Gas Flow Totalizer and Controlling System Using Turbine Flow Meter

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Abstract:- **In many industries, gas is used as fuel or for different processes, and it's very important to measure how much gas is being used and control the flow to avoid waste, ensure safety, and maintain efficiency. This project is about creating a smart system that can do exactly that measure the gas flow and control it automatically using a device called a turbine flow meter .A turbine flow meter works by placing a small rotating blade (like a fan) inside the gas pipeline. When gas flows through, it spins the blade. The faster the gas flows, the faster the blade spins. A sensor counts how many times it spins, and this data is used to calculate two things:**

1. **Flow rate – how fast the gas is moving right now.**
2. **Total flow – how much gas has passed through in total (this is called the "totalizer").**

This system uses a microcontroller (like an Arduino) to read the signals from the turbine flow meter. It calculates and displays the current gas flow and the total amount used on a screen. The user can see this information in real-time. But it doesn't stop there this system can also control the gas flow automatically. If the gas flow is too high or too low, the system can open or close a valve, or even shut off the supply to prevent accidents or gas wastage. It can also trigger alarms if something goes wrong, like a leak or sudden pressure drop .This kind of system is useful in many areas such as factories, chemical plants, gas stations, or even in large kitchens or laboratories anywhere that gas flow needs to be monitored and managed .By combining accurate measurement with smart control, this project helps improve safety, efficiency, and cost savings. It can also be expanded to support remote monitoring using IoT (Internet of Things) so you can check gas usage from a phone or computer.

In short, this project builds a smart, automated, and reliable gas flow measurement and control system using a turbine flow meter making gas usage safer and more efficient.

Keywords:- **Gas Flow Measurement, Turbine Flow Meter, Flow Totalizer, Flow Rate Monitoring, Automatic Flow Control, Microcontroller, Real-Time Display, Gas Flow Regulation, Safety System, Signal Processing, Valve Control ,Data Logging.**

1.INTRODUCTION

Gas is widely used in industries for heating, chemical processing, fuel, and other purposes. In these environments, it's very important to know how much gas is being used and to control the flow accurately. If too much gas flows, it can be dangerous or wasteful. If too little flows, the process might not work properly. That's why we need a system that can measure and manage gas flow automatically. This project focuses on building a Gas Flow Totalizer and Controlling System using a turbine flow meter. A turbine flow meter is a device that has a small fan-like rotor inside a pipe. When gas flows through the pipe, the rotor spins. The speed of this spinning tells us how fast the gas is flowing, and by counting the spins, we can calculate the total amount of gas used. The signals from the turbine meter are read by a microcontroller (like an Arduino), which processes the data and displays the current flow rate and total flow on a screen. The system also includes automatic control, so it can open or close valves based on the flow for example, to stop the flow if it becomes too high or too low.

This kind of system is very useful in industries because it helps:-Reduce gas waste, Improve safety, Save money and automate the process without needing constant human monitoring.

2.LITERATURE SURVEY

Sr. No.	Author(s)	Research Paper Title	Key Findings / Contributions
1.	Bunyamin, Nyayu Latifah Husni, Hasan Basri, Irsyadi Yani	Challenges in Turbine Flow Metering System: An Overview	Identified challenges in turbine flow metering, such as discrepancies between manual metering and Electronic

			Volume Correctors (EVC).
2.	Sylwia Włodarczak, Marek Ochowiak, Michal Doligalski, Magdalena Matuszak	Flow Rate Control by Means of Flow Meter and PLC Controller	Designed a flow measurement system using a PLC-controlled turbine flow sensor (Gems FT-210). The system provided accurate flow measurements and enhanced automation capabilities.
3.	Minemura et al.	Simultaneous Measurement of Volumetric Flowrates of Gas–Liquid Bubbly Flow Using a Turbine Flowmeter	Demonstrated a method to measure gas and liquid flow rates simultaneously in two-phase flows using a turbine flowmeter, achieving accuracies of 3.2% for gas and 1.5% for liquid.
4.	Ziyan Tang, Ningde Jin, Yiyu Zhou, Weikai Ren	Measurement of Gas-Liquid Flows in Vertical Pipes Using Turbine Flow Meter and Conductance Sensor	Investigated the performance of turbine flow meters in gas-liquid two-phase flows by combining them with a rotating electric field conductance sensor (REFCS). Evaluated three models (mass, momentum, torque) and found that the torque model combined with the Chisholm slip ratio model achieved the best accuracy, with an average absolute deviation of 1.23 m³/d and an average absolute percentage deviation of 7.69%.
5.	Fitria Hidayanti	Working Principle of Gas Turbine Meter Fluxi 2000/TZ and Gas Volume Converter Corus	Discussed the operation of the Fluxi 2000/TZ gas turbine meter and the Corus gas volume converter, highlighting their roles in improving measurement accuracy by accounting for temperature, pressure, and gas compressibility.

3.PROPOSED METHODOLOGY

This project aims to measure the gas flow using a turbine flow meter and control it automatically using electronic components and a microcontroller. Here's how we plan to do it, step by step:-

A)Measuring the Gas Flow:-
- We start by installing a turbine flow meter into the gas pipeline.
- As gas flows through the pipe, it spins a small rotor (fan blade) inside the meter.

- The rotor's spinning speed depends on how fast the gas is moving.
- A sensor (usually a magnetic or optical sensor) detects each spin and sends a pulse signal.

B) Processing the Flow Data:-
- These pulse signals are sent to a microcontroller (like Arduino or any other board).
- The microcontroller counts the pulses to calculate:
- Flow rate (how much gas is flowing per second or minute)
- Total flow (how much gas has passed through over time – the "totalizer")

C)Displaying the Results:-
- The calculated data is shown on an LCD or LED display in real-time.
- The user can see:
- Current gas flow rate
- Total gas used (totalizer reading)

D)Setting Limits and Automation:-
- The microcontroller has predefined flow rate limits (set in the code).
- If the gas flow is too high or too low, the system reacts automatically.
- A solenoid valve or motorized valve is used to adjust or shut off the gas.
- This helps prevent accidents or gas wastage.

E)Alert System:-
- If there is a dangerous condition (like a sudden pressure spike or very fast gas flow), the system can:
- Trigger an alarm
- Turn on a warning light
- Or send an alert (if connected to IoT or GSM modules).

4. SYSTEM BLOCK DIAGRAM

The following Fig-1 illustrates the key components and interactions within the Flow Totalizer System.
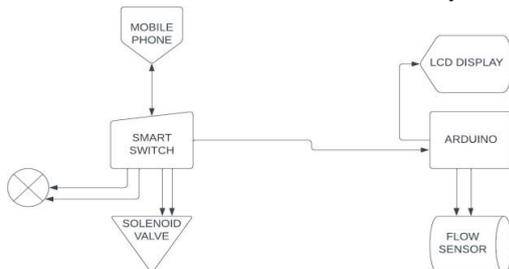
Figure-1: System block diagram

5. IMPLEMENTATION DETAILS

This section explains the technical details of the Flow Totalizer System project in a simple way. It describes how the system works and the technology behind it. The project is designed to measure gas flow and pressure in real time using an Arduino-based system. This part also covers the type of project, the main tools used, the choice of hardware and software, and the required programs for both the user interface (front-end) and the system's internal operations (back-end). The Flow Totalizer System is built using three main hardware components: an Arduino board, a Turbine gas flow sensor, and an LCD display. These parts work together to measure gas flow and show the results on the screen. This section explains each component, including its features, purpose, and how it connects to the system. The software part of the project includes Arduino programming, which collects and processes data, and a user interface that displays the information. This section describes how the software works and how different programs interact to keep the system running smoothly.

To measure gas flow accurately, the system uses a special algorithm. This section explains how the algorithm works, including the mathematical calculations or step-by-step instructions (pseudocode) used to determine flow rates. It also highlights the role of the Turbine Flow sensor in ensuring precise measurements.

Turbine Gas Flow Sensor :
The core algorithm used in this project is responsible for calculating the fluid flow rate and total volume. The key equations are as follows: Flow Rate Calculation : $GAS = FREQUENCY / 7.5$ Volume Accumulation (TOTAL): $TOTAL = TOTAL + LS$
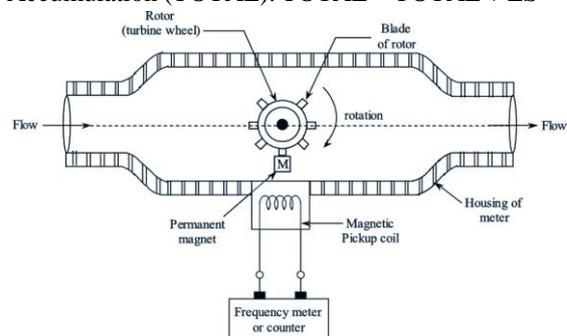
Figure-2:Turbine flow meter

This diagram represents a Turbine Flow Meter, a device used to measure the flow rate of a fluid (like gas or liquid) passing through a pipe.

A)Gas Flow: The gas enters the meter and moves

through the pipe.

B)Rotor (Turbine Wheel): The flow causes the rotor to spin. The speed of rotation depends on the flow rate.

C)Magnetic Pickup Coil & Permanent Magnet: A small magnet is attached to the rotor, and a magnetic pickup coil detects its movement.

D)Frequency Meter/Counter: The pulses are counted and converted into a flow rate reading. Faster rotation means a higher flow rate.

Figure-3: Solenoid Valve

Solenoid Valve:- A solenoid valve is a device that controls the flow of liquids or gases using electricity. It has a small coil of wire and a movable metal piece (plunger). When electricity flows through the coil, it creates a magnetic force that moves the plunger, opening or closing the valve to allow or stop the flow. This makes solenoid valves useful in many applications, such as turning water on and off in irrigation systems.
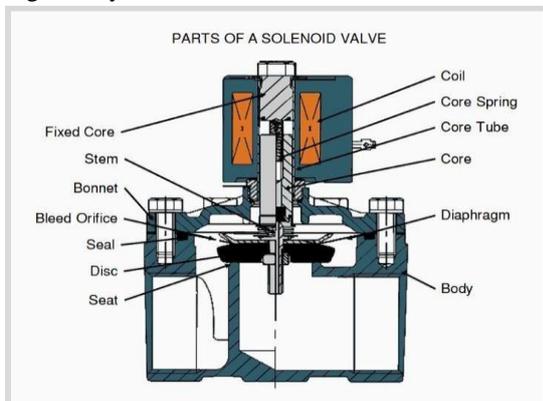

Figure-4: Parts of Solenoid valve

6. RESULT

Figure-5: Final Result of Gas Flow Measurement

Turbine Flow Sensor:-

- This is the black round sensor with red, yellow, and black wires.
- It contains a small fan-like rotor inside.
- As fluid or gas flows through it, the rotor spins.
- The sensor sends pulse signals to the Arduino based on how fast it's spinning.

Arduino Board:-

- This is the blue microcontroller board.
- It reads the pulse signals from the flow sensor.
- Then, it calculates the current flow rate and total volume.
- It acts as the "brain" of the system.

LCD Display:-

- The green screen is a 16x2 characteLCD.
- It shows the live data:
- Volume: This is the flow rate, shown as 6.12 L/M, meaning 6.12 liters per minute.
- Total: This is the total volume passed through the sensor since the Arduino was turned on or last reset — here it's 2.31 liters.
- What the Results Mean:

Volume: 6.12 L/M

- The system is detecting that the fluid is currently flowing at a rate of 6.12 liters every minute.
- This is how fast the gas or liquid is moving through the pipe.

Total: 2.31 L

- Since the system was turned on, a total of 2.31 liters has passed through the pipe.
- This number keeps increasing as long as the fluid is flowing.
- This is what we call the "Totalizer" — it adds up all the flow over time.

Why This is Useful:-

- This setup can be used in industries to monitor gas or water consumption.
- It helps in saving resources and detecting leaks or overuse.
- By adding a valve and some control logic, it can also automatically stop or adjust the flow.
- It's a great example of combining hardware (sensor + Arduino) with software (code that calculates and displays the data).

7. CONCLUSION AND FUTURE SCOPE

The Flow Totalizer System was developed to provide an accurate and affordable way to measure gas flow and monitor pressure. By using an Arduino, a Hall Effect gas flow sensor, and an LCD display, the system has proven to be useful in improving process control and data accuracy.

Adding More Sensors: New sensors can be included to make the system even more precise and useful for different applications.

Wireless Connectivity: The system could be upgraded with wireless features, allowing users to monitor data remotely.

Data Analysis: Connecting the system to data analysis tools can help track flow and pressure trends, making it easier to predict maintenance needs and improve efficiency.

Automation & Smart Control: Integrating automated control mechanisms could allow the system to adjust flow and pressure settings in real-time without manual intervention.

Energy Efficiency: Using energy-saving components and smart algorithms can help reduce power consumption, making the system more eco-friendly.

Compatibility with Different Platforms: The system could be designed to work with mobile apps or web-based interfaces, making it easier to access and monitor from anywhere.

Automated Alerts: Implement real-time notifications for abnormal flow or pressure conditions.

Smart Control System: Enable automatic adjustments based on sensor data to optimize performance.

User-Friendly Interface: Improve the display and controls to make it easier to use.

Industrial Applications: Adapt the system for large-scale industrial and commercial use.

CONCLUSION

The Flow Totalizer System is an important step in improving gas flow measurement and pressure monitoring. It is accurate and easy to use, making it a valuable tool. By overcoming its limitations and adding new features, the system can continue to improve and be used in more industries and applications.

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