

Real Application of Three Phase Water Pump Control and Level Sensing using GSM and Mobile

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Abstract— Now a day's technology is running with time, it completely occupied the life style of human beings. Even though there is such an importance for technology in our routine life there are even people whose life styles are very far to this well-known term technology. So it is our responsibility to design few reliable systems which can be even efficiently used by them. This basic idea gave birth to the project GSM based irrigation water pump controller for Illiterates and this project aims in providing a user friendly, reliable and automated water pumping system for illiterates. Here the automation process is done through the wireless GSM technology and the user need not require any knowledge about the operation of the GSM mobile. For the efficient usage of the device the end user should know the basic switch operation which is more than sufficient to use the device efficiently. The microcontroller form the heart of the device and there are also mobile and GSM modem which are meant for exchanging the commands from one end to the other end. The GSM modem present at motor end is interfaced with micro controller. The mobile is used as an operating device which sends commands to GSM which sends command to controller; the controller performs the equivalent action with respect to the commands received.

Key words: GSM, Submersible Water Pump

I. INTRODUCTION

The heart of most irrigation systems is a pump. To make an irrigation system as efficient as possible, the pump must be selected to match the requirements of the water source, the water piping system and the irrigation equipment. Pumps used for irrigation include centrifugal, deep well turbine, submersible and propeller pumps. Actually, turbine, submersible and propeller pumps are special forms of a centrifugal pump. However, their names are common in the industry.

II. SUBMERSIBLE PUMPS

A submersible pump is a turbine pump close-coupled to a submersible electric motor as shown in Figure. Both pump and motor are suspended in the water, thereby eliminating the long drive shaft and bearing retainers required for a deep well turbine pump. Because the pump is located above the motor, water enters the pump through a screen located between the Small submersible pumps (fewer than 5 horsepower) use single phase power. However, most submersible pumps used for irrigation need three phase electrical power. The controlling of these motors includes different methods. Few are listed below.

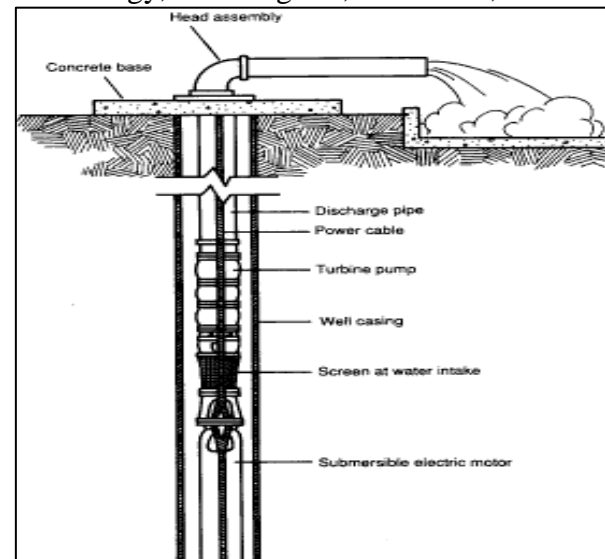


Fig. 1: Submersible Water Pump

III. MANUAL CONTROL OF MOTOR

In conventional motor control system, motors have to be operated manually, where the on off control of motor will be located near the motor panel. And have to be operated manually.

IV. INFRARED REMOTE CONTROL OF MOTOR

Controlling devices using wired switches are common. A few years back controlling devices using wireless remote control switches like infrared remote control switch, RF based remote control switches were used. But these technologies have their own limitations in terms of operation and range.

V. CONTROL OF MOTOR USING GSM & MOBILE

Where as in this project controlling of motor is very easier, user can control the motor from wherever he is ranging from meters to kilometers of distance, which mainly uses GSM & mobile. Using this service, farmers can control and switch on irrigation pumps from the distance, instead of walking to them for kilometers. These are also applicable in Domestic and Commercial fields.

A. Objectives of the Present Work:

The main objective of our project is 1.Reduce the time consumption in manual on & off operation.2.Controlling of the motor from long distance.3. Helping illiterates and also farmers. In this project Microcontroller and GSM is used in the sensor side and also motor side. The main features of three phase water pump control and level sensing using GSM & mobile are explained with a block diagram as shown:

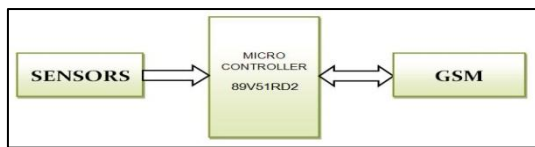


Fig. 1.1: Block Diagram of Sensor Side

The electromagnetic sensor at the sensor part senses the maximum or minimum level of the water, and it sends the signal to the microcontroller which is interfaced with GSM. The GSM will send message to user as tank low. Then from the instruction given by the user motor will be switched on by using the commands given by the microcontroller. And after filling up of the water tank sensor senses the maximum level, and similarly motor will be switched off as switching on operation.

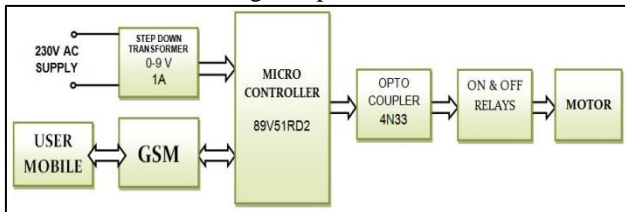


Fig. 1.2: Block Diagram of Motor Side

Message will be send to the user regarding happenings of all the operation. Step down Transformer is used to step down the supply voltage from 230V to 9V, which is again step down to 5V using regulator. And this 5V is given to drive the 89V51RD2 microcontroller. The main function of the microcontroller is to control the communication between different components of premises unit. The main function of an opto-coupler is to block high voltages and voltage transients, so that a surge in one part of the system will not disrupt or destroy the other parts. Through opto- coupler relay is operated. And motor will be controlled using GSM & mobile. Features of GSM based Control Panel for Agricultural and Domestic Water Pumps

- No need to point the remote to the device as in infrared remote.
- Not limited by distance [range] as in RF [Radio frequency] remote.
- Microcontroller and GSM based operation.
- Timer can be set from the mobile phone to switch ON / OFF the water pump automatically.
- This device saves money, time and needless effort.
- phase and 1 phase control panel interface is available

VI. GLOBAL SYSTEM FOR MOBILE COMMUNICATIONS

The Global System for Mobile Communications (GSM) uses the 890 to 915 MHz band for uplink signals (signals from the cell user to the cell site) and the 935 to 960 MHz band for downlink signals (from cell site to user). In newer GSM systems, the uplink range is 1.71 to 1.785 GHz and the downlink range is 1.805 to 1.88 GHz. The spacing between the uplink and downlink signals is 45 MHz on the lower and 95 MHz on the upper frequencies. Each channel has a bandwidth of 25 kHz. GSM uses time-division multiplexing. This system is known as time-division multiple accesses (TDMA). This is a plug and play GSM Modem with a simple to interface serial interface. Use it to send SMS, make and receive calls, and do other GSM operations by controlling it through simple at commands from

microcontrollers and computers. It uses the highly popular SIM300 module for all its operations. It comes with a standard RS232 interface which can be used to easily interface the modem to microcontrollers and computers. The GSM net used by cell phones provides a low cost, long range, wireless communication channel for applications that need connectivity rather than high data rates. Machinery such as industrial refrigerators and freezers, HVAC, vending machines, vehicle service etc. could benefit from being connected to a GSM system.

A. Theory of Operation:

GSM Modem provides full functional capability to Serial devices to send SMS and Data over GSM Network. The product is available as Board Level or enclosed in Metal Box. The Board Level product can be integrated in to Various Serial devices in providing those SMS and Data capability and the unit housed in a Metal Enclosure can be kept outside to provide serial port connection. The GSM Modem supports popular "AT" command set so that users can develop applications quickly. The product has SIM Card holder to which activated SIM card is inserted for normal use. The power to this unit can be given from UPS to provide uninterrupted operation. This product provides great feasibility for Devices in remote location to stay connected which otherwise would not have been possible where telephone lines do not exist The protocol used by GSM modems for setup and control is based on the Hayes AT-Command set. The GSM modem specific commands are adapted to the services offered by a GSM modem such as: text messaging, calling a given Phone number, deleting memory locations etc. Since the main objective for this application note is to show how to send and receive text messages, only a subset of the AT-Command set needs to be implemented. The European Telecommunication Standard Institute (ETSI) GSM 07.05 defines the AT-Command interface for GSM compatible modems. From this document some selected commands are chosen, and presented briefly in this section. This command subset will enable the modem to send and receive SMS messages. The sim300 allows an adjustable serial baud rate from 1200 t 115200 bps (9600 default)



Fig. 1.3:

Modem a low power consumption of 0.25 A during normal operations and around 1A during transmission.

B. AT Command Set:

Unlike mobile phones, a GSM modem doesn't have a keypad and display to interact with. It just accepts certain commands through a serial interface and acknowledges for those. These commands are called as AT commands. There is a list of AT commands to instruct the modem to perform its functions. Every command starts with "AT". That's why they are called as AT commands. AT stands for attention. The following section describes the AT-Command set. The commands can be tried out by connecting a GSM modem to one of the PC's COM ports. Type in the test-command, adding CR + LF (Carriage return + Line feed = \r\n) before executing Table gives an overview of the implemented AT-Commands in this application. The use of the commands is described in the later sections.

AT	It is used to test the connection.
AT+CMGF=1	It is used to instruct the modem to operate in text mode. AT+CMGF=0 will instruct the modem to operate in PDU mode.
AT+CMGS="mobile number"	It is used to send a text message. It accepts the recipient mobile number. As soon as this command is accepted the modem waits for the message content. The text message has to be sent sequentially and terminated by the char 0x1A.
AT+CMGW="mobile number"	It is used to store a message in the memory. After execution it returns an index for the message stored. Eg: AT+CMGW=1 . Here 1 is the index for the saved message. Later this index is used to process the message like deleting it or forwarding to the recipient number.
AT+CMGD=2	It is used to delete a message from the storage. The index of the stored message is used to delete it. Above command deletes the message with index 2.

Table 2.1: AT-Command Set Overview

VII. ELECTROMAGNETIC SENSOR

A. Magnetic Floats:

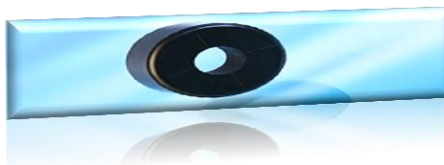


Fig. 1.4: Magnetic Floats

B. Magnetic Float Sensor Function:

Magnetic float switches / level sensor are used to detect the sensor shave sealed reed switches in a stem with a permanent magnet installed in the float. As float rises or falls, switch is activated /deactivated. Power House float

sensor uses unique magnetic push at the floating magnet to respond fast to any change of liquid level.

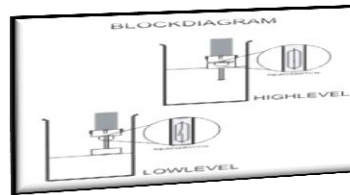


Fig. 1.5: Block Diagram for Electromagnetic Sensor

Here is a simple, automatic water level controller for overhead tanks that switches on/off the pump motor when water in the tank goes below/above the minimum/maximum level. The water level is sensed by two floats to operate switches for controlling the pump motor. Each sensors float is suspended from above using copper insulated wire. This arrangement is encased in a PVC pipe and fixed vertically on the inside wall of the water tank. Such sensors are more reliable than induction type sensors. Sensor 1 senses the minimum water level, while sensor2 senses the maximum water level. When the water level is low, the magnetic push at the floating magnet respond fast to change of liquid level, and goes low. And gives signal to the microcontroller as tank low.

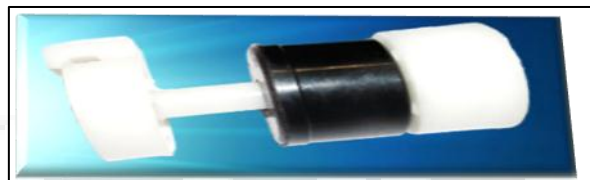


Fig. 1.6: Physical Appearance of Electromagnetic Sensor

Now the pump motor is switched on and it starts pumping water into the tank. As the water level rises further to reach the maximum level above the magnetic push of both the float sensor then the sensor will send signal as tank full and motor will be switched off automatically. The float sensor units can be assembled at home. Both the units are identical, except that their length is different. The depth of the water tank from top to the outlet water pipe can be taken as the length of the minimum level sensing unit. The depth of the water tank from top to the level you want the tank to be filled up to is taken as the length of the maximum level sensing unit. The GSM and microcontroller can be connected in the control room providing a lengthy wire. Each pipe is closed at both the ends by using two caps. A 5mm dia hole is drilled at the centre of the top cap so that the aluminum rod can pass through it easily.

VIII. ELECTROMECHANICAL RELAY

A. Electromechanical Relay:

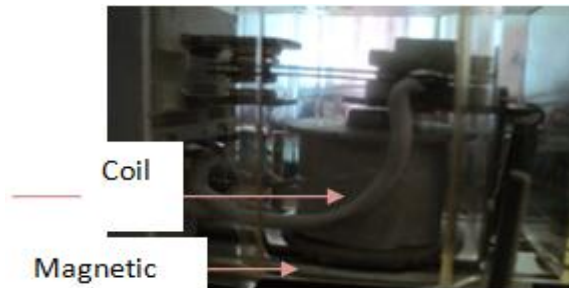


Fig. 1.7: Electromechanical Relay

A simple electromagnetic relay consists of a coil of wire wrapped around a soft iron core, an iron yoke which provides a low reluctance path for magnetic flux, a movable iron armature, and one or more sets of contacts (there are two in the relay pictured). The armature is hinged to the yoke and mechanically linked to one or more sets of moving contacts. It is held in place by a spring so that when the relay is de-energized there is an air gap in the magnetic circuit. In this condition, one of the two sets of contacts in the relay pictured is closed, and the other set is open. Other relays may have more or fewer sets of contacts depending on their function. The relay in the picture also has a wire connecting the armature to the yoke. This ensures continuity of the circuit between the moving contacts on the armature, and the circuit track on the printed circuit board (PCB) via the yoke, which is soldered to the PCB. When an electric current is passed through the coil it generates a magnetic field that activates the armature and the consequent movement of the movable contact either makes or breaks (depending upon construction) a connection with a fixed contact. If the set of contacts was closed when the relay was de-energized, then the movement opens the contacts and breaks the connection, and vice versa if the contacts were open. When the current to the coil is switched off, the armature is returned by a force, approximately half as strong as the magnetic force, to its relaxed position. Usually this force is provided by a spring, but gravity is also used commonly in industrial motor starters. Most relays are manufactured to operate quickly. In a low-voltage application this reduces noise; in a high voltage or current application it reduces arcing. When the coil is energized with direct current, a diode is often placed across the coil to dissipate the energy from the collapsing magnetic field at deactivation, which would otherwise generate a voltage spike dangerous to semiconductor circuit components. Some automotive relays include a diode inside the relay case. Alternatively, a contact protection network consisting of a capacitor and resistor in series (snubber circuit) may absorb the surge. If the coil is designed to be energized with alternating current (AC), a small copper "shading ring" can be crimped to the end of the solenoid, creating a small out-of-phase current which increases the minimum pull on the armature during the AC cycle.

B. 8 Pin Electromechanical Relay:

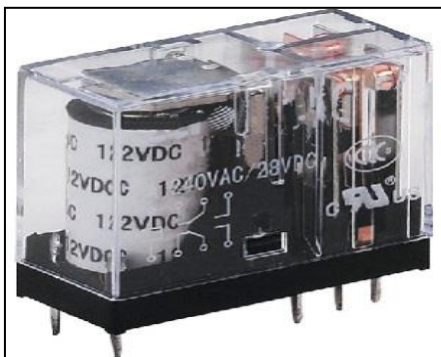


Fig. 8: 8 Pin Electromechanically Relay

It's a Versatile and Function-filled Miniature Power Relay. It works on the same principle as 5 pin Electromechanical Relay.

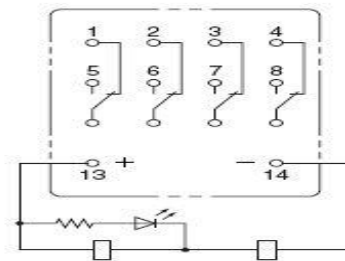


Fig. 9:

C. Working of the model:

This chapter consists of the circuit diagram of the project and detailed step by step working of the project model. Here we have shown the circuit connections of motor side and sensor side.

IX. FUNCTIONAL BLOCK DIAGRAM

A. Sensor Side:

DESCRIPTION: Here's a three phase water pump control and level sensing based on 89V51RD2 microcontroller to control the ON & OFF Operation of the motor when water level in the tank reaches the specified level. The controller is simple and easy to construct, which includes following parts.

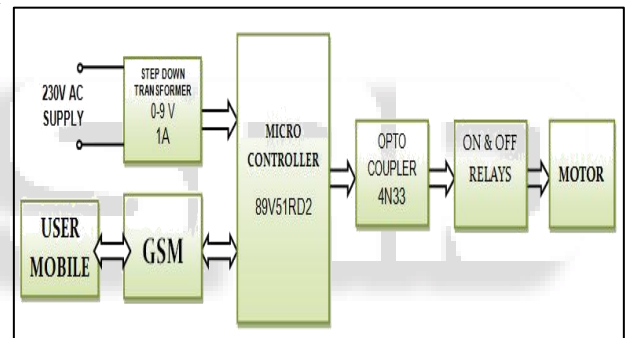


Fig. 10:

B. Stepdown Transformer:

Here 230/9V (i.e., 0-9V 1A) step-down transformer is used. It is used to step down the supply voltage from 230V to 9V, which is again step down to 5V using regulator. And this 5V is given to drive the 89V51RD2 microcontroller.

C. Microcontroller 89v51rd2:

Here 89V51RD2 microcontroller is used. The main function of the microcontroller is to control the communication between different components of premises unit. The P89V51RD2 are 80C51 8 bit microcontrollers with 16/32/64 kB flash and 1024 B of data RAM.

D. Optocoupler 4n33:

Opto-couplers (optical couplers) are designed to isolate electrical output from input for complete elimination of noise. The main function of an opto-coupler is to block high voltages and voltage transients, so that a surge in one part of the system will not disrupt or destroy the other parts.

X. WORKING PRINCIPLE

When 230V supply is given to the system, the transformer step down the voltage to 9V, 1A. And then bridge rectifier

converts that AC to DC. This 9V DC is then stepped down to 5V DC by 7805 voltage regulator for driving the microcontroller. Now when the water in the tank becomes lower than the sensor at the bottom level suspended inside the tank, it senses & gives the signal to sensor side microcontroller which in turn gives the command to the GSM. Now the GSM will send message to the user number as “tank low”. When user receives the message as “tank low” he will send the message as “motor on” to the GSM of the motor side. Through DB-9 this signal is send to microcontroller, mc reads this command and via optocoupler it operates the ON relay. When the relay operates, the relay which is initially at N/O position changes to N/C position & the motor gets switched ON and message will be send to the user as “motor switched on”. Similarly when the tank fills, the another sensor which is kept at the upper level of the tank, senses maximum level of water and it gives the signal to the mc and which in turn gives the command to the GSM. Now this GSM will read this command & sends a message to motor side GSM to switch off the motor, from mc the OFF relay is operated via optocoupler. Now OFF relay which is initially in N/C position changes to N/O position & the motor gets switched OFF automatically without users command (i.e., message) & then message will be delivered to user number as “motor is switched off”.

A. Eagle Software:



Fig. 11: Eagle Software

EAGLE (Easily Applicable Graphical Layout Editor) PCB design software to design an electronic schematic and lay out a printed circuit board (PCB). Eagle is a PCB design software package consisting of a schematics editor, a PCB editor and an auto router module. The software comes with an extensive library of components, but a library editor is also available to design new parts or modify existing ones. Eagle is made by Cad Soft, and is available in three versions. The light-version is limited to one sheet of schematics and half euro-card format (80x100 mm), but can be used under the terms of the freeware license for non-commercial use. This software can be downloaded from Cad Soft's homepage, for windows or Linux. We are investigating the possibilities of getting one or more licenses for the professional version, which does not have these limitations.

B. Keil Microvision:



Fig. 12: Keil Microvision

The μ Vision IDE, μ Vision Debugger and Analysis Tools, the simulation, and debugging and tracing capabilities. In

addition to describing the basic behavior and basic screens of μ Vision, this book provides a comprehensive overview of the supported microcontroller architecture types, their advantages and highlights, and supports you in selecting the appropriate target device. This book incorporates hints to help you to write better code. As with any Getting Started book, it does not cover every aspect and the many available configuration options in detail. We encourage you to work through the examples to get familiar with μ Vision and the components delivered. The Keil Development Tools are designed for the professional software developer; however programmers of all levels can use them to get the most out of the embedded microcontroller architectures that are supported. Tools developed by Keil endorse the most popular microcontrollers and are distributed in several packages and configurations, dependent on the architecture. MDK-ARM: Microcontroller Development Kit, for several ARM7, ARM9, and Cortex-Mx based devices. PK166: Keil Professional Developer's Kit, for C166, XE166, and XC2000 devices. DK251: Keil 251 Development Tools, for 251 devices. PK51: Keil 8051 Development Tools, for Classic & Extended 8051 devices. In addition to the software packages, Keil offers a variety of evaluation boards, USB-JTAG adapters, emulators, and third-party tools, which completes the range of products.

C. Flash Magic:



Fig. 13: Flash Magic

Introduction:

Flash Magic is Windows software from the Embedded Systems Academy that allows easy access to all the ISP features provided by the devices.

XI. FIVE STEP PROGRAMMING

- 1) Step 1 – Connection Settings
Before the device can be used the settings required to make a connection must be specified.
- 2) Step 2 - COM Port Settings
Select the desired COM port from the drop down list or type the desired COM port directly into the box. Select the device being used from the drop down list. If you have a serial cable connecting your COM port to the target hardware, then chooses "None (ISP)". Enter the oscillator frequency used on the hardware.
- 3) Step 3 – Selecting the Hex File
Enter a path name in the text box or click on the Browse button to select a Hex File by browsing to it.
- 4) Step 4 – Options
Flash Magic provides various options that may be used after the Hex File has been programmed. Verify After Programming.
- 5) Step 5 – Performing the Operations

Step 5 contains a Start button. Clicking the Start button will result in all the selected operations in

the main window taking place.

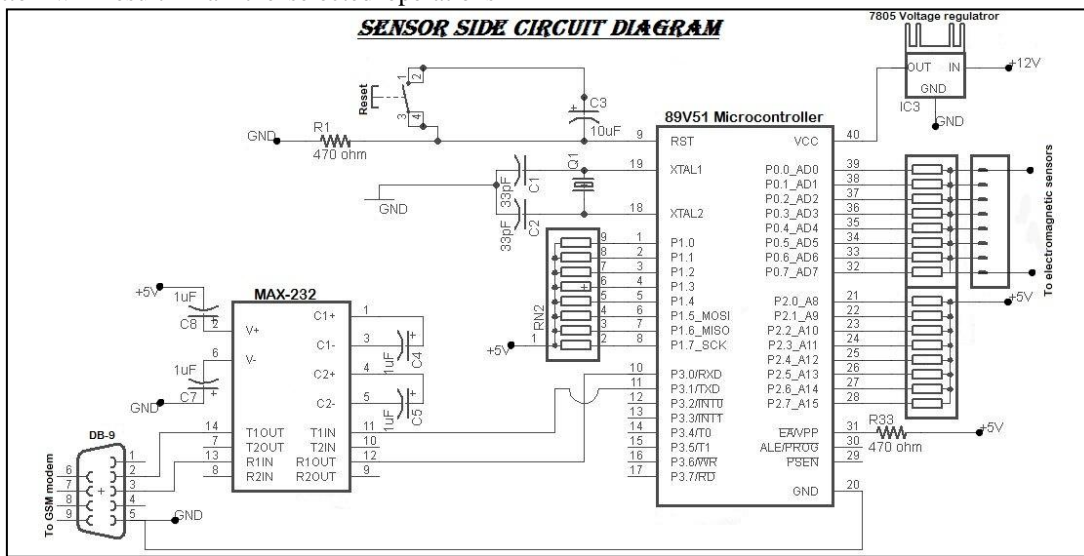


Fig. 14: Sensor Side Circuit Diagram

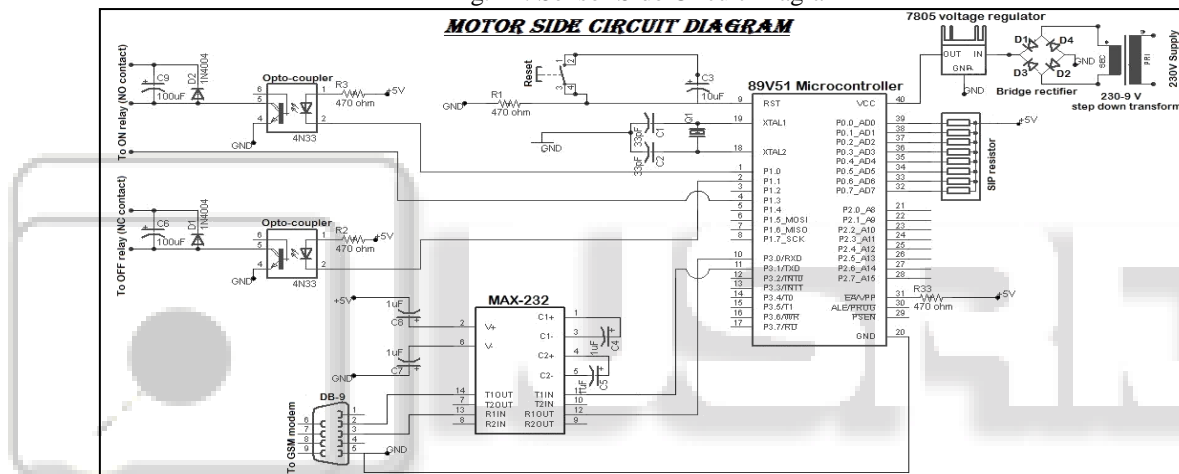


Fig. 15: Motor Side Circuit Diagram

XII. CONCLUSION

Ongoing conventional motor control method of manual operation can be replaced by this new project water pump and water level control using GSM & mobile. So as to provide reliable simpler and easy way to control the pump. The use of GSM & mobile makes the control system simpler and to operate at any distance ranging from meters to kilometers. If the water tank at the irrigation site or may be in home, gets filled up, and if person is not there at the site, then there will be pole of water as well as continuous running of motor and wastage of power will be there. So person has to go on site to operate the motor. Hence till that time there will be wastage of time, power as well as poling of water. This result in burden for both consumer and the electricity supply company as there will wastage of power. And the consumer has to pay more electric bill. And also if he uses infrared remote control system then also he has to go onsite to operate the motor. Because the infrared remote control system cannot operate for long distance. Water pump control and water level sensing using GSM and mobile will provide easier and simpler control of water pump. With this new control system we can control the motor from long distance ranging from meters to kilometers.

This system will save the power, time consumption as well as human power. This system is reliable and helpful for illiterates; they can also operate this new system. And this can also be operated in Domestic & Commercial fields. Especially this system is very helpful in irrigation field.

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