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Automatic Tank Water Level Monitoring and Notification

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Abstract*: *There is wastage of energy as well as of water if not managed well. There are overhead tank at the home to store the water. So when water pump is started to fill the overhead tank, we do not have no any idea when it gets filled up. Because of that lot of water as well as electricity gets wasted since no action is taken by user. The water starts spilling out from the tank. In this work we have developed system which detect the water level and save the water from spilling out of the tank. Here, the main part comprising the development of the system that capable to detect water level using micro controller. In this work we targeted to monitor and send SMS or calls to respective authority (user) by using GSM module.
Keywords: Microcontroller, Sensor, GSM Transceiver, Motor Control, Water Level

I. INTRODUCTION

Water scarcity is one of the major problems facing most cities in the world and wastage during transmission has been identified as a drawback. Student's hostels are usually provided with water tanks and placed at the roof top of hostel buildings. Water from main inlet is pumped up to the tanks using electrical water pump. Water supplies to most part of the hostels are drawn from the tanks by means of gravity. When there is power failure, no water is pumped up to fill the tanks. As a result the water level in the tank reduces gradually.

The situation becomes worse especially at the weekends and public holidays when most of the hostel residences are in. The water level of the tank reduces drastically and within short period of time the water runs out. Unexpected water shortage does occur any time if the tank is not properly monitored. Hence, a monitoring system to monitor the tank water level has to be developed and eventually able to alert the person, in-charge or technician on the current status of the tank. The system consists of water level detector circuitry integrated with GSM module. Upon reaching the water level in the tank, an SMS is sent through GSM module to the technician in-charge for further action.

This system is particularly design for the overhead tanks in offices or houses. Sometimes the tank gets full and the water spills out of the tank. This leads to the wastage of water and energy also. The system consists of water level detector sensor integrated with GSM module. Upon reaching the critical water level in the tank, the call is sent through GSM module to the technician, in-charge for further action.

II. LITERATURE SURVEY AND SYSTEM REALIZATION

Hughes et al. 2006 introduced a flood monitoring and warning system with the help of intelligent technique. This work represents the wireless sensor network for flood warning which can be used in many programs like it can work with remote fixed network and in flood purpose and also capable to perform on flood site. By developing sensors on sites of flood we can manually collect data through GSM telemetry method [1]. Call to users advising them to proactively reduce their power consumption before system capacity is reached and systematic power shutdown takes place. This could increase cost-effective wireless distributed load shedding system for non-emergency scenarios [2]. The system used microcontroller to automate the process of water. Pumping in an over-head tank storage system and has the ability to detect the level of water in a tank, switch on/off the pump according and display the status on an LCD screen. This research has successfully provided an improvement on existing water level controllers by its use of calibrated circuit to indicate the water level and use of DC instead of AC power thereby eliminating risk of electrocution [3]. The similar work presented by [4][5] which designed and developed a smart home application system. The system allows the home owner to be able to monitor and control the house appliances via a mobile phone set by sending commands in the form of SMS messages and receiving the appliances status. The aim is to use the readily available material to construct low cost sensors. Relays are controlled by the micro controller through the high current driver IC and provided for controlling solenoid valves, which controls the flow of water to different parts of the field. Other relay is used to "shut-off" the main motor which is used to pump the water to the field. Performance of sensors in terms of energy consumption has also been analyzed [6]. The system was capable of monitoring the meter reading and sent an SMS to the authorized center. This could reduce the number of estimated reading when the

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authorize person unable to reach the meter. Another work presented by using wireless text messaging system to send early warning SMS messages to users advising them to proactively reduce their power consumption before system capacity is reached and systematic power shutdown takes place [7]. Khaled Reza el al.,(2010) introduced the notion of water level monitoring and management within the context of electrical conductivity of the water. The authors motivated by the technological affordances of mobile devices and the believe that water level management approach would help in reducing the home power consumption and as well as water overflow; investigated the microcontroller based water level sensing and controlling in a wired and wireless environment. The research result was a flexible, economical and easy configurable system designed on a low cost microcontroller and finally, proposed a web and cellular based monitoring service protocol to determine and senses water level globally [8]. The functions are performed by a single microcontroller and sensors used for different purposes. This project involves the use of microcontroller, water pump, display and an assembly language program. The water level indicator monitors the filling of overhead tank and displays the water level in the display [9]. This research has successfully provided an improvement on existing water level controllers by its use of calibrated circuit to indicate the water level and use of DC instead of AC power thereby eliminating risk of electrocution [10]. Water scarcity is the serious issue in major cities. One has to keep on observing his tank water level to switch off the motor once it is switched on. And sometimes this also can happen that the motor coil burns because of absence of water in the pump. We have discussed about design and implementation of water level control system which is wireless, automatic, cost effective and reliable. It uses two Radio Frequency transceivers along with a controller used for wireless communication. It is completely automated with the help of a micro controller. The system does not need any attention of the user unless the sump is empty. Installation cost is reduced since the system is wireless. It is reliable because it has no problems arising after installation such as breakage of wire [11]. The greenhouse based modern agriculture industries are the recent requirement in every part of agriculture in India. In this technology, the humidity and temperature of plants are precisely controlled. It is observed that for the first time an android phone-control the Irrigation system, which could give the facilities of maintaining uniform environmental conditions are proposed. 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 use to inform the user about the exact field condition. The information is passed onto the user request in the form of SMS. The work presents a system of an automatic water level controller with SMS notification [12].

GSM network communicated between intelligent terminal and management centre. This system has excellent features such as wireless, good quantity of data transmission, low workload, low expenses and high veracity [13]. Johari etal. 2011 provide detailed of tank water level monitoring system by using GSM Network. This paper presents the development of water level monitoring system with an integration of GSM module to alert the person through Short Message Service (SMS).This project gives the solution of shortage of water supply in dense population like in hostel where students are suffers from this situation because there is no system for monitoring the water level, when it reached at critical level. There is no person when the situation becomes bad due to this reason water level

Is monitored and data through SMS. The system was tested to reduce the shortage of water supply [14]. In early there is no method for monitoring water level and bore as well. Farmers have to face very difficult situation and they work for the whole to switch the, pump motor off but they cannot sort the solution. It can solve by GSM and it will automatically give alarm sound to mobile user. It describes it's solution when the water level in the bore well drops threshold below or rises to the threshold level for pumping. The user will immediately switch on or off the pump motor by mobile phone through SMS [15]. The GSM modem performs the operation of sending message to a defined SIM number. GSM technology provides with high quality signal and giving them way to reach high quality digital communication at very lowest rates [16]. Rojiha (2013) analyzed this existing oil-pumping system and discovered that they have a high power-consuming process and needs more manual power. He then proposed a sensor network based intelligent control system for power economy and efficient oil well health monitoring. Several basic sensors were used for oil well data sensing, and the sensed data was given to the controller which processed the oil wells data and it was given to the oil pump control unit which controls the process accordingly. If any abnormality is detected then the maintenance manager is notified through an SMS via the GSM[17].

A. Block Diagram of Proposed Model

The block diagram of water level notification consists of following blocks:

1) PIC Microcontroller (16F877A)
2) Float Sensor
3) Transceiver 300

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4) Relay
5) Optocoupler

Block Diagram of the proposed system is shown in figure 1, in which the float switch senses the water level with the help of inbuilt switches. This switches activated with the help of trigger which is given to the microcontroller. Therefore microcontroller gives the two outputs. Out of which one for the GSM modem to trigger the SIM 300 and transceiver and make the call to the particular person which number is stored on it.

The output trigger is given to the transceiver module using the optocoupler which trigger the module. Another output of microcontroller is given to relay circuit to turn off the motor. Actually relay will be connected to the coil of starter in series with water pump. PIC16F877A microcontroller is used to obtain different time setting to turn off the motor.

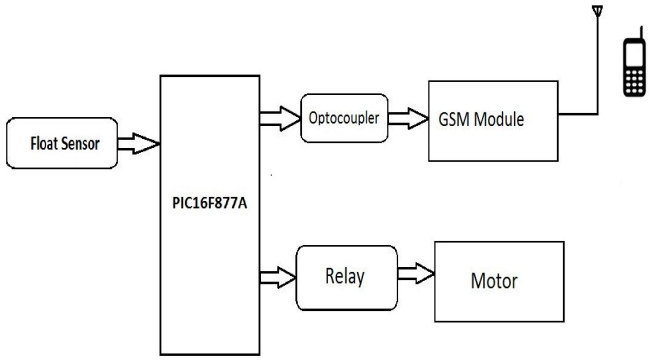


Figure 1 Block Diagram of Automatic Tank Water Level Monitoring and Notification

1) PIC Microcontroller (16F877A):

PIC16F877A was used in a microcontroller circuit for processing unit. PIC microcontroller is used as a central processor because it's capability to operate without other external components due to all necessary peripherals is already built into it. Thus it reduce time and space required to construct the device. This PIC works on a 5V DC power supply, with a crystal oscillator and 2 units of 22pF capacitors.

PIC microcontroller contains inbuilt ADC so there is no need of external converters. The float sensor is directly interfaced with the PIC.

2) Float Sensor: A float switch is a device used to detect the level of liquid within a tank. The switch may be used in a pump, an indicator, an alarm, or other devices. Float switches range from small to large and may be as simple as a mercury switch inside a hinged float or as complex as a series of optical or conductance sensors producing discrete outputs as the liquid reaches many different levels within the tank. Perhaps the most common type of float switch is simply a float raising a rod that actuates a micro switch. A very common application is in condensate pumps where the switch detects the rising level of liquid in the sump or tank and energizes an electrical pump which then pumps liquid out until the level of the liquid has been substantially reduced, at which point the pump is switched off again. Float switches are often adjustable and can include substantial hysteresis. That is, the switch's "turn on" point may be much higher than the "shut off" point. This minimizes the on-off cycling of the associated pump.

*3) GSM Transceiver 300:*Highly integrated radio frequency (RF) Agile Transceiver designed for use in 3G and 4G base station applications. Its programmability and wide band capability make it ideal for a broad range of transceiver applications. The device combines a RF front end with a flexible mixed-signal base band section and integrated frequency synthesizers, simplifying design-in by providing a configurable digital interface to a processor. 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 SMS programming. It uses the highly popular SIM300 module for all its operations. The modem consists of all the required external circuitry required to start experimenting with the SIM300 module like the power regulation, external antenna, SIM Holder, etc.

4) Relay: A relay is device that acts as an electrically operated switch. It a device which controls the switching of circuit by receiving energy to operate itself it can be considered as remote control switch. Most relays are electromagnetically operated current through a coil generates a magnitude coil that attracts the armature which in turn closes of opens the electrical contact.

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Operation is in millisecond range, thus relays can be considered as remote control switches. A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults.

5) *Optocoupler:* An optical coupler, also called opto-isolator, optocoupler, photo coupler or optical isolator, is a passive optical component that can combine or split transmission data (optical power) from optical fibers. It is an electronic device which is designed to transfer electrical signals by using light waves in order to provide coupling with electrical isolation between its input and output. The main purpose of an optocoupler is to prevent rapidly changing voltages or high voltages on one side of a circuit from distorting transmissions or damaging components on the other side of the circuit. An optocoupler contains a light source often near an LED which converts electrical input signal into light, a closed optical channel and a photo sensor, which detects incoming light and either, modulates electric current flowing from an external power supply or generates electric energy directly. The sensor can either be a photo resistor, a silicon-controlled rectifier, a Photodiode, a phototransistor or a triac.

6) *Motor Control:* After getting the call if the authority can't take action, we can add the feature of turning off the motor. The signal from sensor will be send to the pins of the microcontroller then this signal will operate the relay. The relay will auto turn off the motor which operate on the 230 V AC supply. The turning off time of the motor can be decided and can be managed by the controller.

B. Firmware Development

The flowchart of the firmware of the system is depicted in Figure2.

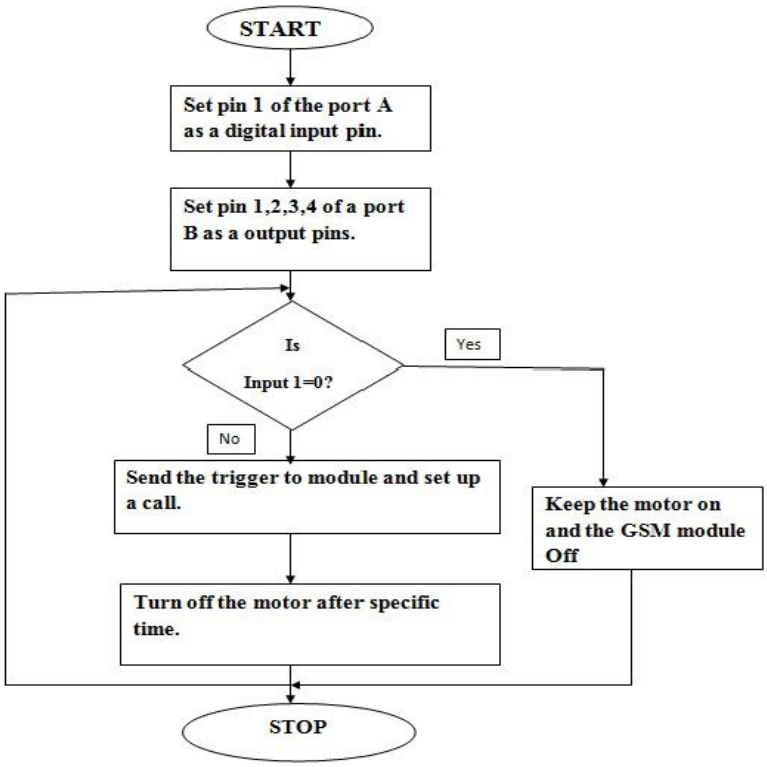


Figure 2: Flow Chart

III. RESULTS AND DISCUSSION

A. Experimental Result

After actual implementation we got the expected result. When the liquid level rises to the point at which the float passes 45 degree upward, the internal switch will actuate, re-opening the normally open contact (NO) and re closing the normally closed contact (NC) which gives the signal to microcontroller and GSM get triggered.

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Table I
DIFFERENT CONDITION OF FLOAT SENSOR

Input	Output (Volt)
Float Sensor upward above (45◦)	trigger of 5V
Float Sensor downward below (45◦)	no trigger (0V)

The particular number saved in GSM will get the call. After 2 minute of trigger the motor will be switched off.

B. Actual Implementation

For actual testing of project we used bucket and toy motor. In actual project will be implemented on the tank and AC motor. In this implementation the call is sent after bucket gets filled and after 2 minute the motor will turn off.



Figure 3. Overview of Hardware Setup

IV. CONCLUSIONS

Water is one of the most important basic needs for all living beings. But unfortunately a huge amount of water is being wasted by uncontrolled use. Some other automated water level monitoring system is also offered so far but most of the method has some shortness in practice. We tried to overcome these problems and implemented an efficient automated water level monitoring and controlling system. Our intention of this research work was to establish a flexible, economical and easy configurable system which can solve our water losing problem. We have been used a low cost PIC 16F877A microcontroller in this system which is the key point to reduce cost.

The automatic water level controller is Smart system as all processes occur automatically with continuous updates by controller, to the user, via GSM technique i.e. calling and SMS Notification. This system is deprived of any sort of noise and has effective switching action. To widen the application to this project work, security home alarm system can be matching application. The automatic water level controller system can be used in home, office sectors, swimming pool and even in industrial areas. As mentioned earlier there is no link between reservoirs tanks henceforth, communication between the two can take this project to another level. Furthermore, extra care needs to be given as water is used as conducting media.

Moreover, GSM module can be replacement to cell phone. The system also can be modified to two tank system with wireless communication between tank of interest and reservoir tank. All in all , despite being the smart system there are many rooms for improvement, which when considered, this system can be more smart ultimately user being smarter.

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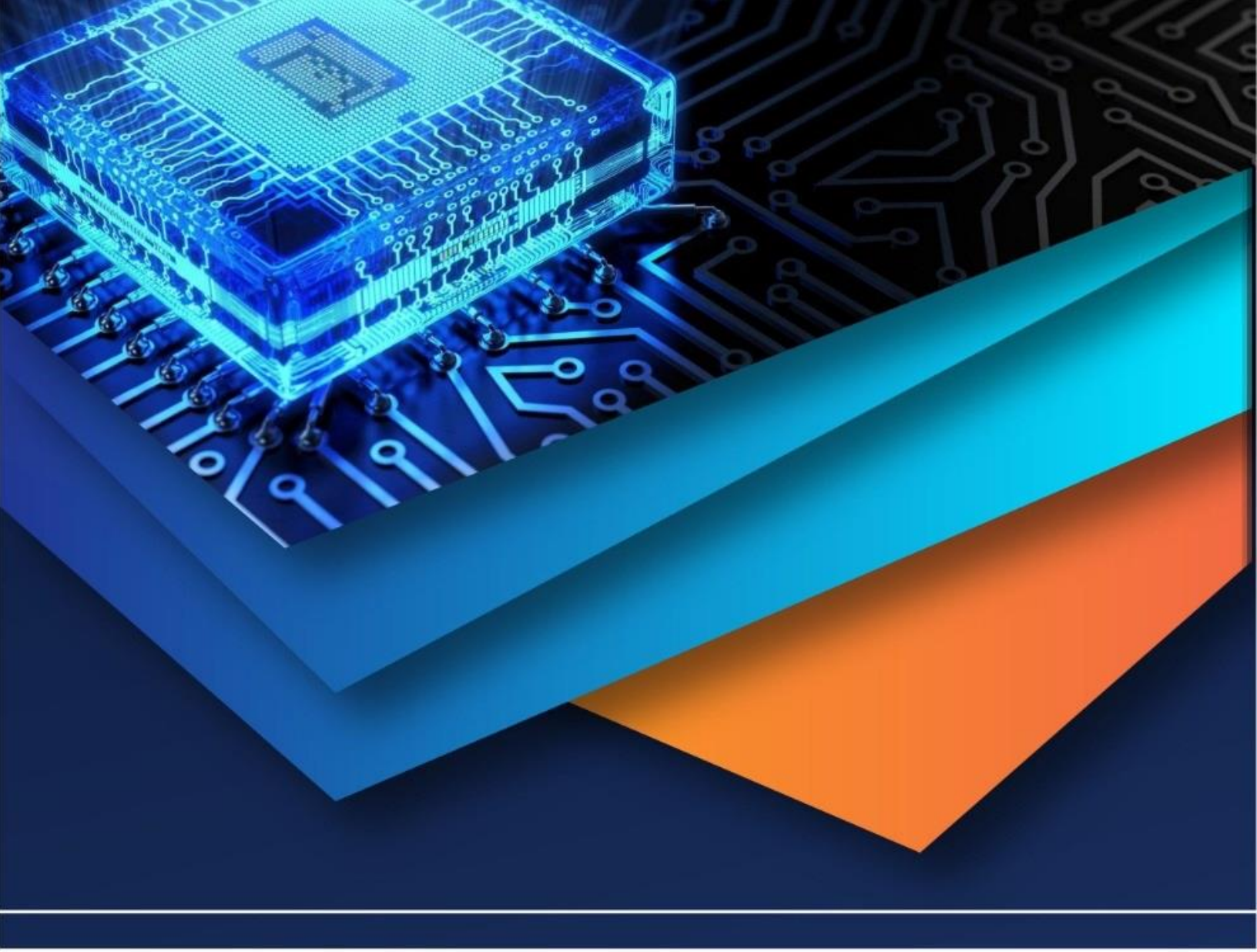
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