SMART WATER MANAGEMENT

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ABSTRACT

Smart water management systems are becoming increasingly popular as a means of optimizing water usage and reducing wastage. One key component of such systems is valve automation, which enables the remote control and monitoring of water flow within a network. This technology enables the real-time adjustment of water flow rates, pressure, and volume, allowing for efficient distribution of water resources. With the help of sensors and analytics, smart water management systems can detect leaks and other anomalies, allowing for rapid response and preventive maintenance. By using valve automation, water utilities and municipalities can improve the efficiency of their water supply networks, reduce water losses, and improve the overall quality of water services. This abstract explores the benefits of smart water management systems with valve automation and highlights the potential for the technology to address global water scarcity challenges.

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1 INTRODUCTION

Smart water management projects aim to improve the efficiency, reliability, and sustainability of water supply systems using advanced technologies such as sensors, data analytics, and automation. These projects leverage the power of the Internet of Things (IoT) to collect real-time data on water usage, water quality, and network performance, enabling water utilities and municipalities to optimize their operations and improve service delivery. One key component of smart water management projects is valve automation, which enables remote control and monitoring of water flow within a network. By automating valves, operators can adjust flow rates, pressure, and volume in real-time, enabling efficient distribution of water resources. Valve automation can also help detect leaks and other anomalies, allowing for rapid response and preventive maintenance. Smart water management projects have many benefits, including reducing water losses, improving the quality of water services, and ensuring the long-term sustainability of water resources. By optimizing water usage, these projects can also help reduce costs and increase operational efficiency for water utilities and municipalities.

1.1 Objective

- Remote control of valves
- Water conservation
- Leak detection
- Cost-saving
- Convenience

2. METHODOLOGY

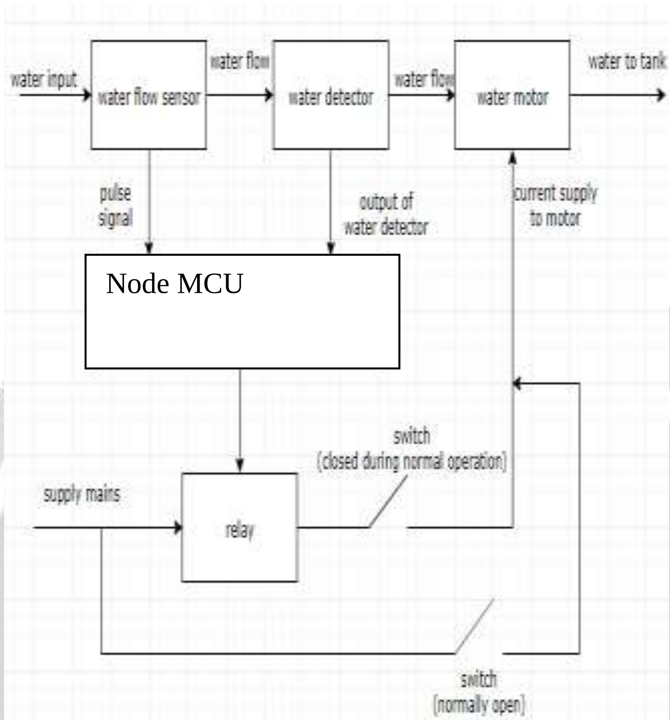

Fig -1 Methodology

2.1 Flow of Methodology

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The water flow sensor is kept in series with water inlet into the house, 2 electrodes of water detector are inserted in the pipe vertically opposite to each other. Both the water flow sensor and water detector are connected to node MCU node MCU controls the relay, which controls the water motor. One manual switch is connected in series to relay and one more manual switch is connected in parallel to relay. Whenever there is the flow of water in the pipe, water flow sensor sends PPM signals as input to the node MCU and the code is written in the node MCUand then it is uploaded to the Node MCU to calculate the flow of water in liters/hour by counting the number of pulses. But there is a drawback in this sensor, the rotor of this sensor rotates even there is the flow of air, and hall effect sensor will give out PPM signals as output only based on the speed of the rotor. So to differentiate the flow of air and the flow of water we use a water detector in the pipe to detect the presence of water. Here the logic we used to detect the presence of water is water which has dissolved salts in it will conduct electricity. The salts present in municipal water are enough to conduct electricity. Here we place two electrodes in the pipe, one of the electrodes is connected to 5v supply and the other is connected to the analog input pin of node MCU. When water is present in the pipe it acts as a conductor and the electrode which is connected to the analog input pin of Arduino will give some voltage greater than 0V and less than 5V as an output, the analog voltage is then mapped into integer value in between 0 and 1023 by the inbuilt analog to digital converter of node MCU.

3. SOFTWARE AND HARDWARE

3.1 SOFTWARE

Android Studio is the official integrated development environment (IDE) for Google's Android operating system, built on JetBrains IntelliJ IDEA software and designed specifically for Android development It is available for download on Windows, macO and Linuxbased operating systems. It is a replacement for the Eclipse Android Development Tools (E-ADT) as the primary IDE for native Android application development.

Android Studio was announced on May 16, 2013, at the Google I/O conference. It was in early access preview stage starting from version 0.1 in May 2013, then entered beta stage starting from version 0.8 which was released in June 2014.[10] The first stable build was released in December 2014, starting from version 1.0. At the end of 2015, Google dropped support for Eclipse ADT, making Android Studio the only officially supported IDE for Android development.[12]

On May 7, 2019, Kotlin replaced Java as Google's preferred language for Android app development. Java is still supported, as is C++.

NetBeans is an integrated development environment (IDE) for Java. NetBeans allows applications to be developed from a set of modular software components called *modules*. NetBeans runs on Windows, macOS, Linux and Solaris. In addition to Java development, it has extensions for other languages like PHP, C, C++, HTML5, and JavaScript. Applications based on NetBeans, including the NetBeans IDE, can be extended by third party developers.

3.1.1 Configuration Module

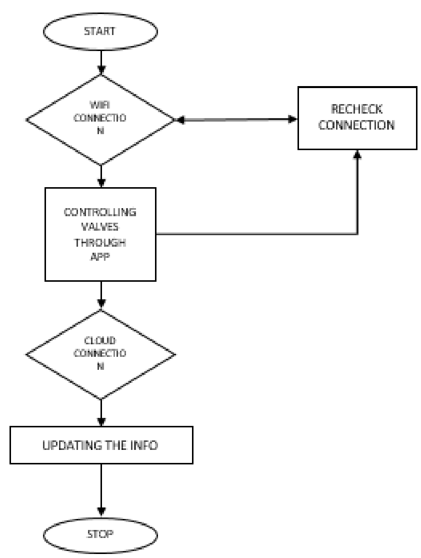

Fig - 2: Software flow diagram

3.2 HARDWARE

3.2.1 Solenoid Valve

Solenoid valves differ in the characteristics of the electric current they use, the strength of the magnetic field they generate, the mechanism they use to regulate the fluid and the type and characteristics of fluid they control. The mechanism varies from linear action plunger-type actuators to pivoted-armature actuators and rocker actuators

Fig - 3: Solenoid Valve

3.2.2 NodeMCU

NodeMCU is an open source firmware for which open source prototyping board designs are available. The name "NodeMCU" combines "node" and "MCU" (micro-controller unit).[8] Strictly speaking, the term "NodeMCU" refers to the firmware rather than the associated development kits.[*citation needed*]Both the firmware and prototyping board designs are open source.

The firmware uses the Lua scripting language. The firmware is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjso and SPIFFS.[10] Due to resource constraints, users need to select the modules relevant for their project and build a firmware tailored to their needs. Support for the 32-bit ESP32 has also been implemented.

Fig - 4: NodeMCU

3.2.3 Relay

Relays are used to control the switching of high power circuits using low power signals. They are used to open or close the contacts (basically it is an electrically operated switch). It can be controlled with low voltages (5V) which can be provided by an Arduino. The high voltage side of the relay has 3 terminals mentioned below:-

- COM (common).
- NC (normally closed):-If we need the circuit to be closed by default, we use this configuration. (In this case when Arduino sends 5V output to relay, then high power circuit will open.)

NO (normally open):- If we need the high power circuit to be open by default (and the high power circuit will get closed only when microcontroller sends 5V signal to relay), then we use this configuration

Fig - 5: Relay

3.2.4 Power supply module

Power modules are high-power electrical components that contain a single or several components combined into a functional, isolated unit. They typically have a base plate for mounting a heat sink and electrical contacts that allow for quick and easy mounting and removal. By manufacturing the component as a module, improved power handling, reliability, and decreased parasitic circuit elements are all possible.

3.2.5 Battery

A 12V lead acid battery is a type of rechargeable battery that is commonly used in a wide range of applications, including automotive, marine, and off-grid power systems. It is composed of several lead-acid cells connected in series, each of which produces 2 volts. The lead-acid battery works by converting chemical energy into electrical energy. Each cell contains a positive electrode made of lead dioxide, a negative electrode made of lead, and an electrolyte solution of sulfuric acid and water. When the battery is charged, the chemical reaction converts the lead dioxide and lead plates into lead sulphate, and the sulfuric acid is converted to water. When the battery is discharged, the reverse reaction occurs, converting the lead sulphate back into lead dioxide and lead, and releasing electrical energy.

3.2.5 Water level indicator

A **water detector** is an electronic device that is designed to detect the presence of water for purposes such as to provide an alert in time to allow the prevention of water leakage. A common design is a small cable or device that lies flat on a floor and relies on the electrical conductivity of water to decrease the resistance across two contacts. The device then sounds an audible alarm together with providing onward signaling in the presence of enough water to bridge the contacts. These are useful in a normally occupied area near any infrastructure that has the potential to leak water, such as HVAC, water pipes, drain pipes, vending machines, dehumidifiers, or water tanks.

Fig water level sensor

4. IMPLEMENTATION

Smart water management using a solenoid valve can be implemented in several ways, depending on the specific requirements and goals of the project. Here is a general overview of how such a system could be set up: Water usage sensors: Install sensors throughout the water system to monitor usage and identify leaks or areas of inefficiency. These sensors could include flow meters, pressure sensors, and temperature sensors. Control system: Set up a control system that can receive data from the sensors and use it to control the solenoid valve. This system could be a microcontroller or a more advanced control system that uses machine learning algorithms to optimize water usage. Solenoid valve: Install a solenoid valve at key points in the water system, such as near appliances or in irrigation systems. The valve can be controlled by the control system to turn water on or off as needed.

Communication: Ensure that the control system can communicate with other devices and systems as needed, such as sending alerts to a smartphone app or integrating with a smart home system.Analytics: Collect and analyze data from the water usage sensors to identify patterns, trends, and areas for improvement. This information can be used to optimize water usage and reduce waste.

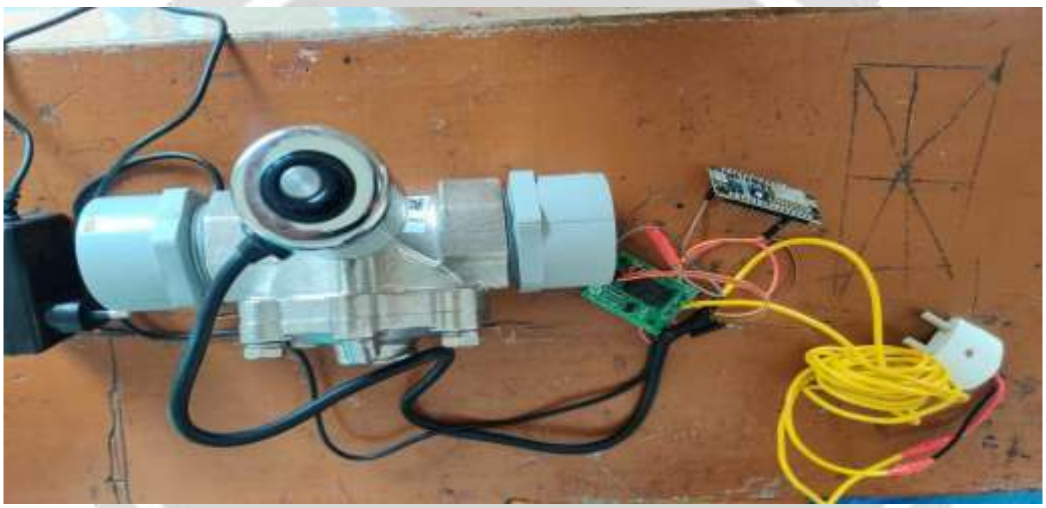

Fig -1 IMPLEMENTATION

4. CONCLUSION & FUTURE SCOPE

Installing this system at home makes life easy. One need not wait for municipal water to get released by municipal authorities. Municipal water will automatically go into the overhead tanks as automatic switching of the water pump motor will take place. This saves time as well as energy which we spend in monitoring the motor to switch it ON and OFF. The user can also put a water detector at the top of the tanks so that the motor will automatically get switch off whenever the tank is filled with water (we have not included it in our project).

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