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Application of IoT on Water flowmeter

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Abstract
In recent decades, the scarcity of water is a major problem that the big industrial cities and even small towns are suffering from. The only pathway that can lead to a better future with sustainable development is the judicious use of present day resources. Inefficient ways of using the resources can lead the crisis. Water is also an important resource. Usable water is present in limited quantities. Hence, conservation becomes an important measure. A well-automated water flow meter inbuilt with a proper billing system can be an important alternative for water management. This paper describes the automation of mechanical water flow meters. 0.25 inch water flow sensor is being used for analysis. The automation was done by the help of TT-Go microcontroller along with sub components like battery, adapter, cable etc. Here, a microcontroller that is TT-Go helps in calculation of flow and then the flow data is sent to the cloud. The user can abstract the real time data by the help of a website.

Keywords
TT-Go microcontroller, Water flow sensor, Mechanical water flow meter, flow rate of water, flow meter, Website.

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I. INTRODUCTION

Water is one of the most important natural resources for living entities. It is one of the fundamental building blocks. Because of its importance it is treated as a separate discipline of study with a lot of hidden facts and knowledge.

Clean water is the elementary necessity of life without which life cannot be imagined. The idea of water conservation and management arose in the last two decades with the rapid increase in demand for clean water for a healthy biosphere. The complete disordered industrialization results in disturbance of the sustaining ecosystem and completely shifts our biosphere to a new phase. This shifting results in environmental issues such as air, water and soil pollution.

This paper concentrates on the water flow measurement technique with a proper billing system. First of all, water is measured by the help of a mechanical water flow meter which has a rotating turbine. The hall-effect sensor attached to the turbine captures the data and sends it to a microcontroller that is a TT-Go module. The TT-Go contains a GSM module which works on a 2G SIM card and gives it a unique identification number. Then the data goes and is stored in the server. Any user can see the data by going to the website and login via their ID and password. Application instead of website can also be an alternative for data abstraction.

II. PREVIOUS WORKS

Gaurav Gosavi et. Al (2017) introduced about "Smart water flow monitoring and forecasting system" he discussed about this paper includes demand management, asset management, and leakage management aspects of water management system. F. S. Zhang et. Al (2010), introduced about Flow Rate Measurement water/oil/gas three phases with V- Cone Flow Meter he discussed about the mass flow rate of oil/gas/water flow could be measured by V- cone flow meter efficiently and the experiment error is acceptable. Jankovic-Nisic et.Al (2004) introduced about the real life application of water flow meter in paper " Use of flow meters for managing water supply networks". Butean Fabian-Manuel et. Al (2020) introduced about the basic ideas of automation of water flow meter in his paper "design and development of automatic water flow meter ". His idea can provide the foundation for future development of more effective water flow meter.

III. METHODOLOGY

Apparatus details

The various apparatus that we have used in our projects are:-

Water Flow Sensors (0.25 inch and 0.75 inch dia) :- They are used for measuring various ranges of flow. For example the range of flow of 0.25 inch dia water flow sensor is 0.35 liter/min to 3 liter per minute whereas the flow range for 0.75 inch dia water flow sensor is 4 liter/min to 45 liter per minute as shown in fig 1.

Fig 1:- Water flow sensor

TT-Go Module This module has a microcontroller along with GSM module. The microcontroller helps in calculation of flow by the process of quantization and sampling where as the GSM helps in data transfer or connection through server, It also give unique identity number to the device as shown in fig 2.

Fig 2:-TT-Go Module

Jumper Wire: **-** They are the connecting copper wires with insulating above used to establish the connection between the parts as shown in fig 3.

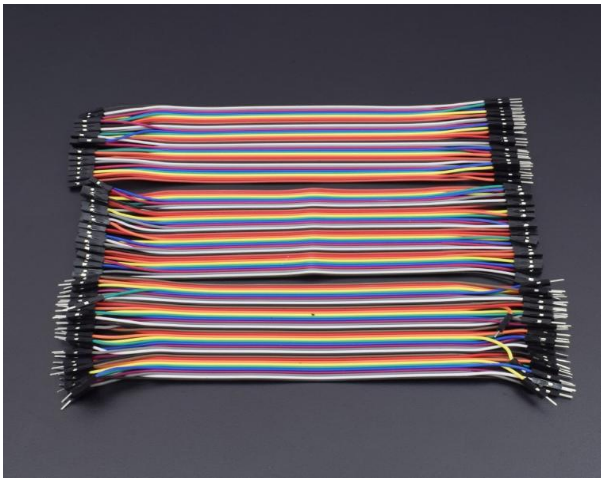


Fig 3:-Jumper wire

Battery and AC adaptor: **-** They are used for continuous power supply to different modules for working shown in fig 4

Connecting cables: **-** They are used for transfer of data or power supply. They are also known as data cables as shown in fig 4

Fig 4:-Power bank and Data cable

Assembling & Working

First, the water flow sensor is connected with TT-Go which is loaded with programming in order to calculate the water flow at any instant. For the power supply we may use AC directly with the 5V input. In the case of discontinuity of power supply, the power bank may be used. One of the ports of the power bank is connected to the charging cable and the other to the TT-Go .

When the water flows through the mechanical water flow sensor, it rotates the turbine in the inner part. The rotation of the turbine is counted by the Hall Effect sensor (just like that in the tachometer) which gives the continuous analog form of data.

This analog form of abstracted data goes to a microcontroller TT-Go. The microcontroller converts this data to a digital form by the process of sampling and quantization .Then the obtained values match with the range flow in the experimental data set and flow is calculated. The real-time addition of flows in a regular time interval will give the discharge.

Now, the calculated data set is transferred to the server and finally stored to the cloud. Any user can abstract these data by going through the web page and login by their personnel credential.

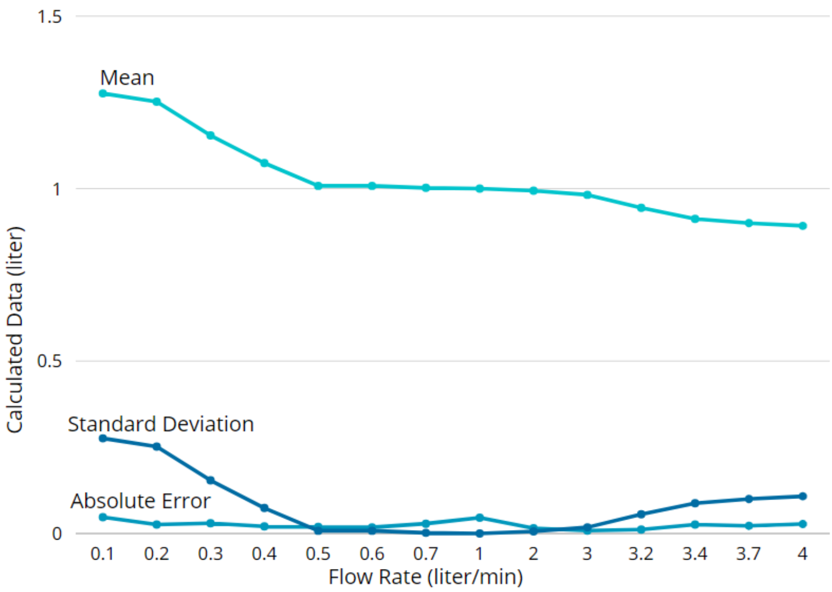
IV. RESULT & CALCULATION

In order to take the observation, we passes 1 liter of water through the sensor at different flow rate and note down the sensor reading. The constant head is maintained by maintaining the water column to a certain height. Change of water column changes the head and hence the flow changes as shown in graphs a, b and c.

Observation Table

Flow (L/min)	Obs 1 (L)	Obs 2 (L)	Obs 3 (L)	Obs 4 (L)	Obs 5 (L)	Mean (L)	Std. Dev.	Abs. Error
0.1	1.28	1.26	1.35	1.27	1.22	1.276	0.0472	0.276
0.2	1.29	1.24	1.26	1.22	1.25	1.252	0.0259	0.252
0.3	1.2	1.15	1.16	1.12	1.14	1.154	0.0297	0.154
0.4	1.1	1.09	1.07	1.06	1.05	1.074	0.0207	0.074
0.5	1	0.98	1.02	1.03	1.02	1.008	0.0192	0.008
0.6	1.03	0.99	0.99	1.02	1.01	1.008	0.0179	0.008
0.7	1.04	1	1.02	0.98	0.97	1.002	0.0286	0.002
1	1.06	0.97	0.99	0.96	1.02	1	0.046	0
2	0.99	1	1.01	0.97	1	0.994	0.0152	0.006
3	0.99	0.98	0.98	0.97	0.99	0.982	0.0084	0.018
3.2	0.93	0.95	0.94	0.94	0.96	0.944	0.0114	0.056
3.4	0.92	0.95	0.91	0.88	0.9	0.912	0.0259	0.088
3.7	0.91	0.93	0.9	0.89	0.87	0.9	0.0224	0.1
4	0.85	0.88	0.92	0.9	0.91	0.892	0.0277	0.108

Graph



When water was flowing at rate of 1 liter/min average value of observation is coming approximately the same as the true value. Hence, at the flow of 1 l/min, the accuracy is maximum but no proper relation can be established between standard deviation and flow.

V. CONCLUSION

This paper gives the idea about an alternative way of water management that can be applicable in present day scenarios. This process can be easily applicable and cost effective. The automation can open the pathway to a advanced water distribution techniques. Further many IOT application can be applied with demand of time to meet with the challenges of the market. The billing system can also be integrated in future to make system self-sufficient. Based upon the study it is found that the mentioned techniques can effectively measure the flow rate of the water. It is also found that the error of estimation of the flow is greater at higher flow rate and lower flow rate. While at the medium flow rate the estimation done through IOT based system suggested in this study is better.

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