MICROCONTROLLER-BASED IMPROVED WATER QUALITY MONITORING

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Abstract

The goal of this research is to create a useful portable gadget that can check the water quality and inform the customer or user about the water they intend to drink or use. The largest issue facing the entire planet now is water supply pollution. The water delivery system in rural areas is not as robust as it is in metropolitan areas. Because they don't have any testing modules within their budgetary constraints, the population of rural areas relies only on water filtration systems. The key water parameters, including TDS, Turbidity, Hardness, and Conductivity, will be carried out in this and monitored with the use of a microcontroller and many sensors. Develop "portable gadgets" for assessing the quality of drinking water as part of an innovation challenge.

Keywords: TDS, turbidity, and portable

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1. Introduction

The capacity of a body of water to deliver ecosystem services is impacted by pollution. Aquifers, reservoirs, lakes, rivers, seas, and groundwater are a few examples of water bodies. Water bodies are contaminated when they are exploited in ways that are detrimental to their intended usage.

The primary indicators of water quality are continuously tracked in this study. All measured water parameters are compared to threshold levels that identify the purest form of the substance in order to monitor all of its properties. As soon as the parameters are measured, alert news is provided to the display panel for informational reasons.

1.1 Research Problem Statement

"Portable devices that can be utilised at the home level to evaluate the drinking water quality" are the project's stated goals. Several portable gadget kinds could be created. For one, two, or all three of the available types of water testing kits, we can suggest developing portable devices.

1. A gadget that can test every parameter.
2. A sensor having the capacity to solely find bacterial contamination.
3. A portable gadget that can test one or more parameters.

1.2 Literature Survey

(Bartram & Ballance, 1996). The water quality index (WQI) model is a well-liked tool for assessing the quality of surface water. The WQI model has been used internationally to assess water (surface water and groundwater) based on regional water quality standards. The most popular models and concerns impacting model accuracy are compared and discussed in this study.

(Chorus & Welker, 2021) The following water quality criteria were examined in order to determine the level of water contamination in the water bodies: Total dissolved solids (TDS), total solids (TS), total alkalinity, dissolved oxygen (DO), chemical oxygen demand (COD), and biochemical oxygen demand are the first nine parameters (BOD) Overall Hardness: 10. Temperature, pH, turbidity, salinity, nitrates, phosphates, and other variables may all be examined. Examining the aquatic macroinvertebrates might also reveal information about the water's quality.

(Chapman, 2021) This article introduces the Water Quality Monitoring System for Inland Lakes (WQMSIL), which intends to facilitate future decision-making by experts and public engagement. A range of information on the issues with inland lakes' water quality is provided through remote sensing data in conjunction with ground-based observation data. The article also discusses how the system will be improved in the future.

The relationship between conductivity and total dissolved solids in various types of water was examined by (Chapman, 2021; Nicolet et al., 2004). TDS = k EC is a common equation used to explain the relationship between these two quantities (in 25 0 C). TDS may be extracted from water samples using a more involved procedure than EC. According to findings from earlier studies, the relationship between TDS and EC is not always linear. Salinity inside has a significant impact on the ratio, but so do the materials' contents. A sense of the quality of the water may also be obtained by looking at the TDS concentration based on the EC value.(Strobl & Robillard, 2008) TDS concentrations must be measured in the lab using the gravimetric technique for greater accuracy.(Akhter et al., 2021; Demetillo et al., 2019; Kedia, 2015)

2. Proposed methodology

There are typically two main categories of methodologies:

- Continuous approach the sensor is constantly submerged in water while using this approach to transmit readings to the user.
- Method that is intermittent with this approach, the sensor is configured to provide readings at regular intervals.

We have chosen the intermittent monitoring approach since the project's goal is to make the gadget portable. The advantages of this strategy include decreased power usage, which increases battery life, less thermal problems like overheating, and a lack of the additional cooling fans that the continuous method requires. low cost of production.(Kumar et al., 2018)

These are the steps:

1. Sensing: TDS sensor and turbidity sensor modules, both of which are analogue in nature, are used to detect characteristics including hardness, turbidity, and total dissolved salt (TDS).(Rusydi, 2018)
2. Computing and Controlling: The ATmega328, a high-performance Microchip 8-bit AVR® RISC-based microcontroller, is used to compute and control the input data from the sensor.(Pasika & Gandla, 2020) It includes 32 KB ISP Flash memory with read-while-write capability, 1 KB EEPROM, 2 KB SRAM, 23 general-purpose I/O lines, 32 general-purpose working registers, three flexible timer/counters with compare modes,

internal and external interrupts, serial.(Akhter et al., 2021)

3. Showing or communicating: We are utilising a 1.8-inch SPI 128x160 TFT LCD panel to display calculated data. 128160 colour pixels make up the 1.8 display. Its display is a real TFT, unlike the inexpensive Nokia 6110 and other LCD screens that are CSTN type and have limited colour and sluggish refresh. The ST7735R TFT driver can show full 18-bit colour (262,144 shades). And since the 1.8 Inch SPI 128160 TFT LCD Display Module has a comparable driver chip, our code will definitely not function. It has a micro-SD card slot, allowing us to easily load full-color bitmaps from a micro-SD card with a FAT16/FAT32 file system.

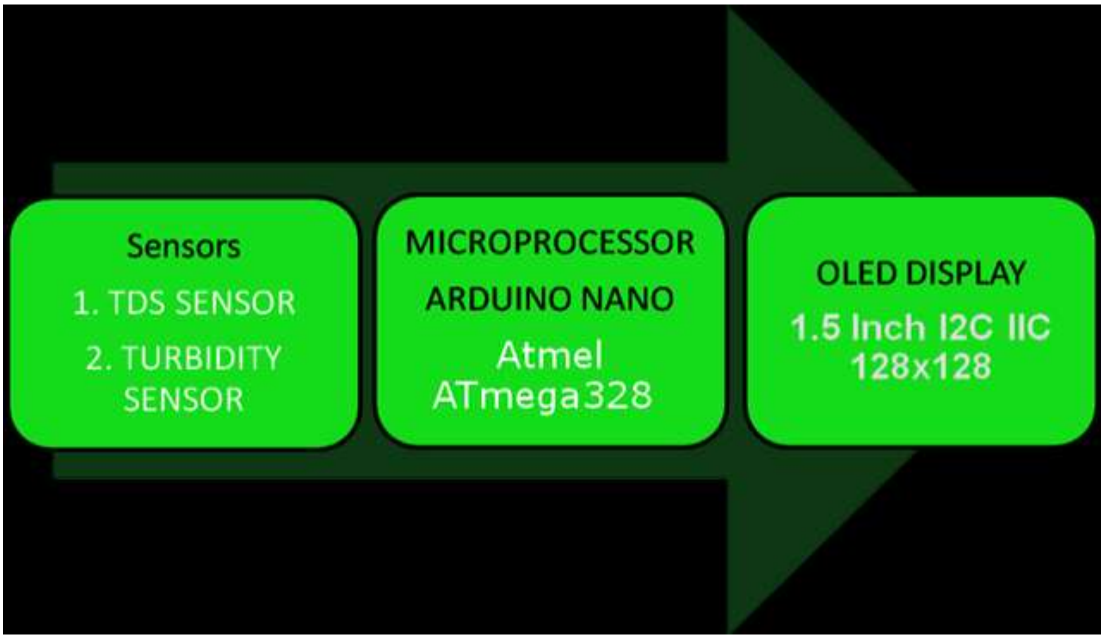

Figure -1: Flow chart of Methodology

3. Used components

3.1. Arduino UNO: Arduino Microcontroller is an open source hardware and software initiative, business, and user group that develops and produces single-board microcontrollers and microcontroller kits for the construction of digital devices.


Figure 2: Arduion UNO

3.2. TDS sensor: TDS sensor A TDS pen is the most typical piece of TDS testing equipment. It is affordable and simple to use, but it cannot analyse water quality, undertake long-term online monitoring, or communicate data to the control system. Data may be transferred with great precision using a specialised equipment, but it is highly expensive. To this purpose, we have in particular created the Arduino-compatible TDS sensor, which, when connected to the Arduino controller, may be used to test the TDS value of water

Figure 3: TDS meter

3.3. Turbidity sensor: The Arduino turbidity sensor can measure turbidity to determine the water quality and to make a detection. Digital or analogue signals placed adjacent to the relevant pins on the related electrical module can be used to confirm turbidity readings. At its edges, the turbidity sensor emits infrared light. It is invisible to the human eye and is capable of detecting particles floating in water as well as measuring how light transmission and dispersion vary as total suspended solids (TSS) levels do.

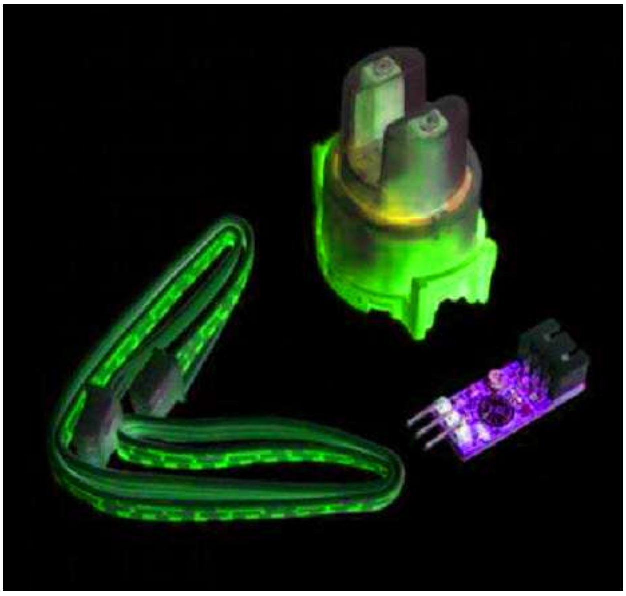

Figure 4: Turbidity sensor

3.4. LCD screen: a 2 inch LCD display module by Waveshare. a general-purpose LCD display module featuring an internal controller, a 2 inch diagonal IPS screen, 240 x 320 resolutions, and an SPI interface for communication. It works with Arduino, STM32, Raspberry Pi, and other devices .

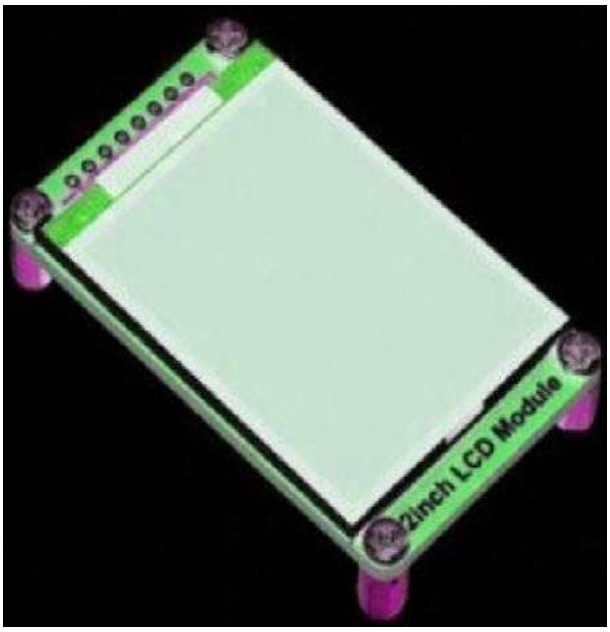

Figure 5: LCD screen

4. Component specification

TDS module

TECH SPECS FOR GRAVITY'S ANALOG TDS SENSOR

Board of a signal transmitter

- Voltage range: 3.3 to 5.5V
- 0 to 2.3V as the output voltage
- Working current is 3 to 6 mA.
- 0 to 1000 ppm is the TDS measurement range.
- Ten percent F.S. accuracy for TDS measurement (25)
- Module Dimensions: 42 x 32 mm
- PH2.0-3P Module Interface
- XH2.54-2P Electrode Interface

probe TDS

- There are two needles.
- 83 cm in total length
- XH2.54-2P, Connectivity Interface
- the hue black
- Additional: Waterproof Probe

Other Conditions

- Hardware
- One DFRduino UNO R3 (or comparable)
- One analogue TDS sensor
- One TDS Probe
- Three jumper wires
- tested the liquid x1.
- Software: Turbidity module requires Arduino IDE version 4.2 (V1.0.x or V1.8.x).
- DC 5V working voltage
- working with 30Ma (max)
- Response time: 500 milliseconds
- 100M of Insulation Resistance (Min)
- Operating range (0 C): -30 to +80
- Dimensions (mm) 33
- Width (mm) (mm): 20
- Height (mm) (mm): 12
- Weight: 55 grammes
- Weight of shipment 0059 kg
- Measurements for Shipping: 8 5 5 cm

4.3 For the Arduino UNO

- Microcontroller: ATmega328P from Microchip
- 5 volts is the operating voltage
- 7 to 20 volts of input voltage
- 14 Digital I/O Pins (of which 6 can provide PWM output)
- There are six PWM pins, one each for UART, I2C, SPI, and analogue input.
- I/O pin DC current is 20 mA, while supply 3.3V pin DC current is 50 mA.
- ICSP Header: Yes • Length: 68.6 mm • Width: 53.4 mm • Weight: 25 g • Clock Speed: 16 MHz • Flash Memory: 32 KB, of which 0.5 KB • SRAM: 2 KB • EEPROM: 1 KB • Power Source: DC Power Jack & USB Port

4.4 Unit for Display

- General 2 inch IPS LCD Display Module, Waveshare brand, 240x320 resolution
- 3.3V/5V as the operating voltage (Please make sure that the voltage of power supply and logic voltage are consistent, otherwise it will not work properly)
- SPI interface; IPS type LCD; ST7789V controller
- 240(V) x 320(H) RGB resolution
- Pixel size: 0.0975(H)x 0.0975(V)mm; Display size: 30.60(H)x 40.80(V)mm; Dimension: 58 x 35 (mm)

4.5. Pin Configuration

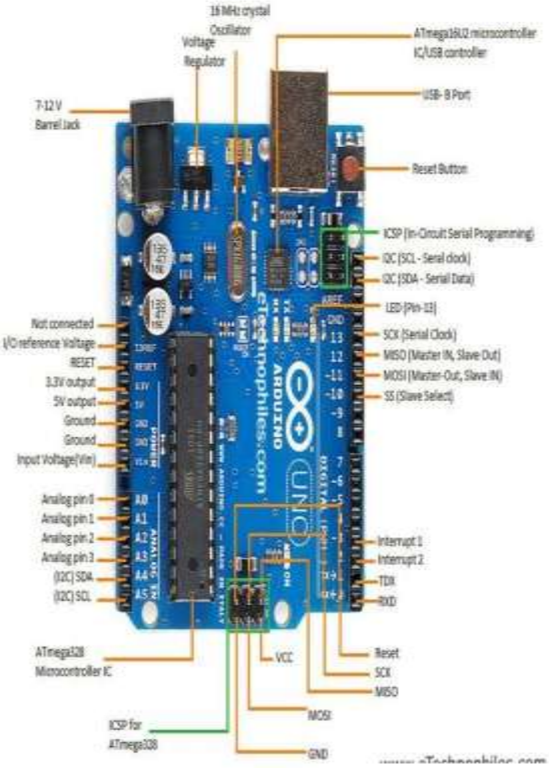

Figure 6: pin configuration

PIN configuration in general

- Built-in LED: Digital pin 13 powers the built-in LED. The LED will be on if the pin is high and off if the pin is low.
- VIN: When utilising an external power source, this is the input voltage to the Arduino or original board. This pin can be used to access power or to supply power if the device is powered by an external power connector.
- 5V: A regulator on the board produces a controlled 5V at this pin. The DC jack (720V), the USB connection (5V), or the board's VIN pin can all be used to power the board (720V). Bypassing the regulator by applying a voltage through the 3.3V or 5V pins might harm the circuit board.
- 3V3: The onboard regulator produces the 3.3 volts needed for the power supply. 50mA is the maximum current usage.

Ground pins, or GND

- IOREF: The voltage reference utilised by the microcontroller to function is provided by this pin on the Arduino / Genuino board. The output voltage converter can run at 5V or 3.3V if the shield is properly designed to read the voltage at the IOREF pin and choose the appropriate current source.
- Reset: A reset button is typically added to a shield that physically blocks another shield on the board.

Certain pins serve specific purposes:

- UART/Serial pins 0 (RX) and 1 (TX). used to send and receive TTL serial data (RX and TX). The ATmega8U2 USB-to-TTL serial chip's matching pins are connected to these pins.
- Pins 2 and 3 are external interrupt pins. These pins can be set up to create an interrupt on low values, rising or falling edges, or value changes.
- Pins 3, 5, 6, 9, 10, and 11 are used for pulse width modulation (PWM). can provide an analogue Write () function and an 8-bit PWM output.
- Pins 10 (SS), 11 (MOSI), 12 (MISO), and 13 of the Serial Peripheral Interface (SPI) (SCK).
- Two-Wire Interface (TWI)/I2C: SDA (A4) and SCL are the pins (A5). TWI communication using the Wire library should be stopped.
- A reference voltage for the analogue inputs is known as an AREF (analogue reference).

4. Conclusions

The analysis of the device's real operation and efficacy is the goal of this study. The aim will be accomplished by conducting a thorough examination of water parameters and measurements in all relevant aspects.

It is concluded that the gadget effectively delivered the desired results with no reading variation lag. It is manageable and portable, so no further connections are required.

5. References

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