WATER QUALITY MONITORING SYSTEM

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ABSTRACT

Water is the driving force of the nature. Still in many areas of our world, people don't have access to clean and safe domestic water. Monitoring the quality of water will help us control the pollution level as well. Physical conditions such as temperature, turbidity, pH value of water play important role in determining the quality of water. The paper makes use of a microcontroller with the help of various sensors to start a quality check on the water. Each of these sensors has a separate parameter to check. The temperature, pH, turbidity and water level sensors are placed inside the water tank with the help of probes to measure the respective parameters. Water level sensor will be useful to avoid overflow and wastage of water. The LED screen will be fixed with the model and whenever the water exceeds the predefined level, the LED screen will display the message as well as a buzzer will go off at the same time. The messages are sent to the authorized person by using a GSM module. This idea is very useful specially for the remote areas which are cut off from getting clean water and don't have access to expensive water level monitors.

Keywords: *Water quality, temperature, turbidity, pH, microcontroller, GSM module*

[1] INTRODUCTION

On this planet, 20% of individuals do not have access to safe drinking water. One of the reasons for this is various molecules being blended in the water. During rainy season, which is one of the most abundant water providing seasons, water is supplied to most of the areas but this water is not healthy as the level of turbidity is very high. Very few resources are available currently to purify this water for wide range of usage. The main purpose of our project is to provide a cost effective way to determine the quality of water hence avoiding spreading of many water borne diseases.

Nowadays, water quality monitoring in real time faces challenges because of global warming, limited water resources, growing population, etc. Hence there is need of developing better methodologies to monitor the water quality parameters in real time. The water quality parameters pH measures the concentration of hydrogen ions. It shows the water is acidic or alkaline. Pure water has 7pH value, less than 7pH has acidic, more than 7pH has alkaline. The range of pH is 0-14 pH. For drinking purpose it should be 6.5-8.5pH. Turbidity measures the large number of suspended particles in water that is invisible. Higher the turbidity higher the risk of diarrhea, cholera. Lower the turbidity then the water is clean. Temperature sensor measures how the water is, hot or cold. Ultrasonic sensor is used to avoid overflow of water in the case of a closed water storage area thus avoiding water wastage and floods. The traditional methods of water quality monitor involve the manual collection of water samples from different locations. This system is user friendly as it is easy to use and does not require much technical skills. Other than that, all the data is received in the form of a message to the authorized person which is achieved by using a GSM Module.

[2] WORKING METHODOLOGY

This projects aims to check the different parameters of water which determine its quality. To check these parameters, it uses different sensors such as turbidity sensor, pH sensor, temperature sensor and an ultrasonic sensor to determine the water level. First, the temperature of the water is determined by inserting the temperature sensor in the container containing water using probes. Too hot or too cold water might not be suitable for usage at times and this factor is useful in such cases. Simultaneously, code for temperature measurement is fed to the arduino which is a microcontroller and the code is run. The temperature of the water is displayed on the 32 bit LED screen. In order to avoid wastage of water and flooding, an ultrasonic

sensor is used in this model to measure the level of water. Ultrasonic sensor is fixed in the water container and water is poured in to the container slowly. As soon as the water crosses a predefined level, arduino detects the output from the sensor and the water level is displayed on the 32 bit LED screen along with a buzzer going off at the same time, indicating that the water has crossed the safe level.

Next the code for pH sensor is fed to the arduino and a text reading "output taken from pH sensor" is displayed on the LED screen. A pH sensor probe is then dipped into the water container and the reading is taken from it. Ideally the pH of water must be from 6.5 to 8.5. The pH obtained from the water is displayed on the LED screen along with a text informing whether the water is safe for use or not. We then take multiple varieties of water in order to take multiple pH readings. At last we check the turbidity of water. A sample of water with mud particle suspended in it is taken in a container and the turbidity probe is dipped into it. The code for the same is fed into the arduino. In general, the turbidity level should be 6.0 NTU (Nephelometric Turbidity unit), When the probe is dipped into dirty water, the LED screen displays a message of "turbidity level = 5.0NTU, unclean". When the same sensor is dipped into a clean sample of water, it reads "turbidity level = 7.0, water norm clean".

All the above readings from every sensor is recorded and sent to the phone via SMS using GSM shield and a text reading "initializing all parameters" is displayed on the LED screen and step by step, all the data of each sensor for every sample of water is sent via SMS to the authorized person. This service is useful when the person is not available near the system to monitor the quality and hence SMS provides that service. This is a process only for testing purpose and the same can be applied for commercial purpose also without manual support.

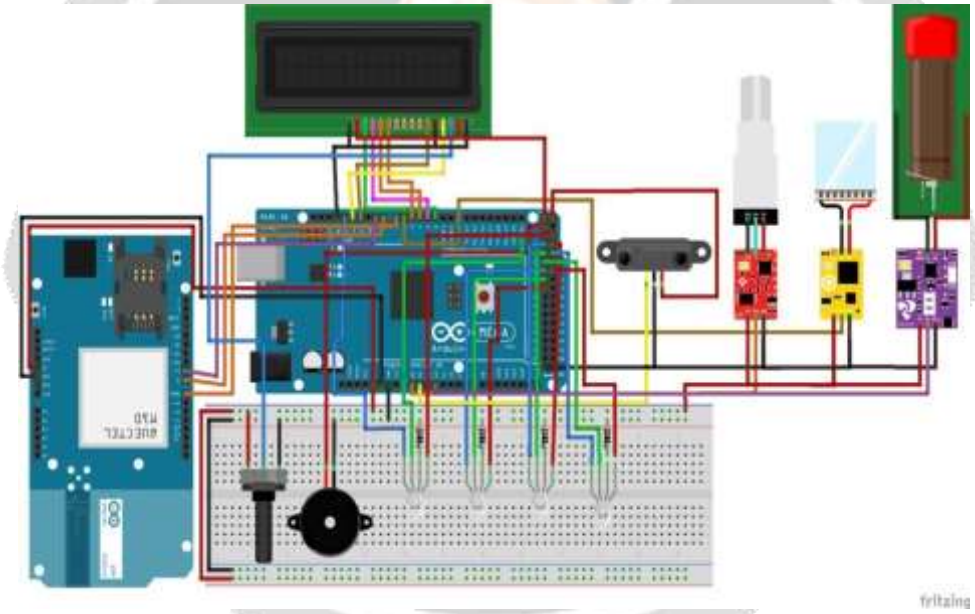

Figure: 1. Graphical view of the system

[3] COMPONENTS USED

[3.1] ARDUINO MEGA BOARD: Mega 2560 is a microcontroller board based on the Atmega 2560. It has 54 digital input/output pins, 15 of which can be used as PWM outputs, 16 analog inputs, 4 UARTs, a 16 MHz oscillator, a USB connection, an ICSP header, and a reset button. The Arduino Mega2560 has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega2560 provides four hardware UARTs for TTL (5V) serial communication. An ATmega8U2 on the board channels one of these over USB and provides a virtual com port to software on the computer (Windows machines will need an .inf file, but OSX and Linux machines will recognize the board as a COM port automatically. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the board. The RX and TX LEDs on the board will flash when data is being transmitted via the ATmega8U2 chip and USB connection to the computer (but not for serial communication on pins 0 and 1).

Figure: 2. Arduino Mega

[3.2] GSM SHIELD: The Arduino GSM Shield 2 allows an Arduino board to connect to the internet, make/receive voice calls and send/receive SMS messages. The shield uses a radio modem M10 by Quectel. It is possible to communicate with the board using AT commands. The GSM library has a large number of methods for communication with the shield. The shield uses digital pins 2 and 3 for software serial communication with the M10. It supports TCP/UDP and HTTP protocols through a GPRS connection. To interface with the cellular network, the board requires a SIM card provided by a network operator. See the getting started page for additional information on SIM usage. The SIM900 is a complete Quad-band GSM/GPRS solution in a SMT module which can be embedded in the customer applications.

Figure: 3. GSM Sim900

[3.3] TURBIDITY SESNOR: The arduino turbidity sensor detects water quality by measuring level of turbidity. It is able to detect suspended particles in water by measuring the light transmittance and scattering rate which changes with the amount of total suspended solids (TSS) in water. As the TTS increases, the liquid turbidity level increases. This turbidity sensor has both analog and digital signal output modes. You can select the mode according to the MCU as threshold is adjustable in digital signal mode. Turbidity sensors can be used in measurement of water quality in rivers and streams, wastewater and effluent measurements, sediment transport research and laboratory measurements.

Figure: 4. Turbidity Sensor Haier DW: 6250

[3.4] TEMPERATURE SENSOR: This is a pre-wired and waterproofed version of the DS18B20 sensor. It is handy for when you need to measure something far away, or in wet conditions. While the sensor is good up to 125°C the cable is jacketed in PVC so we suggest keeping it under 100°C. Because they are digital, you don't get any signal degradation even over long distances.
These 1-wire digital temperature sensors are fairly precise (±0.5°C over much of the range) and can give up to 12 bits of precision from the onboard digital-to-analog converter. They work great with any microcontroller using a single digital pin, and you can even connect multiple ones to the same pin, each one has a unique 64-bit ID burned in at the factory to differentiate them.

Figure: 5. Temperature sensor DS18B20

[3.5] pH SENSOR: pH sensor is an electronic device used to measure hydrogen-ion activity (acidity or alkalinity) in solution. Fundamentally, a pH meter consists of a voltmeter attached to a pH-responsive electrode and a reference (unvarying) electrode. The pH-responsive electrode is usually glass, and the reference is usually a mercury–mercurous chloride (calomel) electrode, although a silver–silver chloride electrode is sometimes used. When the two electrodes are immersed in a solution, they act as a battery. The glass electrode develops an electric potential (charge) that is directly related to the hydrogen-ion activity in the solution (59.2 millivolts per pH unit at 25 °C [77 °F]), and the voltmeter measures the potential difference between the glass and reference electrodes.

Figure:6. Liquid pH0-14

[3.6] ULTRASONIC SENSOR: An Ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back. By recording the elapsed time between the sound wave being generated and the sound wave bouncing back, it is possible to calculate the distance between the sonar sensor and the object.

Figure: 7. Ultrasonic sensor HC-SR04

[4] RESULT:

After connecting all the components and sensors as per the given circuit diagram, the output is observed on the 32 bit LED screen. Firstly, the temperature output is seen on the screen where it displays the temperature of water in degree Celsius. Secondly, the pH value of the water is checked and an initialization message is displayed on the screen. The message also says if the pH level of water is safe or not considering it safe between 6.5 and 8.5. There is an ultrasonic sensor attached to the tank which keeps calculating the level of water simultaneously. If it goes above a set value, a buzzer goes off to indicate that the tank is almost full. Other than this, the turbidity sensor displays the turbidity level in terms of NTU which is the unit for turbidity of water. All the values are displayed on the 32 bit LED screen once the output is obtained and are also send to the authorized user in the form of a SMS indicating the values of the above parameters.

[5] CONCLUSION:

Still in many areas of our world, people don't have access to clean and safe water. Monitoring the quality of water will help us to control the pollution level as well. Physical conditions such as temperature, turbidity, pH value of water play important role in determining the quality of water. Hence this model helps to provide a monitoring system to measure and control the quality of water using arduino technology thus making it feasible and effective for every household. Though this idea may be very useful, implementing this can turn out to be expensive. Due to this, implementation of this project will be difficult in rural areas. This can be further enhanced by adding more sensors which help to determine the quality by checking more parameters. Hence it can be used for bigger water bodies like rivers to check for pollution level. This in turn will help in preserving the aquatic life.

[6] ACKNOWLEDGEMENT:

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