

Automation of Water Pump Controller for Irrigation Using ATMEGA 16

Snehal R. Mulmane¹, R.S. Khamitkar²

¹(ENTC DEPT, RSCOE, Tathwade, Pune, India)

²(ENTC DEPT, NBNSCOE, Solapur, India)

Abstract: *This project aims in providing a user friendly, reliable and automated 3- phase water pump control system for farmers. Here the automation process is done through the wireless GSM technology. Automation of water pump includes monitoring of availability of proper electric supply, water level inside the reservoir, flow rate of water through pump and also taking care of short circuit conditions related to irrigation pump. The microcontroller ATMEGA 16 is the heart of this system. The design of this system is very much sensitive and should be handled with utmost care because the microcontroller is a 5 volts device and it is employed to control high voltage 3-phase irrigation water pump. The major advantage of this device is, it is very user friendly as the status of the motor can be known by a simple LED indication and more over the device is very economical and can be brought available to the common man. Most of the figures included in this paper are simulated using proteus simulator. AVR studio is used for ATMEGA 16.*

Keywords- *ATMEGA-16, Flow sensor, GSM module, 3-phase irrigation System, MCB*

I. 1.Introduction

India is an agricultural country. In India due to uncertainty of rain river water is used to water the fields. Electric irrigation pumps are used from many years for this purpose. But farmers are facing lots of problems while operating the irrigation pumps. The major problems faced by the farmers are-

1. Physical effort and inconvenience
2. Frequent damage of irrigation equipment
3. Frequent damage of irrigation equipment

Our project is aims to reduce the physical efforts by the farmers as it allows the farmers to remotely check to see that there is electricity, water level inside the tank, flow rate of water and to automatically turn the pump on and off, all through a mobile phone. Goal of the project is to develop irrigation system by continuously monitoring the availability of electricity to operate the pump, water level in the reservoir through which the pump draws water, pressure of the water flowing out of pump. Whenever the failure in the system occurs such as pump stops watering due to cutting down of electricity or there is lack of water inside the reservoir or pump draws water with low pressure, then the controller automatically sends a alert message to the authorized person by using GSM module. After the person receives a message he can ON/OFF the water pump according to his requirement by passing a simple message. For this purpose different circuits to check the water level, flow rate, phase link are interfaced to microcontroller ATMEGA16A, which is heart of the system. GSM module is also interfaced to ATMEGA16A which is used to send the alert messages whenever failure in the pump system occurs.

1.1 Interfacing of system related components to ATMEGA 16

Main components of the system are as shown in Fig.1. Most of the figures drawn in this paper are the simulation of each circuit done using 'Proteus' simulator. It consists of water level indicator circuitry, electricity phase link indicator circuitry, flow sensor circuitry, GSM module, and motor assembly. All these separate circuits are interfaced to ATMEGA 16. ATMEGA 16 is low power CMOS 8 bit microcontroller based on the AVR advanced RISC architecture Here we have designed a module using a microcontroller ATMEGA 16A and GSM. Once the three phase power comes whole system will be automatically starts. If the farmer wants to switch on the motor he just needs to give a ring to the particular modem number which is implemented near the motor.

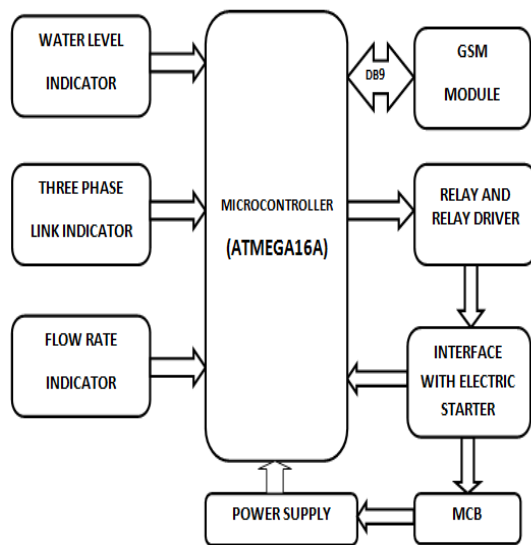


Fig.1. Block diagram of automatic irrigation pump system

Microcontroller checks whether the call is coming from authenticated person, if it matches to the number of authenticated person it will start the motor. If the password doesn't match means some other person is calling then no action will be taken. In every stage it will send the status to the farmer (authenticated user).i.e., whether the motor is on or off by ring. If the motor is on by ring and the farmer needs to switch off he just needs to call back to the same no. the complete operation can be handled by sending SMS also, i.e. by sending ON motor gets on, and by sending OFF motor gets OFF. As the farmers don't have sufficient knowledge for sending SMS we implemented calling feature here. Similar action will be performed while checking the remaining all conditions i.e. level of water, flow rate of water and possibilities of shock absorption.

II. 2. Working of the Circuit

The circuit diagram of the implementing GSM-based water pump controller for irrigation controller system is shown in Fig.2

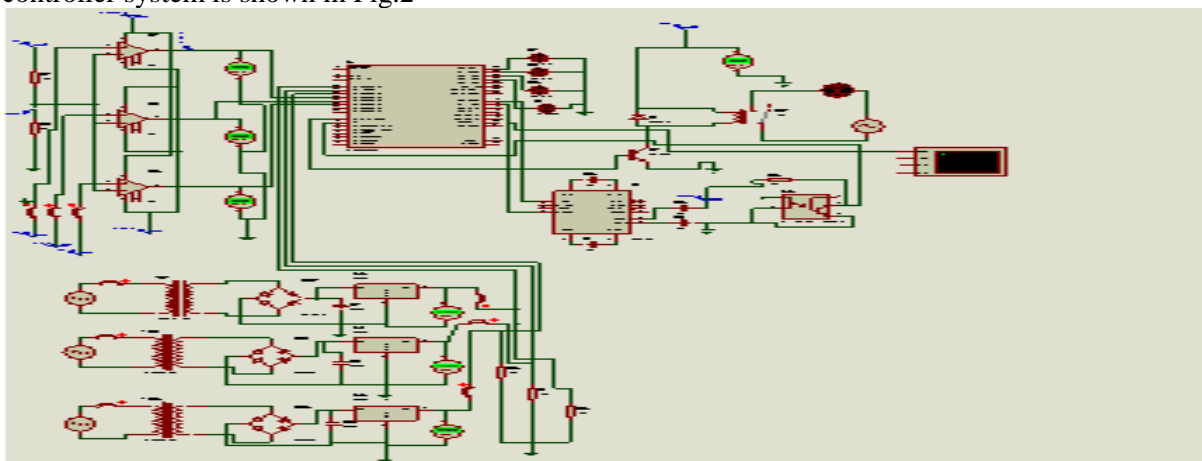


Fig.2. Circuit Diagram

The design consists of three main systems: integrated hardware system, communication system, and control strategy. The integrated hardware system consists of power supply. system,

microcontroller system, water level indication system, electricity indication system, flow rate system; pump switching system, GSM communication module The communication system implements the communication protocol to facilitate data communication among the devices of the integrated hardware and also between the user and the controller system. The control strategy on the other hand is responsible for measures for operating the irrigation system. The operational logic for control of the irrigation system is implemented on the microcontroller. The controller system on initialization checks for the control information and scheduling plan. The microcontroller controls the functions of the various devices that are interfaced to it and also manages the communication protocols required to execute specific tasks. This checking system includes first availability of electricity, water level, rate of flow of water and finally any short circuitry. The GSM module also serves as the medium for system data transfer from the controller system to the user and also requests (conditions and operations) from the user to the controller system via SMS. Description of each circuit interfaced to ATMEGA 16 is given in next section.

III. Electricity Phase Link Indicator

The circuit diagram of the implementing electricity phase link system is shown in Fig.3.

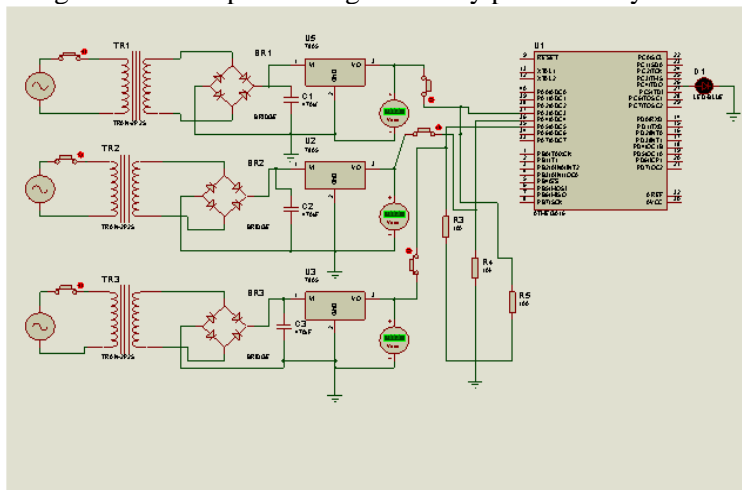


Fig.3. Electricity phase link indicator

It consists of three- transformers, bridge rectifier, regulators, switches and resistors. The integrated hardware system consists of step down transformer; it converts 230V AC to 5V AC. Then it will be given to bridge rectifier which converts AC to pulsating DC and capacitor filter will convert into pure DC signal. To maintain continuous 5V signal it will pass through regulator IC i.e. 7805. The output from this IC which is 5V given to the microcontroller as input to port A. The output from this whole system consists of three signals to visualize the concept of three phase line i. e R, Y, B respectively. This output is indicated by one LED which is connected at output port C. When three phase supply is available then this output LED will be on and motor will also start to work. If any phase link gets open then LED will turn off and motor will get automatically turned off. When motor gets turned off, simultaneously alert message will be sent to the authorized user. This message includes Motor turned off due to link open. Then user comes to know that motor turned off due to failure in three phase link not in mains power supply.

IV. Water Level Indicator

The circuit diagram of the implementing water level indicator is shown in Fig.4. It consists of three- OP-amps, LEDs, switches and resistors.

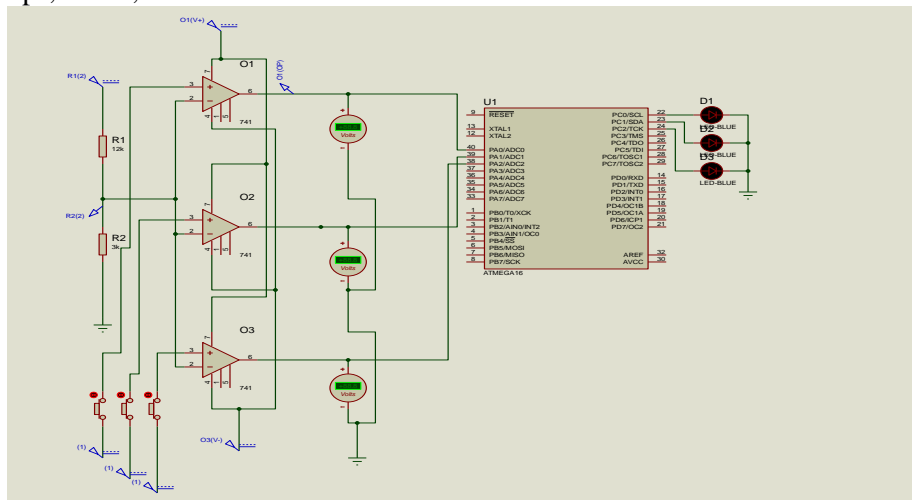


Fig 4. Water level indicator

This water level indicator monitors the level of the overhead tank and automatically switches off the water pump whenever the level goes below a preset limit. The level of the overhead tank is indicated using 3 LEDs and the pump is switched on when the overhead tank is filled. The pump is not allowed to start if the water level in the tank is low and also the pump is switched off when the level inside the tank goes low during a pumping cycle. The integrated hardware system consists of three op-amps in non-inverting configuration acts as a comparator. Here, 1V reference voltage, to inverting terminal which is common for all op-amp is that obtained from voltage divider circuit. Another input to non-inverting terminal is different water levels which are high, medium, and low respectively. The output of these three levels of op-amp is given as input to the microcontroller at port A. The outputs of these three levels are indicated by three LEDs at the output port C. When tank is full of water then there is contact between all three levels. Then all three output LEDs are turns on. When a water level in tank goes below high level then first LED turns off, when water level goes below medium level then first and second LEDs turns off, when water level goes below low level then all three LEDs gets turns off. When water level goes below low level then motor will gets automatically turn off and alert message will send to the authorized user. This message includes Motor turned off due to water reached below low level.

V. Water Flow Rate Indicator

It consists of pressure sensor FL40L0 interfaced to Microcontroller ATMEGA 16. Flow switch works on principle of Hall Effect. It provides output in the form of pulses between 0 to 5V when water flows through it. The frequency of these pulses is high when flow rate of water is high and low when flow rate of water is low. This output is given as a input to microcontroller through opto-coupler. Opto-coupler is used for isolation purpose. When flow rate goes below preset limit due to some blockage at foot valve then alert message will be send to the authorized user. After the person receives a message the he can ON/OFF the water pump according to his requirement by passing a simple message.

VI. Protection against Short Circuit

The circuit diagram of the implementing short circuit protection system is shown in Fig.5.

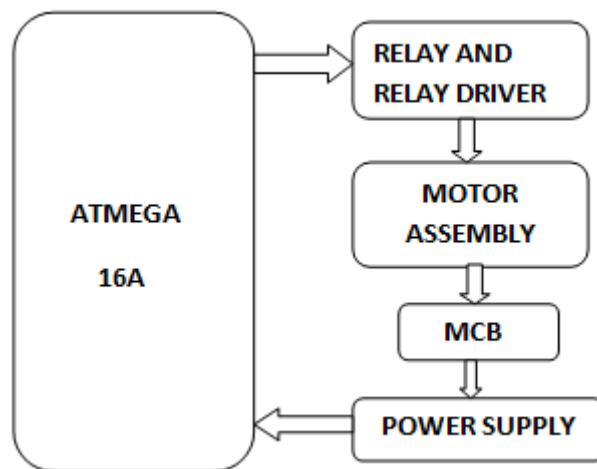


Fig.5. Block diagram for short -circuit protection using MCB

It consists of relay and relay driver circuit, miniature circuit breaker (MCB), and power supply. Protection against short circuit is one of the most important parameter which is implemented in this project. Because sometimes in rainy season there may be chances of contact between water and metal layer of pump motor. Due to this motor catches current and unknowingly when any person touch to that motor then there is possibility of death also. So, to avoid such situation we have implemented this circuit. Here, we have used miniature circuit breaker (MCB) this will protect them from short circuit. Whenever there is possibility of such condition then MCB will get automatically trips and isolates pump motor from mains power supply simultaneously alert message will be send to the authorized user. This message includes Motor turn off due to short circuit.

VII. Interfacing of GSM with ATMEGA16

The interfacing of GSM with ATMEGA16A through MAX232 is shown in following Fig.6.

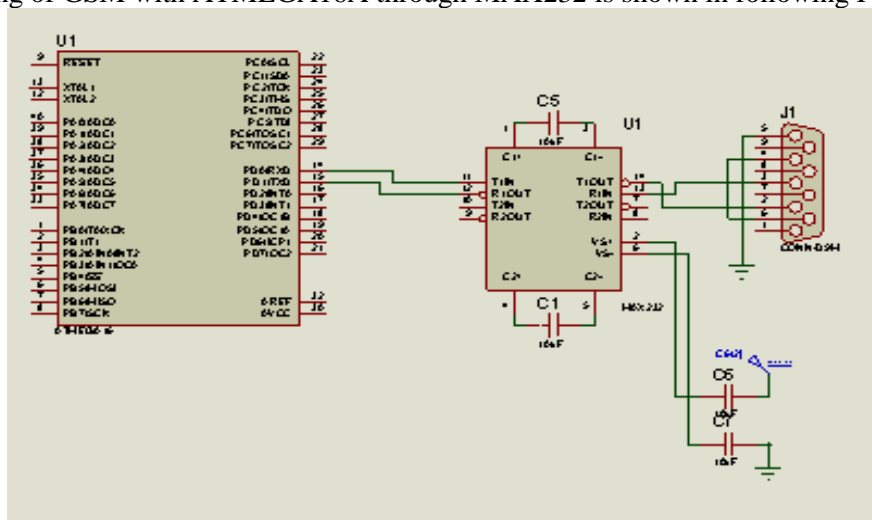


Fig.6. Block diagram for interfacing of GSM with ATMEGA 16

The GSM module used on this development board is the SIM300D made by SIMCOM. The GSM module uses the AT Command set to communicate with the microcontroller. The unit accepts power ranging from 3.4-4.5V and is supplied by our on board battery backup. This GSM Modem can accept any GSM network operator SIM card and act just like a mobile easily. Here MAX232 is used

which contains the necessary drivers (two) and receivers (also two), to adapt the RS-232 signal voltage levels to TTL logic.

VIII. Algorithm

Algorithm provides the flow of tasks of the automation of water pump controller for irrigation

1. Start
2. Initialize all the devices
3. If password matches with authorized user then start system
4. Check for availability of electricity
5. Any one link opens then send message
6. Check for water level
7. It is below low level then send message
8. Check for flow rate of water
9. It is below preset limit then send message
10. Check for any short circuit
11. Turn off motor then send message
12. Stop

For implementing all these processes we have used 'AVR Studio'. AVR studio is an Integrated Development Environment (IDE) by ATMEL for developing applications based on ATMEL microcontrollers. This tool will generate hex file of the code Use that Hex file to burn your microcontroller. While working in real time if you want to change the code, make changes and build the file again. This will automatically update the previous hex file

IX. Result

Going through the planning, flow process, design and software implementation, the system has been a tough one, we have actually tried as much as possible to explain vividly almost all (if not all) what is involved in the construction of this project. After the complete design of the system, the deviation between the expected result and the actual result was very close. All the results are simulated using Proteus and AVR studio. Also all the states of circuits are checked using LED indicators. We got following results from implemented dummy system.

Observation Table

Sr. no.	Observations	Status of motor	Message received by user
1.	User make call to turn on motor	On	Your motor started.
2.	Any of three phase link of power supply off	Off	Motor turn off due to phase link open.
3.	Water level reached below low level	Off	Motor turned off due to water reached below low level.
4.	Flow rate of water become low	Off	Flow error Your Motor stopped.
5.	Short circuit in device	Off	Motor stopped due to short circuit.

X. Conclusion

This Automatic irrigation system is very useful and convenient, especially for those who travel at long distance. If installed and programmed properly, automatic irrigation systems can even save users money and helps to save the time required to detect and correct the faults in irrigation pumps. This enables users to take advantage of the globally deployed GSM networks with its low

SMS service cost to use mobile phones and simple SMS commands to manage their irrigation system. This system is useful for farmers who have plenty of farm area so they need automation, for farmers who travels more and can't give proper attention to their farms and mainly finds the applications in farms and housing areas to water plants.

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