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Water Quality Monitoring System

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Abstract - *In this research paper, we will be talking about a water quality monitoring system which will detect the TDS level and temperature level of the water. Instead of the normal sensors we are using thermistor and water sensor for getting the values of temperature and TDS respectively. In addition to that, we will also be talking about an AC motor which is being used as a pump in this project. It will be controlled with the help of calling feature of the phone. A phone is also connected to the system. Putting them together, we created a system that could move water from one place to another with the help of phone and can also test it's TDS and temperature levels.*

Keywords—Water quality monitoring system, TDS and temperature level, AC motor as pump

1. INTRODUCTION

Water is essential commodity for all forms of life. Although water is available in plenty on this planet but if not used properly, it can leads to scarcity of water. In order to make water fit for use, it needs to be processed as per the application. Hence, it is required to process the water in order to consume it and make it fit for our use as the water available to us cannot be consumed directly. Usage of water besides consumption is also done on a wide scale in industries.

Water holds a very important part in human life. It is directly related to the health of a human being. For water to be consumable by humans, it should be free from any type of organism that can live in it and can be dangerous for humans. water quality refers to the physical, chemical, biological and radiological properties of water. This determines if the water being used by one is fit for his/her purpose or not. Drinking water must not have any kind of turbidity, odour, colour or any unpleasant taste. Also, it should have a proper temperature, neither too hot nor too cold. Any form of water which fulfils all these conditions is known as 'Potable', and it can be consumed in any quantity without worrying about one's health.

1.1 Why do we need water quality monitoring system?

Water quality monitoring is required to give consumers good and constant quality of water to fulfil their purpose. In the 21st century with the growing use of chemicals in our everyday life that can make their way into our water, constant analysis is essential. Well-designed water quality monitoring systems can help one to be alerted before consumption. These systems can also prevent one from drinking toxic water that could have made way into one's tap. In industries where water is needed to have specific quality like pH level, salinity etc. require good quality water monitoring system to get the output the industry has desired.

Monitoring provides the objective evidence necessary to make sound decisions on managing water quality today and in the future. It helps to determine if water quality is getting better or worse, and formulate new policies to better protect human health and the environment.

Water quality can either be monitored in laboratories and can also be don using portable kits. Laboratory control in the quality management of water is indispensable. A well-equipped along with competent analyst is a very important part off any water quality monitoring. There are 3 different levels of laboratories at village, district and state level. Their main objective is to obtain reliable and useful data, to check the impact of human activities on water quality as well as to check the quality of water in its natural state. The samples taken by the laboratories should follow some basic criteria:

- The sample which is taken should be representative of the source.
- The sampling point should be uniformly distributed throughout the system.
- The sampling point should include the condition at most unfavourable places of the area.
- There should be at least one sampling point directly after the clean water outlet from each plant.
- At least one sample should be taken from the farthest stand post.

After all this, the analysts do their respective testing for different parameters and the analyse the result.

1.2 What are the factors that can contaminate the water?

Water can get contaminated by both natural and human factors. Naturally, water may get contaminated if it is not flowing. When the water is not flowing, there is microbial growth in it which makes it unhealthy to drink. Other factors include water shedding characteristics, fire in the nearby area, climatic conditions and geology of the area.

Human factors include:

- Discharge of industrial wastes.
- Unrestrictive use of fertilizers and pesticides.
- Dumping of domestic waste
- Dumping of radioactive by-products
- If there is any spill of material while transporting them through water.

Many other factors along with these can cause water contamination. But here we are only concerned with the water used in small industries and houses.

2. LITERATURE REVIEW

A research paper was published in 2015 where a team was working on making an IOT and remote sensing-based water quality monitoring system seeing the water quality in Fiji Islands as it required frequent data collection [2]. Taking help from this, we used Arduino and mega 2560 to make a Water Quality Monitoring System which can give real time data of the water quality on a phone-based application. In 2009, another research paper was published which used Zigbee based wireless sensor for the monitoring of water of far distant places [1]. One of the research paper we read was published in 2013 which analyzed the limitations of the existing water quality monitoring system used for agricultural purposes and differentiated between the earlier methods and the new wireless water quality monitoring system. They talked about the issues like wiring system, low performance of the system and the price ratio [7]. Another research paper published in 2010 which used web-server-embedded technology with mobile telecommunication technology to create a water monitoring system but for the purpose of intensive fishing. The results demonstrate that multi-parametric, long-distance and online monitoring for water quality information can be accurately acquired and predicted by using this established monitoring system [3]. One of the research paper published in 2009 talked about how to design a water quality monitoring system for rivers. The factors included the parameters one has to calculate, how to select the samples for the quality check and also how to come with location fir the location of sampling stations. They basically focus on an optimal water quality monitoring system which can determine all the major quantities [8]. A research paper published in 2009 tried to resolve the issues of manually taking down of reading of water quality check. It brought a new novel like system where water quality check in remote areas can be done through wireless system network. The system about which the paper talks takes down the readings very conveniently and the system runs very stably. The system had a very simple kind of structure and was independent of the geographical location it was used in [6]. One of the research paper published in 2013 shares the idea of wireless water quality monitoring system for the test of underground water using solar panels. They used sensors along with a base station to check the water. The architecture of the model suggested by them connects all the nodes with the base station using wireless system like Zigbee. Another research paper published in 2015, takes a survey of smart water quality monitoring system. It says that it is the future of water quality monitoring technology and talks about how it collects data, communicates it, analyses it and then gives an early warning for the same. It majorly focuses on the collection of data, transmission of that data and the analysis of the same [9]. One of the research paper published in 2018, showed us the way for collection of data, it's transmission, storage and visualization. It used the concept of smart cities IoT in the monitoring of the environment. It featured the uses of high frequency, real time water quality check and its data [5]. We are here trying to create a water quality monitoring system which will have application in checking the water quality for small industries and houses. It will determine the TDS value and temperature of the system and will display it on a 16*2 LCD screen. Along with this, we have added an electrical aspect to the project by adding a water pump which will move water from one container to another container. The interesting part is that we can control this motor from anywhere. A phone will be attached to this pump and when we will call on that phone and after someone picks it, if we press any number the pump will start to work. We can press the same number to switch the pump off. Wireless sensing systems offer the potential to reduce these costs considerably, as well as provide more useful, continuous monitoring capabilities by giving an accurate idea of the changing environmental and water quality in real time. [4]

3. COMPONENT USED

3.1 Arduino Uno

Arduino Uno is an ATmega328P based micro-controller board. It contains 14 digital I/O pins, out of which, 6 can be used as PWM outputs. It also contains 6 Analog inputs, an USB port, a 16 MHz ceramic resonator and a reset button. It can easily be used by anyone by simply connecting it to a computer through an USB cable or by supplying power to it from an AC to DC adapter. It contains every aspect which a micro-controller need.

3.2 Thermistor

We will be using a simple thermistor rather than a proper temperature sensor. It is nothing but a resistor whose resistance changes with change in temperature. It is made using metallic oxides. The name of this equipment is made by combining the words thermal and resistance. They are majorly used as temperature sensors, as current limiter for incoming current and also as a self-regulating heating element.

3.3 Transformer

As we all know that the Transformer is used to alter the voltage by "step up" or "step down". When non electrically bonded coils are provided with equal voltages in and out, a transformer can be used for isolating.

Transmitting at low voltage by can result in power loss and hence which the consumers need. In order save the cost voltage is raised which causes less copper and heat losses resulting in decreasing the transmission cost, this is achieved by the use of transformer is used. It increases the voltage used in transmission which is cheaper. In order to use this transmitted electricity, a transformer is used to step it down at a substation and further it is distributed to the customers

Here, transformer is used so that there is no lag in the working of the system. In this system we are using two transformers for both the systems, one for the ac motor working as a pump and one for the Arduino system. Both of them are of the rating 500 mA with 12 V AC supply.

3.4 Water Sensor

This sensor works by dipping its legs in water of which one leg is supplied positive voltage and the other is grounded. The change in conductivity of water between the two legs determines the quality of water as compared to the ideal value set. Here we are using this sensor to get the value of Ph of the water.

3.5 NPN Transistor

In NPN transistor, a p type semiconductor is placed between two n type semiconductors. Movement is from emitter to the base. Input current is supplied to the emitter (heavily doped) which moves the majority charge carrier to the base which in turn makes the electron to jump to a p type and combine withe holes. As this is lightly doped it causes to initiate a electric flow with the remaining electrons known as base current. The electrons are collected at the collector due to the reverse bias potential of that region. This results in the all the current of emitter to enter the base. Emitter current is sum of all currents of collector and base region.

Here it is used to amplify the signals from the IC 4013.

3.6 AC Motor

AC motor is an electrical motor which works on alternating current. The motor is basically divided into two parts, stator and rotor. The stator is the outside part of the motor which is supplies with alternating current and it produces a rotating magnetic field. The rotor part of the motor also produces a rotating magnetic field.

Here we are using this motor as pump which is used to move water whose testing is to be done from one part to another.

3.7 M 8870 DTMF Reciever

This Chip is used to send input to the system by hands free device. The auxiliary port on this chip is used to get a input which is further converted into the desired output (switching on the pump). A combination of two separate sin wave is produced, this is further decoded and output is received in binary It can be used by micro-controllers like PIC, Arduino etc. A 5v supply is given to this board. Four I/O pins are required to interface with four outputs pins(binary). This module helps in smooth functioning of the system and provides remote access to the project

3.8 IC 4013

IC 4013 includes two separate D flip flops which are not dependent on each other and its input/output pins are asynchronous. The working of the IC is that when it is given input as 1, it will give output as 1 and after that if we give the same input again, it will give 0 as output.

Here in this projected it is connected to the DTMF receiver.

3.9 Relay

In this project, relay is used to operate our pump. A relay is nothing but a switch which is used to open or close the system electrically as well as electromagnetically.

Here it is connected between the transformer and the NPN transistor.

3.10 LCD Screen

A sixteen by two LCD display with 224 different characters and symbols is incorporated in order to provide instant data without any latency. Also known as Alphanumeric displays and is supplied with 5v of supply. It is used for various applications such as photocopier, computers, mobiles etc.

Here it is used to output the Ph and temperature value of the water which we obtained using the sensors.

4. WORKING

For the working of the pump, we need a cell phone on which we can call that will be connected to the system through a hand-free. When we will call on that cell phone and after call is received, if we press any number from the number pad, the pump will start to move water. This process can also be made better if the phone has the feature of automatic picking of the call, which will reduce the need to

pick up the call on the receiver's end. Here we are using a relay to operate our pump. A relay is nothing but a switch which operated electrically. We have a M-8870 DTMF receiver which is used when a call is received on the phone which is attached to the system. This DTMF receiver functions includes a band split filter which filters out between the low and high tones on the receiving end, and a digital decoder which verifies both the frequency as well as the duration of the signal which is received. Using this, we convert the signal through the cell phone to voltage which can be used further. After that, this voltage is sent to the IC 4013. This IC is made from two D flip-flops which are independent and have asynchronous set and reset input. Whenever any of them receives 1 as the input, the appropriate output is shown immediately. And when the set and reset receives input as 0, the output expresses the data from the input which is present due to the last low to high clock transition. The IC holds this data until the next transition. After the IC, the signals go through NPN transistor. NPN transistor contains a P type material sandwiched between two N type material. The main function of this transistor is to amplify the signal. It amplifies the signal which enters through the base and then is given as a strong signal from the collector end. After this, the signal goes to the relay which then helps us to operate the pump.

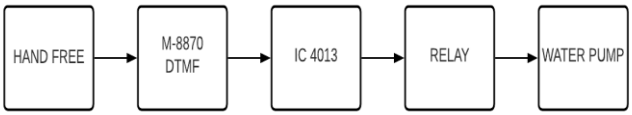

Fig 4.1: Block diagram for pump system

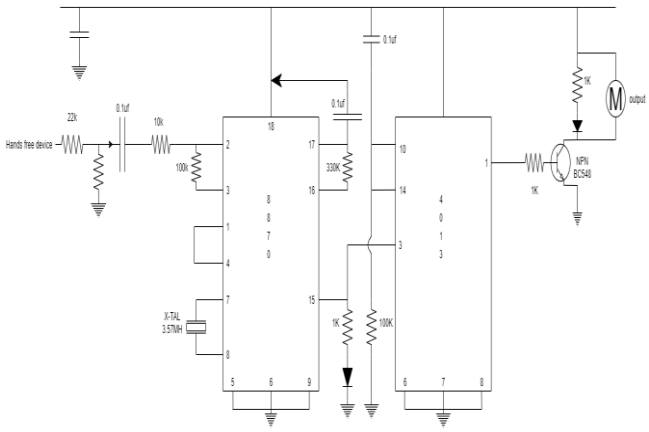

Fig 4.2: Circuit diagram for pump system

To get the TDS value and temperature value of the water, we are using their respective sensors. To get the temperature of the water, instead of a normal sensor, we are using a thermistor. Thermistor is a resistance thermometer whose resistance is dependent on temperature. So, as temperature increases, the resistance of the thermistor increases which is then using formula is changed to a temperature value. The TDS sensor is a device which is used to detect the TDS level in the water. Both the sensors which we used were compatible with Arduino. To get the data from the sensors to the screen, we used Arduino uno. Arduino Uno is a microcontroller board which consists of 14 digital input or output pins and 6 analog pins. Out of the 14 digital I/O pins, 6 can be used as PWM outputs. In this system, we connected the sensors to the Arduino, where the data from the sensors, after testing the water, the data is sent to the Arduino from the input pins 0 and 1. From there, the data is then sent to the LCD screen through the output pins where it gets displayed. Here we used 16*2 LCD screen which has the capability to display 224 different characters and symbols.

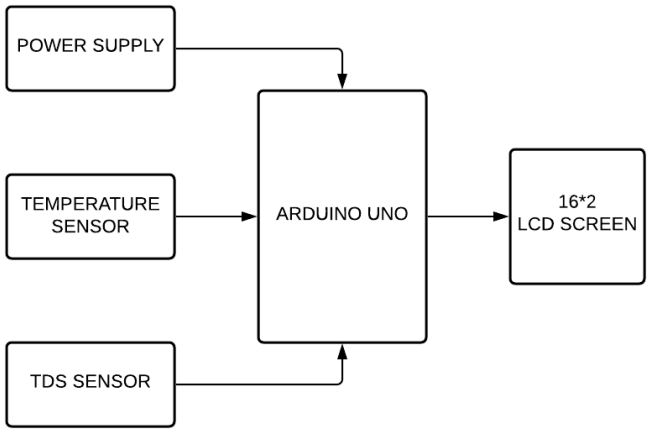

Fig 4.3: Block diagram for the sensors

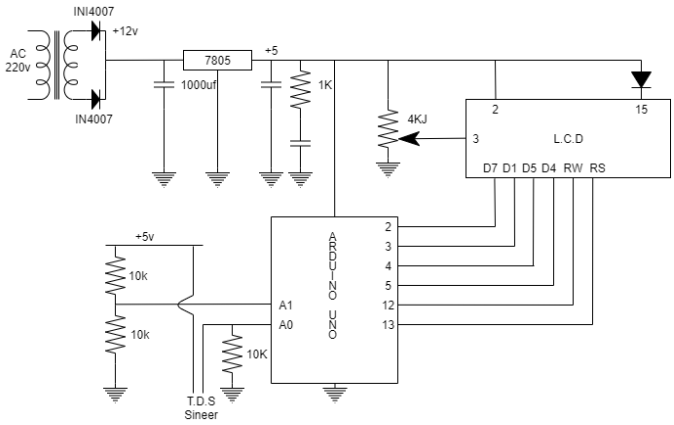

Fig 4.4: Circuit diagram for the sensors

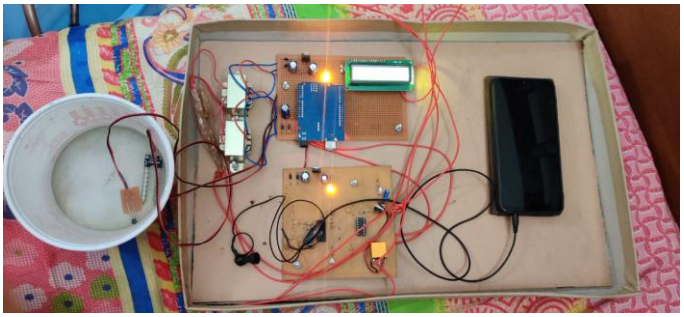

Fig 4.5 Model of our project

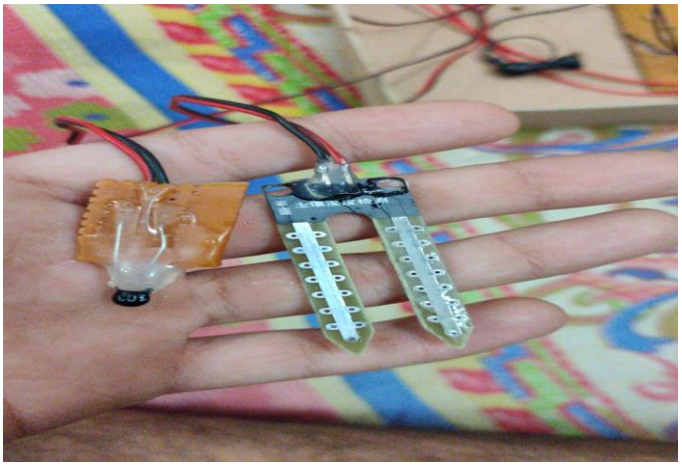

Fig 4.6: Sensors we used

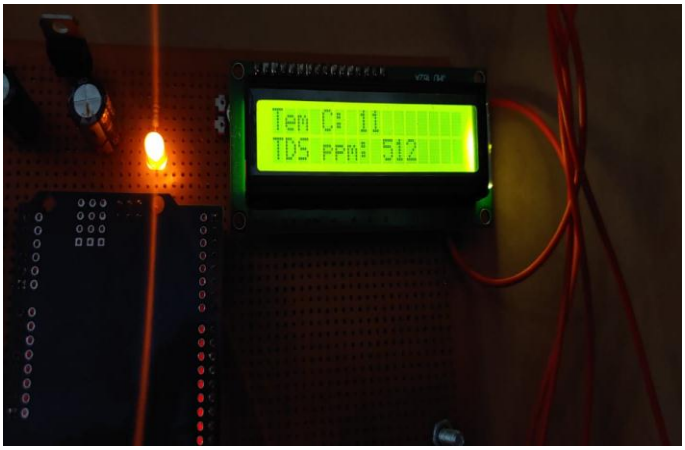

Fig 4.7: Readings on the LCD screen.

5. ADVANTAGES

We can easily get to know if the water we are testing is drinkable or not by checking the TDS value of it.

Also, by checking the TDS and temperature levels of the water, we can get to know whether it is contaminated or not. By this, we can see if it is usable or not for home or industry purposes.

By the help of the pump, which is actually an AC motor, we can move the water from one place to another with a lot of ease.

6. DISADVANTAGES

As only two parameters are seen, it is not a complete water quality monitoring system. We need to add a few more parameters.

Getting the values on LCD is a bit hectic. Making it fully IOT based will ease the thing a lot and we can also keep a track of the previous results.

7. APPLICATIONS

On the spot data: The data of all the parameters that are being taken under consideration can be obtained on the spot with good accuracy. The advantage of such appliances is that we don't have to wait for lab results and get the data on the spot.

Drinking water test: Testing for TDS level in the water using this device, we can check that whether the water is fit for drinking or not. For drinking purposes, TDS has different brackets for different conditions:

If TDS is less than 300 mg/Lt – Excellent

If TDS is between 300 mg/Lt to 600 mg/Lt – Good

If TDS is between 600 mg/Lt to 900 mg/Lt – Fair

If TDS is above 900 mg/Lt – Poor

Water health: To keep a regular check on water's health, TDS and Ph level of the water should be checked regularly. If the TDS of the water is high or the Ph is low, it is possible that some harmful contaminants may be present in the water.

Easy testing: Using the mobile controlled pump, we can move a small portion of the water whose testing is to be done into a different tumbler. It will be helpful as the testing can be done anywhere and not only beside the tank.

Easy movement of the water: The water can be easily moved from one place to another using the phone-controlled pump. The only thing we need to do is to call on the cell phone attached to the pump and press any button on the dial pad and the pump will start to work. We need to press the same button to switch the motor off.

This system could easily tell us whenever the conditions of the water changes. In that way we can easily get the water treated and make it fit for use again.

8. CONCLUSION

The aim of our project was to make a device that could be used to measure two parameters for water quality check. The two parameters we chose are TDS level and temperature level of the water. Checking of TDS level for any water is important as it could help the people to know if the water is fit for drinking and also if it is starting to contaminate. We tried to make it a bit more convenient with a phone-controlled pump that could move the water to be checked from one point to another. This project can be used for home as well as small industrial purposes.

9. FUTURE SCOPE

Many more changes can be made to this water quality monitoring system. The system can be made to obtain much more reliable and efficient results. Many more sensors can be added to the system to obtain the results for more parameters. These can include a turbidity sensor, Electric conductivity sensor, dissolved oxygen sensor, precipitation sensor and many more. The system can be made using wireless sensors which would make it more compact and easier to use. The system can be added with equipment which could help to monitor air pollution, pollution from industries and even hydrologic parameters. The mobile system which is used to get the pump working, can be replaced with an application that could do all the things. Instead of using a LCD screen to see the output results, an application can be created which can show the real time results on the cell phone.

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