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RELIABLE AND ENHANCED INDUSTRIAL SAFETY PARAMETERS MONITORING IN IOT ENVIRONMENT

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ABSTRACT The importance of industrial waste water monitoring is undoubted in this age. Industrial waste water monitoring is very important to know as to check whether the quality of our water is getting better or worse. Information gathered through industrial waste water monitoring is important to many different decision makers. So it is necessary to develop a system that monitors the industrial waste water conditions. Industrial waste water monitoring is a system of devices which collects the data in real time and transfers it through a Wireless Sensor Network (WSN) to the particular company web site or environmental department for analysis. System generally combines embedded system hardware techniques that are useful for online monitoring industrial waste water and send this information to android app. Further, this project is enhanced by using node-mcu IOT module. Whole sensor output results will be uploaded to mobile android app.

Keywords: Wireless Sensor Network, inter net of things, chemical oxygen demand, total suspended solids, biological oxygen demand

INTRODUCTION The term waste water is commonly used to describe liquid wastes that are collected and transported to a treatment facility through a system of sewers. Waste water is generally divided into two broad classifications: domestic waste water and industrial waste water. Domestic waste water comes from communities of homes, businesses, and institutions. Domestic waste water is 99.9 percent water and only 0.1 percent solids. Milligrams per liter (mg/L) is the metric equivalent of parts per million (one part in a million parts). One percent is equal to 10,000 mg/L. So a 0.1 percent solids concentration is equal to 1000 mg/L. The solids in domestic waste water are both dissolved and suspended solids. Suspended solids can be settled out or filtered but dissolved solids will have to be converted to suspended solids during the treatment process. Industrial waste water may contain organic pollutants, metals, nutrients, sediment, bacteria, and viruses. Industrial processes, such as steel or chemical manufacturing, produce billions of gallons of waste water daily. Some industrial pollutants are similar to those in municipal sewage, but often are more concentrated. Other industrial pollutants are more exotic and include a variety of heavy metals and synthetic organic compounds. In sufficient dosages, they may present serious hazards to human health and aquatic organisms. Industrial processes, such as steel or chemical manufacturing, produce billions of gallons of waste water daily. Some industrial pollutants are similar to those in municipal sewage, but often are more concentrated. Other industrial pollutants are more exotic and include a variety of heavy metals and synthetic organic compounds. In sufficient dosages, they may cause serious hazards to human health and aquatic organisms. The industry is of importance in terms of its impact on the environment. The waste water from industry is generally strong and may contain toxic pollutants. Industrial wastes usually contain organic and inorganic matter in varying degrees of concentration. It contains acids, bases, toxic materials, and matter high in biological oxygen demand, color, and low in suspended solids. Many materials in the chemical industries are toxic, mutagenic, carcinogenic or simply hardly biodegradable. Surfactants, emulsifiers and petroleum hydrocarbons that are being used in industry reduce performance efficiency of many treatment unit operations. The best strategy to clean highly contaminated and toxic in industrial waste water is in general to treat them at the source and sometimes by applying on site treatment within the production lines with recycling of treated effluent. Since these wastes differ from domestic sewage in general characteristics, pretreatment is required to produce an equivalent effluent. In chemical industry, the high variability, stringent effluent permits, and extreme operating conditions define the practice of waste water treatment. With the increasingly serious pollution of water resources, China's awareness of water resources protection is becoming stronger and stronger, and a series of effective measures have been taken. The water quality monitoring technology can detect and analyze the water quality timely, so as to obtain accurate detection results. This method is one of the effective methods to protect water resources in our country. Scholars at home and abroad have also made corresponding research on this issue. Qi et al., (2004) propose a soft sensor method based on radial basis function (RBF) neural network, train and simulate the RBF neural network by using a large amount of measured data, and prove the effectiveness of the soft sensing model based on RBF neural network through experiments. Qiao et al., (2014) use the COD, solid suspended solids (SS), pH and dissolved oxygen (DO) as input variables, use the improved T-S fuzzy neural network model to predict the effluent BOD, and achieve good results. Tian et al., (1998) compare the ozone biological activated carbon system model of BP and RBP artificial neural network. The research shows that the model of water treatment system based on BP artificial neural network has good generalization ability.

LITERATURE SURVEY: Mr. KiranPatil et.al research on Monitoring of Turbidity, PH & Temperature of Water Based on GSM. The traditional method of testing Turbidity, PH & Temperature is to collect samples manually and then send them to laboratory for analysis. However, it has been unable to meet the demands of water quality monitoring today. So a set of Monitoring of Turbidity, PH & Temperature of Water quality has been developed. The system consists of Turbidity, PH & Temperature sensor of water quality testing, single-chip micro-controller data acquisition module, information transmission module, monitoring center and other accessories. Turbidity, PH & Temperature of water is automatically detected under the control of single chip micro-controller all day. The single chip gets the data, and then processes and analyzes them. After that, the data are instantaneously sent to monitoring center by GSM network in the form of SMS. If the water quality is abnormal, the data will be sent to monitoring center and management department at the same time [1]. 2. Meng et.al. in the paper "Research of on-line monitoring system of COD in waste water based on the light absorption method", Introduces as online monitoring system of COD in waste water based on the optical absorption method. The system uses advanced processor STM32F103, advanced sequential injection platform, accurate optical measurement structure, efficient pressure digestion method, high resolution colorimetric module [2]. 3. S.Harivardhaginiet. al. in the paper "developing a control technique using Variable Structure control [VSC] methodology for a pH control plant", The pH control process involves a prototype model in which acidic and alkaline streams are mixed into a Continuous Stirred Tank Reactor [CSTR] in proper proportions so as to control the pH of the plant [3]. 4. Adrian Korodiet. al. Introduces the lack of well-trained automation and SCADA works designers causes delays in project implementation and adds difficulties to supervise the developments for both the consultant and the beneficiary. The paper proposes to integrate in the curriculum of students a course material regarding the steps to be followed in order to produce correct automation and SCADA technical documentation.

PROPOSED TECHNIQUE:

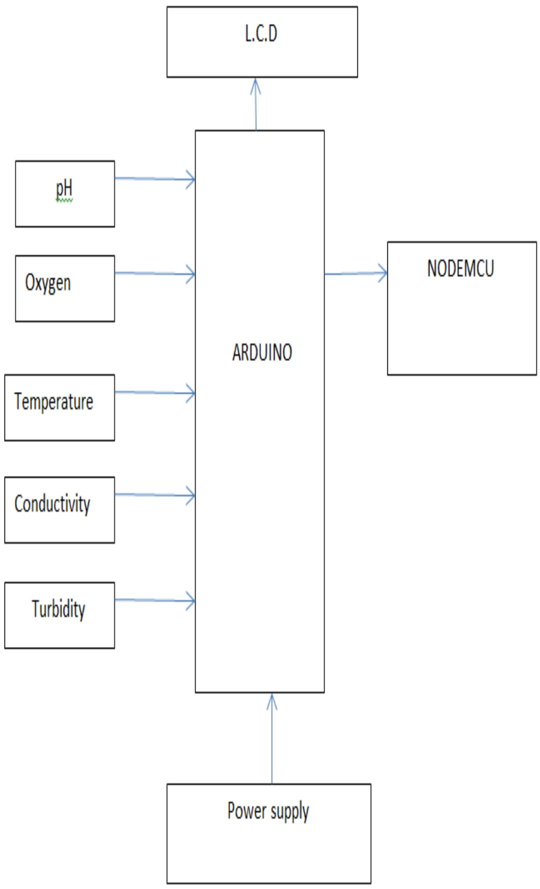

Fig1. Proposed block diagram

The above block processing thread is responsible for the processing of the data and the online updating. Firstly, the data measuring program verifies the data frame sent from sensor to IO pins of Arduino- Uno, and then it will extract and parse the measured data after confirmation. After that, it will process the measured values of the various sensors using standard NODE MCU communication format by the polling method. As shown in above, pH, Oxygen, temperature, Conductivity, turbidity sensors are used to design this prototype.

ARDUINO UNO: The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter. The Uno board has a resistor pulling the 8U2 HWB line to ground, making it easier to put into DFU mode.

- The board has the following new features:
- 1.0 pinout: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible with both the board that uses the AVR, which operates with 5V and with the Arduino Due that operates with 3.3V. The second one is a not connected pin, that is reserved for future purposes.
- Stronger RESET circuit.
- Atmega 16U2 replace the 8U2.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards.

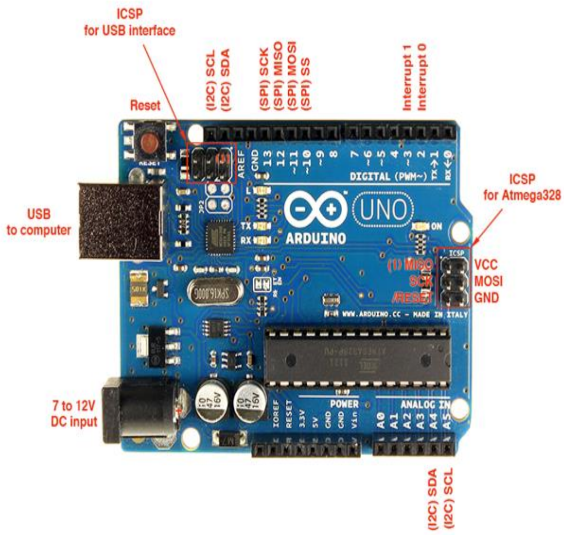

Fig2: Arduino pin Diagram

NODE MCU: The Node MCU is an open source firmware and development kit that helps you to prototype your IoT product with ArduinoIDE or in few Lau script lines. It includes firmware which runs on the ESP8266 Wi-Fi SoC. And hardware which is based on the ESP-12 module. In this tutorial we explain how to use NodeMCU with Arduino IDE.

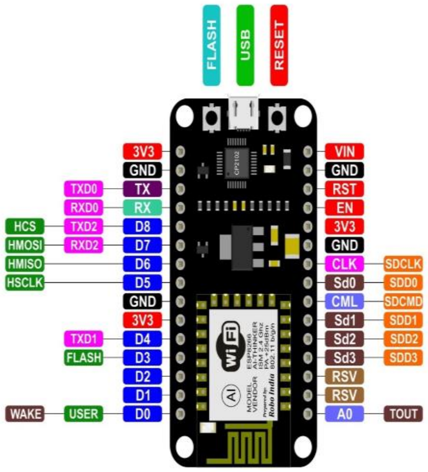

Fig3: NODE MCU pin diagram

ESP8266:

The ESP8266 series, or family, of Wi-Fi chips is produced by Espressif Systems, a fabless semiconductor company operating out of Shanghai, China. The ESP8266 series presently includes the ESP8266EX and ESP8285 chips.

ESP8266EX (simply referred to as ESP8266) is a system-on-chip (SoC) which integrates a 32-bit Tensilica microcontroller, standard digital peripheral interfaces, antenna switches, RF balun, power amplifier, low noise receive amplifier, filters and power management modules into a small package. It provides capabilities for 2.4 GHz Wi-Fi (802.11 b/g/n, supporting WPA/WPA2), general-purpose input/output (16 GPIO), Inter-Integrated Circuit (I^2C), analog-to-digital conversion (10-bit ADC), Serial Peripheral Interface (SPI), I^2S interfaces with DMA (sharing pins with GPIO), UART (on dedicated pins, plus a transmit-only UART can be enabled on GPIO2), and pulse-width modulation (PWM). The processor core, called "L106" by Espressif, is based on Tensilica's Diamond Standard 106Micro 32-bit processor controller core and runs at 80 MHz (or overclocked to 160 MHz). It has a 64 KiB boot ROM, 32 KiB instruction RAM, and 80 KiB user data RAM. (Also, 32 KiB instruction cache RAM and 16 KiB ETS system data RAM.) External flash memory can be accessed through SPI. The silicon chip itself is housed within a 5 mm × 5 mm Quad Flat No-Leads package with 33 connection pads — 8 pads along each side and one large thermal/ground pad in the center.

LIQUID CRYSTAL DISPLAY The LCD is used for the purpose of displaying the words which we are given in the program code. This code will be executed on microcontroller chip. By following the instructions in code the LCD display the related words. Fig. shows the LCD display.

Fig4 : LCD Display

The LCD display consists of two lines, 20 characters per line that is interfaced with the PIC16F73.The protocol (handshaking) for the display is as shown in Fig. The display contains two internal byte-wide registers, one for commands (RS=0) and the second for characters to be displayed (RS=1). It also contains a user-programmed RAM area (the character RAM) that can be programmed to generate any desired character that can be formed using a dot matrix. To distinguish between these two data areas, the hex command byte 80 will be used to signify that the display RAM address 00h will be chosen Port1 is used to furnish the command or data type, and ports 3.2 to 3.4 furnish register select and read/write levels.

PH SENSOR pH is the numeric representation of gram-equivalent per liter of hydrogen ion concentration in any solution. It varies between 0 to14. It is the logarithmic measurement of moles of hydrogen ions per liter of solution. The solutions having pH value between 0 to 7 are acidic solutions with large concentration of hydrogen ions whereas solutions having pH value between 8 to 14 are basic solutions with small hydrogen concentration. The solutions having pH value of 7 are neutral solutions. Measuring the pH gives the measure of alkalinity or acidity of a solution.

- To monitor pH level of blood, which must be between to 7.35 and 7.45
- To monitor pH level of soil for optimal growth of crops according to the requirements.
- To monitor pH of rain so that we can detect the pollutants in air, if the rain water becomes more acidic.
- To monitor pH of many other daily used products like milk, shampoo etc.

OXYGEN SENSOR According to its datasheet, the OXYGEN alcohol sensor detects 25 to 500 ppm of alcohol (ethane). Here's the graph of voltage vs. alcohol concentration: Blood alcohol level (BAC) is normally measured in grams per deciliter (g/dL). 1 g/dL is equivalent to 10000 ppm. In the US and Canada, the minimum BAC for driving is 0.08 g/dL or 800 ppm. In most European countries, it's 0.05 g/dL or 500 ppm. Note that the graph was derived with a load of 4.7 kΩ. It would be difficult to replicate the results of the graph if we will be using the OXYGEN as a breathalyzer. Instead, we will be using the RS/R0 graph:

Fig5. Gas sensor outlook

The alcohol level is readable via the AOUT pin. Since it's a varying voltage, this pin should be connected to any of the Arduino's or PIC's analog pin. To use the OXYGEN alcohol sensor with the Raspberry Pi you need an external analog to digital converter. The DOUT pin becomes high when the alcohol level exceeds a threshold value. Based on the schematic, the threshold value depends on the value of Rp which is the trimmer on the breakout board. You will need to test the device as to which BAC will trigger DOUT.

TEMPERATURE SENSOR(LM35):

LM35 is a precision IC **temperature sensor** with its output proportional to the temperature (in °C). The sensor circuitry is sealed and therefore it is not subjected to oxidation and other processes. With **LM35**, temperature can be measured more accurately than with a thermistor. It also possess low self heating and does not cause more than 0.1°C temperature rise in still air. The operating temperature range is from -55°C to 150°C. The output voltage varies by 10mV in response to every °C rise/fall in ambient temperature, *i.e.,* its scale factor is 0.01V/°C.

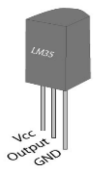

Fig6. Temperature sensor outlook

TURBIDITY SENSOR Turbidity is a property that is a result of particles of solid matter being suspended in water, rather than dissolved into it. If water is turbid it appears to be cloudy, so is a visual guide to water quality. Turbidity water testing is an important part of water quality maintenance. Increased levels of turbidity raises water temperatures, because heat is absorbed by the suspended particles. Warm water holds less dissolved oxygen than cold, so increased water temperatures result in decreased levels of dissolved oxygen. Turbidity sensors measure the amount of light that is scattered by the suspended solids in water. As the amount of total suspended solids (TSS) in water increases, the water's turbidity level (and cloudiness or haziness) increases. Turbidity sensors are used in river and stream gaging, wastewater and effluent measurements, control instrumentation for settling ponds, sediment transport research, and laboratory measurements.

RESULTS:

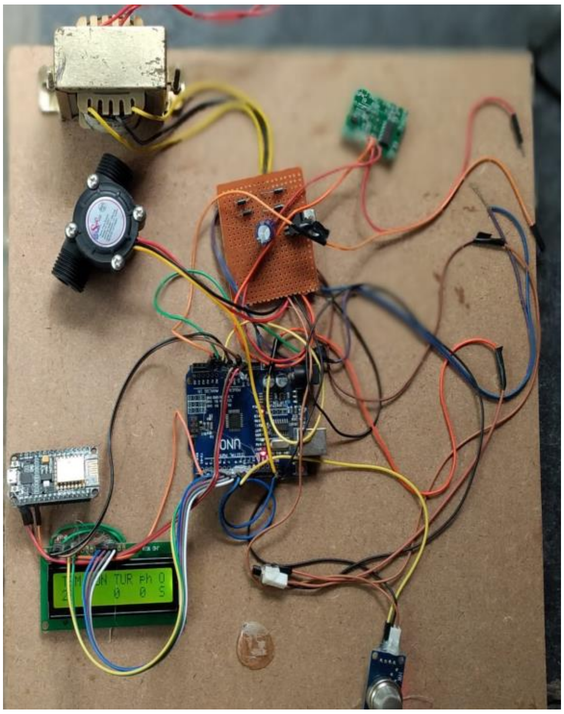

Fig7: Proposed hardware prototype kit

Above hardware kit snap shows whole integrated sensors, Arduino processing element, and IOT application device (Node MCU). Each and every measured sensor values are compared with predefined threshold values; yielded result will be uploaded to Blyn app through IOT technology.

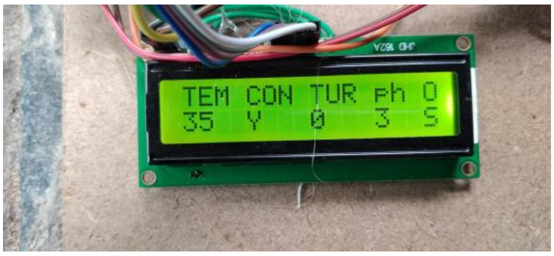

Fig8: Proposed hardware with full LCD

Above hardware kit snap shows whole sensor values in a single Liquid Crystal Display. Temperature, Conductivity, Turbidity, Ph and Oxygen quantity values are as shown in above LCD correspondingly.

Fig9: IOT uploaded yield

Above virtual snap shot in Blynk app shows client side output represents high turbidity

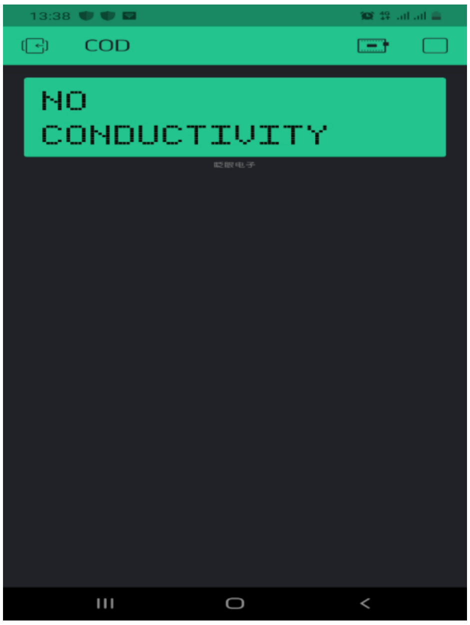

Fig10: IOT uploaded yield

Above virtual snap shot in Blynk app shows client side output represents No conductivity

CONCLUSION With the rapid development of industry and society, urban sewage treatment has become an important research topic in the field of environmental protection. In the process of sewage treatment by activated sludge, chemical oxygen demand, biochemical oxygen demand, nitrogen content and other parameters are the key indicators to evaluate the performance of sewage treatment, and also an important parameter to measure the quality of sewage. Due to the limitations of the current measurement methods and measuring instruments, some parameters are difficult to obtain in time, thus affecting the control effect of water quality parameters in wastewater treatment. To solve this problem, this paper tries to use the strong nonlinear identification ability of neural network to realize soft sensing of chemical oxygen demand. The experimental results are satisfactory and can be used for reference in actual production.

FUTURE SCOPE The proposed system does the reconfiguration of the sensors threshold values. There is scope for development of an environment which can be automatically controlled based on the alerts from the monitoring system. For example, when the temperature exceeds the threshold value that is set, coolers will be turned on automatically to required temperature.

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