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*Full Length Article*

# Aquaguard: Iot Based Smart Water Contamination Alert System

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***Abstract***
*Water is vital resource for life. Drinking safe water is important aspect for a healthy life. In modern world water pollution is one of the major causes for various types of water-borne diseases, 40% of the deaths worldwide are caused by water pollution. The clean and safe drinking water is getting depleted every second hence water purification is todays need. World bank estimates that 21% of communicable diseases in India are related to unsafe water, contamination has been a long-standing problem in our country. The older methods are unable to monitor the water quality in real time and notify the user about the contamination. So, it is necessary to develop a real time water quality monitoring and notification system. Smart solutions for water quality monitoring are gaining importance with advancement in communication technology. Water quality depends on pH, turbidity, temperature along with some other factors are significant, and will be monitored by the system using sensors, through wifi system the sensor output data is sent to concern authority for further steps to improve water quality.*

***Keywords***
*IoT, Water Quality Monitoring, ESP8266 microcontroller, DHT11 Temp sensor, Thingspeak, Turbidity Sensor*

## Introduction

Drinking safe water is an important factor I n our basic lifestyle as diseases occurs due to unhygienic lifestyle and so water hygiene is one of the factor that should not be overlooked. At home most people have purifiers installed. Information and communications technology systems for water control are currently facing interoperability problems due to the lack of support of standardization in monitory and control equipment. The proposed system is portable, automatic water quality monitoring and notification system, it saves time and human resources. The notification will be sent to authorised person when sensor will detect bad water quality .It is low cost system for real time water quality monitoring.

## Literature Review

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## Existing System

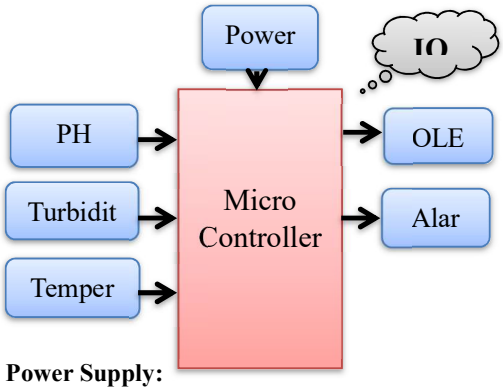
Water quality is typically tested manually at regular intervals by collecting samples and analyzing them in laboratories. This process is time-consuming, requires trained personnel, and often results in delayed detection of contamination. In many areas, contamination is only discovered after health issues arise, and there's little to no real-time monitoring or immediate alert system in place.

## Proposed System

The proposed AquaGuard system uses IoT-enabled sensors to continuously monitor water quality parameters such as pH, turbidity, temperature, and the presence of harmful substances. These sensors are connected to a microcontroller that sends real-time data to the cloud. If any readings exceed safe

limits, the system instantly sends alerts to users and authorities via a mobile, enabling quick action. This ensures early detection, faster response, and safer water for consumers.

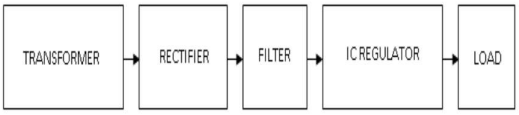
**5. Block Diagram**




**Power Supply:**

The power supply section is the section which provide +5V for the components to work. IC LM7805 is used for providing a constant power of +5V.

The ac voltage, typically 220V, is connected to a transformer, which steps down that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation.




**Transformer:**

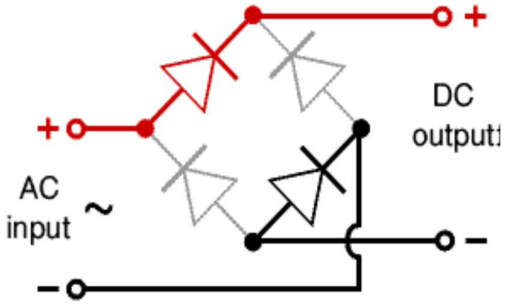
Transformers convert AC electricity from one voltage to another with little loss of power. Transformers work only with AC and this is one of the reasons why mains electricity is AC.

Step-up transformers increase voltage, step-down transformers reduce voltage. Most power supplies use a step-down transformer to reduce the dangerously high mains voltage (230V in India) to a safer low voltage.

The input coil is called the primary and the output coil is called the secondary. There is no electrical connection between the two coils; instead they are linked by an alternating magnetic field created in the soft-iron core of the transformer.

**Bridge Rectifier:**

When four diodes are connected as shown in figure, the circuit is called as bridge rectifier. The input to the circuit is applied to the diagonally opposite corners of the network, and the output is taken from the remaining two corners. Let us assume that the transformer is working properly and there is a positive potential, at point A and a negative potential at point B. the positive potential at point A will forward bias D3 and reverse bias D4.



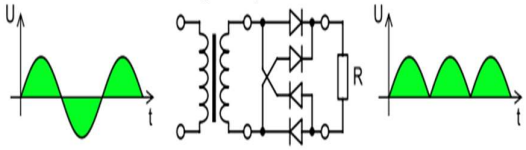

The negative potential at point B will forward bias D1 and reverse D2. At this time D3 and D1 are forward biased and will allow current flow to pass through them; D4 and D2 are reverse biased and will block current flow.

One advantage of a bridge rectifier over a conventional full-wave rectifier is that with a given transformer the bridge rectifier produces a voltage output that is nearly twice that of the conventional full-wave circuit.

i. The main advantage of this bridge circuit is that it does not require a special centre tapped transformer, thereby reducing its size and cost.

ii. The single secondary winding is connected to one side of the diode bridge network and the load to the other side as shown below.

iii. The result is still a pulsating direct current but with double the frequency.



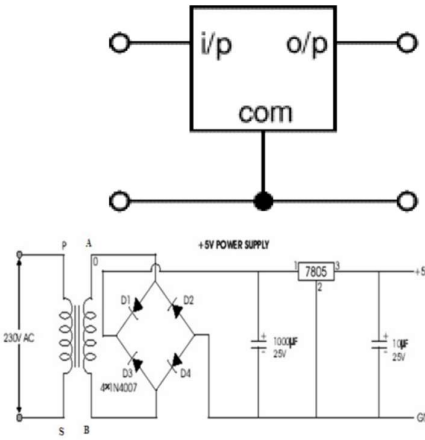

**Voltage Regulators:**

Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustably set voltage. The regulators can be selected for operation with load currents from hundreds of milli amperes to tens of amperes, corresponding to power ratings from milli watts totens of watts.

A fixed three-terminal voltage regulator has an unregulated dc input voltage, Vi, applied to one input terminal, a regulated dc output voltage, Vo, from a second terminal, with the third terminal connected to ground.

The series 78 regulators provide fixed positive regulated voltages from 5 to 24 volts. Similarly, the series 79 regulators provide fixed negative regulated voltages from 5 to 24 volts. Voltage regulator ICs are available with fixed (typically 5, 12 and 15V) or variable output voltages. They are also rated by the maximum current they can pass. Negative voltage

regulators are available, mainly for use in dual supplies. Most regulators include some automatic protection from excessive current ('overload protection') and overheating ('thermal protection').



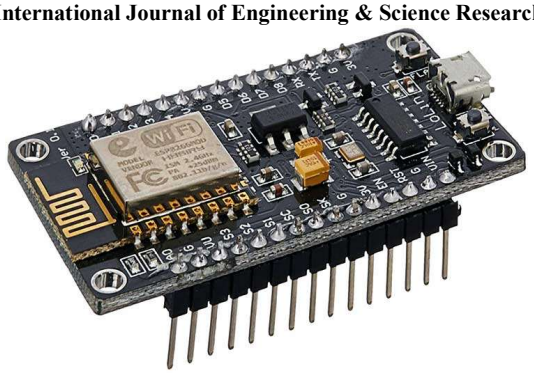

**MICROCONTROLLER:**

**NodeMCU ESP8266**

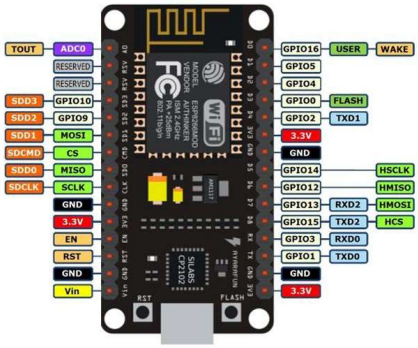
NodeMCU is an open-source Lua based firmware and development board specially targeted for IoT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module.

**NodeMCU ESP8266 Specifications & Features**

- Microcontroller: Tensilica 32-bit RISC CPU Xtensa LX106
- Operating Voltage: 3.3V
- Input Voltage: 7-12V
- Digital I/O Pins (DIO): 16
- Analog Input Pins (ADC): 1
- UARTs: 1
- SPIs: 1
- I2Cs: 1
- Flash Memory: 4 MB
- SRAM: 64 KB
- Clock Speed: 80 MHz
- USB-TTL based on CP2102 is included onboard, Enabling Plug n Play
- PCB Antenna
- Small Sized module to fit smartly inside your IoT projects



**ESP8266 NodeMCU**




**NodeMCU ESP8266 Pinout**

**General Purpose Input/Output Interface (GPIO):**

ESP8266EX has 17 GPIO pins which can be assigned to various functions by programming the appropriate registers.

Each GPIO can be configured with internal pull-up or pull-down, or set to high impedance, and when configured as an input, the data are stored in software registers; the input can also be set to edge-trigger or level trigger CPU interrupts. In short, the IO pads are bi-directional, non-inverting and tristate, which includes input and output buffer with tristate control inputs.

These pins can be multiplexed with other functions such as I2C, I2S, UART, PWM, IR Remote Control, etc.

**Secure Digital Input/Output Interface (SDIO):**

ESP8266EX has one Slave SDIO, the definitions of which are described below. 4-bit 25 MHz SDIO v1.1 and 4-bit 50 MHz SDIO v2.0 are supported.

| Pin Name | Pin Num | IO | Function Name |
|---|---|---|---|
| SDIO_CLK | 21 | 106 | SDIO_CLK |
| SDIO_DATA0 | 22 | IO7 | SDIO_DATA0 |
| SDIO_DATA1 | 23 | IO8 | SDIO_DATA1 |
| SDIO_DATA_2 | 18 | IO9 | SDIO_DATA_2 |

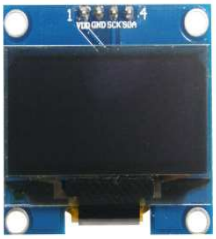
| | | | |
|---|---|---|---|
| SDIO_DATA_3 | 19 | IO10 | SDIO_DATA_3 |
| SDIO_CMD | 20 | IO11 | SDIO_CMD |

**I2S Interface**

ESP8266EX has one I2S data input interface and one I2S data output interface. I2S interfaces are mainly used in applications such as data collection, processing, and transmission of audio data, as well as the input and output of serial data. For example, LED lights (WS2812 series) are supported. The pin definition of I2S is as below. I2S functionality can be enabled via software programming by using multiplexed GPIOs, and linked list DMA is supported.

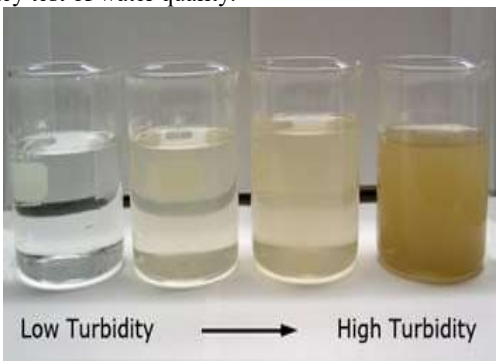
**OLED (Organic Light Emitting Diodes):**

OLED (Organic Light Emitting Diodes) is a flat light emitting technology, made by placing a series of organic thin films between two conductors. When electrical current is applied, a bright light is emitted. OLEDs are emissive displays that do not require a backlight and so are thinner and more efficient than LCD displays (which do require a white backlight). OLED displays are not just thin and efficient - they provide the best image quality ever and they can also be made transparent, flexible, foldable and even rollable and stretchable in the future. OLEDs represent the future of display technology.



**TURBIDITY SENSOR:**

Turbidity is the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye, similar to smoke in the air. The measurement of turbidity is a key test of water quality.




Turbidity is caused by particles suspended or dissolved in water that scatter light making the water appear cloudy or murky. Particulate matter can include sediment, especially clay and silt, fine organic and inorganic matter, soluble colored organic compounds, algae, and other microscopic organisms.

**Impact of Turbidity**

High turbidity can significantly reduce the **aesthetic quality** of lakes and streams. It can increase the cost of water treatment for drinking and food processing. It can **harm fish** and other **aquatic life** by reducing food supplies, degrading spawning beds, and affecting gill function.

water bodies during rainstorms due to stormwater runoff.

**Sensor Specification** 1. Operating Voltage: 5V DC
2. Operating Current: 40mA (MAX)
3. Response Time: <500ms
4. Insulation Resistance: 100M (Min)
5. Output Method: Analog
6. Analog output: 0-4.5V
7. Digital Output: High/Low-level signal (you can adjust the threshold value by adjusting the potentiometer)

**Sensor Construction & Circuit**

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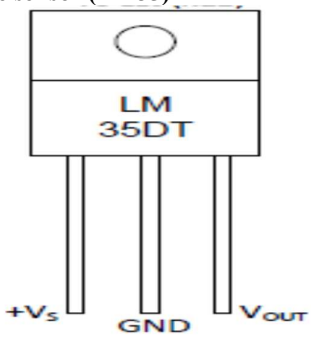
**TEMPERATURE SENSOR**

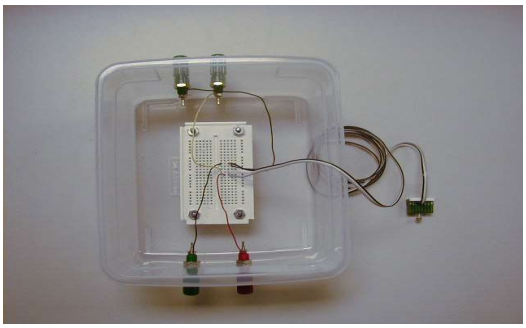
Temperature is the most-measured process variable in industrial automation. Most commonly, a temperature sensor is used to convert temperature value to an electrical value. Temperature Sensors are the key to read temperatures correctly and to control temperature in industrials applications.

**Temperature sensor (LM35)**




**DESCRIPTION OF TEMPERATURE SENSOR FUNCTIONAL MODULE:**

The temperature sensor functional module consists of two parts: the function module box and the probe head. The LM34 temperature sensor is mounted on the probe head. Be careful to make sure that the sensor is properly mounted on the probe head. (refer to Figure 4 Labeled picture of the probe head.)



By replacing the LM34 with another precision integrated-circuit temperature sensor LM35, we can easily get an output voltage proportional to the centigrade temperature. The LM35 sensor has a linear +10.0 mV/°C scale factor and a temperature range from -55°C to +150°C.In fact LM34 and LM35 are among the same series of temperature sensors so that they can be easily exchanged in different applications. The wiring for LM 35 is the same as that of LM34. Please refer to the datasheets of LM34 and LM35 for more detailed packaging and features information.

**BUZZER:**

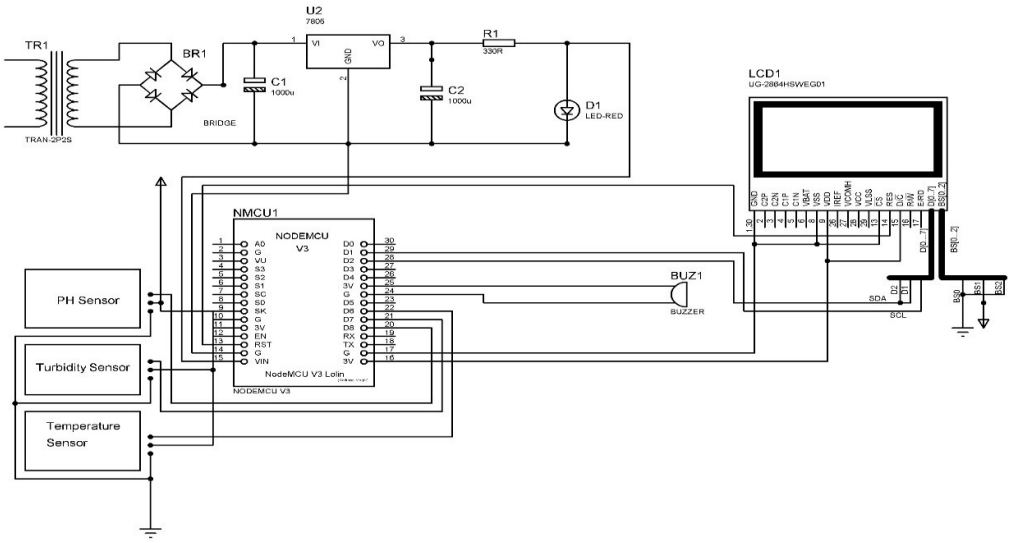
A buzzer or beeper is a signaling device, usually electronic, typically used in automobiles, house hold appliances such as a microwave oven, or game shows.

It most commonly consists of a number of switches or sensors connected to a control unit that determines if and which button was pushed or a preset time has lapsed, and usually illuminates a light on the appropriate button or control panel, and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound. Initially this device was based on an electromechanical system which was identical to an electric bell without the metal gong (which makes the ringing noise).

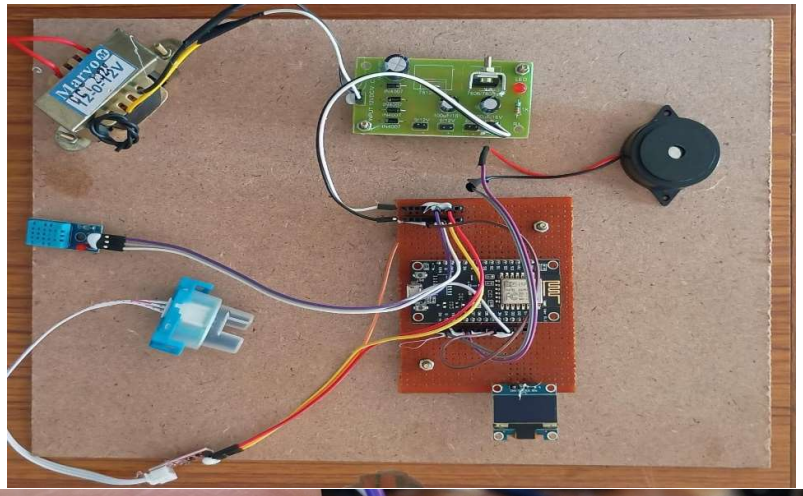
**USES**

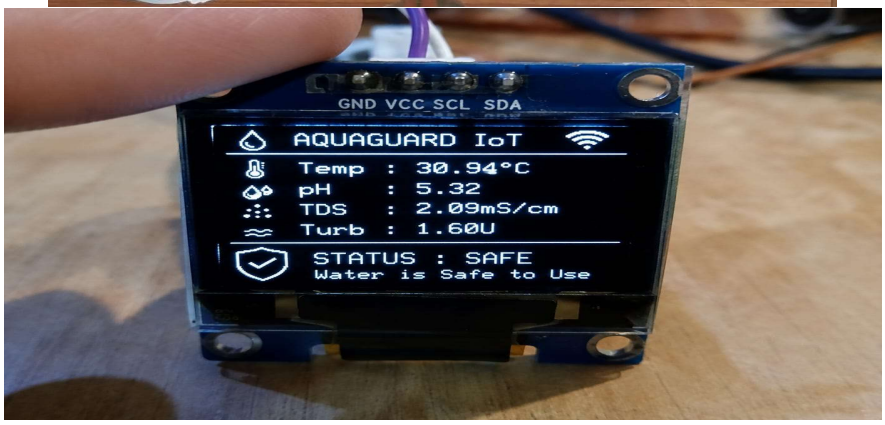
- Annunciator panels
- Electronic metronomes
- Game shows
- Microwave ovens and other household appliances
- Sporting events such as basketball games
- Electrical alarms

**SCHEMATIC DIAGRAM:**




**RESULT:**






Output in the OLED display

Outputs units of temp, pH,Turbidity

## CONCLUSION

In this project we connected water purifier to internet, and achieved real time water quality monitoring and notification system with the help of temperature sensor, turbidity sensor, pH sensor, UV sensor and raspberry pi. The older methods are unable to monitor the water quality in real time and notify the user about the contamination. So, it is necessary to develop a real time water quality monitoring and notification system for the users, to control water borne diseases. Proposed system will not only monitor the quality of water but also monitor the working of water purifier. The monitoring of working of water purifier is necessary and it is not present in the current system. Hence the project is low cost advancement in the current available systems for water purification. The components used are easily available and low cost. The proposed system saves time as well as human resources and ensures proper working of the water purifier.

## FUTURE SCOPE :

Integration of AI for water contamination prediction.
Use of advanced sensors for higher accuracy.
Expansion for outdoor large-scale monitoring.
Mobile app development for user Interface.
Solar powered system for energy efficiency.

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