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Smart Water Management: Revolutionizing Billing with IoT Technology

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Abstract—

Wastage of water in the process of manually operated water pump, human error associated with manually operated system, incorrect bill creation, delay in bill availability, and delay in payment process are all issues that have led to the development of a ")" system. In the system, a low-cost water flow meter is proposed, which measures the flow rate of water passing through the supply pipe of a specific user and generates invoices based on that user's water use. This allows the consumer to adjust their water consumption without incurring additional costs. If the consumer consumes too much water, the supplier will cut off the water supply. The fundamental purpose of this project is to ensure that there is no wastage or blockage in the delivery of water to all homes, as well as to create water bills for specific families utilising IoT platforms. To put this system together, we'll be using Arduino. Water how sensors and a valve to regulate the water from the tank ultrasonic sensor provides a sequence of electric pulses through which the user's water use, and the quantity of water delivered can be determined.

The system's major goal is to reduce water waste and human interaction in this process to avoid mismanagement. Water billing system is an online project that allows water billing administration to publish each customer's bill as well as any other water billing transactions such as customer information, service record module, statement of accounts, and all data.

Keywords:

ULTRASONICSENSOR,NODEMCU,ARDUINOUNO,WATER MOTOR

INTRODUCTION

The sustainability of accessible water resources is currently a severe concern in many parts of the world. This issue is inextricably linked to insufficient water use and integrated water mismanagement. Water is extensively used in agriculture, industry, and household use. Water monitoring is an essential restriction for several human uses. Unnecessary water waste can be reduced by levying small fees that are affordable to the poor. At the moment, just one bill is generated for the whole building, which is distributed equitably among the building's users. As a result, persons who use a great amount of water are equivalent to those who use a little amount of water, and they pay additional money for water consumption. Existing manual water billing methods are expensive and have additional drawbacks, such as missing water bills. Due to different socioeconomic dynamics, India has experienced a substantial increase in water demand in recent years. As a result, most bodies of water and groundwater resources are over utilized, resulting in water shortage. It is critical that we understand how much water we have access to. Water resource management and distribution is a critical problem since it entails methods to safeguard water sources from contamination and overuse. Water supply, quality, and management are the most pressing issues in India.

Manpower is required to transport water to various locations. The volume of water distributed and the water bills are not checked in such circumstances. Industries. This is an intelligent system that employs ultrasonic sensors to create a series of electric pulses that may be used to determine the quantity of water used by the user, the flow rate, and the amount of water delivered. The suggested system continually monitors the water level in the main tank and turns the motors ON/OFF based on the level. A control valve and an ultrasonic sensor govern the flow of water through the pipe. This procedure may be carried out using an IoT platform. The administrator can collect the data at various time intervals and utilise it for automatic billing. Analysis of resources and approximation for later usage. The tank water level and bills will be sent to IOT.The IOT water distribution level to calculate the

government rules and the result will be monitor the water bill.So that the administrator may use a battery or an adapter to power up the view.

An embedded system is a type of computer system that is primarily designed to access, process, store, and control data in various electronics-based devices. Embedded systems are made up of hardware and software, with the software being known as firmware that is embedded in the hardware. An embedded system is a combination of hardware and software. The software utilised in the embedded system is a collection of instructions known as a programme. Microprocessors or microcontrollers used in embedded system hardware circuits are designed to do certain tasks by following a set of instructions. Embedded systems are grouped into several varieties based on the complexity of the hardware and software, as well as the microcontroller (8 or 16 or 32-bit). Hence, embedded systems are designed depending on the performance of the microcontroller.

LITERATURE SURVEY

[1 Small towns do not emerge spontaneously, but evolve, with water governance issues emerging at each stage of the community's growth. This paper examines small town water governance in Ghana, using field research in two communities, Gwollu and Daffiama, in north-western Ghana, which had water systems installed in the 1960s. Systems' thinking was used to unravel the evolution of the water systems. The paper uses historical analysis to focus on the water systems' successes and vulnerability issues, and to explain how management has been able to respond to different pressures over time.

[2] This paper presents a prototype design and implementation of home users' postpaid electricity and water usage monitoring system. The system design is consisted of four main components such as Arduino UNO microcontroller and Bluetooth module, current and water flow sensors, RGB LED, and alarm buzzer. Current and water flow sensors will measure the current and water flow driven in installation. Three different situations have been applied to test the device performance.

[3] Water is one of the important resource and basic essential need for all living organisms including human being. The water must be in certain parameters and it consider as potable water. A person who drinks pure and hygiene water can stay strong and healthy. Nowadays there are various implementation is available to determine the water quality but there is a lack in real time challenges to maintain the quality of supplying the water to the houses. So here the paper proposes a system design which uses pH sensor, turbidity sensor and conductivity sensor for determine its quality of the water. The system uses the solenoid valve for regulating the pipeline for supplying the potable water..

[4] Theworld's population growth and climate changes increase the demand for high-qualitywater. This fact forces humankind to create new water management strategies. Smart cities have successfully applied the Internet of Things (IoT) technology inmany sectors. Moreover, Complex Event Processing (CEP) can analyze and process large data sets produced by IoT sensors in real-time. Traditional business processes are too rigid in expressing the dynamic behavior of water supply systems. Every execution pathmust be explicitly specified. On the other hand, declarative business processes allow execution paths that are not prohibited by the rules, providing more flexibility for water supply managers.

[5] Water is an all-important need of all living beings. With the exponential growth of the human population, the need for conservation of water resources is gaining greater importance. Many water management systems have been proposed in the past using different technologies to address the issue which are high in cost and energy consumption. With the advent of the Internet of Things (IoT), the pursuit of the smart water management system is gaining momentum.

[6] The provisions of the European law have defined "Smart Metering" as a tool for remote meter readings and management of energy networks. Currently, after years of research and many real-life applications, it is one of the most popular solutions that defines friendly and modern cities. Similarly to automatic street lights, traffic signals or waste management systems, monitoring and control of water supply and sewage systems significantly improves the quality and comfort of life of city residents.

[7] 18% of world's population lives in India. On the other hand the usable water availability is less as compared with the population in India. Around 4 % of world's usable water is present in India. The water is basic need of human being. India is facing issues with uneven distribution of rainfall and on the other hand the need of water for drinking and other day to day activities is unavoidable.

[8] The restructuring of the Maharashtra State Electricity Board is changing the power scenario in the state. Within a span of one year, the restructuring has started yielding good results and there seems a great promise for the future of the power sector in the state. Proper restructuring of an electrical utility is possible only by proper analysis of the randomly varying parameters of the entire system. The analysis of these randomly varying parameters is done using various statistical methods..

[9] Water is one of the important resource and basic essential need for all living organisms including human being. The water must be in certain parameters and it consider as potable water. A person who drinks pure and hygiene water can stay strong and healthy. Nowadays there are various implementation is available to determine the water quality but there is a lack in real time challenges to maintain the quality of supplying the water to the houses. So here the paper proposes a system design which uses pH sensor, turbidity sensor and conductivity sensor for determine its quality of the water.

[10] The aforementioned countries have transitioned from a fixed charging to a volumetric charging regime composed of traditional water meters and SWM. Both the status and progress of SWM implementation are quite different among countries, although governments across the world have been applying water policies responding to water scarcity, population growth, and water demand management

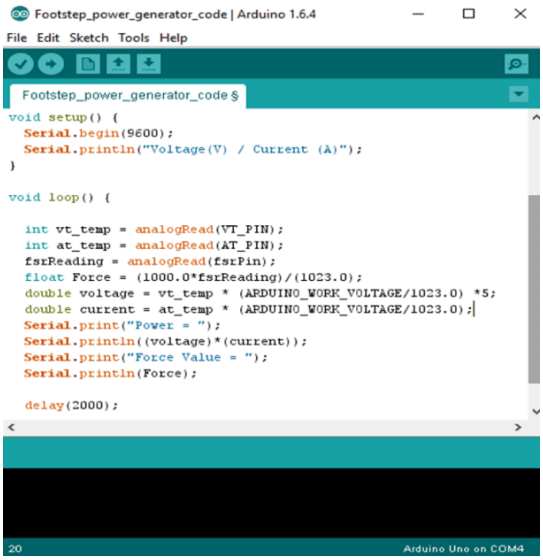
PROPOSED METHOD

An IoT-based water billing system can be a smart solution that can help monitor and manage water usage, detect leaks, and ensure accurate billing. Here are some key components and features of such a system: The system would require smart water meters installed in homes and businesses. These meters would be equipped with IoT sensors that can monitor water usage and transmit data to a central server in real-time. Data Collection and Processing: The central server would collect and process data from the smart water meters to generate accurate bills. The system would also use machine learning algorithms to detect abnormal water usage patterns that may indicate leaks or wastage. A mobile app can be developed that allows users to view their water consumption in real-time, receive alerts for unusual usage patterns, and make payments online. Water suppliers can be provided with a dashboard that shows them the overall water consumption patterns in their service area, identify areas with high water usage, detect leaks, and generate reports. The system can be integrated with the existing billing system to automate the billing process and ensure accurate and timely billing. The system can send alerts and notifications to users and water suppliers in case of unusual water usage patterns or leaks. The system can provide real-time monitoring of water usage, which can help users identify and correct wasteful habits. In summary, an IoT-based water billing system can be a smart solution that can help conserve water, detect leaks, and ensure accurate billing. It can also help users become more aware of their water usage patterns and encourage them to adopt more sustainable habits.

SOFTWARE DESCRIPTION

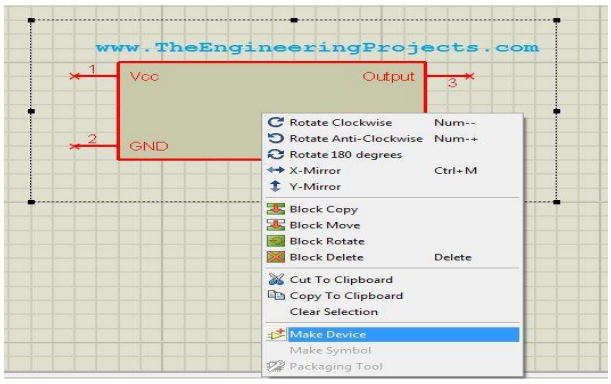
ARDUINO IDE

Together with a text editor for writing code, a message box, a text terminal, a toolbar with buttons for frequently used actions, and a number of menus, the Arduino Software (IDE), sometimes referred to as the Arduino, is also available. In order to upload and communicate with programs, it establishes a connection with the Arduino hardware. In the Arduino programming language, sketches are computer programs (IDE). Using a text editor, these drawings were created and saved as.ino files. Text replacement and text search features are included in the editor. The message box highlights problems with saving and exporting and provides feedback. The terminal shows text generated by the Arduino Software (IDE), together with additional data and detailed error messages. . In the window's bottom right corner, the configured board and serial port are shown. The toolbar buttons may be used to make, open, and save drawings, validate and upload programs, and start the serial monitor.

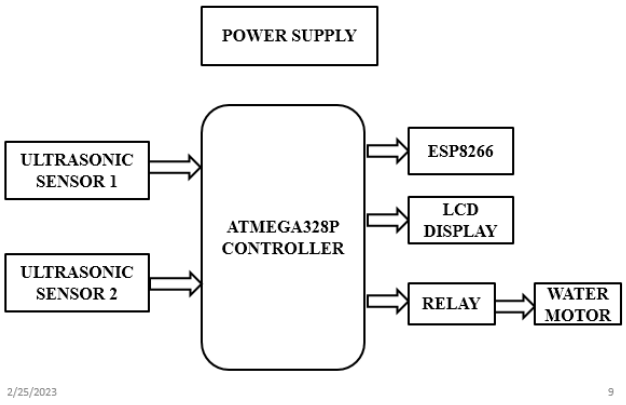


PROTEUS

The most exciting and important aspect of Proteus VSM is its ability to simulate the communication between software running on a microcontroller and any analogue or digital devices connected to it. The schematic displays the microcontroller model along with the other elements of your product design. It simulates the way a real chip would execute your object code (machine code). The logic levels in the circuit vary in accordance with what your program code sends to a port, and your program code will detect, exactly as in real life, if the circuit modifies the state of the processor's pins. All I/O ports, interrupts, timers, USARTs, and other peripherals present on each supported chip are entirely emulated by the VSM CPU models. It is not just a simple software simulator since the complete system is emulated and the interaction of all these peripherals with the external circuit is meticulously detailed down to the waveform level. With more than 750 supported microprocessor types, hundreds of embedded SPICE models, and one of the largest libraries of embedded simulation peripherals in the world, Proteus VSM continues to be the ideal option for embedded simulation.



HARDWARE BLOCK DIAGRAM



HARDWARE EXPLANATION

A water billing system based on IoT is presented. This system is made up of an ATMEGA328P microcontroller that is linked to an ultrasonic sensor and a water motor. The system measures the water level in the main tank with an ultrasonic sensor. The water is delivered to the dwellings from the main tank. As a house's water tank becomes dry, an ultrasonic sensor detects it and distributes a limited amount of water to each residence. The technology collects data based on water use, and payment information is updated on IoT.

METHODS

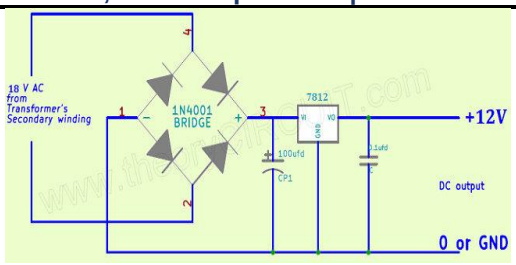
MODULE LIST

- ARDUINO UNO
- POWER SUPPLY
- CAMERA
- LCD DISPLAY
- NODEMCU
- BUZZER

MODULE DESCRIPTION

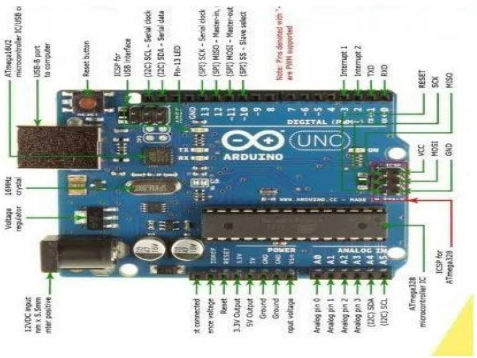
POWER SUPPLY

One of the most popular power sources in use today are 12V power supplies (also known as 12VDC power supplies). With the help of a few transformers, diodes, and transistors, a 120VAC or 240VAC input may frequently be converted into a 12VDC output. Regulated power supplies and unregulated power supplies are the two different types of 12V power supply. Switching regulated AC to DC, linear regulated AC to DC, and switching regulated DC to DC are the three different forms of 12V regulated power supply. The output of linearly controlled 12VDC power sources is regulated using a dissipative regulating circuit. They don't have any switching frequencies that produce EMI, have very little ripple, and are incredibly stable.



Arduino uno

The Arduino UNO is a standard Arduino board. UNO means "one" in Italian. The initial release of Arduino Software was labelled as UNO. It was also the first USB board made available by Arduino. It is regarded as a powerful board that is employed in a variety of tasks. The Arduino UNO board was created by Arduino.cc. The Arduino UNO is built on the ATmega328P microprocessor. In comparison to other boards, such as the Arduino Mega, it is simple to use. The board is made up of digital and analogue I/O pins, shields, and other circuitry. The Arduino UNO has six analogue input pins, fourteen digital pins, a USB connection, a power jack, and an ICSP (In-Circuit Serial Programming) header. It's written in IDE, which stands for Integrated Development Environment. It is compatible with both online and offline platforms.

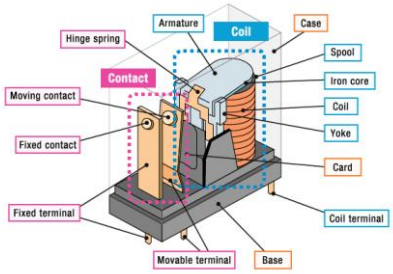


ULTRASONIC SENSOR

Ultrasonic / level sensors, as the name implies, use ultrasonic waves to measure distance. The sensor head generates an ultrasonic wave and detects the reflected wave from the target. The period between emission and reception is used by ultrasonic / level sensors to calculate the distance to the target. A transmitter and receiver are used in an optical sensor, but an ultrasonic / level sensor employs a single ultrasonic element for both emission and reception. A single oscillator generates and receives ultrasonic waves alternately in a reflecting model ultrasonic / level sensor. This allows for the sensor head to be miniaturized.

RELAY

Relays are electrically driven switches that open and close circuits in response to electrical signals received from outside sources. Some individuals may identify the term "relay" with a racing competition in which team members take turns passing batons to complete the race. The "relays" included in electrical devices function similarly; they receive an electrical signal and transfer it to other equipment by switching on and off. When you press a button on a TV remote to watch TV, it sends an electrical signal to the "relay" within the TV, which turns on the main power. Relays of various varieties are used in a variety of applications to manage varying currents and circuit counts.



WATER MOTOR

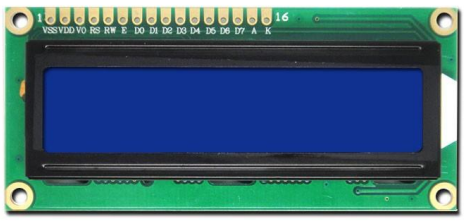
DC powered pumps transfer fluid in a number of ways by using direct current from a motor, battery, or solar power. Motorized pumps are commonly powered by 6, 12, 24, or 32 volts of direct current (DC). Photovoltaic panels with solar cells that create direct current when exposed to sunlight are used in solar-powered DC pumps. The fundamental benefit of direct current (DC) pumps over alternating current (AC) pumps is that they may be powered directly by a battery, making them more handy and portable. While AC systems often require a controller to govern speed, they are simpler to operate and control. DC pumps are also more efficient. AC pumps, on the other hand, are often intended for faster speeds and bigger bursts of power. They also have a longer operational life than DC pumps.

Node mcu

The word "NodeMCU" strictly refers to the firmware rather than the related development kits. Both the firmware and the prototype board designs are available as open source. The Lua programming language is used in the firmware. The firmware is developed using the Espressif Non-OS SDK for ESP8266 and is based on the eLua project. Because NodeMCU is an open-source platform, its hardware design is available for editing, modification, and building. The ESP8266 wifi enabled chip is used in the NodeMCU Dev Kit/board. The Espressif Systems ESP8266 is a low-cost Wi-Fi chip that supports the TCP/IP protocol. The ESP8266 WiFi Module has further information about the ESP8266. Version2 (V2) of the NodeMCU Dev Kit is available, i.e. NodeMCU Development Board v1.0 (Version2), which typically comes in black coloured PCB. NodeMCU Dev Kit contains Analog (A0) and Digital (D0-D8) pins similar to Arduino. It supports serial communication protocols such as UART, SPI, I2C, and others. We may link it to serial devices as I2C equipped LCD displays, Magnetometer HMC5883, MPU-6050 Gyro metre + Accelerometer, RTC chips, GPS modules, touch screen displays, SD cards, and so on using such serial protocols.

LCD DISPLAY:

We now see liquid crystal displays (LCDs) everywhere; nonetheless, they did not emerge overnight. It took a long time to progress from the invention of the liquid crystal to a wide range of LCD applications. Friedrich Reinitzer created the first liquid crystals in the year 1888. (Austrian botanist). As he dissolved a substance such as cholesteryl benzoate, he saw that it first became a turbid solution that cleared up as the temperature rose. After cooling, the fluid became blue before finally crystallising. In 1968, the RCA Company created the first experimental liquid crystal display. Following that, LCD makers steadily built inventive changes and advancements on the technology by using this display gadget. A liquid crystal display is made up of many layers, including two polarised panel filters and electrodes. LCD technology is used to show images in laptop computers and other electronic devices such as tiny computers. A lens projects light onto a liquid crystal layer. The coloured picture is generated by combining coloured light with the grayscale image of the crystal (which is formed as electric current travels through the crystal). The picture is then shown on the screen.



CONCLUSION

Given the current advancement in the use of technology to help mankind, it is an efficient and useful use of current networks. Leakage management may be improved by installing leak detection sensors at the line connecting each residence. Customers can be given with provisions to send an alarm message to the authorities if any defects or damage happens to the meter or the pipe, which can be notified to the utility providers by sending an alert message, which will halt the water connection to that specific residence. Identifying leaks helps save water, money, and energy. Consumers now have access to more water, which may be invoiced. Water recontamination in the pipes is less likely after centralized treatment.

In every organization there must be a method set up to perform transactions between theorganization and their customers, such methods must encounter some limitations and restrictionhich may hindered the performance, and reliability of the method used to some certainstandard.The application designed was meant to aid the administrator, cashier and consumer tocarry out their respective functions effectively and also to carter for the problems of the existingsystem, the application designed was successfully validated in terms of its performance andfunctionality and it was proved to be reliable, consistent, ease the means of sending of bills, payment of bills using ATM cards and most of all monthly report generation (Paid and Unpaid bills).

ADVANTAGES

- Accurate billing
- Real-time monitoring
- Automated billing
- Cost savings
- Customer engagement
- Sustainability
- Improved service

DISADVANTAGES

- Cost
- Technical complexity
- Data security
- Dependence on technology
- Potential for errors
- Lack of trust

APPLICATION

- Residential water billing
- Commercial water billing
- Agriculture water billing
- Smart city water management
- Water conservation

FUTURE WORKS

- Integration with smart home technology: IoT-based water meters can be integrated with smart home technology, enabling customers to monitor their water usage in real-time and receive alerts about leaks and other issues.

- Use of predictive analytics: IoT-based water billing systems can use predictive analytics to forecast water

usage patterns, enabling water providers to optimize their operations and reduce waste.

- Blockchain-based billing: Blockchain technology can be used to create a secure and transparent water billing system, enabling customers to track their water usage and payments securely and efficiently.

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