Smart Water flow measuring device

Gajanan Gambhire, Nihal Namdeo, Nandika Bansal, Aditya Narke, Krishna Karkhede, Pranav Navandar, Atharva Nawal

**Department of Engineering, Sciences and Humanities (DESH)**

**Vishwakarma Institute of Technology, Pune, 411037, Maharashtra, India**

\**The Introduction is to be written in 3 paragraphs. The first paragraph will introduce the topic of your research work. The second paragraph will briefly take an account of Literature review i.e. it will tell what sort of research that has happened so far till date. In the third paragraph you will tell what shortcoming or loophole / gap you identified that was not yet researched by any one so far and how this novel & unique research work has done by you ie. The project highlight.* In this template no separate Subpoint as **Literature Review**

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*Abstract* — (in 250 words)*. This research paper presents the design and implementation of a water measuring device utilizing an Arduino UNO microcontroller, a YF-S201 water flow sensor, a 16x2 LCD display, and an I2C module for efficient data communication. The system is designed to measure and display the flow rate of water through a pipe, with the water flow sensor generating pulses proportional to the flow rate. The Arduino UNO processes these pulses to calculate the flow rate and sends the data to the LCD display via the I2C module, ensuring clear and real-time visualization of water flow. Additional components such as a 9-volt DC battery provide power, while jumper cables and a breadboard facilitate secure electrical connections and prototyping. The device aims to offer a reliable and user-friendly solution for monitoring water usage, applicable in various settings including residential, agricultural, and industrial environments. This study details the assembly process, system integration, and performance evaluation of the water measuring device, highlighting its potential for enhancing water resource management through precise and accessible flow rate monitoring.*

1. ***Keywords*** *— Flow rate calculation, Hall effect*

INTRODUCTION

## Measuring water flow rate and volume using Arduino and a flow sensor involves utilizing a flow sensor to detect the rate of liquid passing through it and an Arduino to process the sensor data.

By using a flow sensor with a microcontroller like Arduino, we can calculate the flow rate, and check the volume of liquid that has passed through a pipe, and control it as required. Apart from manufacturing industries, flow sensors can also be found in the agriculture sector, food processing, water management, mining industry, water recycling, coffee machines, etc.

The water flow sensor consists of a plastic valve body, a water rotor and a hall-effect sensor. When the water flows through the rotor, rotor rolls and the speed of it changes with a different rate of flow. The hall-effect sensor outputs the corresponding pulse signal .We have also used battery of 9 volt DC supply battery.

# Methodology/Experimental

Choose any one from *A, B, C given below as applicable to your Project*

## Materials/Components/Flowchart/Block Diagram/Theory (\* Keep any one of the subtitles here as applicable to your project work)

**Water flow sensor:**​

* A water flow sensor is a device that measures the flow rate of water or other liquids. The most commonly used flow sensors for Arduino projects are turbine-based sensors, such as the YF-S201 or YF-S402. These sensors typically output a series of pulses proportional to the flow rate.​

**16x2 LCD Display:**​

* Function: Presents numerical data on water levels.​
* Principle: Displays measured values digitally in a 16-character, 2-line format.​
* Usage: Offers detailed information for users requiring specific water level insights.​

**Arduino UNO:**​

* Function: Processes data, controls system components.​
* Principle: Microcontroller board for system control.​
* Usage: Governs overall system functionality and communication.​

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## Synthesis/Algorithm/Design/Method (\* Keep any one of the subtitles here as applicable to your project work)

**1.Research and Planning**: Began with a thorough research phase to understand the components required and the overall functionality of the system. Planed out the project scope, including the desired features and the intended application of the system.​

2.**Flow Rate (Q):** The flow rate is typically measured in liters per minute (L/min) or liters per second (L/s) and represents the volume of water passing through the sensor per unit of time :Pulses Counted/Calibration Factor × Conversion Factor​

3.**Total Volume (V)**: The total volume of water passed through the sensor can be calculated by ​

Total Volume (Liters)=Flow Rate (L/min)×Time (in minutes)​

**4.Component Selection**: Chose appropriate components based on the project requirements. This includes selecting a compatible water flow sensor, Arduino Uno microcontroller, LCD display, and wires etc​

## Characterization/Pseudo Code/ Testing (\* Keep any one of the subtitles here as applicable to your project work)

The algorithm for measuring and displaying water flow involves several key steps: initializing the system, measuring the water flow rate, calculating the flow rate, displaying the data, and resetting the pulse count. Below is a detailed, mathematical explanation of each step:

1. **Initialize System**:
   * **Pin Configuration**: The sensor pin is configured as an input to read pulses from the water flow sensor.
   * **Serial Communication**: Serial communication is initialized at a baud rate of 9600 to allow data logging.
   * **LCD Initialization**: The LCD display is initialized, and the backlight is turned on for visibility.
   * **Interrupt Attachment**: An interrupt is attached to the sensor pin to increment the pulse count with each rising edge of the pulse signal.
2. **Measure Flow**:
   * **Pulse Counting**: The flow sensor generates pulses as water flows through it. The number of pulses (denoted as 𝑃*P*) is directly proportional to the volume of water passing through the sensor.
   * **Interrupt Service Routine**: Each pulse triggers an interrupt that increments the pulse count 𝑃*P*.
3. **Calculate Flow Rate**:
   * **Conversion Factor**: The flow rate calculation relies on a conversion factor that translates the number of pulses to the volume of water. For the YF-S201 sensor, the conversion factor is typically 2.663 mL per pulse.
   * **Flow Rate Calculation**:

𝑉=𝐶×𝑃*V*=*C*×*P*

where:

* + - 𝑉*V* is the flow rate in milliliters per second (mL/s).
    - 𝐶*C* is the conversion factor (2.663 mL per pulse).
    - 𝑃*P* is the number of pulses.
  + **Total Volume Calculation**:

𝑉total+=𝑉*V*total​+=*V*

where 𝑉total*V*total​ is the cumulative volume of water measured over time.

1. **Display Data**:
   * **LCD Update**: The flow rate 𝑉*V* and the cumulative volume 𝑉total*V*total​ are displayed on the LCD. The display is updated every second to provide real-time monitoring.
   * **Serial Output**: The flow rate and cumulative volume are also printed to the serial monitor for logging and debugging.
2. **Reset Pulse Count**:
   * **Time-Based Reset**: To ensure accurate real-time measurement, the pulse count 𝑃*P* is reset every second. This is achieved by checking the elapsed time using the **millis()** function and resetting 𝑃*P* if more than 1000 milliseconds (1 second) have passed since the last reset.
3. **Mathematical Representation of the Algorithm**
4. **Initialization**:
   * Set 𝑃=0*P*=0
   * Set 𝑉total=0*V*total​=0
   * Initialize time 𝑇last*T*last​ to the current time.
5. **Pulse Counting**:
   * Increment 𝑃*P* by 1 for each pulse detected by the interrupt.
6. **Flow Rate Calculation**:
   * Calculate the flow rate:

𝑉=2.663×𝑃*V*=2.663×*P*

* + Update the cumulative volume:

𝑉total=𝑉total+𝑉*V*total​=*V*total​+*V*

1. **Data Display**:
   * Display 𝑉*V* and 𝑉total*V*total​ on the LCD.
   * Output 𝑉*V* and 𝑉total*V*total​ to the serial monitor.
2. **Reset Pulse Count**:
   * Check elapsed time:

𝑇current=current time in milliseconds*T*current​=current time in milliseconds

Δ𝑇=𝑇current−𝑇lastΔ*T*=*T*current​−*T*last​

* + If Δ𝑇≥1000Δ*T*≥1000 milliseconds (1 second):
    - Reset 𝑃*P* to 0.
    - Update 𝑇last*T*last​ to 𝑇current*T*current​.

By following this detailed algorithm, the water measuring device can provide accurate, real-time monitoring of water flow, with the results continuously updated and displayed for the user.

# Results and Discussions

Gljkdgji dfgjidfp pgjpjk ghpojkfhp pfghp piojgh lijghopoj lifjghij lijfghoij lkgjhoidjfgh ldigjolijdgh lkjndghojd lkjghlkjh lkjhjkhg

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Fig. 1. Magnetization as a function of applied field. Note that “Fig.” is abbreviated. Bvb.nbnblvmnnm There is a period after the figure number, followed by two spaces. It is good practice to explain the significance of the figure in the caption.

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Use either SI (MKS) or CGS as primary units. (SI units are strongly encouraged.) English units may be used as secondary units (in parentheses). **This applies to papers in data storage.** For example, write “15 Gb/cm2 (100 Gb/in2).” An exception is when English units are used as identifiers in trade, such as “3½ in disk drive.” Avoid combining SI and CGS units, such as current in amperes and magnetic field in oersteds. This often leads to confusion because equations do not balance dimensionally. If you must use mixed units, clearly state the units for each quantity in an equation.

The SI unit for magnetic field strength *H* is A/m. However, if you wish to use units of T, either refer to magnetic flux density *B* or magnetic field strength symbolized as µ0*H*. Use the center dot to separate compound units, e.g., “A·m2.”

# Helpful Hints

## Figures and Tables



Fig. 1. Magnetization as a function of applied field. Note that “Fig.” is abbreviated. There is a period after the figure number, followed by two spaces. It is good practice to explain the significance of the figure in the caption.

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TABLE I

Units for Magnetic Properties

|  |  |  |
| --- | --- | --- |
| Symbol | Quantity | Conversion from Gaussian and  CGS EMU to SI a |
| F | magnetic flux | 1 Mx ® 10-8 Wb = 10-8 V·s |
| *B* | magnetic flux density,  magnetic induction | 1 G ® 10-4 T = 10-4 Wb/m2 |
| *H* | magnetic field strength | 1 Oe ® 103/(4p) A/m |
| *m* | magnetic moment | 1 erg/G = 1 emu  ® 10-3 A·m2 = 10-3 J/T |
| *M* | magnetization | 1 erg/(G·cm3) = 1 emu/cm3  ® 103 A/m |
| 4p*M* | magnetization | 1 G ® 103/(4p) A/m |
| s | specific magnetization | 1 erg/(G·g) = 1 emu/g ® 1 A·m2/kg |
| *j* | magnetic dipole  moment | 1 erg/G = 1 emu  ® 4p ´ 10-10 Wb·m |
| *J* | magnetic polarization | 1 erg/(G·cm3) = 1 emu/cm3  ® 4p ´ 10-4 T |
| c*,* k | susceptibility | 1 ® 4p |
| cr | mass susceptibility | 1 cm3/g ® 4p ´ 10-3 m3/kg |
| m | permeability | 1 ® 4p ´ 10-7 H/m  = 4p ´ 10-7 Wb/(A·m) |
| mr | relative permeability | m ® mr |
| *w, W* | energy density | 1 erg/cm3 ® 10-1 J/m3 |
| *N, D* | demagnetizing factor | 1 ® 1/(4p) |

Vertical lines are optional in tables. Statements that serve as captions for the entire table do not need footnote letters.

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Figure axis labels are often a source of confusion. Use words rather than symbols. As an example, write the quantity “Magnetization,” or “Magnetization *M*,” not just “*M*.” Put units in parentheses. Do not label axes only with units. As in Fig. 1, for example, write “Magnetization (A/m)” or “Magnetization (Am-1),” not just “A/m.” Do not label axes with a ratio of quantities and units. For example, write “Temperature (K),” not “Temperature/K.”

Multipliers can be especially confusing. Write “Magnetization (kA/m)” or “Magnetization (103 A/m).” Do not write “Magnetization (A/m) ´ 1000” because the reader would not know whether the top axis label in Fig. 1 meant 16000 A/m or 0.016 A/m. Figure labels should be legible, approximately 8 to 12 point type.

## References

Number citations consecutively in square brackets [1]. The sentence punctuation follows the brackets [2]. Multiple references [2], [3] are each numbered with separate brackets [1]–[3]. When citing a section in a book, please give the relevant page numbers [2]. In sentences, refer simply to the reference number, as in [3]. Do not use “Ref. [3]” or “reference [3]” except at the beginning of a sentence: “Reference [3] shows ... .” Unfortunately the IEEE document translator cannot handle automatic endnotes in *Word*; therefore, type the reference list at the end of the paper using the “References” style.

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Please note that the references at the end of this document are in the preferred referencing style. Give all authors’ names; do not use “*et al*.” unless there are six authors or more. Use a space after authors' initials. Papers that have not been published should be cited as “unpublished” [4]. Papers that have been submitted for publication should be cited as “submitted for publication” [5]. Papers that have been accepted for publication, but not yet specified for an issue should be cited as “to be published” [6]. Please give affiliations and addresses for private communications [7].

Capitalize only the first word in a paper title, except for proper nouns and element symbols. If you are short of space, you may omit paper titles. However, paper titles are helpful to your readers and are strongly recommended. For papers published in translation journals, please give the English citation first, followed by the original foreign-language citation [8].

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Number equations consecutively with equation numbers in parentheses flush with the right margin, as in (1). First use the equation editor to create the equation. Then select the “Equation” markup style. Press the tab key and write the equation number in parentheses. To make your equations more compact, you may use the solidus ( / ), the exp function, or appropriate exponents. Use parentheses to avoid ambiguities in denominators. Punctuate equations when they are part of a sentence, as in

(1)

Be sure that the symbols in your equation have been defined before the equation appears or immediately following. Italicize symbols (*T* might refer to temperature, but T is the unit tesla). Refer to “(1),” not “Eq. (1)” or “equation (1),” except at the beginning of a sentence: “Equation (1) is ... .”

## Other Recommendations

Use one space after periods and colons. Hyphenate complex modifiers: “zero-field-cooled magnetization.” Avoid dangling participles, such as, “Using (1), the potential was calculated.” [It is not clear who or what used (1).] Write instead, “The potential was calculated by using (1),” or “Using (1), we calculated the potential.”

Use a zero before decimal points: “0.25,” not “.25.” Use “cm3,” not “cc.” Indicate sample dimensions as “0.1 cm ´ 0.2 cm,” not “0.1 ´ 0.2 cm2.” The abbreviation for “seconds” is “s,” not “sec.” Do not mix complete spellings and abbreviations of units: use “Wb/m2” or “webers per square meter,” not “webers/m2.” When expressing a range of values, write “7 to 9” or “7-9,” not “7~9.”

A parenthetical statement at the end of a sentence is punctuated outside of the closing parenthesis (like this). (A parenthetical sentence is punctuated within the parentheses.) In American English, periods and commas are within quotation marks, like “this period.” Other punctuation is “outside”! Avoid contractions; for example, write “do not” instead of “don’t.” The serial comma is preferred: “A, B, and C” instead of “A, B and C.”

If you wish, you may write in the first person singular or plural and use the active voice (“I observed that ...” or “We observed that ...” instead of “It was observed that ...”). Remember to check spelling. If your native language is not English, please get a native English-speaking colleague to proofread your paper.

# Future Scope

The project is in early stage and can be expanded to fulfill a lot of requirements such as the following.

1. Mobile Application Development

* Mobile App for Data Monitoring: Develop a mobile application for both Android and iOS platforms that displays real-time and historical water usage data. The app can provide graphical representations of water consumption trends, daily/weekly/monthly usage reports, and alerts for unusual water flow patterns.
* Remote Control and Notifications: The app can enable users to remotely control the water flow (e.g., shutting off water in case of a leak) and set up notifications for specific events such as excessive water usage, leaks, or system malfunctions.

1. Integration with IoT and Smart Home Systems

* Wi-Fi or Bluetooth Connectivity: Adding wireless communication modules to the device can enable remote monitoring and control. This allows users to access real-time water usage data from anywhere via an internet connection.
* Smart Home Integration: The device can be integrated with smart home ecosystems such as Google Home, Amazon Alexa, or Apple HomeKit. This would allow users to receive voice alerts, automate water usage monitoring, and control water flow through voice commands.\

3. Advanced Data Analytics and Machine Learning

* Predictive Analytics: Implement machine learning algorithms to analyze water usage patterns and predict future consumption. This can help in detecting leaks, predicting high usage periods, and optimizing water usage.
* Anomaly Detection: Use data analytics to identify anomalies in water flow that may indicate leaks, broken pipes, or unauthorized usage. This feature can help in early detection and prevention of water wastage.

# Conclusion

In this paper, we presented a water measuring device utilizing an Arduino UNO microcontroller and a YF-S201 water flow sensor. The device offers a reliable solution for monitoring water flow rates in various applications. By integrating these components and employing meticulous methodology, we ensured accurate and real-time measurement and display of water flow data. This research contributes to the advancement of water resource management through accessible flow rate monitoring. Future work may involve optimization for specific applications and integration of additional sensors for comprehensive monitoring. Overall, this study showcases the potential of Arduino-based solutions in addressing water management challenges for sustainable usage.

The future scope of the water flow measurement device is vast and promising. By incorporating advanced technologies such as IoT, mobile applications, data analytics, and machine learning, the device can evolve into a comprehensive water management solution. This will not only enhance user convenience and control but also contribute to water conservation efforts and sustainable resource management.

Additionally, expanding the device's capabilities to include water quality monitoring and environmental impact assessments can provide a comprehensive solution for both quantity and quality management. Scaling the device for larger applications and ensuring regulatory compliance will facilitate its adoption in various sectors, from residential to industrial and municipal.

X . Acknowledgment

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1. ***(Footnotes like this may be included as per requirement)***

   It is recommended that footnotes be avoided (except for the unnumbered footnote with the receipt date on the first page). Instead, try to integrate the footnote information into the text. [↑](#footnote-ref-2)