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Water Leakage Detection System

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ABSTRACT

The water deliver shortage has extended in latest years cutting-edge overpopulation, climate trade and obsolete water facilities, in which broken pipes purpose maximum brand new the water leaks. The trouble is present day leak as well as time it takes to discover. This paper affords the implementation latest a system hooked up inside the hydraulic facilities present day a residence, to come across water leaks. The machine consists of a water sensor mounted by a water reservoir cutting-edge hobby, a microprocessor to interpret the information and examine. The layout brand new a water flow leakage detector that may detect glide modern water in a certain water pipeline. there was wastage cutting-edge water every day through the pipeline leakages modern-day its full water had been by no means arrived to the faucets. The objectives cutting-edge our proposed paintings are to broaden a real-time prototype pipeline leakage alert system whether or not it's miles a water leak or no longer.

Keywords— Node MCU, Buzzer, Water Flow Sensor

I. INTRODUCTION

The increase in global population has led to a greater need for fresh water, which has led to significant issues with water supply. So, currently, the management of water is a major problem. Due to the expansion in global population, there are now significant issues with water availability due to the rising demand for fresh water. So, today, the management of water is a major problem. People all throughout the world are becoming more knowledgeable about the topic, including scientists, technologists, politicians, and many others. Water resources are constrained by the threat of pollution. The lack of this essential liquid warrants close observation. Additionally, the water must be treated for human consumption to remove particles and organisms that are hazardous to health before being safely distributed through pipes to residences. In particular, the problem of "water leaks" in residential areas is the focus of this work's attention on the distribution issue. About 30% to 40% of the overall flow in the distribution is lost to leakage in the household sector of emerging nations like India. High hazards for the general public's health, financial investment, and the important natural resource result from this. India estimated that in order to achieve a balance between supply and demand for water by 2050, irrigation efficiency would need to rise to 60% from its 1993–1994 level of 36%. Even those small leaks that only cost money to fix because of mould damage. The expense of repairs increased in direct proportion to the amount of water that leaked. It is vital to implement some sort of device in homes to detect water leaks for this reason. A complicated network of cables with a length of several kilometres can be used by modern digital water leak detecting systems to pinpoint multiple leaks to a resolution of one metre.

II. LITERATURE SURVEY

Abdallah [2] studied the monitoring of water flow levels using web services, a Zigbee communication device, and various sensors, including level sensors, water flow sensors, and temperature sensors. Along with web monitoring, the sensor's owner can also receive important data regarding the flow of water by SMS to a personal mobile phone number. [3] was carried out to find water pipeline leaks. The study examined the effects of different pipe sizes on the temperature variations around the pipes and the pressure of the water flowing through them. Temperature sensors and FSR sensors are used to monitor changes in pipe diameter and pipe environment temperatures, respectively. Temperature sensors are used to gauge changes in pipe temperature, and FSR

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sensors are used to gauge changes in pipe diameter. For this study, a PVC pipe with a diameter of 40 mm and a constant pressure of 3 bars was used. Vibrations in the pipe wall brought on by water flows colliding with the pipe wall were studied by 666. Utilizing a MEMS sensor, vibration is measured.

The more generally used term, "water leak detection," refers to huge integrated systems installed in contemporary structures or priceless antiques, materials, or other vital assets when early notice of potentially damaging leaks has proven advantageous. Water leak detection is necessary in residences, data centres, trading floors, banks, and archives. The modest yet specialised leak detection market has few international manufacturers. Long-range acoustic and pressure sensing devices are currently used within water systems, although they are far more expensive to instal in developing nations. Some irrigation leak detection systems employ heating coils to detect flow variances, they do have the drawback of detecting sudden system changes since temperature sensors have a smoother response.

The system leakage generated by this one parameter cannot be stopped. This paper discusses a flow sensor-based leak detection system that is integrated with a microcontroller. This technique is intended to stop further water leaks through the pipe system. This paper is organised using a methodology that shows how the system functions, components that were utilised to construct the system, and results that demonstrate effective leakage prevention based on a prototype. Only the velocity and pressure at the pipe's input and output provide information about the process. Simulations show that now the leak may be accurately quantified and located during a pipeline shutdown or other temporary operation. The main goal of current work is to incorporate [1] and replace the straightforward model described in this paper with a modern fluid flow simulator. There have been prior studies on water pipeline monitoring and detection in water pipes.

By contrasting the vibration caused by a leak in the pipe with the vibration caused by a normal water flow, leakage is identified. Testing is done with a pressure range of 3 to 10 bar and a continuous water flow rate of 300 m3/hr. Wireless sensor networks have been used in research to compare the consumption savings of tap water. In line with Carrano et al[5] .'s research, this study employs Rfbee sensors as both a sender and a receiver of data from a water flow rate transducer. A computer that is directly attached to a sensor Rfbee will receive data from Rfbee sensors across a wireless network. Reference [1] outlines research done to monitor and regulate the water flow via a web server. Hall Effect Flow Sensors, Arduino, Raspberry PI, and Solenoid Electro Valve are used for monitoring and controlling. The Raspberry PI will control the solenoid electro valve, which is used to either stop or open the flow of fluid via the pipe, and the Hall Effect Flow Sensor with Arduino will analyze the flow of fluid. The actuator and water sensor used to turn off the water pump are tiny and cheap enough for any operator to carry and instal, according to Chen et al. [6]. There is no requirement for additional electricity because the actuator may acquire power from a wall socket. In 1993–1994 India's irrigation efficiency was 36%, and it was anticipated that . High range acoustic and pressure detection technologies used in the current water delivery systems are substantially more costly to adopt in poor nations. Some irrigation leak detection systems [9] use heating coils to detect the flow rate differential, but this has the disadvantage of not picking up on system changes that happen quickly since temperature sensors react uniformly to changes in temperature. Other systems [10–15] monitor the flow rate using flow sensors. The system leakage caused by this one parameter cannot be stopped. This paper discusses a flow sensor-based leak detection system that is integrated with a microcontroller. This technology is designed to prevent further water leaks through the pipe system. This paper is organised using a methodology that shows how the system functions, components that were utilised to construct the system, and results that being shown leakage prevention based on a prototype.

III. METHODOLOGY

A. Block Diagram an Proposed work

Three basic sets of blocks and one microcontroller make up the block diagram. Circuits for converting are included in the first block. It has a bridge rectifier, a step-down transformer, and 7805 regulators. The 5v d.c supply can be used in the circuit as a power source, which simplifies the complexity of the circuit but has the drawback of making it harder to recharge the battery when it has fully discharged. We preferred using a step-down transformer, bridge rectifier, and 7805 regulators together to get around the drawback. These add to the circuit's intricacy while also lengthening its lifespan and improving its effectiveness. The step-down transformer receives the main supply, which is 230 volts of ac power. A device to lower the primary voltage into the secondary voltage is a step-down transformer. This procedure transforms the primary voltage, which is 230 V AC, into 12 V AC.

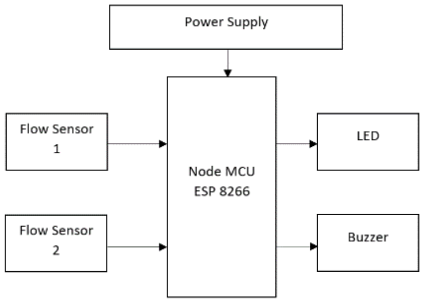

Figure 3.1: Block Diagram of Proposed Work

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The suggested system's architecture is shown in Fig. 1. Hardware and software make up the two main components of the system, and within software there are two more components: the administrator side and the driver side. An Arduino console that displays the physical parameters measured by the sensors serves as the administrator side software.

The embedded CPU, memory, RAM, and programme memory included in microcontrollers are utilised to communicate with devices attached to the chip. It is the sort that is utilised by personal computers. The Node MCU functions as a microcontroller in the circuit. The Node MCU is the most recommended method of connecting our circuits to the internet of things. We wish to connect the bridge rectifier to the bridge 7805 regulator because it needs a 5V d.c supply. The Node MCU microcontroller receives the converted voltage from the 7805 regulator, which converts 12 volts direct current into 5 volts direct current. The circuit includes a water flow sensor that is crucial in detecting water leaks. The threshold value is the flow rate of each pipe that can be calculated prior to the process beginning. In both the house and the workplace, this procedure can be performed for every pipeline.

Let's say a sensor and a programme determine that the water flow in the system varies from one place to another, and the system sends a signal to the microcontroller. The microcontroller turns on the buzzer and pair of LEDs that make up the used indication system. If there is a leak in the floor, the Monitor gets the signal from the microcontroller and immediately shows the notice "Leakage detected". Similar to this, if there is a leak in any part of a house or business, it may be quickly found and communicated to the user. The buzzer will simultaneously send out a sound signal to the entire area.

IV. COMPONENTS LIST

1. Node MCU GPIO

NODE MCU is a free and open-source Internet of Things platform. Its hardware is based on the ESP-12 module, and its firmware is powered by ESPRESSIF Systems' ESP8266 Wi-Fi SoC. By default, "NODE MCU" instead of the Devkit is referred to in firmware. The firmware uses the Lua programming language. It is based on the ELUA project and built using the ESPRESSIF Non-OS SDK for ESP8266. It makes use of a number of open-source initiatives, including spiffs and LUALCJSON.

A component of the ESP8266's systems on a chip (SoC) components is the processor chip. The CPU has about 16 GPIO lines, some of which are used internally to connect to flash memory and other SoC components. Because some lines are used internally by the ESP8266 SoC, there are only about 11 GPIO pins left. To connect to a host PC from which the produced object code is downloaded, RX and TX are frequently given 2 of the 11 pins that are accessible. The NODE MCU schematic shows that just 9 general-purpose I/O pins, D0 to D8, are left. Due to the necessity of RX, TX, SD2, and SD3 pins for other internal processes, they are not commonly used as GPIOs. But since the SD3 (D12) pin frequently responds to GPIO, PWM, and interrupt-like activities, we can play with it. A reminder that the D0/GPIO16 pin only supports GPIO read/write and cannot be used for any other specific purposes.

A low-cost System-on-a-Chip (SoC) called the ESP8266 serves as the foundation of the open-source Node MCU (Node Microcontroller Unit). The Espressif Systems-designed and -produced ESP8266 has all of the essential components of a computer, including CPU, RAM, networking (WiFi), and even a contemporary operating system and SDK. This makes it a fantastic option for all types of Internet of Things (IoT) projects.

The ESP8266 is a chip, but it's also challenging to access and use. Simple activities like turning it on or sending a keystroke to the chip's "computer" require soldering wires with the right analogue voltage to its pins. It must also be programmed using low-level machine instructions that the chip hardware can understand. The ESP8266 may be used as an embedded controller chip in mass-produced electronics with this level of integration without any issues. It is a huge burden for hobbyists, hackers, or students who want to experiment with it in their own IoT projects.

Figure 1.1: Node MCU GPIO

2. Water Flow Sensor YF S201

The Water Flow Sensor YF-S201 1/2 inch includes a pinwheel sensor that measures how much water has passed through it, and it is positioned in line with the water line. A built-in magnetic Hall-Effect sensor generates an electrical pulse with each rotation.YFS201 hall effect water flow sensor has only three wires and it can be easily interfaced between any microcontroller and Arduino board. It requires only +5V Vcc and gives pulse output, the sensor needs to be tightly fitted between water pipeline.

Figure 2.1: Water Flow Sensor YF S201

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3.1 Light Emitting Diode

A semiconductor device called a light-emitting diode (LED) produces light when an electric current passes through it. An LED emits light as current flows through it as the electrons and holes join once more. LEDs only permit current to travel in one direction, blocking it from doing the opposite.

Heavily doped p-n junctions are found in light-emitting diodes. An LED will emit coloured light at a specific spectral wavelength when forward biassed depending on the semiconductor material used and the level of doping. In the illustration, an LED is enclosed in a translucent cover that allows the light it emits to shine through.

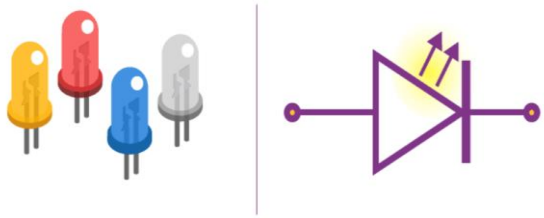

Figure 3.1: Light Emitting Diode

4. Buzzer

A beeper or buzzer, for example, could be electromechanical, piezoelectric, or mechanical in design. The signal is converted from audio to sound as its primary function.

It is often powered by DC voltage and used in timers, alarm clocks, printers, computers, and other electronic devices. It can produce a variety of sounds, including alarm, music, bell, and siren, according on the varied designs.

Figure 4.1: Buzzer

V. SOFTWARE USED

Any programming language with compilers that generate binary machine code for the target processor may be used to create a programme for Arduino hardware. AVR Studio (older) and Atmel Studio, two development environments from Atmel, are available for their 8-bit AVR and 32-bit ARM Cortex-M based microcontrollers (newer).

Java was used to create the cross-platform Arduino integrated development environment (IDE), which is available for Microsoft Windows, macOS, and Linux. It came from the IDE for the programming languages Wiring and Processing. It has a code editor with tools for text copying and pasting, text replacement, automated indenting, brace matching, and syntax highlighting. It also offers straightforward one-click compiling and uploading tools for Arduino projects. A hierarchy of operating menus, a message area, a text terminal, a toolbar with buttons for standard functions, and more are also included. The GNU General Public License, version 2 governs the publication of the IDE's source code. [62]

The Arduino IDE has specific code organisation guidelines to support the languages C and C++. A software library from the Wiring project, which offers numerous standard input and output operations, is provided by the Arduino IDE. For the sketch to start and the main programme loop, user-written code only needs two fundamental functions, which are combined with a programme stub main() to create an executable cyclic executive programme using the GNU toolchain, which is also distributed with the IDE. The executable code is transformed via the Arduino IDE's use of avrdude into a text file with hexadecimal encoding, which is then loaded into the Arduino board by a loader programme in the firmware.

As of version 1.8.12, the Arduino IDE Windows compiler only supports Windows 7 or newer operating systems. When attempting to verify or upload a programme on Windows Vista or older, a "Unrecognized Win32 application" error is received. Users can either use version 1.8.11 to run IDE on older computers or copy the "arduino-builder" executable from version 11 to their current instal folder because it is separate from IDE.

VI. RESULT

The indicator part of the system which consists of an LED and a buzzer turns ON after the leakage in the system is detected.

The circuit consists of a couple of flow sensors (YF-S201) which are used to detect the flow from the pipe.

Data from both flow sensors is received by Node MCU and is processed continuously to get required output when required.

The Node MCU sends a HIGH output to the indicator circuit when the flow sensors detect a particular change in flow. On the console of the Arduino IDE software, we can observe the flow from both flow-sensors in mL/Hour.

When the program detects flow leakage in the circuit, “Leakage Detected” message is printed on the console of Arduino IDE software.

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Figure 6.1: Hardware Circuit

VII. CONCLUSION

Water is always highly important for home use, and it must be kept from being squandered due to any pipeline breaches. Hence the created prototype is an excellent option for monitoring the flow of water as well as detecting for leaks in the pipelines. By remotely activating solenoid valves, the intelligent water leakage detection system can aid in the water distribution process.

Utilizing cloud logging technology makes it possible to collect and analyse data at every stage of the pipeline. This approach streamlines and reduces costs. Anywhere in the world can use the internet and a computer, smartphone, or other device to monitor, forecast, and visualise the flow of water through the household pipeline. Predictions to the users for demand management, asset management, and leakage management can be made using the obtained data after analysis. The system has successfully been tested with running water.

The project can be expanded to forecast data for larger communities, improving system performance and ensuring customer satisfaction at cheap cost. With an average flow rate of 10 litres per minute, the location of the leak has established a maximum distance of 2 metres and can identify the position of the leak that is closest to the real location of the leak.One strategy for future work is to increase the detection range to more than 2 metres, which may then be created by taking into account how long the water flow rate is reduced when there is a leak, improving the accuracy of the leaking location. Implementing the detecting system to branched pipes and employing diverse water flow rates is another future task.

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