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WATER FLOW INDICATOR FOR DOMESTIC PIPELINE SYSTEM

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Abstract : The smart water flow indicator for domestic pipeline system is a system designed to indicate and manage water flow through the integration of flow sensors and GSM communication technology. This project addresses the need for efficient water resource management by providing real-time information about water flow in the domestic pipeline. The system employs flow sensors to detect water flow and sends data via GSM communication to a designated user's mobile phone. The user can receive notifications when the water is supplied in their area, thereby enabling prompt action to prevent water wastage. The integration of water flow sensor and GSM technology offers a convenient and effective solution for conserving the water.

I. INTRODUCTION

The preservation of water resources is a vital requirement for sustainable survival of the human species. Various approaches have been proposed to improve the management of water supplies, including awareness campaigns. To Indicate the water flow in the domestic pipe lines and also previous water management system is leak management, specialised equipment (such as aerating shower spouts, low-flush or composting toilets and high-efficiency clothes washers), the passing of proposed water management laws, rain water harvesting and waste water reuse.

One approach that offers various fringe benefits is that of smart Indicating. Driven mostly by the recent emergence of ubiquitous wireless networking, smart Indicating enables autonomous indicate of utilities (e.g. water flow in domestic pipelines). Two key benefits of smart Indicating, both of which affect savings, are the low latency and highly visualised method of data reporting. These two factors ensure that the consumer of the utility, who is usually also the payer thereof, is aware of water flow patterns, which leads to more responsible behaviour.

The main enabler behind the reduction in latency with smart Indicating, is that utility suppliers do not need to manual purposes, but can autonomously capture and process all the data centrally, have to send an official message to every household. The Significant of the system have been made towards achieving smart indicator in the domestic sector. Progress in smart indicator of water supplies has, however, been much slower. A key challenge faced by smart water indicating system is the prohibitive cost and complexities associated with electronic water flow sensor.

II. NEED OF WATER INDICATION

The need for water flow indication arises from several critical factor

1. **Water Conservation:** In an era of growing water scarcity and environmental concerns, monitoring water flow is essential for promoting responsible water usage. It helps individuals and organizations identify areas where water can be saved, reducing waste and contributing to conservation efforts.
2. **Cost Management:** Efficient water flow management can lead to significant cost savings, especially for household pipe lines. By indicating a water flows, they can lower utility bills and operational expenses.
3. **Regulatory Compliance:** Many regions have regulations and water usage limits that must be adhered to. Water flow indication helps ensure compliance with these regulations, avoiding penalties and legal issues.
4. **Resource Management:** In agricultural and industrial settings, tracking water flow is crucial for optimizing processes, ensuring efficient irrigation, and preventing overuse or underuse of water resources.
5. **Data-Driven Decisions:** Smart water flow indicators provide real-time data and historical usage trends, empowering users to make informed decisions about water consumption and allocate resources more effectively.
6. **Environmental Impact:** Reducing excessive water consumption has a positive impact on the environment by conserving water resources and reducing energy consumption associated with water treatment and distribution.
7. **Water Quality:** Monitoring water flow can also be tied to water quality assessments. By tracking flow rates, it becomes easier to identify changes in water quality that may be indicative of contamination or other issues.

In summary, water flow indication is essential for promoting sustainability, cost-efficiency, and responsible resource management while addressing environmental and regulatory concerns. It plays a crucial role in various sectors, from residential and commercial to industrial and agricultural, by providing valuable insights into water usage patterns and helping users take proactive measures to address water-related challenges.

III. PROPERTIES OF WATER FLOW INDICATOR

A water flow indicator, whether a basic mechanical device or a modern smart system, possesses several key properties that enable it to fulfil its purpose effectively. Here are some common properties:

- **Flow Measurement:** The primary function of a water flow indicator is to measure the rate of water flow accurately. This is typically expressed in units like litres per minute (LPM) or gallons per minute (GPM)
- **Alerts:** Smart water flow indicators can provide real-time alerts or notifications when flow rates deviate from pre-set thresholds. This is especially useful for leak detection or excessive water usage.
- **Data Logging:** Many modern flow indicators have data logging capabilities, recording historical flow data. This historical information can be analysed to identify trends and patterns in water usage.
- **Communication:** Smart flow indicators often include communication options like Wi-Fi, Bluetooth, allowing them to connect to networks and transmit data to other devices or the cloud.
- **Integration:** They can integrate with other smart home or building automation systems. For example, they can communicate with smart thermostats to optimize heating systems based on water flow patterns.
- **Sensors:** Water flow indicators may have sensors that can detect not only flow rates but also temperature, pressure, and sometimes water quality parameters.
- **Power Source:** Depending on the type, flow indicators can be powered by batteries, electricity, or be self-powered through the flow of water itself in some cases.
- **Material and Durability:** The construction material should be compatible with water, resistant to corrosion, and durable to ensure long-term reliability.
- **Installation:** They should be easy to install in various plumbing systems, whether residential, commercial, or industrial, with minimal disruption.
- **Calibration:** Proper calibration is essential to ensure the accuracy of flow measurements. Some indicators may allow for user calibration or may need periodic calibration by professionals.

- **User Interface:** The user interface should be user-friendly, providing clear instructions for setup, configuration, and data interpretation.
- **Maintenance:** Minimal maintenance requirements are preferable, with clear guidelines for cleaning or servicing the device.
- **Cost:** The cost of a water flow indicator can vary widely, and it's important to choose one that aligns with your budget and specific needs.
- **Compatibility:** Ensure that the indicator is compatible with the type and size of the plumbing system it will be installed in.

The specific properties of a water flow indicator can vary depending on its type and complexity. Basic mechanical flow indicators may have simpler features, while smart flow indicators offer advanced capabilities, including remote monitoring and control. The choice of a water flow indicator should be based on the specific requirements and objectives of the user or application.

IV. OBJECTIVES

- Create a system to send SMS alerts to designated users when water flow is detected.
- Integrate a GSM module to facilitate remote communication.
- Calculate flow rates, and determine when flow rates deviate from expected values

V. PROBLEM STATEMENT

- Water is always wasted in the Indian domestic pipeline system because there is no system to alert people whenever water is supplied to an area.
- As a result, people suffer from lack of water during summer.

VI. METHODOLOGY

To connect a GSM module to an Arduino Nano, you'll typically use UART (Universal Asynchronous Receiver-Transmitter) communication, as most GSM modules support this interface.

Connections:

- **Power Supply:** Connect the power source to the GSM module. Most GSM modules operate at around 3.7V, so make sure you provide the correct voltage.
- **Ground Connection:** Connect the GND (Ground) pin of the GSM module to one of the GND pins on the Arduino Nano.
- **TX/RX Pins:** Connect the TX (Transmit) pin of the GSM module to one of the digital pins on the Arduino (e.g., D2) for serial communication. Connect the RX (Receive) pin of the GSM module to another digital pin on the Arduino (e.g., D3) for serial communication.
- **Voltage Level Shifting:** Some GSM modules operate at 3.3V logic levels, while Arduino Nano uses 5V logic. You may need a voltage level shifter or voltage divider to ensure proper communication. Alternatively, check if your GSM module can tolerate 5V logic levels.
- **Antenna:** Attach the GSM module's antenna for better signal reception.
- **Upload Arduino Sketch:** Write an Arduino sketch that initializes the serial communication with the GSM module. You can use the SoftwareSerial library if you want to use different pins for communication.

Power requirements:

Determining the power requirements of components in your project is crucial to selecting an appropriate power source. Let's break down the process of calculating power requirements and selecting a suitable power source.

1. Identify Components and Their Power Requirements:

- Arduino Nano: An Arduino Nano typically operates at 5V and consumes around 20-50mA of current, depending on the attached peripherals and the processing load.
- GSM Module: GSM modules often operate at 3.3V or 5V, and their power consumption can vary based on usage and the specific module. It can range from a few hundred milliamps to around 2A during data transmission.

2. Total Power Consumption:

Calculate the total power consumption by adding up the power requirements of all components. For example:

Arduino Nano: 5V * 0.05A = 0.25W (worst-case scenario)

GSM Module: 5V * 2A = 10W (worst-case scenario)

Total Power Consumption = 0.25W + 10W = 10.25W

3. Voltage and Current Compatibility:

Ensure that your selected power source can provide the required voltage and current. In this case, you need a power source that can supply 5V and handle at least 10.25W (or slightly more to account for inefficiencies).

4. Battery or External Power Supply:

- If you need portability, consider using a rechargeable lithium-polymer (Li-Po) battery. Li-Po batteries can provide 3.7V, which can be regulated to 5V using a voltage regulator.
- If you're using an external power supply, make sure it can provide the required voltage and current consistently.

5. Voltage Regulation:

If your power source provides a voltage that is different from the required voltage (e.g., 3.7V Li-Po battery), use a voltage regulator to step up or down the voltage to meet the requirements.

6. Battery Capacity:

If you're using a battery, consider its capacity (measured in mAh or Ah). Calculate how long the system can run on a single charge based on the total current consumption. For example, if your system consumes 1A, a 2000mAh battery would theoretically last for 2 hours (2000mAh / 1000mA = 2 hours).

7. Efficiency and Safety:

Consider the efficiency of voltage regulators and potential energy losses. Ensure the power source and regulators can operate safely and provide sufficient current without overheating.

8. Environmental Considerations:

Consider factors like temperature, humidity, and any environmental conditions that may affect your power source's performance and the lifespan of your components.

Code development:

To send SMS alerts with relevant flow data and oddity information to designated phone numbers using an Arduino Nano and a GSM module (e.g., SIM800 or SIM900), you'll need to write code that communicates with the GSM module to send the SMS.

We include the SoftwareSerial library to establish communication with the GSM module .We initialize two serial interfaces: Serial for the Arduino's serial monitor and gsmSerial for communicating with the GSM module.

- We initialize both serial interfaces and introduce a delay to allow the GSM module to initialize.
- sendSMSAlert Function:
- We send "AT" to check if the GSM module is responding, and we wait for an "OK" response.

- We set the SMS mode to text using "AT+CMGF=1".
- We set the recipient's phone number using "AT+CMGS" (replace "+1234567890" with the actual recipient's number).
- Sending the SMS Message:
- We send the relevant flow data and oddity information to the GSM module.
- To indicate the end of the message, we send the Ctrl+Z character (ASCII 26).

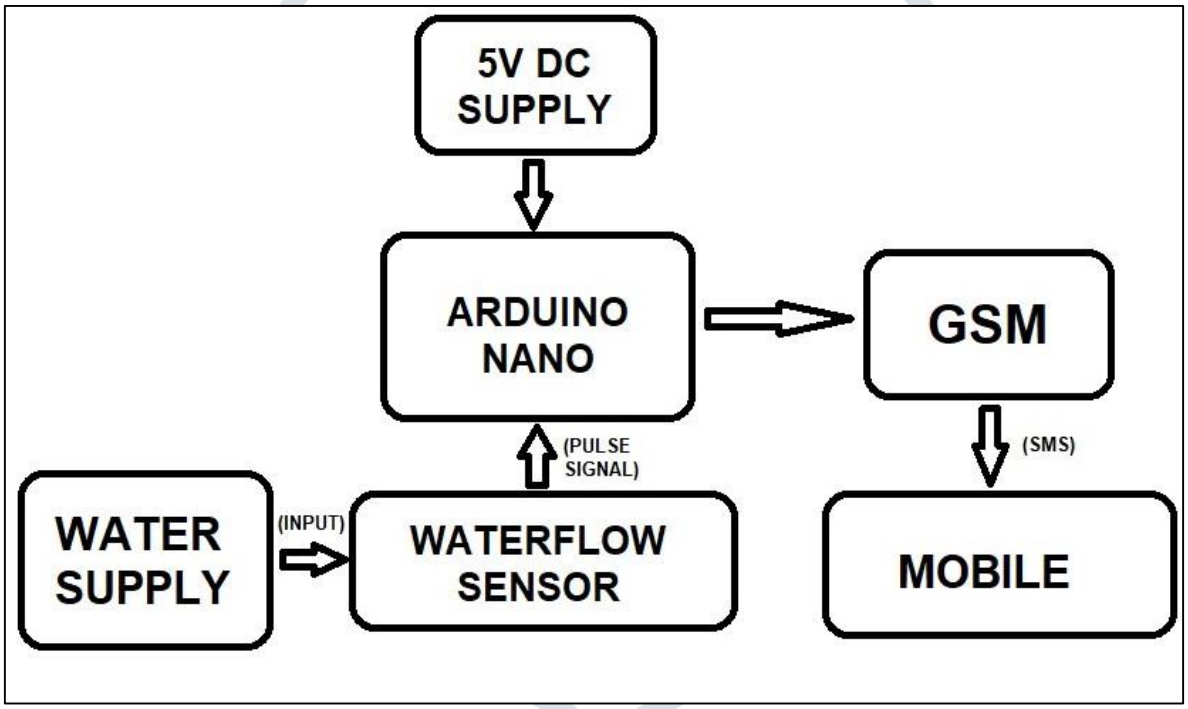
Remember to replace the placeholder recipient's phone number with the actual phone number you want to send the SMS. Also, customize the SMS content with your specific flow data and oddity information.

Testing:

Upload the sketch to the Arduino Nano and open the serial monitor. You can now send AT commands to the GSM module through the Arduino to test its functionality.

Remember to consult the datasheet and documentation of your specific GSM module, as pin configurations and AT commands may vary between different modules. Also, ensure that your power supply can provide the necessary current for the GSM module's operation.

VII. BLOCK DIAGRAM



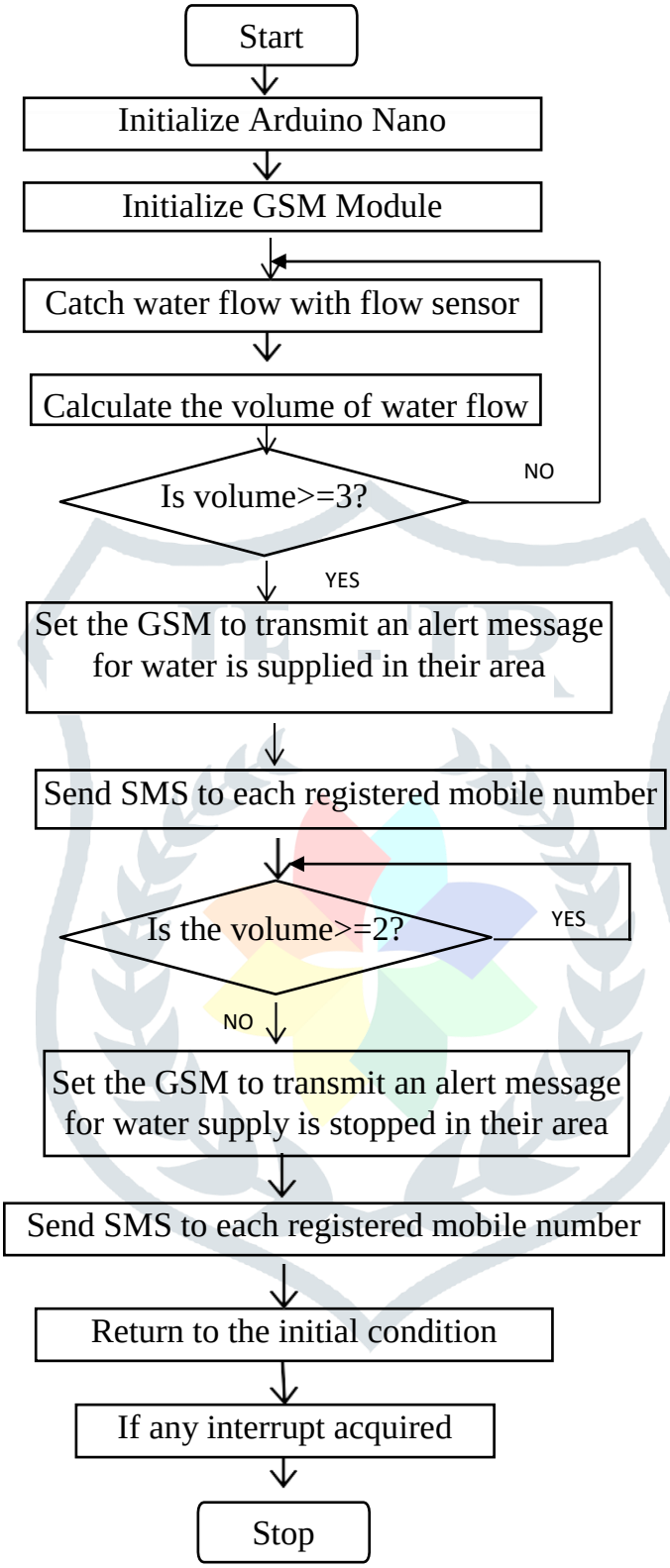
Block Diagram of Smart Water Indicator

- The 5V DC power supply given to the Arduino Nano.
- The water supply is detected by the sensor.
- The water flow sensor is send the pulse signal to Arduino Nano.
- Arduino Nano programmed for sending a signal to the GSM (Global System for Mobile communication) when the water flow is detected.
- After that GSM send the SMS to mobile phone (the message is “water flow detected”).

VIII. ADVANTAGES

- It provide the real time data of the water flow.
- It ensure the efficient use of resource.
- It prevent the water wastage.

IX. FLOW CHART



Flow chart of smart water indicator

1. Initialize Arduino Nano: At the beginning of the procedure, you start by initializing the Arduino Nano. This sets up the microcontroller for further actions.

2. Initialize GSM module: Next, you initialize the GSM module, which allows the Arduino to communicate via text messages (SMS).

3. Catch Water Flow with Flow Sensor: The flow sensor is used to detect the flow of water. It measures how much water is passing through it.

4. Calculate the Volume of Water Flow: Based on the data from the flow sensor, you calculate the volume of water that has flowed through the sensor. It's important to know how much water is being consumed.

5. Is Volume >= 3? : Check if the calculated volume of water is greater than or equal to 3 units. If it is, you proceed to the "Yes" branch.

6. Branch Yes: If the volume is greater than or equal to 3 units, you set the GSM module to transmit an alert message. This likely means there is sufficient water supply in the area.

7. Send SMS to Each Registered Mobile Number: You then send an SMS to each registered mobile number, notifying them about the availability of water.

8. Is Volume >= 2? : Check if the calculated volume of water greater than or equal to 2 units. If it's not, you proceed to the "No" branch.

9. Branch No: If the volume is greater than or equal to 2 units, you set the GSM module to transmit an alert message, indicating that the water supply has stopped in the area.

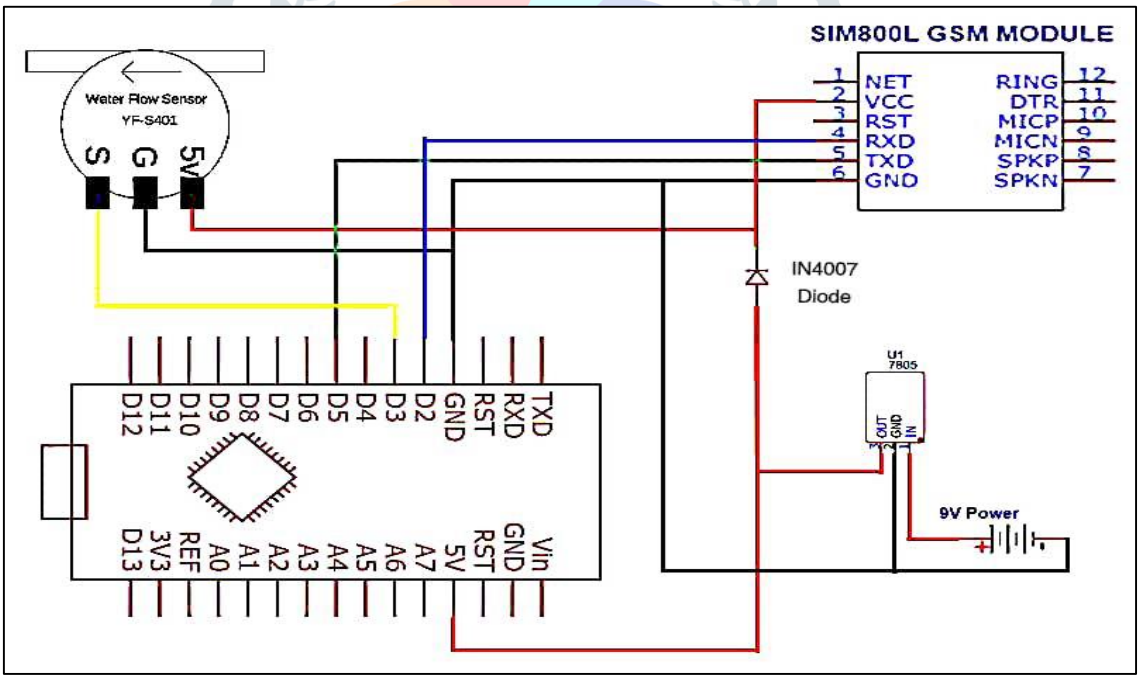
10. Send SMS to Each Registered Mobile Number: Similar to the previous "Yes" branch, you send an SMS to each registered mobile number, notifying them about the water supply is stopped.

11. Return to Initial Condition: After sending the alert messages, you return the system to its initial state, presumably to continue monitoring the water supply.

12. If Any Physical Interrupt Acquired: This step seems to be a condition for handling physical interruptions or anomalies. If any such interruption is detected, you move to stop the program.

14. Stop: This is where the procedure ends or halts in response to a physical interruption.

X. CIRCUIT DIAGRAM



Circuit diagram of smart water indicator

- 3-6V DC power supply is given to the circuit through the switch.
- Digital pin D2 act as a Transmitter (Tx) and D5 act as a Receiver (Rx) for the GSM module.
- Tx of the GSM module connected to the Arduino pin D5 and Rx of the GSM module connected to the Arduino pin D2.They are used to transmit and receive data between Arduino to Gsm module.
- Water flow sensor output is connected to the Arduino digital pin D3. It is used to send pulse signal of the detected water flow.

- Whenever a pulse signal is detected from the water flow sensor the Arduino run the build-in program which send an alert message to the user mobile phone with the help of GSM module.

XI. OUTCOME

The outcome of the project will be an automatic water indicating system that provide a real time data of the water resource in our area via mobile phone.

XII. CONCLUSION

In conclusion, the implementation of a smart water flow indicator for domestic pipeline systems offers several valuable benefits. This technology provides homeowners with real-time information about their water flow, enabling them to make more informed decisions regarding water conservation and usage efficiency. By seamlessly integrating with domestic pipelines and offering intuitive user interfaces, smart water flow indicators empower individuals to monitor and manage their water consumption effectively. Furthermore, these devices can contribute to reducing water wastage and lowering utility bills, making them an environmentally and economically sound investment. They provide homeowners with the tools to detect water flow patterns promptly, helping prevent potential damage to the property and conserving this precious resource. In summary, the smart water flow indicator enhances the functionality of domestic pipeline systems by promoting water conservation, cost savings, and proactive maintenance, ultimately leading to a more sustainable and efficient water usage experience for households.

XIII. REFERENCES

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