digit Value>#	*1234OLC130#	130%	110% - 200%
To Set Motor OFF Time	*XXXXSTMR<4 Digit HHMM>#	*1234STMR0000#	00hr:00sec	00hr:01min - 23hr:59min
To Enable Motor OFF Timer	*XXXXETMR#	*1234ETMR#		
To Disable Motor OFF Timer	*XXXXDTMR#	*1234DTMR#	Disable	
To Enable Dry Run Protection	*XXXXEDRY#	*1234EDRY#		
To Disable Dry Run Protection	*XXXXDDRY#	*1234DDRY#	Disable	
To Enable Auto Mode Operation	*XXXXEAUTO#	*1234EAUTO#		
To Disable Auto Mode Operation	*XXXXDAUTO#	*1234DAUTO#	Disable	
To Enable Over Load/Current Protection	*XXXXEOL#	*1234EOL#		
To Disable Over Load/Current Protection	*XXXXDOL#	*1234DOL#	Disable	
Help Menu	*XXXXHELP#	*1234HELP#		

Table 4.1 GSM command for Motor operation

5. LED

We are using LED slot for status indication and following LEDs represents different status of motor:

1. Supply Healthy (Green) (No fault)
2. SPP/UB/RP (RED): SPP, Voltage Unbalance& Reverse Phase Fault.
3. OL (RED): Over Load Fault.
4. DRY RUN (RED): Dry Run Fault.
5. SET CURRENT(RED): Set Motor Current
6. SMS/CALL(RED): Communication Indication
7. NETWORK(RED): Network Indication

6. Flowchart-

As we know motor can be operated via Auto and Manual mode as per user's requirement. Further motor can be controlled via

Phone/SMS as per user's requirement. The following flowchart represents the step by step working of the motor:
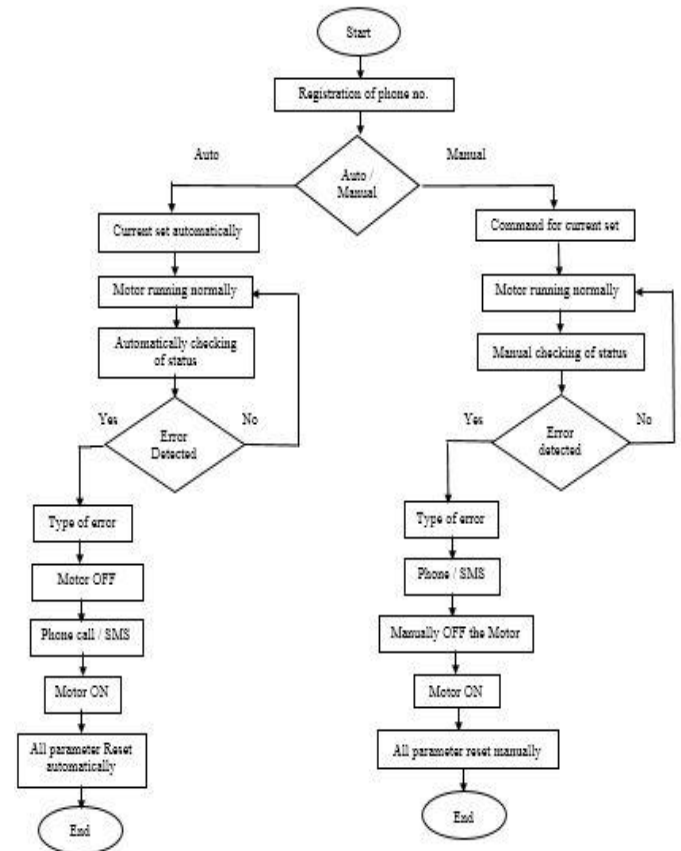

Fig6.1 Flowchart

7. Simulation and result:

The following Simulation are obtained on Gold wave software. Gold wave is a sound recording and sound developing software. By using Gold wave software we can reduced hissing and humming from the voice to get a clear error free voice.
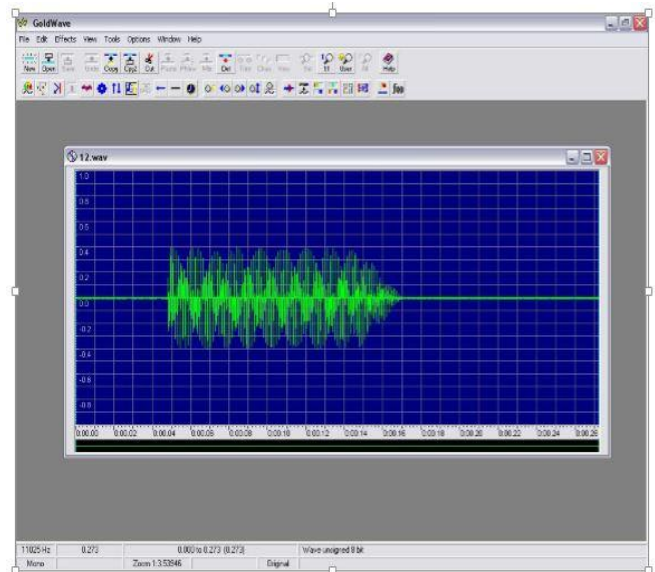

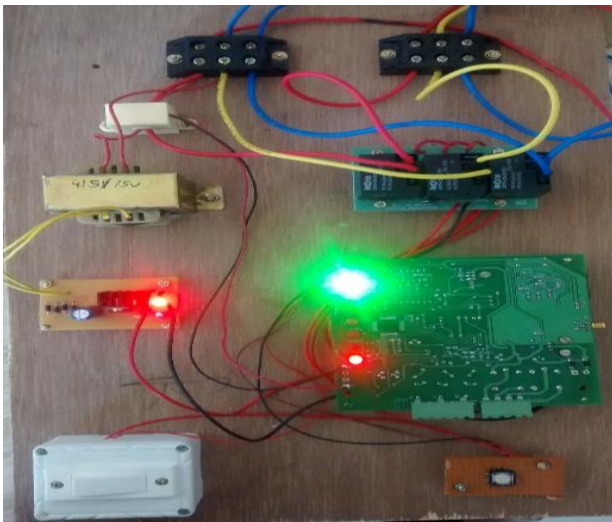Fig7.1 Gold wave software used for voice recording

Fig7.2 Hardware implementation Three phase motor Protection, Control and alert system using GSM with IVR response

In this way we come to know the status of the motor via SMS on our phone and this help us to protect our motor from any type of fault occurred. The most important factor is we can reset the motor via SMS.
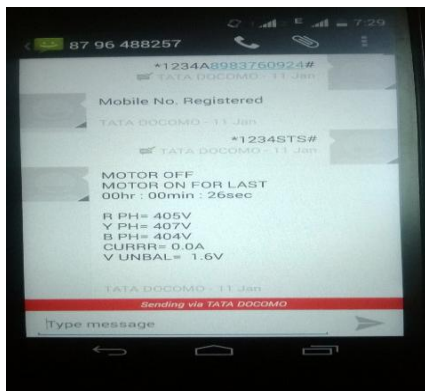

Fig3. Fig7.3 Sample SMS sent via GSM

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8. CONCLUSION:

Based on the results, it can be concluded that the three phase motor can be successfully controlled from remote places. The hardware implementation evidently proves the working of the IVR system and thus the system can be readily used in practice. The existing system was based on SMS communication but we have introduced interactive voice response to make it convenient and user friendly. The results indicate that the proposed GSM technique can be successfully applied to earlier systems. The speed of the communication is increased with distance independency. The key challenge in the motor designing is its flexible control and protection which makes it an important tool in industries. Thus, the findings of this research have opened up new fields in the industrial level motor control area.

REFERENCES:

[1] Arrick Robotics, "Driving High-Power Loads with a Microprocessor,"2005,
http://www.robotics.com/highload.html.

[2] D. Neamen, Electronic Circuit Analysis and Design. New Mexico: Times Mirror Higher Education Group Inc, 1996.

[3] MM74C922, MM74C923 16-Key Encoder, General Manual, 1999.

[4] D. J. Gardner-Bonneau, and H. Blanchard (ed), Human factors and voice interactive system (Boston, USA: Kluwer, 2007)