IoT-BASED SYSTEM FOR MONITORING WATER QUALITY

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ABSTRACT

Water-borne infections, such as dengue fever, cholera, and malaria, have emerged as serious health concerns in the modern world. Water contamination is responsible for 40% of all deaths worldwide. Drinking water quality must be monitored continuously as it is delivered to customers. This article presented a low-cost, real-time water quality measuring system design that leverages the Internet of Things (IoT). Measurements of the water's temperature, humidity, pH, and turbidity must be calculated. The poisoning of fresh water supplies is probably the green globalization's biggest fear. Constant monitoring of water quality is required to provide a safe supply of potable water. In this paper, we outline the steps taken and the features added to a framework designed to make it easy to monitor water quality in real time over the Internet of Things. Multiple sensors, built by a team with experience in water quality assessment, are integrated into the structure. The variables, such as temperature, pH, turbidity, and humidity. The central controller can configure the sensors' perceptive qualities. The ATMEGA328 can serve as the brains of the operation. In the end, WI-FI architecture allows the sensor data to be seen online. A Microcontroller is used as the automation controller for this project. When a PC sends data over Wi-Fi, the Wi-Fi module attached to the microcontroller will pick it up.The Arduino microcontroller links all of the parts together. All hardware modules receive 5v of DC voltage from a regulated power supply and are controlled by an Arduino ATMEGA328 microcontroller programmed in Embedded C using the Arduino IDE.

Keywords:, Internet of things, Water quality management, pH sensor, Turbidity sensor, Arduino controller

1. Introduction

There wouldn't be any humans or other natural phenomena without water. Consumption of contaminated water is directly responsible for almost 80% of ailments in developing countries. Besides being essential for survival, water has many beneficial applications in industry, agriculture, fishing, and other fields. Physical, chemical, and biological factors are the most significant in determining water quality. Lakes, rivers, glaciers, groundwater, rain, and snowfall also play significant roles. No matter how dirty the water may be, it may be found everywhere on Earth. Roughly 80% of Earth's surface is hidden beneath water. Water is essential to all forms of life on Earth and plays a crucial role in our daily lives. Nowadays, people pay a lot of attention to the purity of their drinking water. Therefore, ensuring the water you drink is safe and clean is crucial for a long and fulfilling life. Measuring water quality has traditionally involved shipping samples to labs for analysis, a process that is labor-intensive, time-consuming, and expensive. This method will not deliver real-time data and will result in contaminated water. In order to detect the pH, turbidity, temperature, and humidity of the water, continuous and real-time data, the suggested water quality monitoring systems comprise of a microcontroller with common sensors. In conclusion, implementing a water quality monitoring system is crucial for protecting people and wildlife. the long-term viability of our water supply. It provides essential data for managing and protecting water quality and ensuring the responsible use of water resources. As a result of years of technological study and development, modern society is making strides toward creating "smart cities." Many people now refer to our contemporary era as the "Age of Inventions," "Age of Development," "Age of Globalization," "The Age of Smartness," etc. But on the flip side, we're living in an era where pollution, global warming, instability, and poor health outcomes are the norm, rather than the exception. Water quality monitoring shortcomings and general public apathy are major contributors to this problem that has substantial consequences for public health.

2. LITERATURE SURVEY

Many quality factors, such as turbidity, pH value, water level in the tank, moisture in the surrounding environment, and temperature, can be monitored with the system proposed by Pasika and Gandla (2022) [1]. The microcontroller unit (MCU) communicates with the sensors, and the personal computer (PC) handles the rest of the processing. The ThinkSpeak app, built on the IoT, will transmit the collected data to the cloud, where it can be used to track changes in the water's quality over time. Nitrates, electrical conductivity, dissolved oxygen in the water, and free residual chlorine are just a few of the other parameters that should be analyzed in the future per this instruction. An Internet of Things (IoT) based Smart Water Quality Monitoring (SWQM) system was created by Mukta et al. (2021) [2], which aids in the continuous measurement of water quality based on four different parameters: pH, temperature, turbidity, and electric conductivity. In order to measure the quality characteristics, four separate sensors are connected to an Arduino Uno. All of the sensors' readings are sent to a desktop application written in the.NET framework, where they are parsed and compared to predefined norms. The created SWQM model will efficiently assess the water quality characteristics by using a rapid forest binary classifier to determine whether or not the sample of water under test is drinkable based on the data collected from sensors. A strategy for creating an Internet of Things (IoT)-based Smart Water Quality Monitoring (SWQM) system, complete with a reconfigurable sensor interface device, was proposed by Konde and Deosarkar (2021) [3]. The proposed model utilized sensors, an FPGA board, and a Zigbee based wireless communication module. In real time, we took into account six distinct water quality data, including turbidity, pH, humidity, water level, water temperature, and carbon dioxide (CO_2) at the water's surface. The proposed strategy will help ensure a more stable and secure ecosystem in aquatic areas. In order to maintain a healthy ecological and environmental balance, the SWQM system expedites the process of assessing the quality of water in water resources while cutting costs. To cover the entire area, a WSN network with a greater number of nodes is proposed for further development.

Using a wireless sensor network, Amruta and Satish (2021) [4] presented a solar-powered water quality monitoring system. The fundamental part of solar- or PV-powered wireless sensor network (WSN) technology for monitoring water quality is the Underwater Wireless Sensor Network (UWSN). An extraordinary system architecture consisting of a central hub and dispersed sensor nodes is proposed for real-time, widespread water quality monitoring. Zigbee WSN technology is used to establish connections between all the nodes and the base stations. It's difficult to figure out how to design and build a prototype model employing a node that is powered by solar panels and WSN technology. Using WSN, sensor data including turbidity, oxygen saturation, and pH readings will be transmitted from each node to the control center. At the base station, you may view the data in a comprehensible format and analyze it with a number of simulation programs. Among the many benefits of the newly built water quality monitoring system are reduced energy use and the elimination of carbon emissions. increased mobility and emission. Using the Internet of Things and various sensor modules, Sughapriya et al. (2021) [5] devised a system for assessing water quality. The pH, turbidity, conductivity, and temperature of the water are all measured by separate sensors in this system. The data from the sensors will be available to the Arduino controller. By analyzing the data gathered through IoT, water pollution can be probed with greater rigor. The devised mechanism also notifies worried citizens and administrations of any changes in water quality. Water quality monitoring could be accomplished with less-trained personnel. Next to the water resources (the region of interest), setting up the monitoring system for water quality would be a breeze. Water quality characteristics are calculated in real time using a variety of sensors included in the suggested created model. The developed model is not only accurate but also cost-effective and labor-light. It was proposed by Unnikrishna Menon et al. (2022)[6] to use wireless sensor networks to continuously and remotely monitor water quality indicators in rivers. The system's wireless sensor node is built on continuously measuring pH, the most important factor in water quality. A processor module, signal conditioning module, power module, and wireless communication module are the main building blocks of the sensor node design. After undergoing any necessary signal processing or signal conditioning, the data from the pH sensor is transmitted to the base station using a wireless communication module, such as a Zigbee module. Designing, simulating, and finally building a hardware prototype using appropriate circuit components, the circuit for the sensor node is designed. As a result, less energy is needed to run the system, and a more affordable platform is made available for keeping tabs on the quality of the world's water supplies.

Using remote sensing and IoT technology, Prasad et al.(2020) [7] devised a strategy for a smart water quality monitoring system in Fiji. Oxidation-reduction potential (ORP) and hydrogen potential (pH) are two of the quality metrics used in water analysis. With successful implementation of this monitoring strategy, a comprehensive system utilizing a large number of monitoring stations will be created to serve as an early warning system for water contamination. Also discussed is research on water quality in the Fiji Islands, which highlights the importance of a regularly updated network of sensors and other Internet of Things devices for keeping tabs on the water supply. Several variables, including turbidity, pH, temperature, and conductivity, are compared and contrasted. The created system's accuracy and dependability in real-time water monitoring have proven its worth. To verify the precision of the proposed system's measurements, four water sources were analyzed at regular hourly intervals for a period of 12 hours. Results are compared to expected values to determine accuracy. There is a correlation between temperature and conductivity and pH in water from all four different sources. The end user is alerted via GSM technology based on reference values, allowing for immediate response and the maintenance of water quality. In addition, classifiers used for automating water analysis via Neural Network Analysis are constructed using the reference parameters gathered from all four sources. Jerom B. et al. (2019)[8] suggested a Smart Water Quality Monitoring System that makes use of IoT, Cloud, and Deep Learning techniques to keep tabs on the cleanliness of our planet's many water supplies. In conventional practices, a monitor ring entails physically collecting samples of water from several sources, then analyzing them in a lab. This method is typically ineffective since it is laborious, time-consuming, and does not produce results in real-time. Constant water quality monitoring is necessary to guarantee a reliable supply of potable water from all sources. As a result, it is crucial to create an inexpensive method of real-time IoT water quality monitoring. Keeping an eye on the water quality is the use of Internet of Things-based resources helps in the fight against environmental problems and raises the general standard of living for all forms of life. The created system utilizes IoT devices and Node-MCU to provide continuous water quality monitoring. Connectivity to the internet and the transmission of sensor readings to the Cloud are made possible by the Wi-Fi module integrated into the Node- MCU. The designed prototype tracks multiple water pollutants. The quality of water drawn from sources is evaluated using a number of sensors, each of which measures a unique set of parameters. The collected data is then stored in the cloud, where deep learning methods are used to make predictions about the water's suitability for human consumption.

Geetha and Gouthami(2019)[9] created a low-energy and naïve Internet of Things-based method for tracking in-pipe water quality. Water samples are tested using the created model, and the data from the sensors is examined after being sent to the internet. In order to keep costs down while yet providing accurate readings of important water quality indicators like turbidity, conductivity, and pH, this model uses a central controller with an integrated Wi-Fi module. The created system includes a warning mechanism to notify users of water quality parameter deviations. With this technology in place, sensors may easily send data to clients via the internet. Integrating algorithms for detecting incongruities in water quality can improve the experimental setting. Sengupta et al. (20218)[9] presented a method for inexpensively monitoring and managing water quality in real time using the Internet of Things. Several sensors, including ones for measuring temperature, turbidity, and pH, are included into the system and communicate with the Raspberry Pi through an ADC. Solenoid valve instructions will continue or halt water delivery from the overhead tank to houses through relay mechanism based on data processed by the Raspberry Pi and collected from various sensors. All of this occurs mechanically with no need for human involvement, saving valuable time over manually handling the matter. Finally, it determines if the water quality metrics are within an acceptable range. All of these tools are highly efficient, adaptable, and inexpensive. Kumar and Samalla(2018)[10] suggested a system to efficiently monitor water quality in real-time utilizing IoT at a low cost. The system's sensors were able to detect changes in the water's chemical and physical properties. The CO_2 sensor, pH sensor, turbidity sensor, temperature sensor, and water level sensor are just few of the sensors that are connected to a Raspberry pi controller in this smart water quality system. Cloud-based wireless communication devices and sensors control and monitor the entire operation.

3. EXISTING SYSTEM

Water quality monitoring systems already exist and are in use in a number of regions. In-Lab Water Quality Analysis: This requires taking samples of water and having them tested for things like chemical make-up, microbial contamination, and toxicity in a lab. The current setup only allows for a limited range of measurements, both in terms of pH value and temperature. Temperature, turbidity, pH value, and humidity may all be monitored with the help of IOT in the suggested system. Growing populations, pollution from factories and farms, and other sources all contribute to a water supply that is more difficult to maintain. Time is often wasted using conventional methods for analyzing drinking water quality characteristics including turbidity, pH, conductivity, temperature, etc. There is also the matter of Raspberry Pi code. The slow performance was largely caused by Raspberry units using regular coding. In the end, the organization or agency in charge of water quality monitoring must consider its own unique requirements and available resources when deciding on a monitoring system. A complete picture of water quality through time and in many areas may be obtained by combining several methods.

4. PROPOSED SYSTEM

IoT, a relatively new notion in the field of software development, serves as the primary inspiration for the system's architecture. In general, the package consists of two components: hardware and software. The Wi-Fi module provides the link between the hardware and software, while the sensors assist measure data in real time. The Arduino atmega328 translates analog values to digital ones, and the LCD shows the displays output by sensors. We built an application using the embedded c programming language. After the PCB has been designed, components and sensors are attached to it. In order to view the results, an app must be installed in the Android version. Starting the system converts the 230v ac to 5v dc, which is then supplied to the kit, and Arduino and WIFI connect. Water is put through a series of tests that reveal their results on an LCD screen. The value shown on the kit's LCD display is mirrored by the app provided with the hotspot. When the kit is placed on a body of water with access to WiFi, we can then monitor its real-time value from virtually anywhere using an Android device.

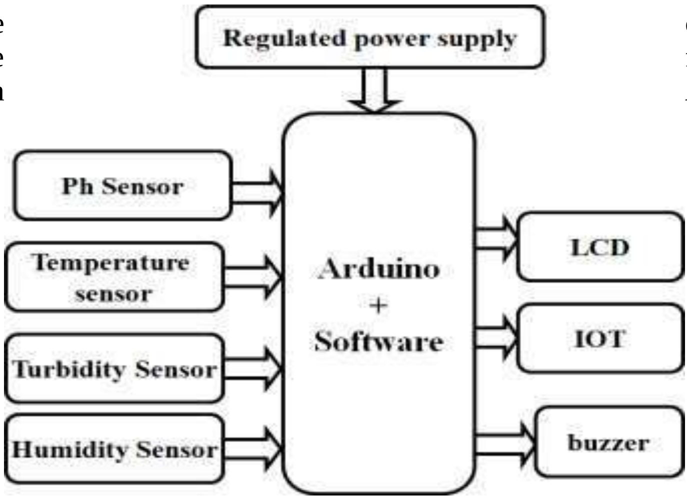
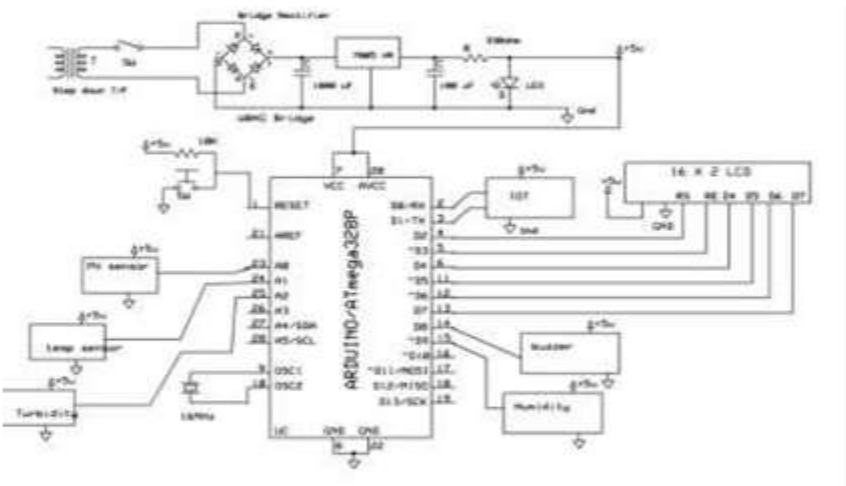


Fig 1: Proposed block diagram of water quality monitoring system.

Fig 2 Schematic diagram



5. Results and Discussion

Here, 12v is supplied to the regulated power source and converted to 5v dc current, turning on the circuit. If 5v current is present, the LED will light up to serve as an indicator. Every piece of hardware in the circuit receives the 5v dc current that is created.

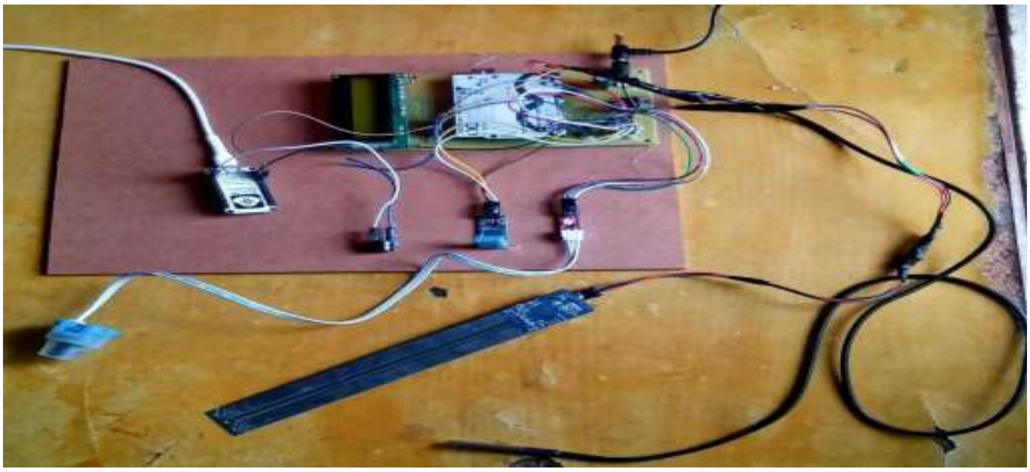


Fig 3.Overview of the Designed Kit

Fig 4. Display values in LCD

When the circuit is plugged into a power source, the LCD screen will show the stored values. When submerged in water, the sensors' readings will be displayed on the screen in real time. The IoT App then shows the calculated data. Values seen on the IoT app are comparable to those on the LCD screen. The values for temperature, humidity, and turbidity are all shown.

Fig 5. Values Displayed In IOT Application

6. CONCLUSION

Internet of Things-based water quality monitoring has the potential to protect and preserve our water supply for the future. Constant monitoring, low costs, simple installation, and excellent data management are just few of the benefits of IoT-based water quality monitoring systems. Innovative technologies, such as Internet of Things-based water quality monitoring systems, are essential for ensuring the security and sustainability of our water resources in the face of rising demand. As the developing world has only began its process of development and industrialization, the outlook for water quality is not promising. However, with early measures and well-timed installation of mechanisms, it is possible to effectively prevent it in emerging nations. The paper's proposed designs will increase the availability of high-quality water in impoverished countries while reducing the need for human involvement.

References

[1]S. Pasika, S.T. Gandla, Smart water quality monitoring system with cost-effective using IoT, Heliyon 6 (7) (2020), doi:10.1016/j.heliyon.2020.e04096.

[2]M. Mukta, S. Islam, S.D. Barman, A.W. Reza, M.S. Hossain Khan, "Iot based smart water quality monitoring system, in: Proceedings of the IEEE 4th International Conference on Computer and Communication Systems (ICCCS), 2019, pp. 669–673, doi:10.1109/CCOMS.2019.8821742.

[3]S. Konde, S. Deosarkar, IOT based water quality monitoring system, in: Proceedings of the 2nd International Conference on Communication & Information Processing (ICCIP), 2020 2020,doi:10.2139/ssrn.3645467.

[4]M.K. Amruta, M.T. Satish, Solar powered water quality monitoring system using wireless sensor network, in: Proceedings of the International Mutli-Conferenc on Automation, Computing, Communication, Control and Compressed Sensing (iMac4s), 2013, pp. 281–285, doi:10.1109/iMac4s.2013.6526423.

[5]T. Sugapriyaa, S.Rakshaya, K.Ramyadevi,M. Ramya, P.G. Rashmi, Smart water quality monitoring system for real time applications, Int. J. Pure Appl. Math. 118 (2018) 1363–1369.

[6]K.A. Unnikrishna Menon, D. P.,M.V.Ramesh, Wireless sensor network for river Water quality monitoring in India, in: Proceedings of the Third International Conference on Computing, Communication and Networking Technologies (ICCCNT'12), 2012, pp. 1–7, doi:10.1109/ICCCNT.2012.6512437.

[7]A.N. Prasad, K.A. Mamun, F.R. Islam, H. Haqva, Smart water quality monitoring system, in: Proceedings of the 2nd Asia-Pacific World Congress on Computer Science and Engineering (APWC on CSE), 2015, pp. 1–6, doi:10.1109/APWCCSE.2015.7476234.

[8]Jerom B.,R.Manimegalai, R.Manimegalai, An IoT based smart water quality monitoring system using cloud, in: Proceedings of the International Conference on Emerging Trends in Information Technology and Engineering (ic-ETITE),2020, pp. 1–7, doi:10.1109/icETITE47903.2020.450. 2020 doi:.

[9]S. Geetha, S. Gouthami, Internet of things enabled real time water quality monitoring system, Smart Water 2 (1) (2016), doi:10.1186/s40713-017-0005-y.

[10] B. Sengupta, S. Sawant, M. Dhanawade, S. Bhosale, Water quality monitoring using IoT, Int. Res. J. Eng. Technol. 6 (2019) 695–701.