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Real-time Water Management System Using Arduino

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Abstract: The Internet of Things (IOT) is used all around the globe for connecting the devices through internet for the purpose of collecting and sharing the data. The "things" in IOT refers to the wireless network having sensors, hardware and software components that are connected together for exchanging the data over internet. This paper proposes a water measuring and controlling system to reduce the current water wastage problems, and also the cheating done with the customers while measuring any kind of fluid. In many big manufacturing industries the measuring and quantifying of the liquid is automated with the help of flow sensors. Various sectors such as the agriculture sector, food processing industries, water management systems, coffee machines, etc. uses the flow sensors.

Keywords **- Water Flow Monitoring, Arduino UNO, sensors, Internet of Things**

1. INTRODUCTION

The measuring of water flow rate and volume by using Arduino and flow sensors has allowed the basic distribution of the water or any other fluid in an efficient manner. Thus, the automation of this distribution of water is a critical process but the pipeline is a significant way for the transportation of water from the water resources to consumer houses [4]. Despite of all the precautions taken and the enormous growth of this water flow system, water can be contaminated through various means such as leakage problem and bursting of pipes with leads to wastage of water. The system becomes a significant challenge as continuous water flow monitoring is required for the control process. To overcome the problem of water wastage, privatization of the water system can be studied to maintain the water supply carefully. It is necessary to maintain the continuous water monitoring to save the environment from various disasters.

So far, the measuring of liquid is done with the Analog measuring tools. The measuring tools that measure the Analog reading often leads to the measurement uncertainty. This is because every individual takes different reading and causes human errors [5]. To avoid these human errors and to ensure the efficiency of the system, the proposed system is totally automated and Arduino based that measures the flow rate and volume of water or any other fluid. Hence, displaying the readings in digital form. The idea of the continuous IOT based water management structure is to give accurate readings. The system contains a couple of sensors along with Arduino to give the measurements of water or fluid. Further, the data recorded is then saved to the cloud that can be accessed by an individual anytime through smart phones. The use of water pumps has increased rapidly. In the field of medical science, the syringe pump has the application of water pump. Several studies have took place that are related with the syringe pump [1].

According to the Law No. 2, the year 1981 concerning Legal Metrology, there should be accuracy and legal certainty in using the measurement units and methods, weighing and measuring instruments and equipment to protect the public interests. In the act it is explained that every item packaged, the actual weight content must be equal to the contents printed and listed on the label or packet [2]. To strengthen the system robustness, the continuous monitoring of the system and immediate reaction in case of any problem is required.

2. LITERATURE SURVEY

"M. Kalimuthu (2020) in Water management and metering system for smart cities"- designed the model to deal with the problem of increasing demand of water in the urban areas but due the lack of proper water distribution system, both the quality and the quantity of water is affected also causes the wastage of water. There is a requirement of a proper water management system with high efficiency. This management system will be used to analyse the quantity and quality of water that is been dispensed in each house and also the quantity of the water that is to be dispensed can be controlled using flow sensor, pH sensor and the sensors data is analysed and stored on the cloud for further processing and analysis of the data. Prepaid billing is also introduced for easy bill generation and also the customer will get a notification if he/she exceeds the limit of water usage with respect to the amount prepaid. As today water is an essential and vital resource for everyone in the world, one can't even survive without water so this water management system will be a great help to distribute water to houses in smart cities efficiently and also save water from unessential wastage of water.

"Nyayu Latifah Husni (2020) in Modified design of water metering system"- To measure the amount of water flow consumed by the customer the analog flow meter has been used widely the in Regional Water Supply. But this analog flow meter is not adequate to measure the quantity of water used by the customer and then convert it properly to the bill amount in rupees. The system involves water flow sensor which detects the velocity of water flow in the form of pulses as this is used to analyse the inputs of the microcontroller. By this system, the output of the flow sensor will be converted as information of how much water consumed and how much amount of money should be paid to the water company in rupees. SIM 800L is used to send the output through SMS.

"Junaidi (2019) in Flow rate and volume control of fluid based on arduino for synthesis of silver nanowires"- The device developed will be a flow rate and volume control system which is based on Arduino. The system consists: container containing liquid, dc motor, keypad, and Arduino UNO which is used as a controller. The principle of the proposed system is to control the pulse width modulation (PWM) and the delay time of dc motor with the help of the Arduino. The aim of this fluid flow and volume rate control system is to control how much amount of the fluid volume enters the chamber for mixing the solution. The proposed system will be provided to the medical field as a substitute for syringe pump.

3. MODELING AND ANALYSIS

The main aim is to design a system that can measure the water flow rate and volume of the water supply through the pipeline with the help of Arduino and flow sensor. The proposed system consists of the Arduino UNO, water flow sensor (YF-S201), connecting wires, pipes, Wi-Fi module used to send the real time data to the cloud server. The water flow sensor uses the principle of electromagnetism (Hall Effect), when the liquid flows through the sensor, the turbine in the sensor spins and generates the pulse, observed by the microcontroller and hence, volume of the liquid passing is determined. The data received and analyzed from the flow sensors is send to the cloud server with the help of Wi-Fi Module.

3.1 Hardware components

Water flow sensor (YF-S201), Arduino UNO, Connector with internal threading, Connecting wires, Pipe, LCD screen, Wi-Fi module, cloud (server)

3.1.1 Water flow sensor (YF-S201)

The YF-S201 water flow sensor works on the principle of Hall Effect. According to the Hall effect, when the magnetic field is applied perpendicular to the flow of current then a potential difference is produced across the electric conductor. The sensor contains a Hall-effect sensor that gives an output pulse rate which is proportional to the flow rate with every revolution [3]. The water flow sensor has 3 wires: Red, Yellow and Black. The pinwheel/ turbine wheel inside the water flow sensor is responsible for measuring the quantity of the liquid. The shaft in the turbine wheel is connected to the Hall Effect sensor and this produces the pulses when water is passed through it. The YF-S201 flow sensor is shown in Figure 1.

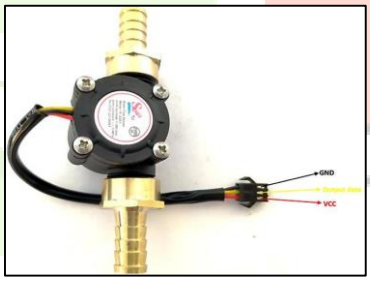


Figure 1: YFS201 Water Flow Sensor

3.1.2 Arduino Uno

Arduino Uno is an open source and flexible electronic platform prototype which enables easy use of both hardware and software [3]. It is a microcontroller which is based on ATmega328P. It consists of 14 digital Input/ Output pins, 6 analog pins, a USB connection and a reset button. Table 1 and Figure 2 shows the technical specifications of the Arduino Uno and the Arduino Uno Board respectively.

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
Length	68.6 mm
Width	53.4 mm
Weight	25 g

Table 1: Technical Specifications of Arduino Uno

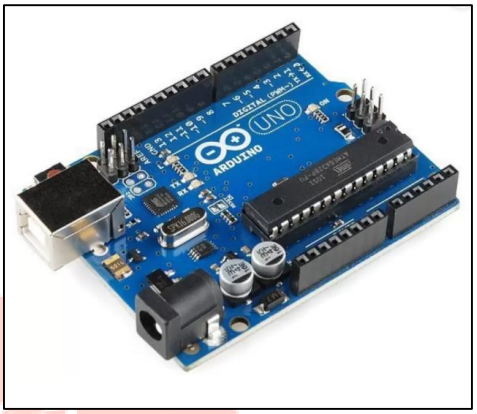


Figure 2: Arduino Uno

3.1.3 Connector with internal threading, Connecting wires, Pipe

Connectors are used to connect the water flow sensor to the pipes, connecting wires are used for the connections between the components of the water measuring & controlling system.

3.1.4 LCD screen

The LCD screen is used to display the water flow rate and volume.

3.1.5 Wi-Fi Module

The Wi-Fi module shown in Figure 3 is integrated with the Arduino Uno Board. ESP8266 Wi-Fi module is integrated with the Uno microcontroller board which is based on the Atmega328P. It is a self-contained system-on-a-chip (SoC) with an integrated TCP/ IP protocol stack that gives the access to the Wi-Fi network. For such a huge, and ever growing community, the Wi-Fi module ESP8266 is an extremely cost effective board [7].

Figure 3: Wi-Fi Module

3.2 Software components

3.2.1 Cloud server

The data recorded by the Water control and measuring system is then send to the cloud server with the help of the Wi-Fi module. There are many cloud platforms that are free source and are available on the internet to which the data is sent to the cloud using the Wi-Fi module and the users can monitor the output i.e. Flow rate and volume that is displayed in the form of graphs or graphical representation [8].

4. PROPOSED METHODOLOGY

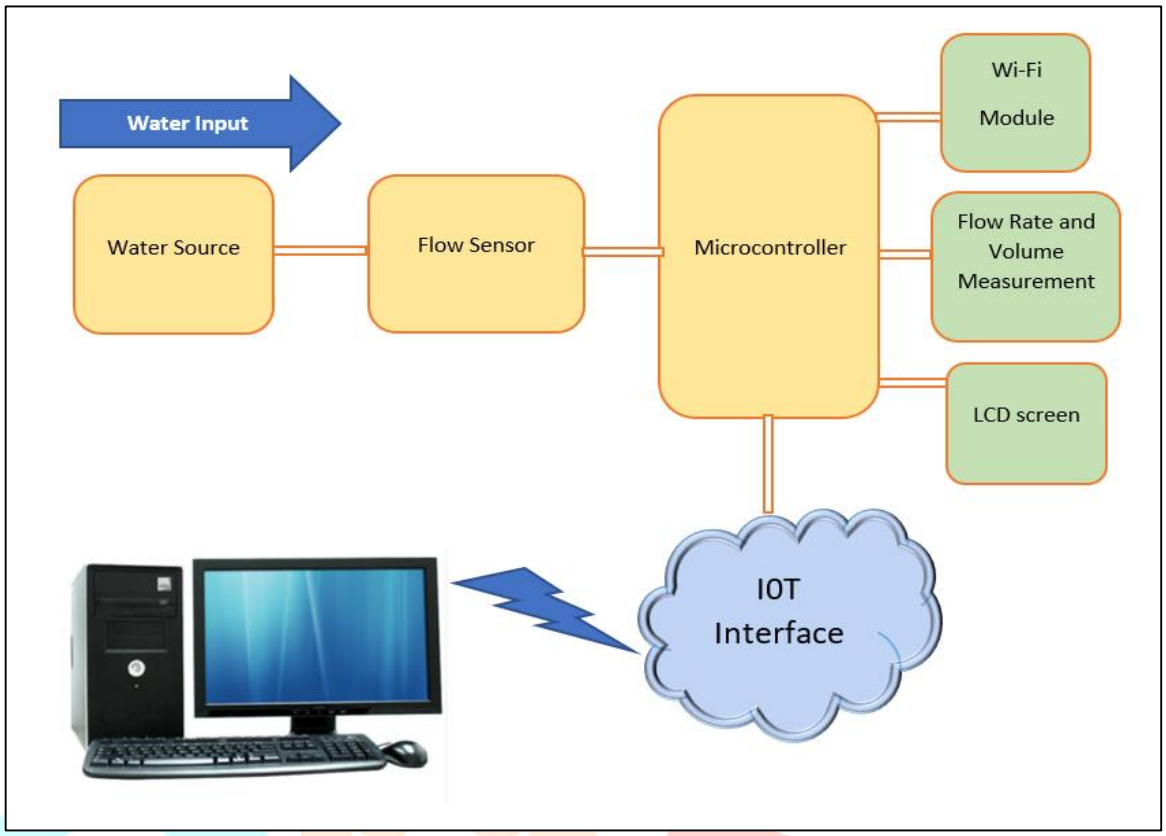


Figure 4: Block diagram of the system

I. Water Source

Water from any available water source is given as an input for measuring its flow rate and volume with the help of flow sensor and microcontroller (Arduino Uno).

II. Flow Sensor

The water input is then passed through the water flow sensor through the valve or inlet of the flow sensor and the flow sensor starts operating on the principle of the Hall Effect. The flow sensor consists of a pinwheel/ turbine which is responsible for measuring the quantity of water or any other liquid.

III. Microcontroller

Arduino UNO is the microcontroller board used here. It consists of 14 digital Input/output pins out of which 6 analog inputs. The microcontroller can simply be connected to the computer with USB cable or providing power supply.

IV. Wi-Fi Module

The Wi-Fi module has all the elements such as CPU, RAM, networking (Wi-Fi) and an operating system alike a modern computer. The Wi-Fi module is integrated on the Arduino Uno board.

V. Flow Rate and Volume Measurement

The flow rate and the volume is measured and is recorded with the help of the flow sensor and microcontroller.

VI. LCD screen

A 16X2 LCD screen is used to display the measurements of the flow rate and volume observed and recorded by the microcontroller.

VII. IOT Interface

All the recorded data is then send to the cloud. In this research, ThinkSpeak cloud server is used to store the real-time data that can be viewed anytime on an individual's mobile phone.

5. RESULTS AND DISCUSSIONS

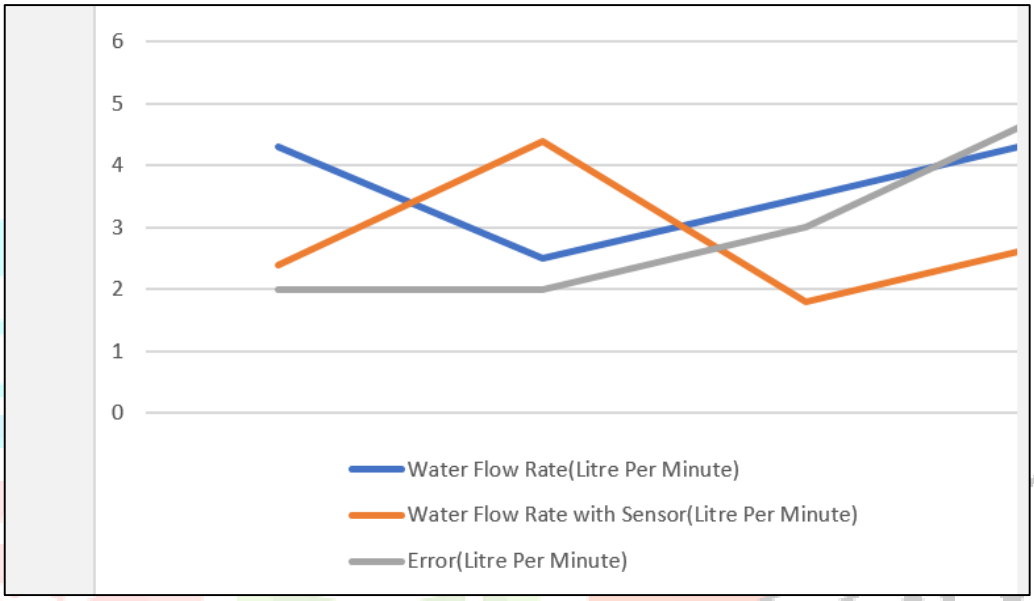
5.1 Previously Existing Systems

The series of tests are carried out for the proper implementation of the system. Table 1 and Graph 1 shows the experimental observations recorded while testing of the earlier systems [10].

Water Flow Rate(Litre Per Minute)	Water Flow Rate with Sensor(Litre Per Minute)	Error(Litre Per Minute)
12.52	11	1.52
10.50	10	0.50
15.28	15	0.28
41.40	41	0.41

Table 1: Comparison between the standard and experimental analysis

For taking the readings, different volume of water is used. It is observed that the actual readings are approximately same to the readings taken by our system.



Graph 1: Comparison of water flow rate with and without using sensor

Graph 1 shows the comparison between the water flow rate (litre per minute) with and without using the flow sensors.

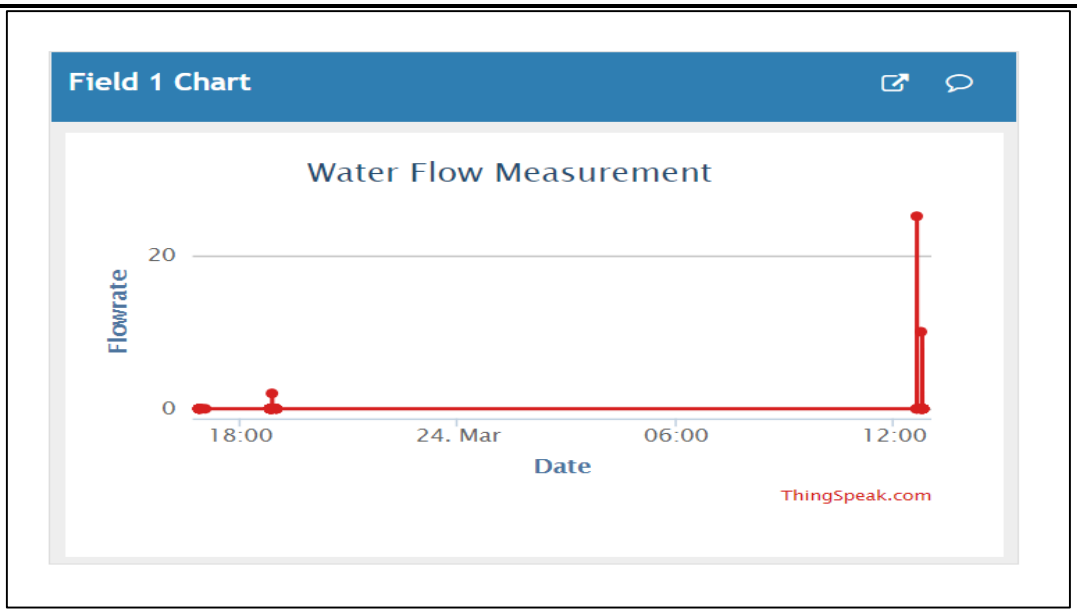
5.2 Proposed System

The Figure 5 and 6 depicts the visuals of the LCD screen, how the Flow rate and Volume (Quantity) of the water or liquid flowing through the flow sensors is measured and displayed on the LCD screen.

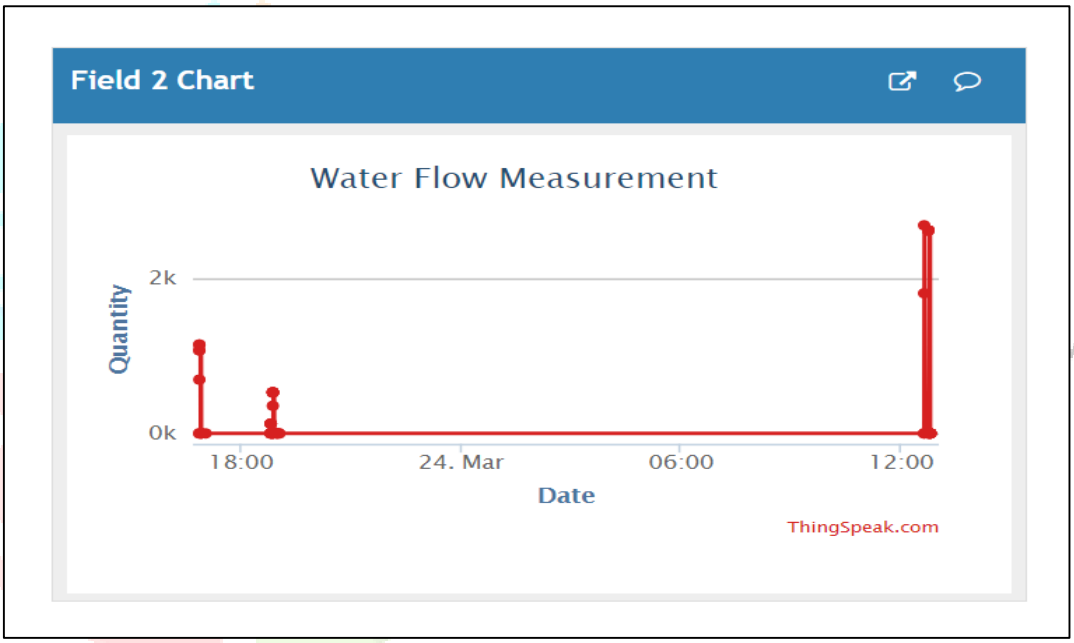
Figure 5: Reading 1

Figure 2: Reading 2

The Graph 2 and 3 shows the real-time data of the Flow rate and Volume/ Quantity of water respectively. In Graph 2, the x-axis shows the Date and Timings (real-time) and the y-axis shows the Flow rate (Litre per minute). In Graph 3, the x-axis shows the Date and Timings (real-time) and the y-axis shows the Volume/ Quantity (Kilo milliliter per minute).



Graph 2: Real-time data of the Flow rate of water



Graph 3: Real-time data of the Volume/Quantity of water

6. Conclusion

The paper will exhibit the fruitful usage of the cloud based approach for estimating, monitoring and controlling the continuous water management system. This paper presented the development of the water control and monitoring system with the help of IOT. Some sensors such as Flow sensor and level detector sensor are used. The data from all the sensors are collected and is used to analyze the efficient distribution of the water supply. The data is send to the cloud server with the help of the Wi-Fi module. This system solves the problem of water wastage as there are many people across the globe who suffer water scarcity, do not have access to safe drinking water. The water flow controlling and monitoring system has enhanced the inspection of the remote pipelines, has enhanced the monitoring system, the real time data can be viewed anytime on cloud server and has led to data processing more accurately and efficiently.

7. Future Scope

The system can monitor water flow rate and volume automatically, also it is low in cost and more efficient. By replacing some of the sensors and modifying the software programs relevantly, this system can be used to monitor and control other parameters of water quality and measurement. More parameters can be detected to form a more secure system. More sensors can be further added to the system to know more parameters.

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