

# Advanced Water Impurity Detection System

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**ABSTRACT:** Water pollution is one of the severe problems that have crippling effect on public hygiene. This paper proposes a novel method to perform detection of impurities by using sensing components to bring quality maintenance of water. In the money conservative market like India, less importance is given for public hygiene and there is a general myth that any quality monitoring system would be costly and complex in its operation. This paper presents a pH level indicator that measures pH level of the water. The design makes use of giving the people to use quality water and indicating them regarding the auto monitoring. The Physical impurities like deposition of sand, mud, rust, Chemical intrusions and Salinity of the water are monitored, computed and analyzed that report is send immediately and documented. The implementation of Laser and pH sensor gives the simple structure, easy manufacture, accuracy & low cost.

**KEYWORDS:** Impurity detection, Quality maintenance, Auto monitoring, Low maintenance equipment

## I. INTRODUCTION

The supply of safe water has long been a key public health and environmental issue Recognition of the importance of water quality for health dates back to ancient times. The WHO Guidelines defines safe drinking water, as water that does not represent any significant risk to health over a lifetime of consumption, including different sensitivities which may occur between life stages. The importance of safe and adequate drinking water for health and development has also been reflected in the agenda of the United Nations (UN). The UN charter on the "right to water" stipulates that : "the human right to water entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses". Under the Millennium Development Goals (MDGs), specific targets are introduced with an aim of accelerating access to safe drinking water and basic sanitation. The United Nations General Assembly declared the period from 2005to 2015 as the International Decade for Action Water for life

The standard water supply system of an urban municipality has one or few centralized water collection and filtration facility that feeds processed / treated water into a network of storage and distribution pipelines. From the central filtration plant the filtered water is distributed through underground pipelines to different areas of the city. The filtered water is stored in intermediate storage tanks which may be located on either underground or ground level reservoirs, open or covered. The proposed system is designed in such a way that it is fixed to these intermediate tanks so that any quantity of impurity can be traced before it even reaches the consumer side. The system consists of a combination of sensors that work together to create a detection system that can practically detect almost any kind of impurity that is present in the water that enters the tank. Further facility is provided that enables alert signal generation and sending to the authorities and also a "Flush On Request" mechanism that will enable to empty the impurity contained water out of the storage tank. The flushed out water may either be drained away or can be used for Irrigation projects.

## II. DESIGN PROCESS

### SYSTEM AND SENSORS DEVELOPMENT

The overall system architecture of the proposed system comprises of the following four sensor subsystems having a pH sensor which measures the pH level of the water present, a laser sensor which scans the water for impurities, an IR circuit which detects colour changes in the water and GSM module.

#### I. pH Sensor

The pH sensor is used to sense the nature (ie acidic or basic) of the water present in the tank. The pH sensor detects the pH level of the water and sends a corresponding electrical signal to the Microcontroller this Signal provided by the Sensor is compared with default values pre programmed into the microcontroller. The microcontroller then produces a signal to the 16bit LCD display and the pH level of the water is displayed on the LCD.

#### II. Laser Sensor

The laser circuit is designed to produce a steady voltage to the microcontroller. If there is any change in the input given to the microcontroller it is assumed that there are impurities present in the water. The presence of solid impurities cuts the supply to the microcontroller. The larger the impurity the greater will be the dip in voltage to the Microcontroller.

#### III. IR Circuit

The IR circuit is used to detect any colour change in the water. The reflection of normal water through the IR circuit is set as the default. If there is a change in colour of the water the output produced by the IR circuit changes. This change is detected by the microcontroller and a signal assigned if any colour Change is detected is sent to the LCD.

#### IV. Solenoid Valve

The proposed system uses two solenoid valves in our device. One is used to control the water input into the tank and the other to drain the impure water if necessary. The solenoid valves are controlled by the microcontroller along with the GSM module.

#### V. GSM Module

GSM module acts as a link between the microcontroller and the user Specific commands are pre designed to help the user to control the device. The user can use the keywords to operate the drain option of the second solenoid valve.

## III. MECHANISM

The proposed system is used to monitor the quality of the water present in the public water distribution tanks. The idea is to place the corresponding sensors in two parallel vertical tubes near to the inlet of the tank running all the way to the bottom of the tank. The sensors are placed at different levels of the water distribution tank.

As the water enters the tank the device checks the pH level of the water. If the pH of the water is not within the normal range device the outlet solenoid valve of the tank is closed immediately and an alert is sent to the authorities. If the pH level is normal the device moves on to check the value of the IR and the laser sensor. The laser sensor is fixed near to the inlet of the tank. The laser output is received by a LDR. If any solid impurity passes through the inlet and to the laser light the intensity of the light reduces and there is a dip in the output of the LDR. This is how the laser sensor detects the solid impurities. Similarly, the IR transmitter produces a specific output in normal colourless water which is noted and pre programmed. If there is any change in the colour of the water the output produced by the IR receiver changes and hence the microcontroller produces a colour change alert to the authorities. If any of the above sensor values changes from the corresponding pre programmed values the outlet solenoid valve is closed. If the water present in the tank is impure the authorities can send a message back to the device to flush the water.

The flush valve present is opened and the impure water can be redirected for other purposes. The device resets itself and checks the water present in cycles. The time period of each cycle is 30 seconds.

All the above equipments work on DC voltage and produce accurate results for the micro controller and hence helps in instantaneous determination of impurity presence. The simulation of the same was made using Proteous and it is shown in Fig3. The Atmega32 microcontroller is loaded with program which controls all the mentioned modules. The sensors were calibrated in such a way that each impurity was given a safe offset which is close to ideally pure water. This was done to ensure efficient operation of the device and was found to be coping with the different types of impurities introduced into the water. The LCD screen used is a 16 by 2 display which is used to display the detection status of impurity, and an alert message gets displayed in an event of detection corresponding to the impurity type displayed. When an impurity is displayed, an alert message is send to the authority with the location and alert that occurred on that specific device.

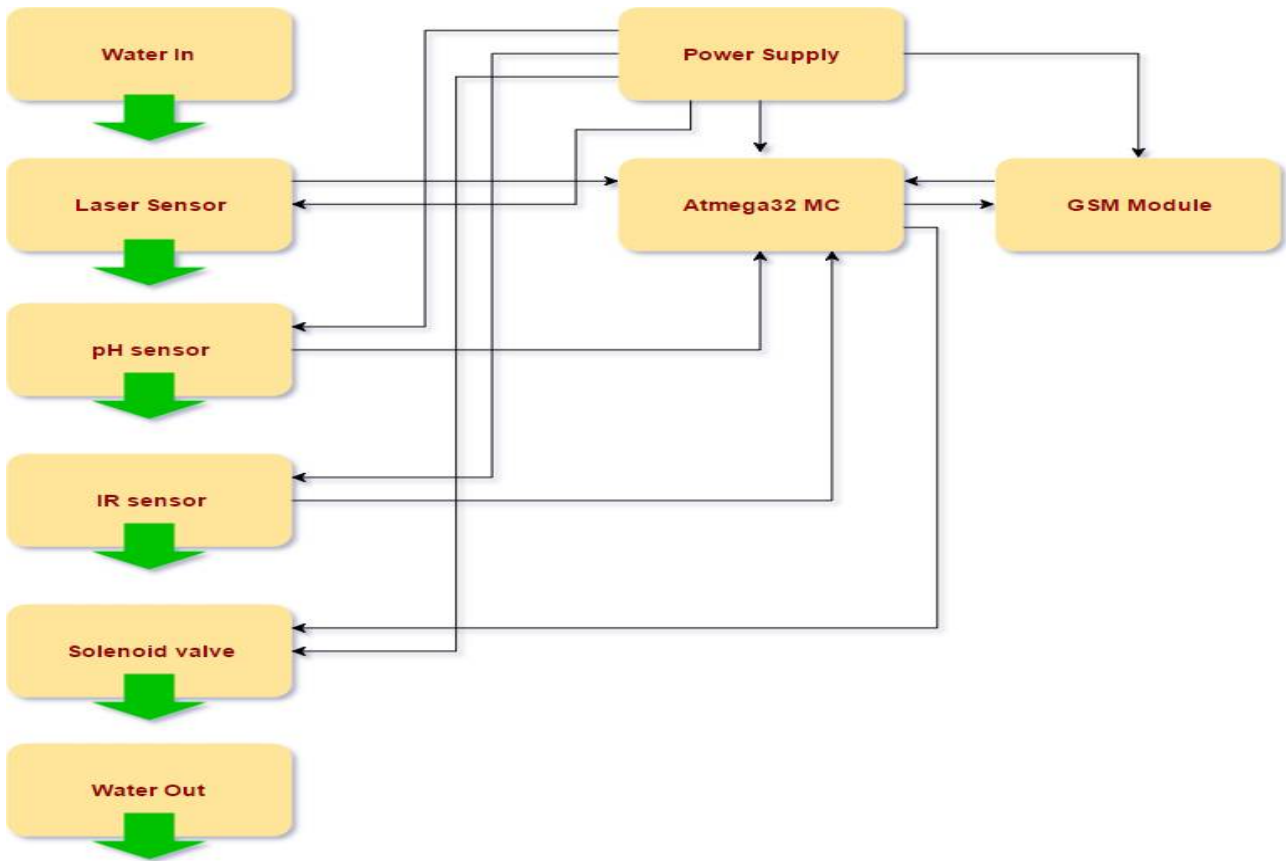


Fig.1 The Block diagram shows the various components of the detection system.

The ATMEGA32 controller is used to control the 2 solenoids based on the signal received from the sensors. If a positive signal is received from the sensors, indicating the presence of an impurity, then the main solenoid is closed and an Alert signal is send through the GSM module. It mainly consists of 3 sensors, an ATMEGA32 microcontroller and 2 solenoid valves. The power supply used is a 12v constant dc.

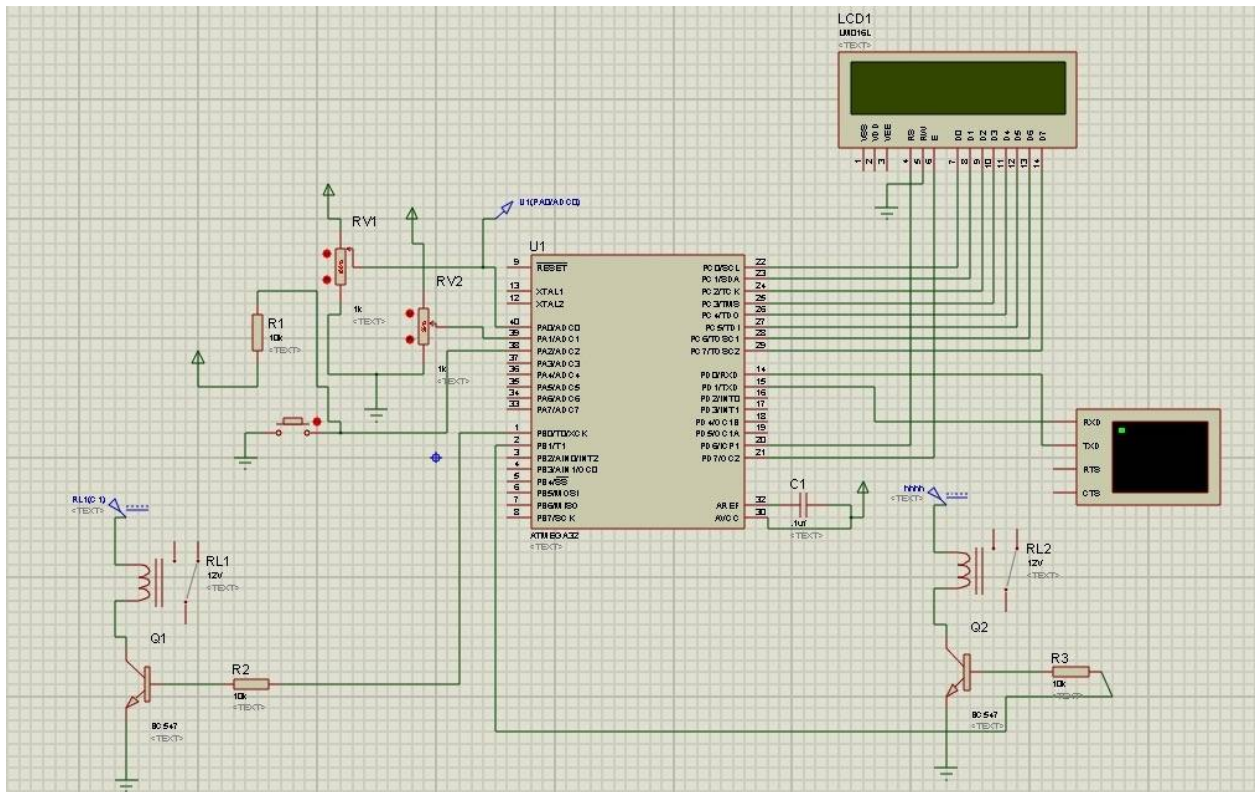


Fig. 3 Proteus simulation window

#### IV.HARDWARE

The prototype of the proposed system was implemented on a small transparent water tank. The IR and Laser sensors were placed on opposite sides of the tank in such a way that the transmitted signals from the transmitter reaches the receiver properly. The pH sensor is mounted on top of the tank and such that its two rods are in contact with the water.

The below pictures show the initial stages of the prototype:



Fig. 4 Prototype in its development phase

#### V.CONCLUSION

The system was tested and found to be working in the desired manner and multiple impurities were detected and alert was produced. This system finds its application mainly in public water distribution networks and if the sensitivity of the sensors are made more precise, then it can be used for industrial standard use.

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