

## Design a Remote Control System for Submersible Pumps Based on GSM-SMS

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### Abstract

In Egypt increasing demand for desert land reclamation has resulted in the increasing use of submersible pumps. And that's where the operation and monitoring of pump malfunction takes a lot of effort and time. The purpose of this paper to design an embedded system which can remotely ON/OFF and monitoring pump status through sending and receiving messages on mobile phones to help the farmer to supply water to the crops and get information about the type of faults. This system, saving time, less Physical effort and inconvenience Loss/ Frequent damage of irrigation equipment Wastage of water and electricity Objective. The design consists of the Arduino UNO board uses an ATMEGA328P-PU connected with GSM modem.

### 1. Introduction

Nowadays GSM based Control System implements the emerging applications of the GSM technology. Using GSM networks, a control system has been proposed that will act as an embedded system which can monitor and control appliances and other devices. The data studied here show the results that may be useful for any business that plans to implement a remote monitoring system using the Cellular Network (GSM/GPRS). Although submersible pumps variables are used in the experiment, other remote monitoring applications are possible using air communication channels, such as monitoring pollutant emissions, river and reservoir level alerts, landslide warnings, wind turbine.

A GSM-SMS remote measurement and control system for greenhouse based on PC-based database system connected with base station was introduced, [1]. Base station was developed by using a microcontroller, GSM module, sensors and actuators. In practical operation, the central station receives and sends messages through GSM module. Criterion value of parameters to be measured in every base station is set by central station, and then in base stations parameters including the air temperature, the air humidity.

Embedded System based submersible motor control to prevent it from overload, dry run and single phasing using GSM for Agricultural Irrigation. [2] 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 the mobile phone as remote control Application for submersible motor pump which is used in agriculture irrigation.

An automated drip irrigation system using linear programming was proposed [3]. Linear programming approach properly uses available water resource to irrigate the field effected in such a way to get maximum profit with lower cost.

A Smart irrigation technique using vocal command The concept of remote controlled irrigation system with the help of voice commands was designed [4]. This system was built using GSM with voice recognition technique and moisture sensor unit to control irrigation.

Remote Sensing and Control of an Irrigation System Using a Distributed Wireless sensor Network was introduced [5] Distributed infield sensor-based irrigation systems offer a potential solution to support site-specific irrigation management that allows producers to maximize their productivity while saving water.

GSM based Automatic Irrigation Control System for Efficient Use of Resources and Crop Planning by Using an Android Mobile was proposed [6] This application makes use of the GPRS [General Packet Radio Service] feature of mobile phone as a solution for irrigation control system. GSM (Global System for Mobile Communication) is used to inform the user about the exact field condition. The information is passed onto the user request in the form of SMS.

Design and Implementation of GSM Based Fertigation System Was implemented [7] By using GSM system, Start and stop action of the motor that feeds the field with water can be controlled only by sending the GSM command through GSM mobile. GSM is used As a control of the whole process and backbone of whole system. This system can be used to control irrigation from any distance.

Automatic power meter reading system using GSM network was developed [8]. It utilizes the GSM network to send power usage reading to authorize office to generate the billing cost and send back the cost to the respective consumer through SMS.

Mahesh M. Galgalikar. 2010 proposed Real-Time Atomization of Agricultural Environment for Social Modernization of Indian Agricultural System [9] focuses on using an ARM7TDMI Core 32-bit microprocessor, GSM services which operate through SMS as a link between ARM processor and centralized unit.

Many existing system use computers, database technologies for monitoring and controlling irrigation activity [10], [11].

Remote monitoring through Internet based monitoring is one of the common approaches. This approach requires PCs (Client/Server) along with additional devices like buffers, modems, etc. for internet connectivity and software support for TCP/IP protocols and control system interaction. The price of such system varies greatly depending on speed and bandwidth requirements. This work provides Short Messaging Service (SMS) approach offers a simple interface with only destination mobile phone addresses and message requirement without any protocol. So this method is suitable for remote monitoring of systems with moderate complexity. The aim of this paper is to develop a simpler and cheaper solution and make system which is suitable for any pumps. This system performed with 60HP pump.

In these systems, it is known as an important issue to get information about not only the control but also the conditions of the pumps through short service message (SMS). In accordance with this need, there are some works about implementation of condition monitoring of system through (SMS). The system allows the user to effectively monitor and control the pumps via the mobile phone set by sending commands in the form of SMS messages and receiving the appliances status. The main concept behind the system is receiving the sent SMS and processing it further as required to perform several operations. The type of the operation to be performed depends on the nature of the SMS sent.



Fig.2. Overload wiring diagram

Two of the three motor cables are fed through integral current transformers mounted on the body of the relay.

B- Phase sequence relay (Phs) to perform a protection when one of the supply phases is missing for three phased submersible motor and over/under voltages

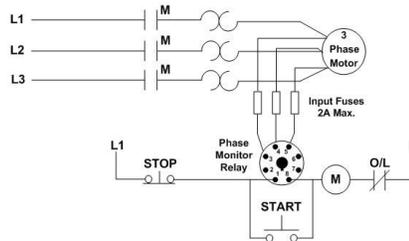


Fig.3. phase sequence wiring diagram

C- Liquid level relay (L.L) is used to monitor the water level of submersible pump.

## B. Arduino Uno board

The brain of this system is Arduino UNO board is seen in the figure.4 Arduino is one of the famous electronic devices in the world due to being open source, flexible software and hardware. The Arduino platform is a simple device built in the AT-mega Microcontroller. Moreover, the software for ARDUINO works with many operating systems, such as Mac, Windows and Linux. The Arduino software language is based on C. There are many types of ARDUINO modules available on the market.



Fig.4. Arduino Uno board

## C. GSM module

A GSM module is responsible for the connection between the pump and mobile phone. A GSM (Global System for Mobile) modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem, except the main difference between them is that a dial-up modem sends and receives data through a fixed telephone line, while a wireless modem sends and receives data through radio waves. The GSM modem performs the operation of sending message to a defined SIM number. The Sim900 GSM/GPRS Used in this system, it works to make a connection between the Microcontroller and the mobile phone. During operations of this unit, the information transfer from the microcontroller to the mobile and vice versa.



Fig.3. GSM module

**D. Relays**

The relay provides isolation between the controller and the device. Arduino microcontroller works on 5v DC but pump control panel works on 220v AC so the relay provides connected between them. Two types of relays are using one of them is energized by 220vAC from protection relays in pump panel and another from Arduino microcontroller when the farmer sends (SMS) to remotely on/off pump.

**E. LCD**

A 16x2 character LCD with white text on blue background display is used to display the type of faults.

**2.2 Interfacing Diagram of Arduino Microcontroller System**

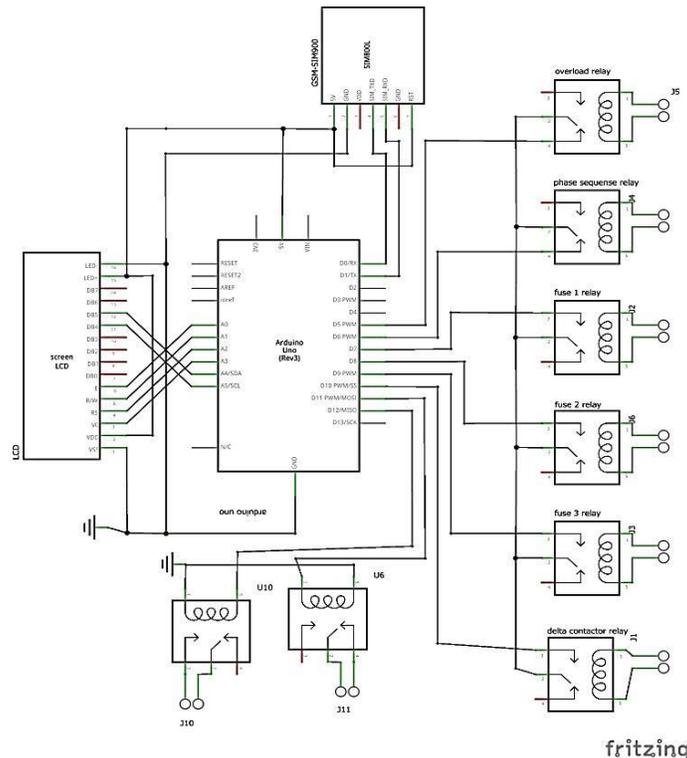


Fig.5. Arduino microcontroller system interfacing

Interfacing diagram of the Arduino microcontroller system is shown in figure 1. Pins D0/RX and D1/TX are used for GSM transmit and receive commands. Analogue pins (A0, A1, A2, A3, A4, A5, and A6) are connected to the LCD display. Pin D5,D6 ,D7, D8, D9 and D10 are configured

as inputs are connected to fuse1, fuse2, fuse3,delta contactor which is used to determine the pump status on or off, overload and phase sequence relays. Two 5vdc relays are connected to D11 and D12 which is used to switch on and off the AC contactor through wireless using GSM. And also to make the pump off when any faults occur.

### 2.3 System software

The software is the Arduino Integrated Development Environment (IDE). This software comes with the Arduino or can be downloaded at no cost from the Arduino site. This software is built in Java. This software allows editing, writing sketches and uploading code to the Arduino, [12]. The basis of this software is the C- language. This software is set up in the computer.

### 3. System operation

In this system the GSM unit is installed in the pump house. The system operates in two sides, one of them is remotely ON/OFF pump and another is monitoring pump conditions.

#### 1. Switch pump ON/OFF:

In the proposed system the user sends a text message to the GSM unit at the pump house to switch on/off the pump. The user send with a predefined password to turn the pump on or off.. The GSM unit senses when the pump starts/stop by a separate contact on the contactor. If the GSM unit at the pump house senses that the pump has switched on/off. The unit notifies the farmer by sending a confirmation message.

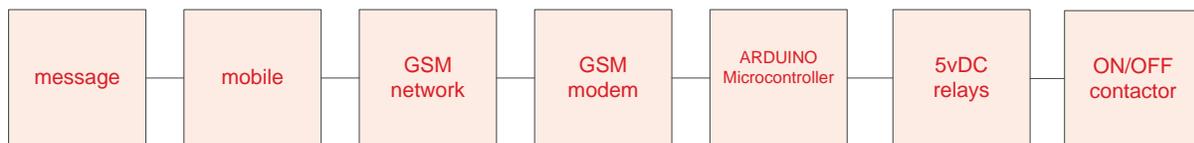


Fig.6.Block diagram for Switch pump ON/OFF

**PSW : Password to turn on or off.**

**KD : contactor in pump panel (responsible for pump status).**

**HIGH : means pump is in OFF state.**

**LOW : means pump is in ON state.**

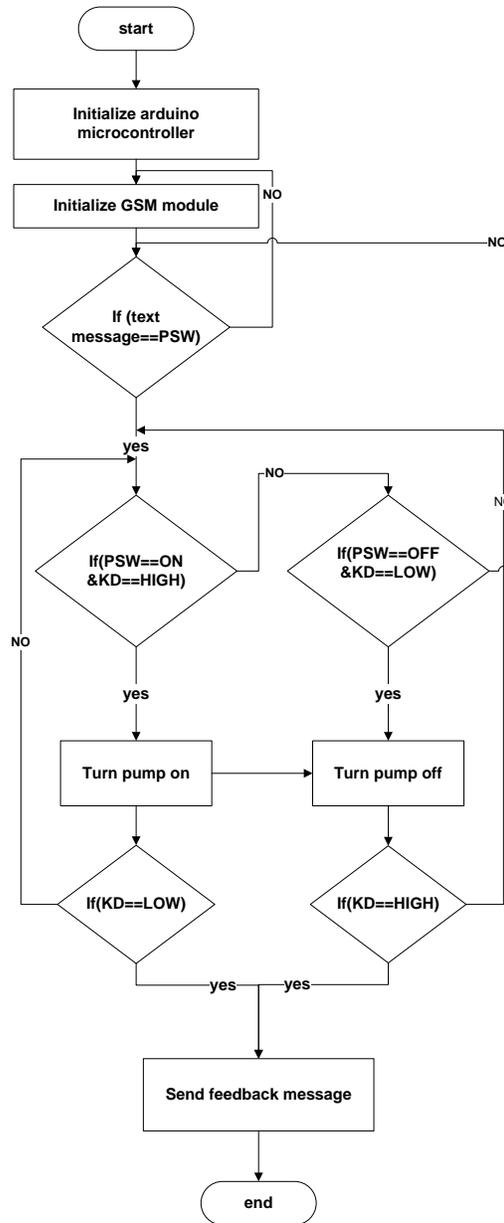


Fig.7.Flowchart for remotely on/off pump

**2.Monitoring pump conditions:**

Remote monitoring devices determine if a machine is functioning correctly and collect information about the equipment. When the pump being off through irrigation process the GSM unit sends message to notify the farmer additionally when any protection relay in the pump panel tripped .the signal converted to the GSM unit by the relay card .The relay card works as an input for the ARDUINO UNO board. And send messages to notify the farmer not only the status of the pump, but also the type of fault.

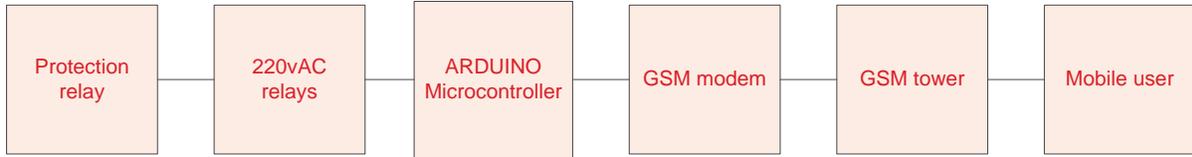


Fig.8.Block diagram for monitoring pump conditions

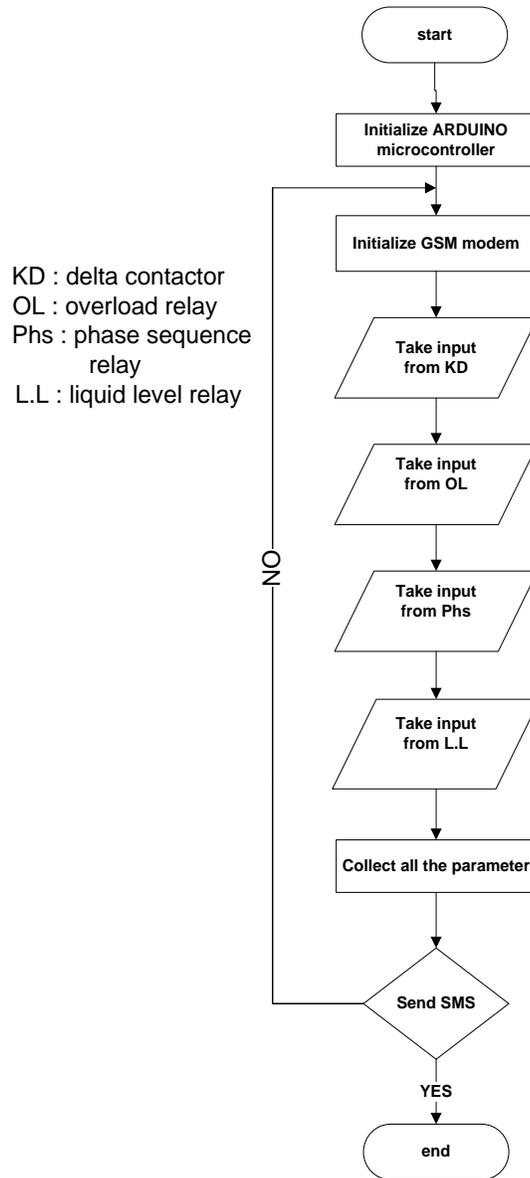


Fig.9.Flowchart for monitoring pump condition

#### 4. Results and discussions

This section describes the output of the implemented system. The system implemented on 60HP submersible pump. The system was designed to send SMS from user mobile phone to the GSM module connected to the Arduino UNO microcontroller. The system then replies by sending a message to the user mobile phone reporting the status of the pump (turned ON or turned OFF) and the faults occur.

The hardware setup of the system is shown in the Fig.10. The PCB(Printed circuit board) is designed with the Proteus software package. The Arduino microcontroller is connected to the GSM modem and the relays are connected to the pump control panel through signal wires. The LCD was interfaced to the Arduino microcontroller in order to display the status of the pump.



Fig.10.hardware setup of the performed system.



Fig.12. shows the SMS sent by the user to control system to remotely ON/OFF the pump and the replied SMS (confirmation message) from the control system to the user.

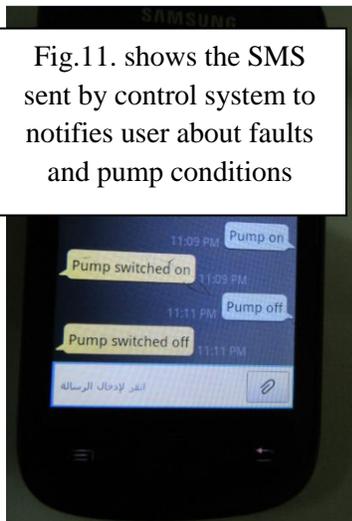


Fig.11. shows the SMS sent by control system to notifies user about faults and pump conditions



Fig.13.The view of the whole system when it is running

## Conclusion

In this study, a system of controlling and monitoring submersible pumps through the short service message (SMS) with GSM modem has been successfully designed and tested. This designed system is GSM based and enables the user to control and monitoring them from anywhere. With these systems, remote powering submersible pumps and continuous monitoring faults were realized. In this way, remote data collection about the conditions of submersible pumps can be obtained. It took great change and flexible to the farmer while power cuts. The performed study is low cost and it is fast compared to alternative systems.

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