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Machine Learning Based Water Quality Checker and pH Verifying Model

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Abstract. Verifying model which mainly results to the measure the quality of some parameters like temp, pH, electric conductivity and turbidity within the water and the assistance of sensors where pH sensor is employed to grasp the pH level of water, temp sensor (LM35) is principally measures the temp, turbidity sensor and TDS sensor are check solid wastage and salts present within the water. Where these four sensors extract the info and send them to the board and therefore the threshold values are already given within the coding which are collected from WHO Organization and they will find the situation. GPRS (General Packet Radio Service) or GSM (Global Model for Mobile Communication) technique is used in order that will take an instantaneous action. Due to this in future we might not have the water to drink and these are the available resources for our future the previous methods which need the more man power and wastage of your time. So as to avoid of these problems we found with these project in order that wastage of your time decreases and more man power isn't required.

Keywords— *PH sensor, Temp sensor, TDS sensor, ARDUINO board, GSM module*

1. Introduction

Water pollution has become a serious problem to all or any the living beings which is beyond the outline. Because the population has been increasing the water problem is becoming a dangerous reason especially in industries, forming and other sectors. Most of the people are feeling sick and fell illness and also for the dearth of potation water. Once a year many of them were dying because of water borne sickness caused by pollution. Research has done and located that 5.2 million were dead due to only drinking polluted water. Research by WHO (World Health Organization) has shown that just about 1.5 million of kids death will be controlled by providing them potable water. The main theme of this project is to design a water quality and pH verifying model which can be helpful to observe different parameters of potation water apart manual process. Several research works have tired recent times so as to develop intelligent model to resolve the issues of water parameters. That's why in real time verifying of water quality supported sensors are suggested which is of low cost, light weight. The sensors which are mainly used for this architecture model are called as optical sensors. This technique is for the water purchaser, water supplying persons and water ceramics. The extracted particulars are analyzed using binary classifier. Where this technique consists of 4 different sensors like turbidity, pH, temp and TDS etc. The aim of this project is to design a sensible water quality checking model where four physical parameters: temperature, pH, conductivity and turbidity with four different sensors which are equipped with ARDUINO UNO.

A desktop application is employed to know tested water samples are polluted or not polluted for drinking. The overview of this technique indicates the planning method together with the hardware setup and desktop application. The measured information helps whether

the water is safe or unsafe to drink them. The purity of drinking water quality are decided by the World Health Organization (WHO) guideline [1]. This World Health organization decided the standard for drinking water parameter like microbiological, chemical and indicator parameter monitor frequently to protect the health of consumer and realize the water condition. The wireless sensors Network used to control the parameter pH, Temp, required for Pisciculture using NI my RIO and by using that particulars they control motor, pump and Filter [2]. Many countries this smart water device uses to check the condition of aquarium health. It specifies parameters like pH, oxidation/reduction potential (ORP), electro conductivity and temp. In some cases of watching that particulars is in real-time operation [3, 6]. They provide fast and effective reaction in case of rising illness. In some experimentation they apply nano sensors to calculate specification. In that they evaluated the 8 variables and used nano sensor give faultless output as compare to conventional methods [15]. Some model gives lightweight implementation, low cost and longtime operation use of optical sensors and in model. pipe line electrochemical methods [5]. At present multi parametric Solid-state sensors are using for testing of water quality. Some other models depend on the thick –film technology with the help of chemical sensors. Those are low cost, with a typical glass reference electrode to control accuracy and have minimum of working period. The model depends on wireless communication technology for verifying large scale water. This model is designed for verifying salinity of Gnd water and surface water temp. To monitor Nitrate, Chloride level and Ammonium in river. The designed model based on energy garners model and use of wireless network model. This model based on solar panel [6, 13, 14]. This model is designed to find the wide range of application in the field and Aquaculture verifying.

2. Model Overview

The suggested MLBWQM model as shown in Fig.1 is able to get particulars from water samples proceeded by micro controller and activate them using ML algorithm to check water quality. The suggested block diagram of MLBWQM model consists of four different sensors connected with controller to measure four important physical parameters (pH, temp, conductivity and turbidity) of water samples. The pH sensor SEN0161 is used to measure the presence of acidity or alkalinity of any solution on log scale. The digital temp sensor DFR0198 provides faultless reading between –55 to 125ºC. To measure the conductivity of water sample, the sensor DFR0300 is utilized.

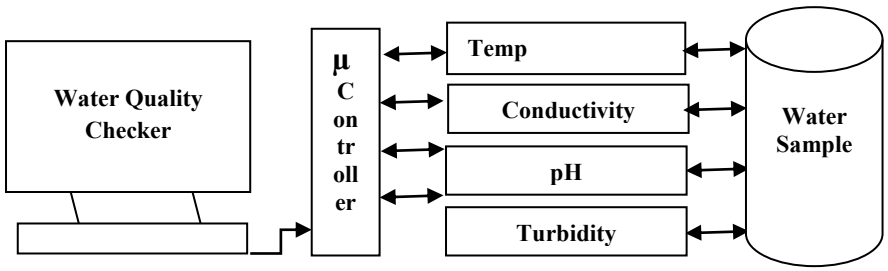

Figure 1. Block Diagram of the suggested MLBWQM model

The expected temp detection range of this sensor is 1 to 15ms/cm within a temp between 0-40ºC. Turbidity sensor SEN0189 is used in the design to detect the presence of drape particles by using light. The extricate particulars from these sensors are approach by the controller ARDUINO UNO and transfer them to the designed desktop application. ML algorithm is implemented at the back end to check the water quality based on the measured

particulars. Since the model will predict either the test water sample is “Potable Water” or “Not Potable Water”. the fast water binary classifier algorithm is employed. 60 different water samples have been collected from nearby tap, filter, soft drinks and other sources. The prediction accuracy of the designed model is compared for the observation particulars.

3. Design and experiment

A. *Circuit Diagram*:

The schematic of the hardware set-up of suggested MLBWQM model is shown in Fig.2. Except the temp sensor, remaining three sensors are same i.e. Analog type each sensor has three different color wires such as red, black and others. Here, red wire is supplied with +5V PS, black wires are for Gnd and others are used for particulars evaluation. A bread board is used for connecting common points for Gnd and PS separately. Then common node of Gnd is connected to the Gnd of ARDUINO and same process is repeated for PS. The Analog sensors are connected to the Analog pins and digital sensor is connected to digital pin of the controller.

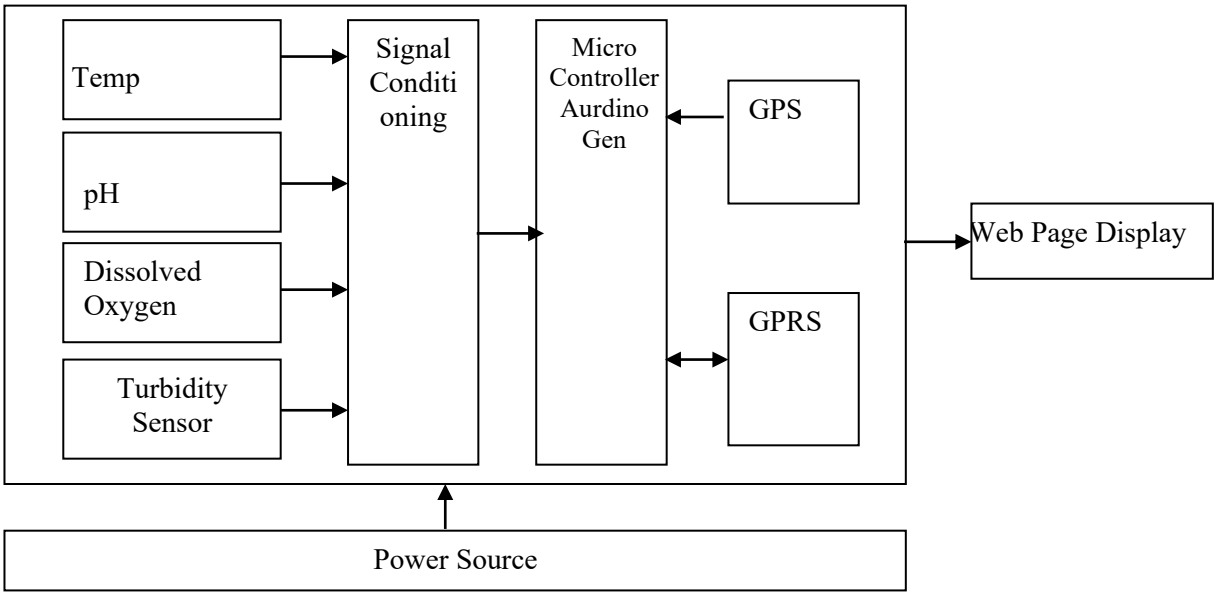

Figure2. Circuit diagram of the hardware of MLBWQM

B. *ML Algorithm:*

For the suggested MLBWQM model, the extracted sensor particulars are processed accordingly to predict the model’s accuracy. Fast forest binary classifier has deployed here where different water samples i.e. salt, mud, drain, tap, soft drinks and drinking water are taken for training the particulars set. The average combination of many small and weak decision trees in fast forest regression model forms a strong learner. The algorithm works as follow: for each tree in the forest a bootstrap sample from Z are selected. At that scenario Z is the bootstrap. This decision tree is tweaked by the decision tree learning algorithm.

C. *Designed Desktop Application:*

The enforcement of the adopted fast forest binary classifier is compared with three other binary classifiers support vector machine (SVM), logistic regression and average perception techniques. Among all algorithms, fast forest binary classifier provides better certainty for

the same set of particulars and used to develop the desktop application "Sprinkle: Water Quality Checker". It exhibits the working principle of the desktop application built in .NET platform. We begin with, ports connected with the ARDUINO are selected. Then, particulars are read with the help of the sensors. These particulars are used to check whether the water sample is potation or not potation, and the result is saved into the database. During the processing of particulars, only three parameters (pH, Conductivity and Turbidity) are considered, because temp is used in the experiment as a factor of conductivity. The complete experimental set-up of the designed MLBWQM model is shown in fig 3. Memory and the DS18S20 return to idle initially. The temperature sensor is used in many industries.

4. Implementation And Performance:

A. Temperature Sensors:

The most vital property compared to other parameter of water is the important feature of the DS18S20 is to produce direct digital values of temperature. The resolution of it (DS18S20) is configure to 9, 10, 11 and 12 bits, increment of 0.5o C, 0.25o C, 0.125o C and 0.625o C respectively. It gives temperature between – 550C and 1250C without any external variables. To initiate temperature measurements, it uses ADCs. Master converts the Command T and temperature is represented using two bytes. Temperature reg is stored with the scratchpad and thermostatic control

B. pH sensor:

One more important factor of water is pH. Acidity or Alkalinity of water is measured by it. Which are evaluated by relative H ions H+ ions i.e., OH- present in the water. Higher the number of H ions indicates acidic nature while the alkaline solutions have higher number of Hydrogen ions. pH is given in a scale range from 1 to 14. While the range from 0 to 6.0 indicates that solution is Acidic in nature, where as the scale in range 7.0 to 8.0 represent solution is Neutral and if it is in 8.0 to 14.0 indicates it as Alkaline. Thus PH sensor output voltage is directly proportional to H ions. At the temp of 250C PH scale will be at 7.0.On mVolit scale the PH value will be in the range of -420mV to +420mV. The pH value of the potable water at 0mV is 7.

C. Turbidity sensors:

A measure of purity of water is given by Turbidity. The turbidity will be low for Clear water but it will be high for mud water. Suspended soils make water clouded by zooplankton in the water column. Transparency of water reduced by turbidity and also decreases photosynthesis rate by increasing the temp of water. It is measured in NTU.

The surface water is likely to have turbidity between 1 NTU and 50 NTU according to standards of USGS. Water is considered safe to drink if its turbidity is 1.0 NTU. Its maximum value should not be more than 5.0 NTU and should ideally be below 1.0 NTU.

5. Proposed Methodology And Software

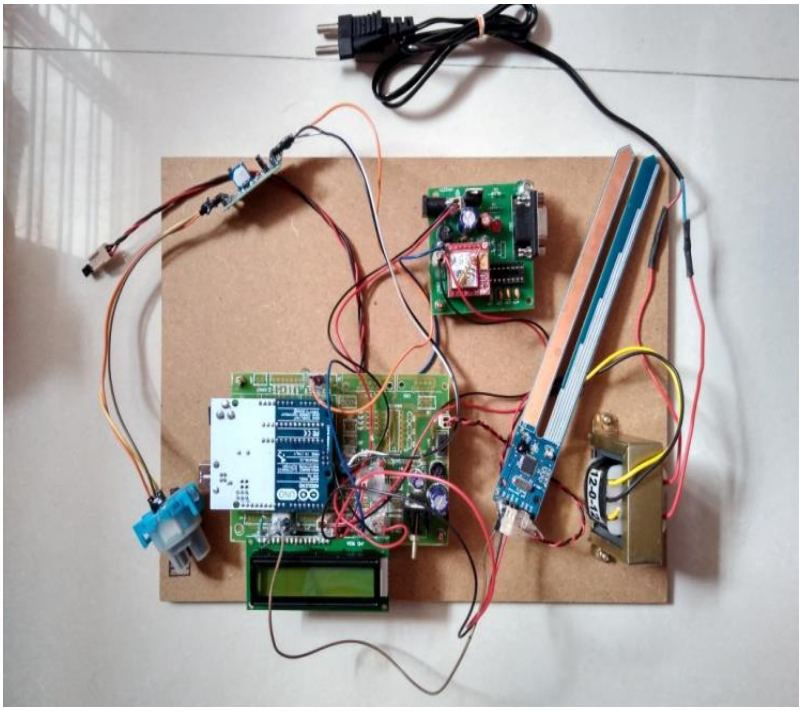

Figure3. Experimental set-up of the designed MLBWQM model.

The architecture of water testing diagram with three different sensors is shown in the figure 3. The main controlling unit used in the system is An Arduino board consists of an Atmel 8-, 16- or 32-bit AVR microcontroller with complementary components that facilitate programming and incorporation into other circuits. The measured temperature value of water is sends as input data to ARDUINO UNO and used as a Controller unit for reading Analog values from sensors to converted into the voltage to calibrate. The ARDUINO board provide with ADC with Analog input slot. In our project ARDUINO UNO interface with LED as a Display unit in the system. This Data can be Access Remotely on the Web.

A. Arduino:

The board supported atmega328 with 14 digital input/output and 6 analog input pins having 16 MHz quartz oscillator. The added more features are ICSP heater, a USB connection, in circuit serial programmer, and push. The Serial out (TX) and Serial in (RX), the external power supply taken AC to DC Adapter. The ARDUINO UNO board is operated on an external supply 6 to twenty volts.

B.*Arduino Software*

The Arduino integrated development environment (IDE) is a cross-platform application written in Java, and derives from the IDE for the Processing programming language and the Wiring projects. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and is also capable of compiling and uploading programs to the board with a single click. The Arduino IDE comes with a software library

called “Wiring” which makes many common input/output operations much easier. The users need only to define two functions to make an executable cyclic executive program.

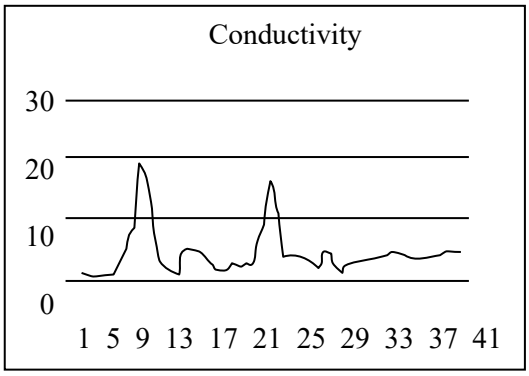

Figure4. Collected data for pH parameter

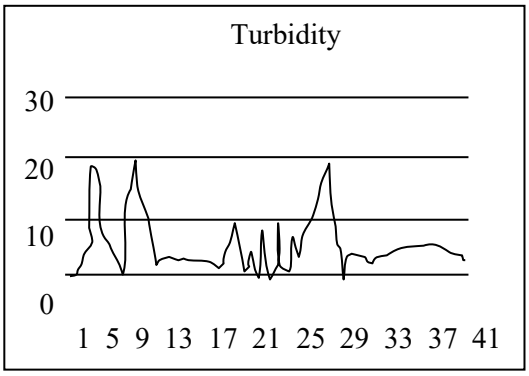

Figure5. Collected data for temperature

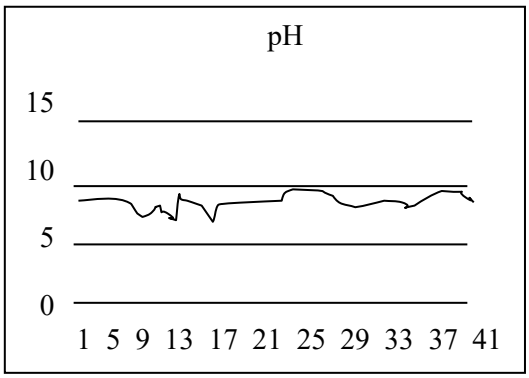

Figure6. Collected data for conductivity

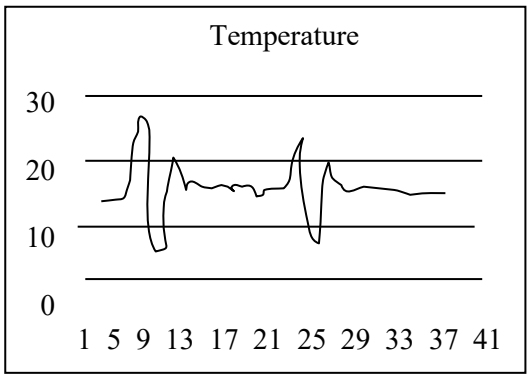

Figure 7. Collected data for turbidity

C.GSM Module Sim 900A

SIM900A is a dual-band GSM/GPRS engine that works on frequencies EGSM 900MHz and DCS 1800MHz. SIM900A features GPRS multi-slot class 10/ class 8 (optional) and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4. With a tiny configuration of 24mm x 24mm x 3mm, SIM900A can meet almost all the space requirements in your applications, such as M2M, smart phone, PDA and other mobile devices. The physical interface to the mobile application is a 68-pin SMT pad, which provides all hardware interfaces between the module and customers’ boards. The keypad and SPI display interface will give you the flexibility to develop customized applications. Serial port and Debug port can help you easily develop your applications. One audio channel includes a microphone input and a speaker output. Programmable General Purpose Input & Output. The SIM900A is designed with power saving technique so that the current consumption is as low as 1.5mA in SLEEP mode. The SIM900A is integrated with the TCP/IP protocol; extended TCP/IP AT commands are developed for customers to use the TCP/IP protocol easily, which is very useful for those data transfer applications.

6. Result And Analysis:

The MLBWQM model is successfully implemented as shown in Fig. 3.The output of the system against a Pure water sample is given in a table. 1 below. NOTE: - The values are taken at the time of experiment from sample; they may vary based on additional components added from nature and change in the quantity of water sample. So, let us compare one parameter between all of them (i.e. pH) now let us plot a bar graph against this values and see what it looks like**.**

TABLE I

Values for various water samples

S. No.	***SAMPLES***	***pH Value***	***Temperat -Values***	***Conductivity Values***	***Turbidity Values***
1	Normal tap water	7.12	29	146	3
2	Drinking Water (Without filter)	6.68	29	142	2
3	Drinking Water (Filtered using sand filters)	6.65	28	186	2
4	Drinking Water (Filtered using purifier)	6.23	30	202	2
5	Drinking Water (Filtered using RO kit)	6.15	28	220	1.78
6	Distilled water	7	27	0.05	1
7	Industrial water	**2.72**	**45**	**46**	**6**
8	Brine Solution	7	32	432	4
9	Carbonated water	3	25	253	3.33
10	Cold Water(Drinking water)	6.78	12	231	3
11	Water Sample (Locality-1)	6.3	25	142	3.4
12	Water Sample (Locality-2)	7.34	26	144	3.12
13	Water Sample (Locality-3)	6.65	27	139	3
14	Water Sample (Locality-4)	6.3	26	132	2
15	Water Sample (Locality-5)	7.12	24	138	3
16	Ground Water	7.6	22	142	2
17	Surface Water	6.68	22	188	1.8
18	Water Harvesting Pit (Rain Water)	6.3	24	170	1.2
19	Rain Water (Precipitation)	4.8	18	130	3
20	Surface Water (Stagnant)	5.8	20	140	3

7. Conclusions And Future Works

Hence here we have designed and implemented the tool to detect the water quality and successful in it.

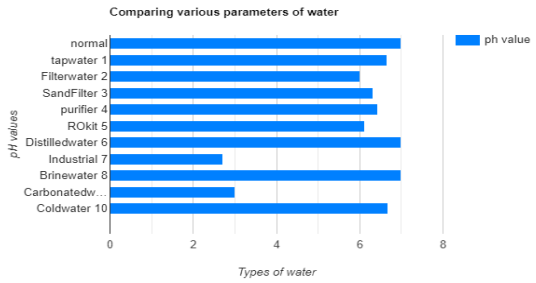

Fig 8 Graph representing pH values

Fig 9. BOD Sensors

Fig 10. COD Sensors

As mentioned we can now detect quality of any kind of water at any circumstances. This can be added with further sensors as mentioned in the future scope and can go on be extended till any extent. So, this project goes on …The kit what we have designed consists of only certain type of sensors and is meant for certain purposes only. If at all we want we will be able to add many more sensors such as;

1. BOD Sensor (Biological Oxygen Demand) BOD Sensor is the innovative, mercury-free and extremely reliable solution for BOD analysis. Easy to handle, quick and easy to read. A microprocessor-controlled pressure transducer transfers the Biochemical Oxygen Demand value directly to the display: results are displayed directly in mg/l with no need for further calculation and are stored automatically in the BOD Sensor. It fits directly on the bottle containing the sample and automatically stores 5 BOD values at 24-hour intervals meaning that analysis can continue over the weekend. The BOD analysis can be obtained directly from the display at any time, even after five days. Measurement is available on 4 different scales - 90, 250, 600 and 999 ppm BOD. Higher values can be measured by diluting the sample.

2. COD Sensor (Chemical Oxygen Demand) Chemical Oxygen Demand or COD is a measurement of the oxygen required to oxidize soluble and particulate organic matter in water. COD can be measured in real-time with our COD analyzers to improve wastewater process control and plant efficiency. The traditional chemical oxygen demand (COD) analysis method is the wet chemistry method. This involves a two hour digestion at high heat under acidic conditions in which potassium dichromate acts as the oxidant for any organic material present in a water sample. Silver sulfate is present as the catalyst and mercuric sulfate acts to complex out any interfering chloride. Following the digestion, the extent of oxidation is measured through indirect measurement of oxygen demand via electrons consumed in the reduction of Cr6+ to Cr3+. This can be done by titration or spectrophotometer.

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