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International Journal of Engineering Research and Science & Technology
ISSN 2319-5991 www.ijerst.com
Vol. 21, Issue 2, 2025

SMART WATER QUALITY ANALYSIS SYSTEM

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ABSTRACT

Drinking water is basic need of the human being. Even though the earth surface is covered by 79% with water, the drinking water is about 3% of it. Out of this 3 % only 0.4 percent is available in the form of the rivers. In India, around 50% people are getting the water of good quality for drinking purpose This project presents a real-time water quality assessment system for residential applications, utilizing Raspberry Pi Pico and Arduino for efficient data processing and control. The system integrates different sensors to continuously monitor key water quality parameters, such as pH levels, flow, and level sensors. The collected data is processed by Arduino and Raspberry Pi Pico, displayed on an interfaced screen, and transmitted to a telnet server. The data is securely transmitted using fast and reliable IoT protocols, ensuring real- time updates on a Telnet Server. This web application has been developed to provide continuous monitoring and visualization of data collected from sensor nodes placed at both the inlet and outlet of the water system. By integrating Arduino for sensor interfacing and Raspberry Pi Pico for cloud connectivity and analysis, this system offers an intelligent, automated, and efficient approach to real-time water quality monitoring for residential use..

Keywords: microcontroller, Ph sensor, Flow sensor, object detecting system, IOT, Telnet Server, motors, etc

I. INTRODUCTION

1.1 INTRODUCTION

Microcontroller are widely used in Embedded Systems products. An Embedded product uses the microprocessor (or microcontroller) to do one task & one task only. A printer is an example of Embedded system since the processor inside it perform one task only namely getting the data and printing it. Although microcontroller is preferred choice for many Embedded systems, there are times that a microcontroller is inadequate for the task. For this reason, in recent years many manufactures of general-purpose microprocessors such as INTEL, Motorola, AMD & Cyrix have targeted their microprocessors for the high end of Embedded

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ISSN 2319-5991 www.ijerst.com
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market. One of the most critical needs of the embedded system is to decrease power consumptions and space. This can be achieved by integrating more functions into the CPU chips. All the embedded processors have low power consumptions in additions to some forms of I/O, ROM all on a single chip. In higher performance Embedded system, the trend is to integrate more & more function on the CPU chip & let the designer decide which feature he/she wants to use.

1.2 EMBEDDED SYSTEM

Physically, embedded systems range from portable devices such as digital watches and MP3 players to large stationary installations like traffic lights, factory controllers, or the systems controlling nuclear power plants. Complexity varies from low, with a single microcontroller chip, to very high with multiple units, peripherals and networks mounted inside a large chassis or enclosure

In general, "embedded system" is not an exactly defined term, as many systems have some element of programmability. For example, Handheld computers share some elements with embedded systems such as the operating systems and microprocessors which power them but are not truly embedded systems, because they allow different applications to be loaded and peripherals to be connected. Embedded systems span all aspects of modern life and there are many examples of their use. Telecommunications systems employ numerous embedded systems from telephone switches for the network to mobile phones at the end-user. Computer networking uses dedicated routers and network bridges to route data.

EXAMPLES OF EMBEDDED SYSTEM:

Automated teller. machines (ATMS). Integrated system in aircraft and missile. Cellular telephones and telephonic switches. Computer network equipment, including routers timeservers and firewalls. Computer printers, Copiers. Disk drives (floppy disk drive and hard disk drive). Engine controllers and antilock brake controllers for automobiles. Home automation products like thermostat, air conditioners sprinkles and security monitoring system. House hold appliances including microwave ovens, washing machines, TV sets DVD layers/recorders. Medical equipment. Measurement equipment such as digital storage oscilloscopes, logic analysers and spectrum analysers. Multimedia appliances: internet radio receivers, TV set top boxes.Small hand-held computer with P1M5 and other applications. Programmable logic controllers (PLC's) for industrial automation and monitoring. Stationary video game controllers.

1.3 CHARACTERISTICS:

Embedded systems are designed to do some specific tasks, rather than be a general-purpose computer for multiple tasks. Some also have

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real-time performance constraints that must be met, for reasons such as safety and usability; others may have low or no performance requirements, allowing the system hardware to be simplified to reduce costs. Embedded systems are not always standalone devices. Many embedded systems consist of small, computerized parts within a larger device that serves a more general purpose. For example, the Gibson Robot Guitar features an embedded system for tuning the strings, but the overall purpose of the Robot Guitar is, of course, to play music. Similarly, an embedded system in an automobile provides a specific function as a subsystem of the car itself.

The software written for embedded systems is often called firmware, and is usually stored in read- only memory or Flash memory chips rather than a disk drive. It often runs with limited computer hardware resources: small or no keyboard, screen, and little memory.

1.4 MICROPROCESSOR (MP):

A microprocessor is a general-purpose digital computer central processing unit (CPU). Although popularly known as a "computer on a chip" is in no sense a complete digital computer. The block diagram of a microprocessor CPU is shown, which contains an arithmetic and logical unit (ALU), a program counter (PC), a stack pointer (SP), some working registers, a clock timing circuit, and interrupt circuits.

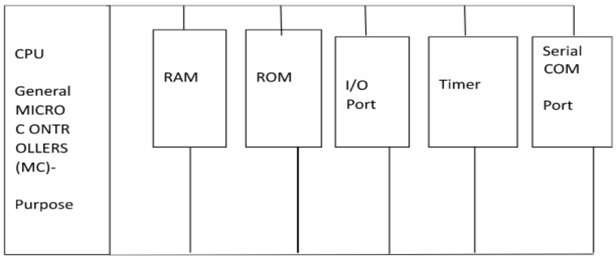

Fig 1.1 Block diagram of microprocessor

1.5 MICROCONTROLLER (MC):

Figure shows the block diagram of a typical microcontroller. The design incorporates all of the features found in micro-processor CPU: ALU, PC, SP, and registers. It also added the other features needed to make a complete computer: ROM, RAM, parallel I/O, serial I/O, counters, and clock circuit.

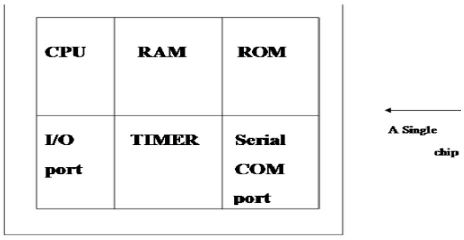

Fig 1.2 Microcontroller

1.6 COMPARISION BETWEEN MICROPROCESSOR AND MICROCONTROLLER

The microprocessor must have many additional parts to be operational as a computer whereas microcontroller requires no additional external digital parts. The prime use of microprocessor is to read data, perform extensive calculations on that data and store them in the mass storage device or display it. The prime functions of microcontroller is to read data, perform limited calculations on it,

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control its environment based on these data. Thus the microprocessor is said to be general-purpose digital computers whereas the microcontroller are intend to be special purpose digital controller. Microprocessor need many opcodes for moving data from the external memory to the CPU, microcontroller may require just one or two, also microprocessor may have one or two types of bit handling instructions whereas microcontrollers have many.

II. LITERATURE SURVEY

2.1 INTRODUCTION

The most important resource is water. It is frequently used for industrial applications in addition to ordinary and commercial ones. Even so, just 2% of the water present on the earth's surface is suitable for human consumption. Thus, using treated water as an option to meet the world's water needs is increasingly necessary. Water is an essential requirement for all living things, including humans. Alternative methods of acquiring water supply, like groundwater and surface water, will no longer be able to meet the increasing demand in water supply due to rapid development expansion.

As a result of the anticipated water deficit in many emerging nations, this problem is predicted to worsen. Therefore, the current trend is to manage and monitor the available natural water supply to avoid water shortage issues during dry periods. Since it has the potential to replace manual monitoring, water monitoring technologies have made significant progress and are now widely used for the operation of water sources and water treatment facilities.

Around the world, this programmed has been used to create projects to support monitoring spanning from surveillance, healthcare, and ecology. It might not directly apply to other sectors, but the same ideas are involved. Three essential elements of the Internet of Things are sensing hardware, a data transmission network, and data processing capability. With the help of the internet and short- range communication networks, it is more innovative to achieve intelligent identification, information exchange, location, tracking, and network administration using devices like RFID, infrared sensors, GPS, and laser scanners..

2.2 LITERATURE SURVEY

IoT-Based Water Quality Monitoring System using Raspberry Pi by S. S. Shinde and S. K. Shukla[1] This paper presents an IoT-based water quality monitoring system using Raspberry Pi that measures different water quality parameters such as pH, temperature, and turbidity. Wireless Sensor Network-Based Water Quality Monitoring System by M. A. Hoque and M. A. Rahman[2] Uses various sensors to measure the water quality parameters, including pH, dissolved oxygen, temperature, and conductivity. The data

International Journal of Engineering Research and Science & Technology
ISSN 2319-5991 www.ijerst.com
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collected by these sensors is transmitted wirelessly to a central data collection unit using ZigBee communication protocol. Design and implementation of an IoT-based water pollution monitoring system using LoRa by H. Kim, D. Kim, and H. Lee.[3]This paper presents the results showed the effective monitoring water quality parameters and transmit the data over a long range with low power consumption. Development of a low-cost IoT-based water quality monitoring system using Arduino by S. S. Suresh and S. M. N. Rao. This paper presents a low-cost IoT-based water quality monitoring system using Arduino that measures various water quality parameters such as pH, temperature, and dissolved oxygen.

III. PROBLEM STATEMENT

With the rapid pace of urbanization, ensuring a continuous supply of safe drinking water has become a significant challenge for city authorities. As cities grow, the demand for clean water increases, but so do the risks of water contamination. Water pollution can occur at any stage, whether during supply, storage, or distribution. Many people rely on traditional water purification methods, but these are often insufficient in detecting and eliminating harmful substances.

In many residential areas, water is stored in rooftop or underground tanks before use. Over time, these tanks can accumulate impurities from external sources. The lack of real-time monitoring makes it impossible to assess water quality manually each time we use it. If contaminated water is consumed, it can lead to severe health issues, including waterborne diseases like cholera, typhoid, and diarrhea.

The existing water filtration systems are often inadequate because they do not provide real-time analysis, leaving people unaware of the actual condition of their stored water. Therefore, a more efficient solution is required to continuously monitor water quality and provide instant alerts in case of contamination.

The existing water purification systems, while useful, have several limitations when it comes to ensuring completely safe drinking water. Most commonly used purifiers are not capable of detecting harmful chemical contaminants, heavy metals, or sudden changes in water quality. Additionally, they do not provide real-time monitoring or alerts, making it difficult for users to be aware of potential contamination in their stored water. Manual water quality checks are impractical and time-consuming, leaving room for unnoticed health risks. Without an automated system in place, residents rely solely on periodic maintenance and assumptions about water safety, which may not always be accurate. As urbanization continues to expand, the current approach to water purification and monitoring remains inadequate in addressing the growing concerns of water safety in residential areas.

IV. PROPOSED SYSTEM

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ISSN 2319-5991 www.ijerst.com
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Our goal is to develop a system for real time quality assessment for water health at residential places

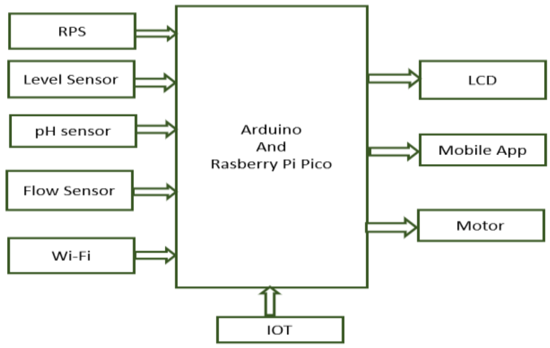
using Raspberry Pi Pico, pH, Level and Flow sensors are used to gather the parameters necessary to monitor

water health in real time. Following are the objectives of the proposed system.

To measure various chemical and physical properties of water like pH, temperature and

particle density of water using sensors. Send the data collected to a Raspberry Pi, show the data in display and send it to a telnet platform Wireless Channel. Data visualization and analysis is done by telnet server for remote access. We have used multiple sensor nodes at both the inlet and outlet of the water system. The collected data is processed by Arduino and Raspberry Pi Pico, displayed on an interfaced screen, and transmitted to a telnet server . The data is securely transmitted using fast and reliable IoT protocols, ensuring real – time updates on a Telnet Server. The proposed project concept is expected to provide a single window portal hosted on cloud which can be used to monitor the water treatment plant using multiple sensor nodes giving collective data of different parameters. The system compares and analyzes the inlet and outlet data to assess the efficiency of the water treatment process.By integrating Arduino for sensor interfacing and Raspberry Pi Pico for cloud connectivity and analysis, this system offers an intelligent, automated, and efficient approach to real-time water quality monitoring for residential use..

4.1 BLOCK DIAGRAM OF PROPOSED SYSTEM



V. BLOCK DIAGRAM OF PROPOSED SYSTEM

HARDWARE COMPONENTS

Power Supply, Raspberry Pi PICO, Ultrasonic Sensor, Fire Sensor, Metal Sensor, ESP32 Cam, L293D, Motor, LCD,

SOFTWARE COMPONENTS

The following software tools used in the proposed system

Arduino IDE, Proteus Design Tool, iot tech

VI. RESULT AND DISCUSSION

6.1 PROTOTYPE (THROUGH KIT)

shows the prototype of the project

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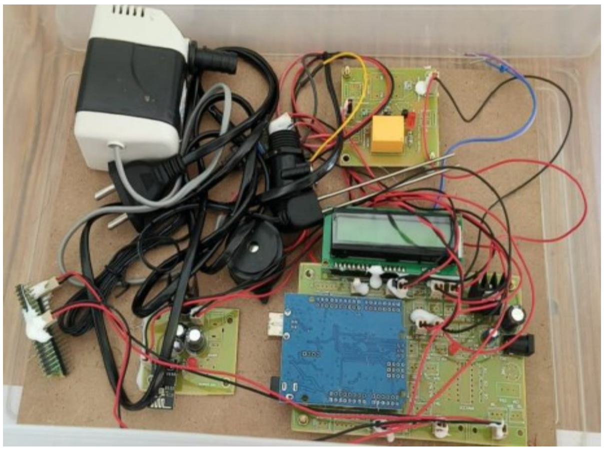
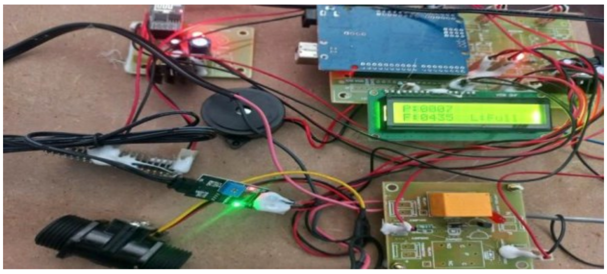
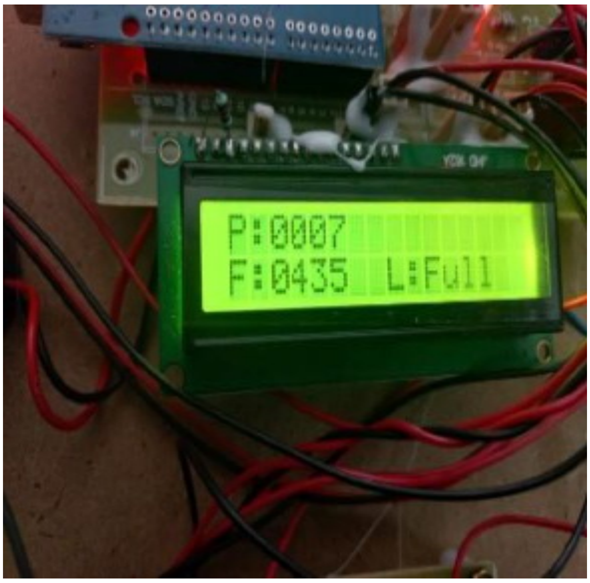


This is our project, which involves a microcontroller-based system featuring an LCD display, relay module, sensors, and power supply. It is designed for automation and monitoring purposes, possibly in an IoT application.



The system monitors water flow and tank levels, displaying real-time data on an LCD while controlling a relay to manage the pump. It uses a microcontroller, flow sensor, and level sensor to automate water management system.



The LCD screen in the image displays key system readings: P: 007 (likely representing pulse count from a flow sensor), F: 0435 (indicating the measured flow rate), and L: FULL (confirming that the water tank has reached full capacity). This suggests that the system is actively monitoring water flow and level, and it may be programmed to control a pump or valve accordingly.

The LCD display shows the real-time monitoring data of the system. 'P: 0003' represents the pH level of the water where it is quite acidic, 'F: 0000' indicates the current flow level where there is no water flow, and 'L: Empty' shows the tank water level status, which is currently empty

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The LCD shows system readings with 'P:0009' indicating a near-neutral pH level, 'F:0111' representing the current flow rate, and 'L:Empty' showing that the water tank is currently empty

The Telnet output displays real-time sensor data for monitoring a liquid system. The pH values indicate the acidity or alkalinity of the liquid, with PH:008 showing a slightly basic solution. The flow sensor (F) measures the liquid flow rate, where F:000 signifies no flow, while F:273 indicates an active flow. The level sensor (L) determines the tank's status, with L:E meaning empty and L:F meaning full. In the readings, the pH starts at 8, the flow varies between 0 and 273, and the level mostly remains empty, suggesting liquid is flowing but not accumulating in the tank. This data helps monitor the system's functionality and detect potential issues like leaks or improper filling.

VII. CONCLUSION

In conclusion, the use of IOT in water treatment plant monitoring has shown promising results in improving the efficiency and effectiveness of water treatment processes. The IOT technology has enabled real-time monitoring of water quality parameters and optimization of treatment processes. The benefits of using these technologies include improved accuracy of water quality prediction, reduced costs, improved equipment uptime, and improved quality of treated water. By automating the monitoring process, this system helps in early detection of contamination and prevents overflow, ensuring better hygiene and environmental safety. With real -time data display and the potential for future upgrades

VIII. FUTURE SCOPE

The project deals with the implementation of the IoT based water treatment plant monitoring system. The future scope of this project is highly promising, especially with the growing need for efficient and sustainable water management systems. With advancements in IoT, automation, and embedded systems, this project can be scaled and improved by integrating wireless data transmission, cloud storage, and real-time alert systems for better monitoring and control.It can be extended to cover larger drainage networks and industrial sewage systems, helping in early detection of contamination, leakage, or overflow. By incorporating machine learning algorithms, the

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ISSN 2319-5991 www.ijerst.com
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system can also predict future trends in water quality and take preventive actions automatically

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