Optimal Water Monitoring System for Smart Cities using IoT

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***Abstract*:- The correct use and management of water has been a source of considerable controversy and caution for everyone since humans first set foot on this globe. Since the dawn of time, everyone has been concerned with the correct use and management of water. Water management is critical in residential areas, and controlling a large system is difficult. As a result, we've developed a system that allows specific users with rights to access the motor controls as well as other community members to report water contamination, water leakage, low water flow, and other issues, as well as check the water status, using a mobile application. It is also possible to track the status of the raised issue. Because everyone nowadays has a cell phone, this method has become well-established.**

Keywords: Water level management, ultrasonic sensor firebase, Internet of Things, Water Quality

I. INTRODUCTION

Industry is responsible for 22% of all global water withdrawals, according to the United Nations World Water Development Report. India is experiencing a shortage of fresh water. India just has 4% of the world's fresh water yet has 16% of the world's people. A better water management system is thus required. The system suggests a method for agricultural, residential, and industrial water management. The flow meter, temperature sensor, and level sensor, which are the three primary components of this system, are connected to the Wi-Fi module via a microprocessor. The flow meter is located within the pipe that leads to the tank. This enables us to detect water flow and calculate total water use. The temperature sensor enables real-time temperature monitoring. It's useful in businesses where water is needed for cooling or when a certain temperature is required for a chemical reaction to take place.

Capacitance-based level sensor is one of the system's most important components. A capacitor's capacitance is proportional to the area of the plates. An electrode is put in the tank's center and has the same height as the tank. The electrode serves as one of the capacitor's plates, while the water in the tank serves as the second plate. The capacitor's dielectric is the insulating material between the electrode and the water. The area of the capacitor plate increases as the water level rises, increasing the capacitance of the sensor. By establishing an Intelligent Controller system for dynamic distribution, the project advises to customers and water providers how to optimally use the resource depending on priorities and needs. The Intelligent Controller includes an intelligence communication system that allows the resource consumer and provider to communicate with one another. The water flow via the pipe is controlled by a control valve, a flow sensor, and a pH sensor. The Internet of Things (IoT) can be used to handle the situation. The management office can collect readings at various time intervals for billing, analysis, and resource estimation for present and future uses.

II. BACKGROUND STUDY (LITERATURE)

Many people are working on developing an improved water management solution. Kaushik Gupta's approach for "Smart Water Management in Housing Societies Using IoT" [1] The water level is measured using an ultrasonic sensor. Long-range ultrasonic sensors are expensive and liable to generate misleading readings when there is turbulence in the water or the production of foam.

In authors [2] present an integrated water resource management system that is secure, smart, and leverages cloud-based machine learning. It incorporates fog nodes, allowing for a large-scale deployment with efficient visualisation tools and a revenue generation system, addressing many of the flaws of past initiatives and allowing the SSIWM system to be commercialised..

Because capacitive sensors have no moving parts that are exposed to the fluids, they are frequently used for water level detection. They can also be utilised for signalling or continuous level control. They're a delicate, low-cost variety. The notion of change in capacitance due to change in dielectric medium between the plates is stated in a research of the conventional capacitance-based level sensor [3]. When the tank size, probe, or mounting needs to be changed, this sort of sensor must be re-calibrated.

The authors of [4] show case their model based on the modern IoT technology, the idea is to develop a water monitoring system and visualization it in a dashboard. The model is using the water flow sensor and a electric value to control the water supply.

The authors of [5] developed a model in which water attribute are monitored with various sensors and the computation is done then the data is uploaded to the cloud servers in this case it is firebase. The data sent to the cloud server is access with a mobile application and with this insight decision are made .

The authors of [6] says that an ultrasonic water level sensor and a turbidity sensor are used in their project. The ultrasonic water level sensor would continuously monitor the water level and relay the information to society people via the cloud. When the water level drops, the secretary will be able to call for a water tanker. Turbidity sensors will monitor basic water quality characteristics, which will be useful when selecting water supplier services. The sensors' perceived characteristics will be recorded and transferred to the cloud, which will update the real-time data and make it available on the smartphone app.

The Authors of [7I information is collected via wireless sensors that are self-configured into a network, according to [. They studied the evolution of IoT systems for water management and quality monitoring, as well as system components, communication technologies, and procedures. The authors focused on IoT-based water quality distribution and monitoring (including pH, turbidity, temperature, and total dissolved solids (TDS)).

The author of [8] explained that the Intel Galileo Gen 2 Board is utilized as an interface device in this study to collect data from sensors and send it to a monitoring station through Wi-Fi. This provides an efficient method for connecting sensing devices and monitoring them in an IoT environment. Different sensors will sense characteristics such as turbidity, water level sensor, and pH, and then a microcontroller will collect the data for processing and transmission via the internet utilizing IoT.

The author of [9] describes their project, which focuses on using Arduino to measure the water flow from the pipe that splits the water flow to each area of the block. A YF S201 flow metre or a solenoid 5 will be used. The flow rate, which is simply the quantity of water consumed per litre in hours, will be sent to the cloud via IOT (Internet of Things). The data is subsequently uploaded from the cloud to a mobile application, which may be used to monitor and control water supply by the user or the corporation's president. In this project, three water flow metres are used: one for summing the water in the main tank and the other two for computations.

The authors of [10] explained a funded project called WatERP.WatERP was a financed project that presented a practical solution in terms of energy and water resource management utilizing data analytic techniques and AI. The project's outcomes led to a more accurate decision-making dashboard based on information interchange in the supply chain and water distribution.

The authors of [11] explained that by establishing an Intelligent Controller system for dynamic distribution, the project advises to customers and water providers how to optimally use the resource depending on priorities and needs. The Intelligent Controller includes an intelligence communication system that allows the resource consumer and provider to communicate with one another. The water flow via the pipe is controlled by a control valve, a flow sensor, and a pH sensor. The Internet of Things (IoT) can be used to handle the situation.

The authors of [12] knew predicting water usage for every year is answer to determine water consumption. The data is obtained using a machine learning method. It’s previous year's consumption data (in MLD) is supplied into the computer. Using the Internet of Things, current data is sent in real time (IoT). The data is then processed and computed as a whole. Wireless IoT-enabled meters will be used in the implementation, and data will be sent to the cloud in real time. The controller will gather data from the cloud, perform the calculations, and then send the results back to the cloud. Users will have access to this output through their internet-connected gadgets.

The authors of [13] proposed system named as intelligent water monitoring system based on IoT. Arduino UNO, precision water level depth detecting sensors, which compute the increase in water level correctly, and a submersible motor pump to evacuate excess water to a storage tank are the components employed in the development of the suggested system model. GSM technology has been used to create an alerting system that provides users with alert calls without requiring them to register or access the internet. The8 proposed system, which requires only a few components and can be simply installed in domestic areas, residential areas, storage rooms, and workplaces, provides precise water level measurements.

The authors of [14] proposed This Water Management System, it is a system for monitoring critical industrial water characteristics such as temperature, water level, and consumption. The system monitors all parameters in real time and can be seen and controlled remotely via smart phones via the Internet of Things (IOT). A capacitive level sensor is used to measure the water level in the system. This sensor works on the principle of changing capacitance as the area of the plate's changes. It eliminates the disadvantages of traditional capacitive level sensors.

The authors of [15] One of many waters associated troubles that may be addressed through the Internet of Things is anomaly detection in water intake. The evaluation of facts accrued through clever meters will assist to customize the remarks to customers, save you water waste and hit upon alarming situations. Water intake facts may be taken into consideration as a time collection.In this paintings we strive to observe which strategies fits higher for water intake. We observe very famous strategies for time collection anomaly detection: an ARIMA-primarily based totally framework anomaly detection method which selects as outliers the ones factors no becoming an ARIMA procedure and additionally a way named HOTSAX which represents home windows of facts in a discrete manner after which discriminates them the use of a heuristic. They are each very exclusive in nature however the proper nice evaluation is excellent.

III. METHODOLOGY

The IoT model is designed in a way that the sensors collect the input from the environment. This raw data is computed based on certain conditions and formulas and is processed. This processed information is uploaded to the cloud server in this case we are using the firebase Realtime database. The firebase Realtime database is designed in such a way that the data is in the form of NoSQL which can be easily scalable and updated. The data stored in the firebase can be retrieved via any platform. In our project we are building a web application which retrieves the data from the cloud server and uses the data to perform data analytics and is visualized by plotting few charts.

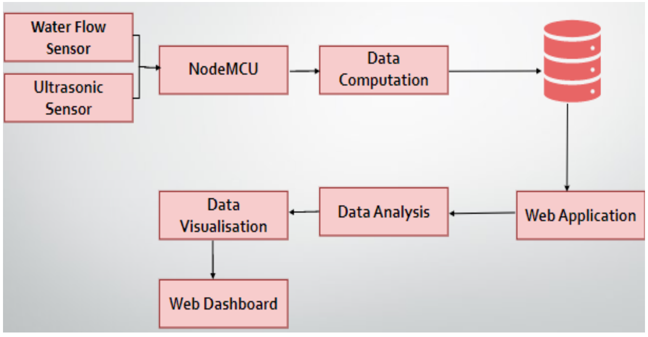

Figure 1: Process Flow

This project is just a prototype of a large-scale work, which could be inculcated on to smart cities. The model is developed mainly to get the insight of the water consumption done in the smart cities and even provide this information to the residents of the smart cities. Currently the model is using the basic and low specification sensors with few upgrades and accurate sensors this model will have higher performance rate.

IV. HARDWARE REQUIREMENTS

1. NodeMCU(8266)

Figure 2: NodeMCU ESP8266

Nodemcu is a high-performance microcontroller with built-in Wi-Fi and a large number of GPIO pins. For NodeMCU, an open-source firmware, there are open-source prototype board designs available. The term "NodeMCU" is a combination of the words "node" and "MCU" (micro-controller unit). The term "NodeMCU" refers to the firmware rather than the accompanying development kits. The firmware uses the Lua scripting language. The firmware is based on the eLua project and was produced with the Espressif Non-OS SDK for ESP8266. Lua-cjson and SPIFFS are two open source programmes that are used. Due to resource limits, users should select important components for their projects and design firmware that meets their demands. Support for the 32-bit ESP32 has been added as well.

2. Water Flow Sensor

Figure 3: Water Flow Sensor

Large industrial operations, commercial and residential structures all demand a lot of water. This need is met by using the public water supply system. The rate of flow of water must be measured in order to monitor the amount of water provided and utilised. This is accomplished through the use of water flow sensors. Water flow sensors are installed at the water source or pipes to calculate the amount of water passed through the pipe by measuring the rate of flow. The rate of water flow is measured in litres per minute.

3. Solenoid Valve

Figure 4: Solenoid Valve

A solenoid valve is a valve that is controlled by electricity. A solenoid is a valve with an electric coil in the middle and a moveable ferromagnetic core (plug). The plunger seals a small aperture in the rest position. A magnetic field is created by passing an electric current through the coil. The plunger rises as a result of the magnetic field, opening the hole. This is the principle that allows solenoid valves to open and close.

4. Ultrasonic Sensor

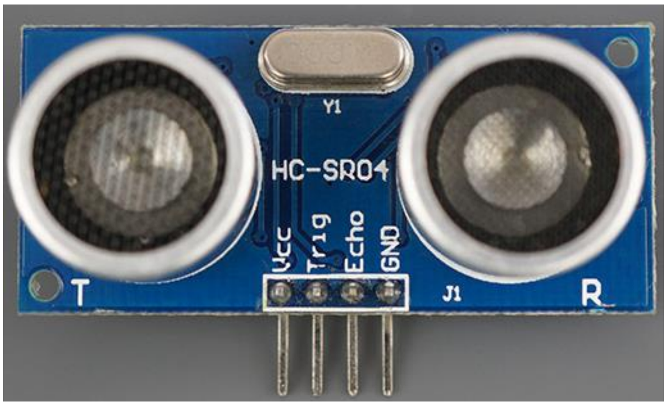

Figure 5: Ultrasonic Sensor

This ultrasonic sensor module can be used for distance measurement, object detection, and motion detection, among other things. The high-sensitivity module can be used in conjunction with a microcontroller and motion circuits to create robotic projects and other distance, position, and motion-sensitive goods. The module transmits eight square wave pulses at 40 kHz and automatically detects whether it receives a response. A high-level pulse is sent on the echo pin if a signal is returned. The time it took the signal to go from first triggering to the return echo is the length of this pulse.

V. IMPLEMENTATION

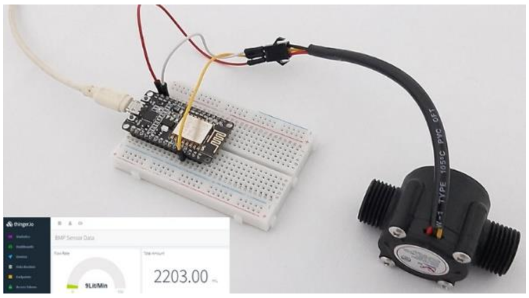

Figure 6: Model Setup

The project is implemented using the nodemcu and the sensors are connected to the board. The nodemcu board takes in the digital input and with help of the sensor library and formulas. The sensor data is sent to the database server and it is retrieved from a web application which does all the data analysis and visualize the data based on certain condition like weekly report of water consumption, scatter plot of water hardness and many more insights. This all collective makes a dashboard which provides effective information for the user so that decisions can be taken easily. The water flow data from the source to the water flow data at the destination are enough to determine or detect any leakage in the supply pipes.

VI. CONCLUSION

This system was proposed to benefit the need for water supply that must be evenly distributed to houses with the help of sensors, and in case of any issue with the system, an error will be shown in the dashboard through which the person can get to know the issue right away, reducing the work of that person of going from house to house to check water supply. In the dashboard, you can see how much water is given to a particular property, as well as the details of the water meter.

VII. ACKNOWLEDGEMENT

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