Embedded System Based Submersible Motor Control for Agricultural Irrigation Using GSM and To Prevent It Against Over Loading, Dry Running and Single Phasing Automatically

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Abstract— Embedded System based submersible motor control to prevent it from over load, dry run and single phasing using GSM for Agriculture Irrigation is the work done in this project which can be used to control and monitor the submersible motor used for agriculture irrigation using GSM network. This project provides the development of mobile phone as remote control application for submersible motor pump which is used in agriculture irrigation. The motor connections depends upon its horse power, it may be Direct on line or Star Delta. The motor is controlled by the micro controller and the present status of motor is sensed and it is automatically controlled by itself and the information is transmitted to the corresponding person through GSM network. The GSM mobile phone is used as an alternative to turn on and off the motor through a message or a missed call and also to send message to the owner about the following three faults. A micro controller is used to detect the three types of fault which cause damage to the motor. The first one is single phase absence fault detection and if it occurs the micro controller will automatically turn of the motor. The micro controller also includes the protection against over current or over load and also from dry running. It is expected that this application will be comfortable for the farmers and this provides easy access of motor to a greater extent. All these control process are achieved by using a PIC microcontroller, GSM and Different interfacing and control circuits.

Key words: Microcontroller, GSM, SMS, Current, Voltage, Motor And Irrigation

I. INTRODUCTION

India is basically an agricultural country, and all its resources depend on the agricultural output. With the rapid development of agriculture in India, many automatic technologies have been introduced into agricultural productions. The total rainfall in a particular area may be either insufficient, or ill-timed. In order to get the maximum yield, it is essential to supply the optimum quantity of water, and maintain correct timing of water. This is possible only through a systematic irrigation system-by collecting water during the periods of excess rainfall and releasing it to the crop as and when it is needed. Irrigation is the science of planning and designing an efficient, low-cost, economic irrigation system tailored to fit natural conditions [1]. By the construction of proper distribution system, the yield of crop may be increased because of controlled water supply. The different methods of supplying water to the fields are Surface irrigation, Sub-surface irrigation and Sprinkler irrigation. The stored or diverted water is conveyed to the agricultural fields through some suitable distribution system. Hence, there are now pressing needs for intelligent irrigation system.

The aim of this project is to develop a cost effective solution that will provide remote control for induction motors through mobile phones using missed calls and messages. The mobile user in the world has a tremendous rise during the past few years. Remote monitoring of processes, machines, etc., is popular due to advances in technology and reduction in hardware cost [2]. Remote monitoring through Internet based monitoring is one of common approach. This approach requires PCs (Client/Server) along with additional devices like modems, buffers, etc. for internet connectivity and software support for TCP/IP protocols and control system interaction. The cost of such system varies greatly depending on speed and bandwidth requirements and hence is justified usually for bio- medical and industrial applications where intensive data transfer is required. Cellular networks provide Short Messaging Service (SMS) and Multimedia Messaging Service (MMS), approach offers simple interface with only destination cell phone address and message requirement without any header / protocol overhead. So this method is suitable for remote monitoring of systems with moderate complexity. Wireless sensor networks also offer opportunity for remote monitoring [3] [6] [9].

II. PROBLEM OF STATEMENT

Many farmers use induction motor pumps to irrigate their farms from wells, rivers and nearby streams. However, shortage of electric power in many states has resulted in unplanned load shedding of long durations in rural areas. Moreover, in villages, single-phasing connections have been implemented. The electricity companies allocate lower priority to 3-phase power supply to rural areas due to unpaid electricity bills running into millions of rupees. Most of farmers use sprinkler based or surface based irrigation. Three phase induction motors with direct-on-line or star-delta starters are used. For sprinkle based irrigation, farmer first arranges set of pipes with nozzles in the region of distribution of water and then switches on the pump. He waits for specific duration to ensure that water is distributed in sufficient quantity and then shifts the set of pipes to other dry regions and repeats the process. In many cases, the distance between location of pump (water source) and the region of distribution of water (farm) might extend to few kilometers. In case of power failure, farmer has to go back to pump region and wait for power restoration. For surface based irrigation, water is discharged through pipe at ground surface and gradient is created to distribute the water through the various regions. There are frequent instances of

burning of motor due to unequal phase voltages and dry running of motor. Repairing cost of pump and non-distribution of water during motor failure period cause substantial reduction in yield of crop. Conventional remote monitoring systems using cellular network use dedicated GSM modem for AT command interface. This modem sends the working condition of the motor to the user cell phone as messages. This helps the users to control the motor using missed calls.

III. System Description

A remote control application to control the motor using the mobile is developed to reduce the risk of farmers. The motor can be turn on and turn off manually and also by using the mobile phone by sending a text message or by giving a missed call. An Embedded system based control panel is designed to control and monitor the motor from various known fault. Basically in the agricultural irrigation the motor is connected to the control panel. The control panel which contains microcontroller monitors the supply of motor and controls the process of motor i.e. the control panel checks the usually known problems and rectify it prevent the motor from damage. The known faults that may occur are phase sequence change, dry running of motor, over load condition and absence of a phase. The motor starts automatically when the power restoration occurs. The microcontroller controls the operation of the starter based on the information from the sensors. When the current level is low or when there is no flow of water in the pipe after a particular period due to motor or starter fault or when there is insufficient water level in the well, the motor gets off automatically and the problem is intimated to the farmers through messages from GSM. The GSM is connected to the microcontroller through the RS232 interface. The user can control the starter using missed calls when needed or when abnormal conditions exist.

The block diagram of the system is shown in the Fig.1. The missed calls are received from the user mobile to perform specific task. Based on the received signals and sensor conditions, the signals are sent to the microcontroller to switch on/off the motor through the starter using the relays. The relay is controlled by the ports.

A. Cell phone Interface

The GSM modem communicates with the user cell phone to intimate the condition obtained for the microcontroller. Serial Port Adapter works in data and AT modes and needs to be properly configured. During power-on condition, SPA is initially in data mode and by sending "///" characters within 3 seconds, the device is moved into AT mode for configuration. In AT mode, series of commands are sent for proper configuration. If match is found, it starts data communication between micro-controller system and GSM. AT commands are sent by sending text strings 'A', 'T', along with specified command strings through serial port to cell phone and are executed on receipt of carriage return. The result codes are sent by cell phone to system (TE) to indicate the status after execution of command [4].

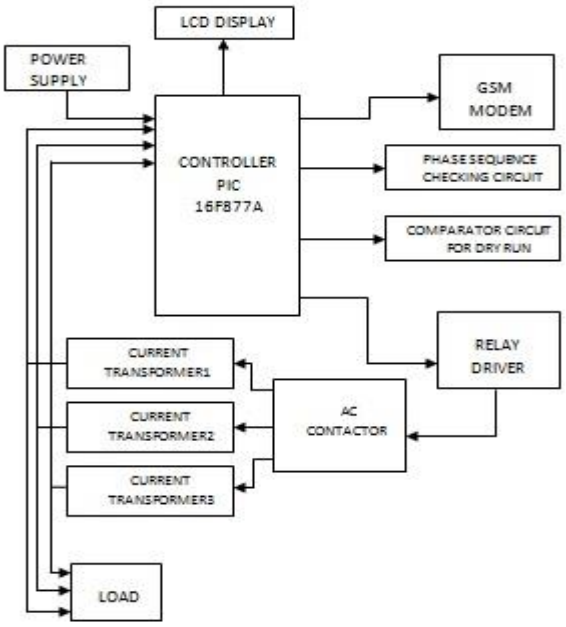

Fig. 1: System Block Diagram

B. SMS Approach

SMS is store and forward way of transmitting messages between cell phones. The major advantage of using SMS is provision of intimation to the sender when SMS is delivered at the destination and ability of SMSC to continue efforts for delivery of message for the specified validity period if network is presently busy. The text message is sent to cell phone using CMGS command. CNMI command is used to indicate to TE about the receipt of incoming SMS message from the network. It is observed that most of current cell phones do not support CNMI command [5].

IV. Controller System & Analysis

The controller is the heart of an embedded system. There are several familiar controllers (8051 microcontroller, PIC microcontroller, AVR, ARM processor, etc…) are used to detect the change in phase sequence, over load condition and dry running. If the any one of the above mentioned fault occurs the corresponding LED will start glow, the information will also be displayed on the LCD display and the information about the situation will also be send to the farmers and also the motor gets off automatically. The motor starts automatically when the power restoration occurs [6].

PIC16F877A microcontroller has RISC architecture with 512 kb of Flash Memory, 256 Bytes E2PROM, 2 kb SRAM, 32-bit General purpose I/O, 8 channel 10-bit ADC, USB, USART, SPI, JTAG interface support, etc…

To perform the various operations of sensing the current and voltage a special current sensing circuit is designed and interfaced to the microcontroller. The analog signals from the circuit are converted to digital signals using the Analog to Digital converter present inbuilt in the controller. These sensors ensures the indication of catastrophic events like burning of motor due to any faults like over-current, bearing breakage, insulation failure etc. so

that preventive measures can be carried out at substantially lower cost.

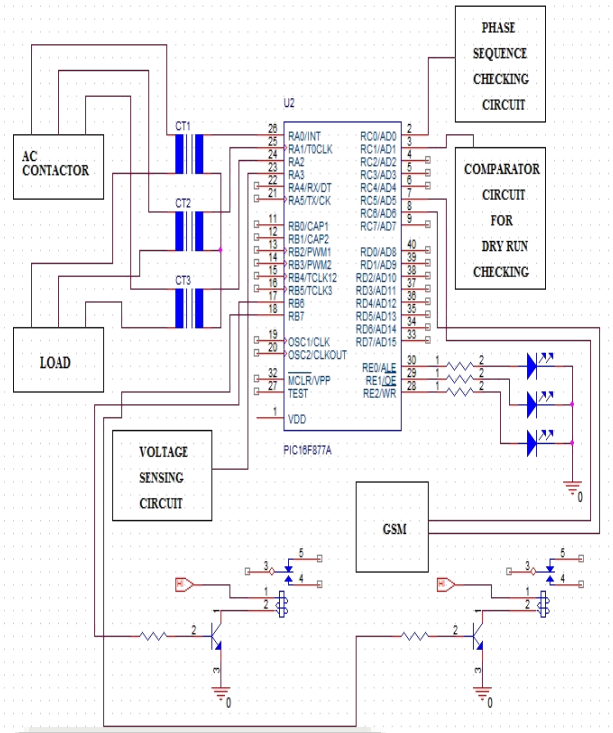

Fig. 2: Microcontroller system Interfacing

Interfacing diagram of micro-controller system is shown in Figure 2. Port A is configured for analog inputs. AN0, AN1, and AN2 is connected to the current flow sensing circuit i.e. current flow sensor and AN3 is connected to voltage sensing circuit i.e. voltage sensor. Port E is configured as output is connected to LEDs which is used to indicate the over load, dry running and normal running. Pins RC5 and RC6 are used for GSM transmit and receive command. A relay drive consists of two relays are connected to RB6 and RB7 which is used to switch on and off the AC contactor through wireless using GSM [7]. And also to make the motor off when the catastrophic events occur like burning of motor due to any faults like over-current, bearing breakage, insulation failure etc.

V. Conclusion

Thus the developed system enhances the motor control through wireless using GSM in the field optimally. The system ensures protection of motor against overloads, overheating, dry running and phase imbalances. It also provides automated restarting if normal conditions are re-established i.e. when proper power restoration takes place. Uniform distribution of water at regular intervals, reduction in labour cost, prevention of unwanted water spillage, minimization of occurrences of motor faults and intimation to user about the completion of task are the major advantage of this system. The use of mobile phone has become more common among the farmers and hence used. The system proves to be great boon to farmers whose pump sets are located far away from their homes due to capability of remote control using cell phone and intimation about any abnormal conditions. The system is designed to have cell phone with in- built security against unauthorized users. Any cell phone model can be used for communication so that the system improves its adaptability to use. Low operating cost using messages and missed calls are the major attractions of this system.

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