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DESIGN DEVELOPMENT AND IMPLEMENTATION OF SMART MOTOR CONTROL SYSTEM FOR IRRIGATION

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Abstract: ***India is emerging country; farmers have started using latest technologies in the farm fields to increase the efficiency and productivity. When it comes to farm's water management system, automated motor control systems have become common in recent days. However, that did not stop the intervention of the human in the process of controlling the motor as the water requirement of every farm is different. There are many products in the market today to automate motor control but, none provide the complete solution. The objective of this paper is to provide a complete solution that allows the farmer to configure the motor control system as per farm's water requirement. In order to achieve this, the motor control system uses GSM technology to control the connected, the system uses EEPROM memory to save user configuration and a RTC to track the timings. The motor control system mentioned is devised considering the fact that it provides complete solution at low cost.***
Keywords: GSM; EEPROM; RTC

I. INTRODUCTION

In our country Agriculture is major source of food production to the growing demand of human population. In agriculture, irrigation is an essential process that influences crop production [3]. Different parts of our country have different environmental conditions. Accordingly, water management requirements vary based on the weather conditions. Farmers adapt different methods to cater the deferent water requirements of their fields. They need to go to farm fields located far from the villages in harsh weather conditions during odd times just to turn on or off the motor pumps installed in the field. Hence, farmers have started using the automated system to control the motor. Though there are motor control systems available in the market that can be controlled by farmers from remote locations by sending SMS or calling the GSM module connected with the motor-pump, it has not stopped farmers to worry about when to turn on or off the motor pump. And sending the message and getting the status of the motor control system involves cost which farmers are not ready to bear. The motor control systems currently available in the market can be categorized as semi-automated system as they need command from the user to handle the motor. An intelligent system is required which can be configured as per farmer's routine and water requirement yet affordable by the farmers. The Figure 1 shown below illustrates the motor control system currently available in the market:

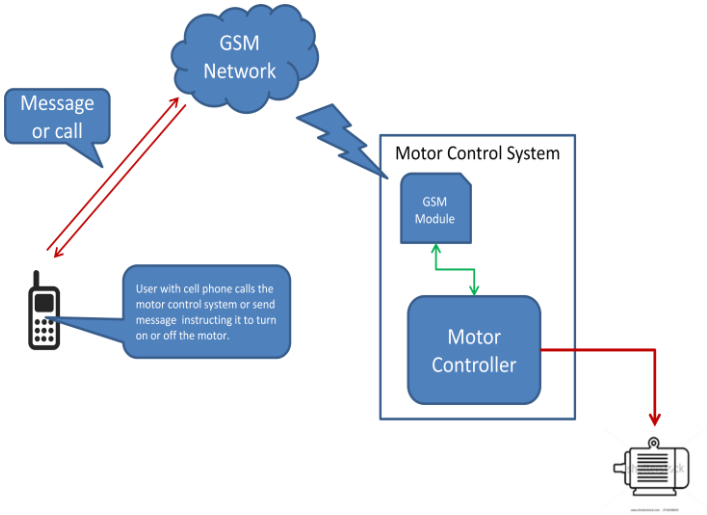

Figure 1: Motor control systems available in the market

The motor controller will receive the commands in terms of Phone call of Simple Text Message and based on that, it will turn on or off the connected motor. In case the user forgets to turn off the motor in the time, then water will go waste causing the harm to the crops.

In this paper we present a prototype of proposed irrigation motor control system which includes memory to store the farmer's configuration to handle the motor and a real time clock to track the timing requirement. The "ATMEGA-328" controller on the "ARDUINO-UNO" retrieves the data from memory and based on the time received from the real time clock module it decides to turn on or off the motor. The diagram shown by Figure 2 illustrates the prototype model of the system.

The motor control system is integrated with GSM modem which is used to communicate with the farmer from remote location. Unlike the currently available motor control systems in the market, the phone call or message is another means of turning the motor ON or OFF.

The controller also gets input from the rain sensor connected to it. When the motor is turned ON and it starts to rain in the farm, then the motor control system will turn OFF the motor until it stops raining. The motor is turned ON after the rain is stopped before the configured motor ON time. If the rain continues beyond the motor's turn ON time, then the motor control system understands that the farm got the required amount of water and motor is not turned ON.

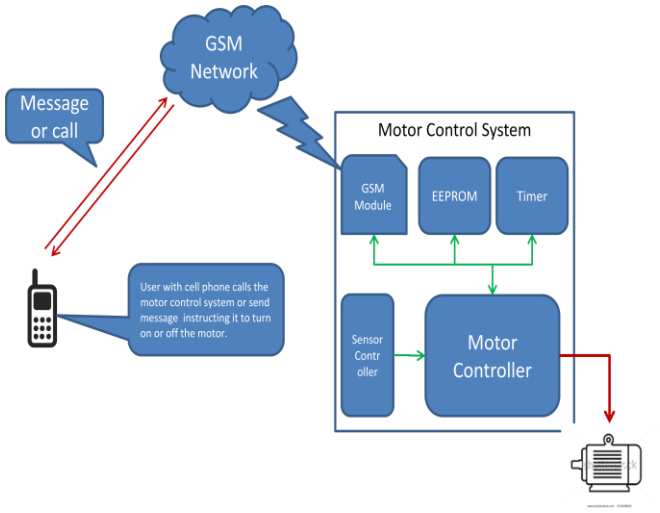

Figure 2: Prototype model of Smart Motor Control System

II. OVERVIEW OF THE SMART MOTOR CONTROL SYSTEM

The motor control system consists of many subcomponents to make the handling easy and comfortable for farmers. Figure 3 shown below details the overall system. The system contains LCD module to display the user setting, the status of the motor and the motor ON duration. For the user to change the motor ON duration and the motor ON schedules, buttons are provided on the panel. These buttons are mentioned as Keyboard in the figure. The system is also integrated with EEPROM and a Real Time Clock module. The controller interacts with the EEPROM and RTC over I2C communication channel. To send the status of the motor, to receive the user's request, the system is equipped with GSM component. The controller interacts with the GSM module over serial communication channel.

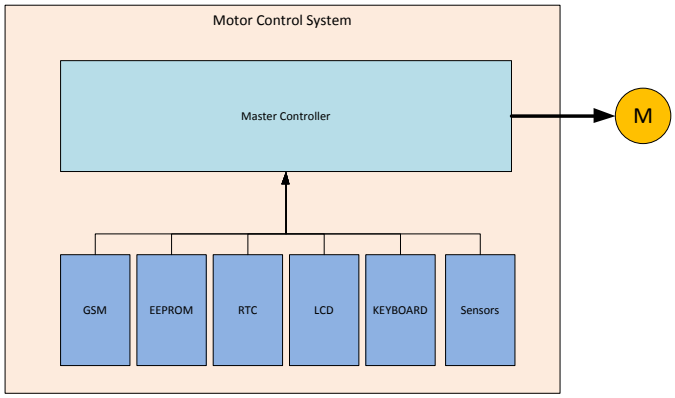

Figure 3: Motor control system component diagram

III. INPUT PROCESSING

Unlike existing models, the prototype model has many inputs along with GSM module to process and handle the motor accordingly. The control system runs the algorithm on the input data before it handles the motor. The algorithm is shown by the figure 4 below.

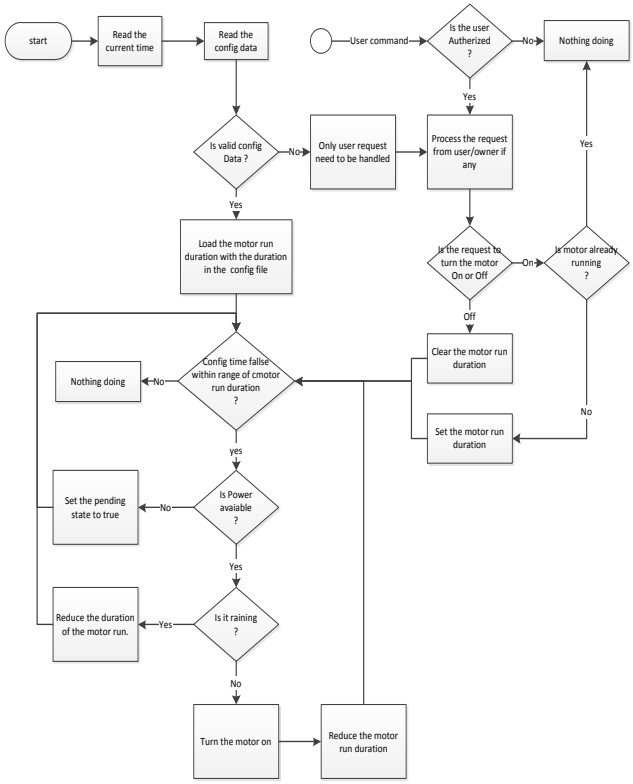

Figure 4: Algorithm for controlling the Motor Pump

To start with, the EEPROM does not contain any configuration data. In that case, the system will operate the motor based on the keys on the panel or from the requests received from connected GSM module. The user is able to set and store the configuration settings from the keys on the panel or by sending the message to the connected GSM module. The configurations are taken into effect after a system reboot as the system reads the memory only during initialization. If the read vales are valid, then the values are checked against the current time. In case, the current time lies between the configured time and duration, the system checks if it is raining. If not, then the motor is turned ON. Phone call or messages are used to turn the motor ON only. Motor is turned OFF only after the configured duration is completed. Phone call or message cannot be used to turn OFF the motor. However, the system responds with the motor status if the message contains the request to get the status of the motor. As the system contains the EEPROM, it does not require a separate battery backup to power itself all the time. The system continues to do so until configurations are changed by the farmer.

IV. ADVANTAGES OF THIS PROPOSED MOTOR CONTROL SYSTEM

This model is considered to be a fully automatic motor control system as compared to the existing motor control system models. As the prototype contains the EEPROM and the timer, it is easy to track the user settings and handle the motor accordingly. With this, the farmer need not worry about the time to turn ON/OFF the motor. As the motor turns OFF after configured time is elapsed, the farmer need not call or send message to the GSM module connected to the

motor to turn the motor OFF. Also as the motor is connected to the rain sensor, it turns the motor OFF until it stops raining. With this both Power saved and the farm is saved from excessive water logging. The farmer can any timer send a message to check the status of the motor. The system will send the current status if the motor is running or if it is due to turn the motor ON. The system is capable of handling other sensors like moisture sensor, phase detector to control the motor pump. Due to these features, the smart system is considered to be unique of its kind.

Cost details of the proposed Motor control system

Component	Quantity	Unit cost	Total Cost
Arduino UNO	1	370	370
SIM900 GSM Module	1	800	800
LCD	1	200	200
RTC Module	1	60	60
Rain Sensor	1	120	120
PowerSuply	1	160	160
Push buttons	2	10	20
Casing	1	50	50

Collectively, the total cost of the device approximates to Rs1800/- only. Which is way cheaper compared to the existing models.

V. CONCLUSION

The automatic motor control system works on the basis of configuration settings stored in the memory and the timer. The system also integrated with GSM technology to enable the farmer to control the motor from remote location as well. Also the motor is connected with rain sensor to detect rain to turn OFF the motor if turned ON. The automatic motor control system can be deployed close to the motor pump so that wiring done is smaller. Using this will benefit farmer in many ways by saving electricity by properly turning OFF the motor on time and this device saves the farms from excessive water logging. The user/farmer can operate the system from only the registered cell phone. This motor control system will save farmer's money by NOT sending the status message for every motor pump status change. The devised system acts as a standalone smart system without requiring human intervention in handling the motor pump reducing the farmer's responsibility of water management.

Abbreviations and Acronyms

GSM Module: This is a GSM/GPRS-compatible Quad-band cell phone, which works on a frequency of 850/900/1800/1900MHz and which can be used not only to access the Internet, but also for oral communication (provided that it is connected to a microphone and a small loud speaker) and for SMSs [8].

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