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Real Time Water Quality Monitoring and Flow Diverting System

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Abstract

Nowadays, almost every person on earth is facing trouble because of growing population, aging infrastructure and pollution. There are several types of pollution namely: Soil, Land, Water, Air etc. Water is a very precious resource for all living beings and its pollution is a grave concern for the society. One major reason for water pollution is industrial waste. The indiscriminate discharge of these wastewater streams into the environment pollutes the receiving bodies. The traditional method to challenge pH, turbidity and other parameters is to collect samples manually and then send them to laboratory for quality check. However, it has been unable to achieve water quality examining. The proposed system consists of model based on IoT platform and uses temperature, pH and turbidity sensors to check the water quality. Water quality is monitored and data from the sensors are sent to the web server at regular interval of time under RaspberryPi-3 using internet. The proposed system is free from any external or human interference and it can be used for water bodies like rivers and ponds.

Keywords: *Water quality, temperature sensor, pH sensor, turbidity sensor, RaspberryPi3.*

INTRODUCTION

With the growing population and infrastructure, more serious problems of environment rise. Water pollution is one of the major problems. Regular monitoring of water quality parameters like temperature, turbidity, pH, chemical oxygen demand, biological oxygen demand and other necessary elements required for survival of aquatic animals present in water bodies is important.

One major reason of water pollution is industrial wastes. Industries use water that are obtained from the water treatment system for a variety of purposes, such as manufacturing goods, heating, cooling, solvent and so on.

The resulting water is then classified as wastewater. The indiscriminate discharge of these wastewater streams into the environment pollute the receiving bodies of water like river, pond. To prevent pollution of water bodies, wastewater management is associated with the protection and preservation of our natural water resources. Wastewater can be managed and monitored by making use of IoT.

Sensor is an ideal method to solve this issue. It can perform required analysis and provide results faster than traditional method.

LITERATURE SURVEY

The available water resources are getting depleted and water quality is deteriorated due to the rapid increase in population and need to meet demands of human beings for agriculture, industrial, and personal use. The quality of ground water is also affected by pesticides and insecticides.

The rivers in India are getting polluted due to industrial waste and discharge of untreated sewage. In order to eliminate problems associated with manual water quality monitoring, many authors and researchers have worked on this. "Online Monitoring of Water Quality Using Raspberry Pi3 Model B"[1] by M.B. Kalpana, has suggested some theories and ideas about detecting the parameters like conductivity, ph and so on to secure water and avoid water pollution. "Advanced Smart Sensor Interface in Internet of Things for Water Quality Monitoring" [2] by Prashant Salunke, Jui Kate has investigated through developing smart system of auto-detecting the water quality mechanism. Another research and project titled "Real Time Water Quality Monitoring using IoT" [3] by Brinda and PC Jain, has demonstrated about monitoring system for water bodies and uses. "IoT based Water Monitoring System: A Review" [4] by Pragati Damor, Kirti Kumar J Sharma has researched and issued a review over use of IoT for water monitoring.

PROBLEM DEFINITION

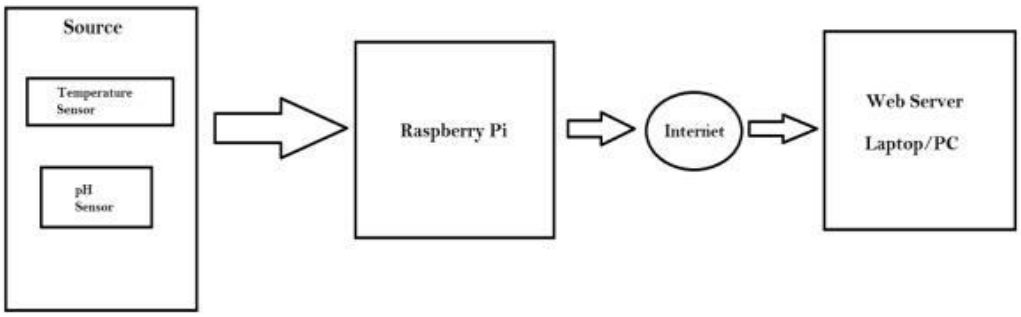
Environmental regulations require the monitoring of the environmental state. With the rapid growth of the thrift/providence, more and more serious troubles of environment arise. Water pollution is one of these problems. One of the major contributing factors for water pollution is Industries.

Industries generate waste which is led through a sewage treatment plant to treat the toxic waste and then release the remnant (treated water) into water bodies. Many a times this water is still not suitable to be released into the water bodies. It is because of various parameters such as High/Low pH, High/Low temperature, and colloidal particles etc. which are harmful for the marine life. The traditional approach to measure these parameters included a lot of delays because of sampling and surveying of water.

Disadvantages of existing system:

- Time consuming and less effective
- High Cost
- more man power

METHODOLOGY



This proposed block diagram consists of number of devices having respective sensors, and the collected data from all devices are gathered and sent to the Raspberry pi model. Sensors are allocated on the route from industry waste exit point to the water body. If the waste water released is less harmful, project model allows it to go to water body. Sensors check the nature of waste water released and send data to the server using IoT. Data is stored to the web server and controlled through web application.

When the sensor reads any data more than the permissible threshold value, data

regarding the exceeded threshold is sent to the server, generating an alert for it. In response, the flow of direction of waste water is changed and led to a recycling tank, thus avoiding the waste water from mixing with water bodies on spot.

Alert generated allows the authority to take immediate actions required and it also informs about the industry generating the type of toxic constituent.
This model allows the systematic control of waste water from industries. Every time, wastes are released from industries, they are checked with sensors for its degree of toxicity.

In case, toxic wastes are released from industry, this model alerts the authority immediately and also provides automated response by blocking the path to the water body and changing the direction to waste water storing recycling tank.

Advantages of proposed system:

- Improve water quality
- No human interference due to automation
- Low maintenance
- Real time monitoring on website

HARDWARE DESCRIPTION

Raspberry Pi 2

Raspberry Pi2 Model B is a small sized board computer; capable of finishing the entire job that an average desktop computer does like spread sheets, Internet, Programming, etc

Raspberry Pi2 Model B works on Linux kernel based operating systems. It boots and runs from the attached SD card. It does not have any internal memory other than the ROM. It has an SD card slot which is capable of reading up to 32 GB. The GPIO pins of the raspberry Pi2 Model B are programmed using Python programming language. The I/O devices like sensors are given to GPIO pins whenever needed.

Fig 1. *Raspberry Pi 2 Model B*

Arduino Board

Arduino is an open-source platform easy to use for hardware and software work. The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board – you can simply use a USB cable.

Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.

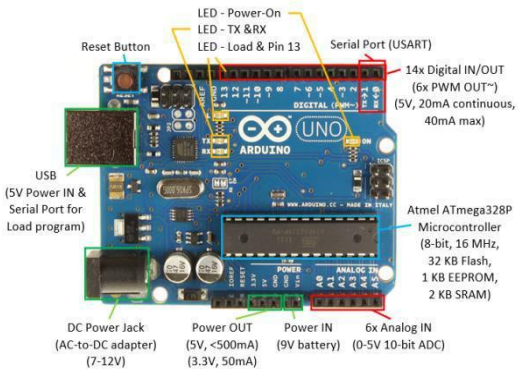


Fig 2. *Arduino Board*

DS18B20 Temperature Sensor

It is a 1-Wire digital temperature sensor. It detects degrees in Celsius range of -55 to 125 (+/-0.5). Each sensor has a unique serial number fetched into it that allows multiple sensors to be used on one data bus. The DS18B20 temperature sensor supports receiving power by the data pin but supply power to the sensor is done by Arduino's 5V port.

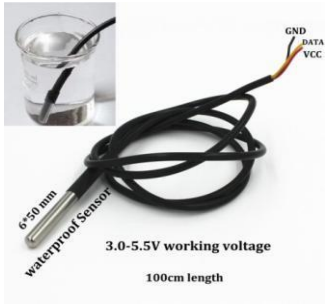
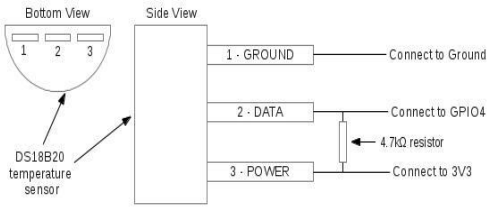


Fig 3. *DS18B20 sensor*



pH Sensor & Kit

PH (Potential of Hydrogen), is a measure of acidity and alkalinity of a solution or water. It is generally expressed in scale ranging from values 0-14. The value 7 represents its neutrality.

The electrode is placed inside the beaker filled with a solution whose pH is to be measure. The glass bulb welded at the end of the measurement electrode consists of lithium ions doped to it which makes it act as an ion selective barrier and allows the hydrogen ions from the unknown solution to migrate through the barrier and interacts with the glass, developing an electrochemical potential related to the hydrogen ion concentration. The measurement electrode potential thus changes with the hydrogen ion concentration.

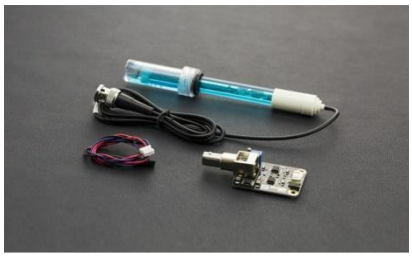


Fig 4. *pH Sensor and Board*

Turbidity Sensor

Turbidity is the measurement of suspended particles in water. Keeping aside the potable purposes, there are industries and household work that make use of water in some or the other way. For instance, a vehicle uses water to clean, a power plant needs water to cool down its machines and rotors, washing machines and dish washers depend on water.

Turbidity Sensor measures scatted light at 90° which is to be used for turbidity values below 40 NTU. NIR light source and light receiver are positioned at a 90° angle to each other. The light transmitting from the source is directed in equal strength to the detector at the other end and into the medium.

Light is scattered from the particles and the portion which is scattered at a 90° angle is received by the detector. The meter now compares the light from the reference detector and scattered light receiver and calculates the turbidity value.

Fig 5. *Turbidity Sensor*

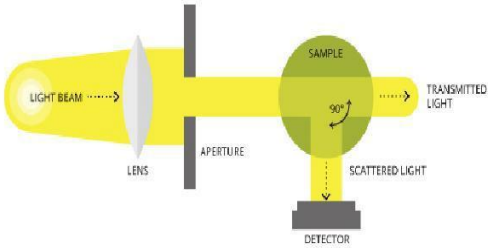


Fig 6. *Working*

Stepper Motor

A stepper motor is an electromechanical device it converts electrical power into mechanical power. Also it is a synchronous electric motor which can divide a full rotation into number of steps.

The stepper motor uses the theory of operation for magnets to make the motor shaft turn a precise distance when a pulse of electricity is provided.

Fig 7. *Stepper Motor*

Arduino IDE

ARCHITECTURE MODEL

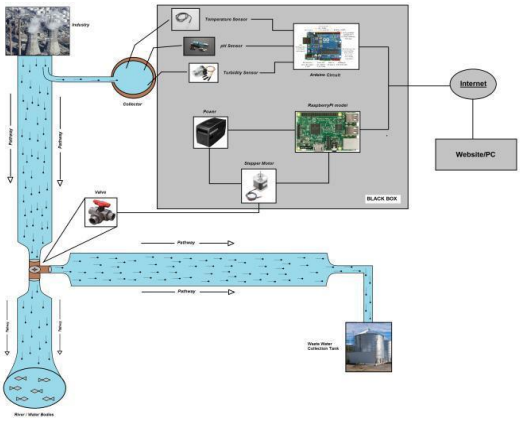


Fig 8. *Architecture Model*

It is an open-source IDE that allows us to write code easily and upload it to the Arduino board. It supports Mac OS X, Linux and Windows. The code is written in Java and based on processor and other open source software.

This IDE (Integrated Development Environment) is a part of Arduino Create, which is an online platform that enables makers to write code, access tutorials, configure it and share the projects. It is designed to provide users a continuous workflow.

Fig 9. *Arduino Interface*

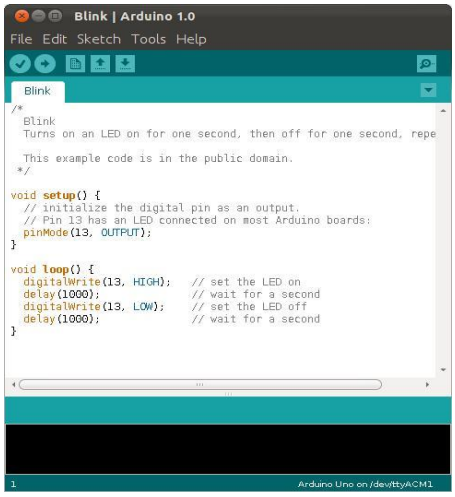


Fig 10. *Arduino Program*

This proposed model consists of number of devices having respective sensors, and the collected data from all devices are gathered and sent to the Raspberry pi model. Sensors are allocated on the route from industry waste exit point to the water body. If the waste water released is less harmful, system model allows it to go to water body. Sensors check the nature of waste water released and send data to the server using IoT. Data is stored to the web

server and monitored through website. When the sensor reads the data exceeding permissible threshold value, data regarding the exceeded threshold is sent to the server, generating an alert for it. In response, the flow of direction of waste water is diverted to a recycling tank using valve, thus avoiding the waste water from mixing with water bodies on spot. This model allows the systematic control of waste water from industries. Every time, wastes are released from industries, they are checked with sensors for its degree of toxicity.

In case, toxic wastes are released from industry, this model alerts the authority immediately and also provides automated response by blocking the path to the water body and changing the direction to waste.

MEASUREMENTS

Temperature Range

Changes in temperature affect the aquatic life. Temperature of water determines the type of organisms which will thrive and diminish in numbers.

Temperature's effect on life of a cold blooded is profound. These aquatic animals, such as fishes, are those whose body temperature is maintained around the temperature of their living medium. Trout eggs will not be able to hatch over a temperature of 14.4° C. Many fishes fail to complete their life cycles due to the required temperatures at the time of spawning and hatching i.e. 10-15° C.

Table 1. *Permissible degree of water quality 8.2pH Range*

Parameter	**Range**	**Reason**
Temperature [5]	10`C –	To maintain
	28`C	dissolved oxygen
		balance, chemical
		processes and
		reproduction cycle.
pH [6]	6 - 8.5	To maintain low
		solubility, avoid
		toxicity and harm to
		fishes.
Turbidity [7]	0 NTU –	To maintain
	50 NTU	photosynthesis and
		other processes.
		High turbid water is
		not suitable for
		marine life.

pH affects both biological and chemical processes of water bodies. pH value below 4.5 and above 9.5 are not suitable for aquatic organisms, and even very less pH values can affect many other biological processes. The pH of most considerable natural waters is between 6.0 and 8.5. pH also affects the solubility of organic compounds like metals and other inorganic salts. In highly acidic water, some minerals can dissolve and produce metals and other chemical substances. It can also determine the chemical form of some organic components, which in turn can adversely affect reactivity, bioavailability and toxicity of water.

Turbidity Range

Turbidity because of a large volume of suspended sediments will reduce light penetration, thereby reducing the photosynthetic activity of phytoplankton, algae, and other macrophytes, especially those who are farther from the surface [8]. Generally, excess turbidity leads to fewer photosynthetic organisms to serve as food sources for many invertebrates. As a result, invertebrate numbers may also decline, which may lead to fish population decline.

RESULTS AND DISCUSSION

The following are the results obtained by the proposed system:

- Checking quality of water released from industries.
- Real time monitoring of entire system.
- No human Interference is involved.
- Closing the valve to divert the waste water to storing tank.
- Data can be accessed anywhere and anytime through website.

As per the proposed system, sensors are checking the parameters at regular interval of time and storing it in database. Website developed at the back end is able to fetch the data from database and represent the same with additional features.

Citizen can access the website easily and look into the current status of the system and quality of water released to water bodies. System has enabled motor to control the valve. If the quality of water released from industry is not fit for water bodies (based on set range of parameters), valve closes the path to water body and divert it to storing tank.

Website Link: https://goo.gl/kwkaJb

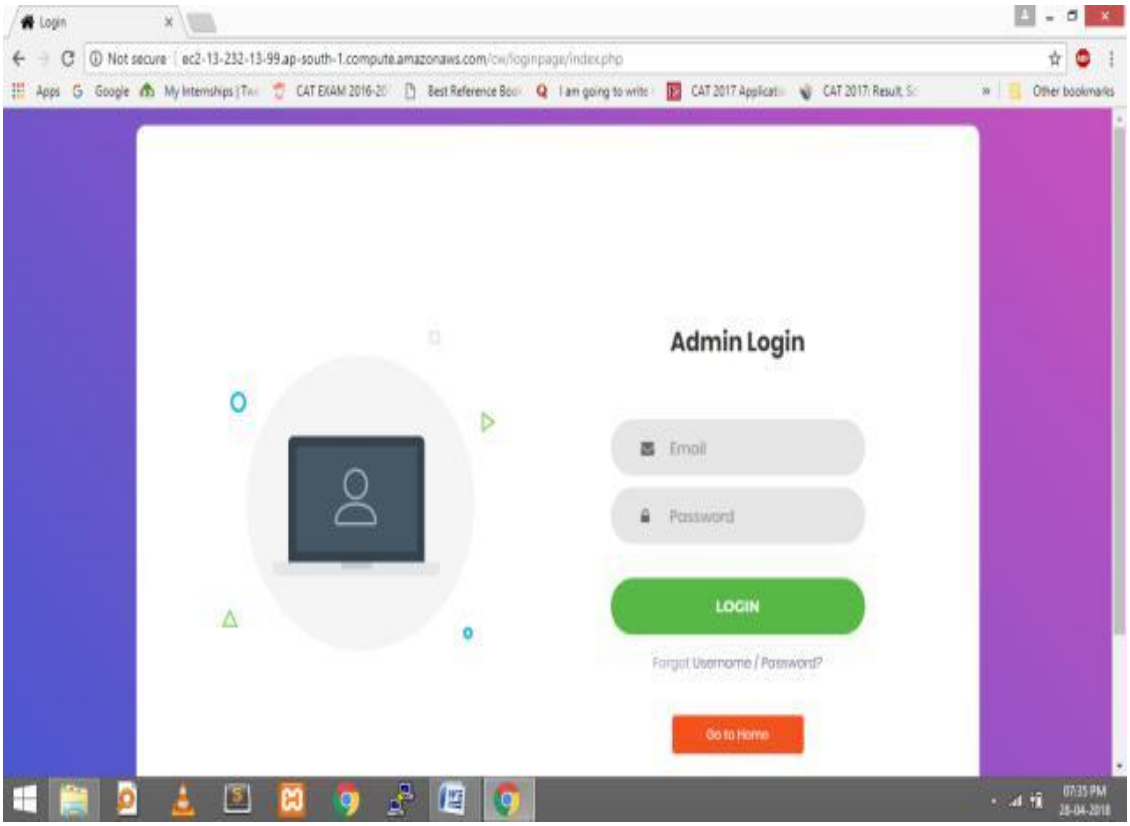


Fig 11. *Login Page*

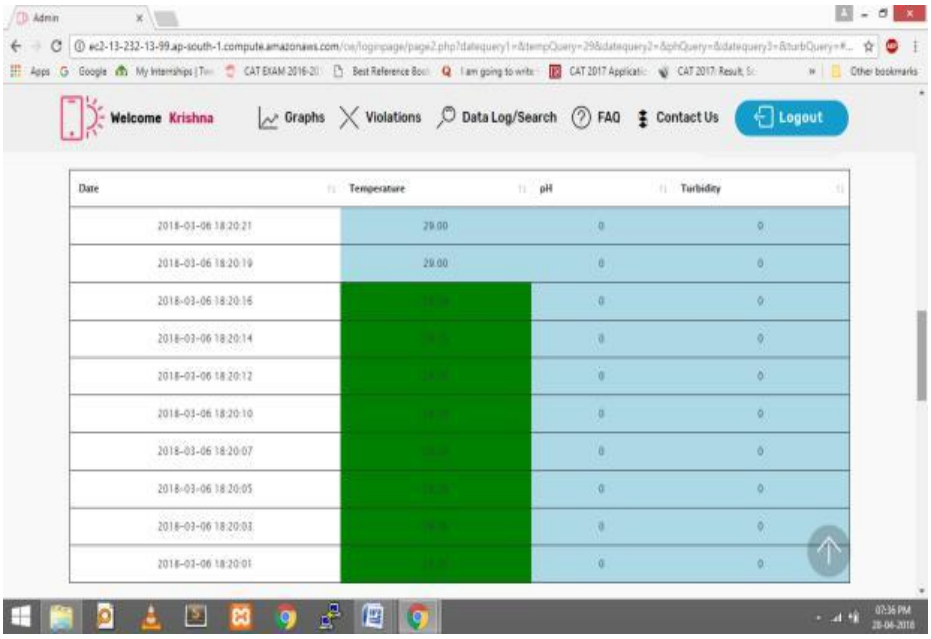


Fig 12. *Table*

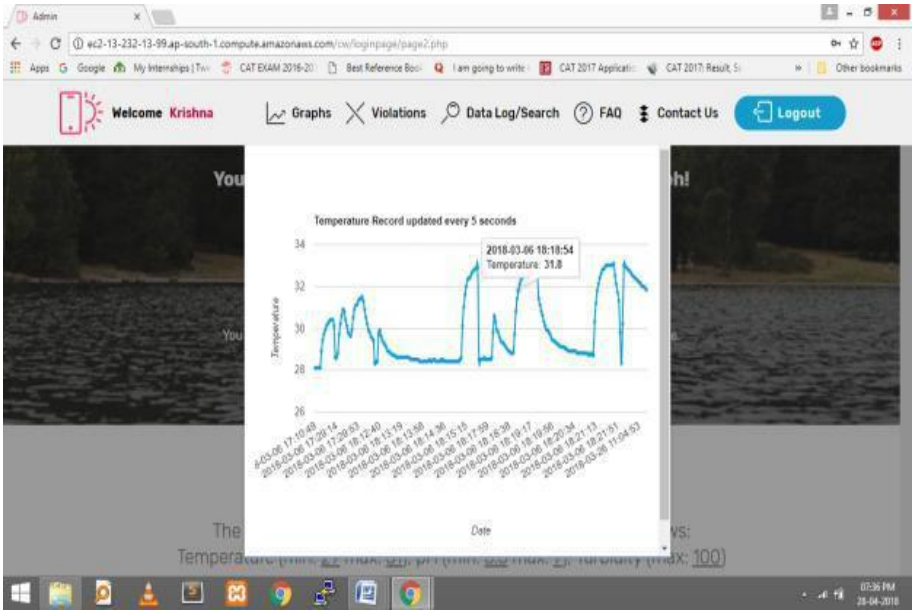


Fig 13. *Graph*

FUTURE WORK

The proposed system can be enhanced by adding more sensors to detect more water quality parameters. With the upcoming technologies, cost efficiency of entire system can be optimized. Server side website can be improved with user interface by including additional features. This system can be used for commercial and domestic purposes.

CONCLUSION

The proposed system monitors the quality of water released from industry. It updates the database periodically which enables the public to check the status in website. This totally avoids any human interference and does not require people on duty. The system is flexible by replacing the corresponding sensors and changing the relevant programs. The entire system is easy to use and operate. It has a

widespread application and can be expanded to do more analysis.

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