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Digital Water Meter Using Arduino

Kanishk Shrotriya[1], Manish Jain[2], Madhur Mittal[3], Lokesh Yadav[4], Nidhi Vijay[5]
[1,2,3,4]Students, Department of Electrical Engineering, SKIT Jaipur, Rajasthan, INDIA
[5]Assisstant Professor, Department of Electrical Engineering, SKIT Jaipur, Rajasthan, INDIA

ABSTRACT

In this fast paced life water suppliers and consumers needs to introduce a new water system which is more efficient and comparatively quicker. Digital Water Meters are used to measure the volume of water used by residential and commercial buildings that are supplied with water by a public water supply system. Thus by using this we can keep monitoring on the usage of water by different consumers. The main objective of our project is to make water supply more accountable and transparent which reduces the manual assistance, deliver secure and time efficient solution for the complex water system. Apart from grown countries, the water supplies in others present with a sensor which is operated electronically. In this project a GSM based billing system is provided. This is a system which leads to a continual hassle free water supply and billing giving maximum convenience to consumers and enhancement in water usage audit.

***Keywords*--** Automatic Meter Reading System, A Tmega 328, Flow rate of water, Global System for Mobile communication, Hall Effect sensor

I. INTRODUCTION

In many parts of the world analogue water meters have been installed by water companies to measure the consumer's water consumption. These water meters are read on a monthly basis by an authorized employee and the consumer's bill is computed based on the approved rates according to the amount of water consumed. Sometimes the customer premises are not easily accessible and consumption estimates have to be used in computation of the water bill. This is error prone as accuracy cannot be guaranteed. This method of manual data collecting is also expensive, labour intensive and hence inefficient.[1]

Smart water systems can serve as alternatives to overcome the shortcomings of manual metering systems. They are wireless sensor networks which can be installed in thousands of households to collect periodic measurements that are reported in real-time [2].

Water metering is the process of measuring water use. There are two basis of measuring flow, these are volumetric basis and weight basis. The basic relationship for determining the liquid's flow in a pipe is given by the product of cross sectional area of the pipe and the average velocity of the flow. The other factors that affect liquid flow rate include the liquid's viscosity, density and the friction of the liquid in contact with the pipe [3].

Flow sensor based water meter presents very low cost, reliable, quick water meter system accompanying with existing GSM networks. Monthly water usage can be sent to municipal corporation office within fraction of seconds in the form of text message by using existing GSM network. Such metering system reduces manpower, with higher accuracy and less power consumption.[4]

Water meters generally fall into one of these three categories: simple mechanical water meters, mechanical water meters with an electronic communication device, and fully electronic water meters.

One of the popular water flow measurement techniques is the velocity type In this research a turbine type meter which is a velocity-based meter has been employed. In this meter the entire fluid to be measured enters the flow meter, then passes through a rotor. The flowing fluid impinges on the blades of turbine and imparts a force that causes the rotation of the rotor. At the steady state, the speed of the rotor is directly proportional to the fluid velocity, and hence to volumetric flow rate. The speed of rotation is monitored in most of the meters by a magnetic pick-up coil which is fitted to the outside of the meter housing. The pick-up coil consists of a permanent magnet with coil windings which are mounted in close proximity to the rotor but external to the fluid channel. As each rotor blade passes the magnetic pick-up coil, it generates a voltage pulse which is a measure of the flow rate, and the total number of pulses gives a measure of the total amount of water. By digital techniques, the electrical voltage pulses can be com The proposed water meter

system seeks to automate water meter reading by sending a short message to the Utility Company after a specified period. It can solve the challenges the other water meters have posed over a period of time especially in terms of accuracy, cost and efficiency. The system is made up of two parts; these are the hardware and the software components computed [5].

Here ATmega328 microprocessor is used. Making ARDUINO (ATmega328) the brain of the project it operates all the other components. Various functions and working areas make ARDUINO important for the project. Here flow sensors send the input to the arduino and thus arduino does operations as per command given. Arduino receives input from sensor and gives output signals to various components like GSM, LCDs etc. There are two common approaches to flow measurement, displacement and velocity, each making use of a variety of technologies. The automatic meter reading meters integrates an electronic measurement component and a LCD with a mechanical water meter. After processing by the microcontroller unit (MCU) in the electronic module, the data are transmitted to the LCD or output to an information management system.

The proposed system seeks to pay more attention on the use of GSM network to update the water utility company on water consumption. The rest of the paper is organized as follows in section II there is the methodology that gives brief details of the components used, section III discussed about the basic requirements of the topic, section IV gives light on the way we work upon the topic to obtain the results in section V.

II. METHODOLOGY

ATmega328- The high-performance Atmel pico Power 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1024B EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, a 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts.
By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.

Hall Effect Based Flow Sensor- Effective water management involves supplying water according to the real requirement, and thus measuring water is very essential step in water management systems. There are many water flow measurement techniques as well as different types of water flow meters used to measure the volume of water flow in pipelines but these all are too costly. This article describes ideas for design and development of low cost automatic water flow meters, with the help of readily-available and low-cost water flow sensors. Accurate flow measurement is an essential step both in the terms of qualitative and economic points of view. Flow meters have proven excellent devices for measuring water flow, and now it is very easy to build a water management system using the renowned water flow sensor YF-S201. There is an integrated magnetic Hall-Effect sensor that outputs an electrical pulse with every revolution. The "YFS201 Hall Effect Water Flow Sensor" comes with three wires: Red/VCC (5-24V DC Input), Black/GND (0V) and Yellow/OUT (Pulse Output). By counting the pulses from the output of the sensor, we can easily calculate the water flow rate (in litre/hour – L/hr) using a suitable conversion formula.

GSM-A GSM module assembles a GSM modem with standard communication interfaces like RS-232 (Serial Port), USB etc., so that it can be easily interfaced with a computer or a microprocessor / microcontroller based system. The power supply circuit is also built in the module that can be activated by using a suitable adaptor. Controller will give amount of water usage by user in the form of decimal values to the GSM Modem. GSM modem then formats the value in the Message form. The MODEM needs **AT commands**, for interacting with processor or controller, which are communicated through serial communication. These commands are sent by the controller/processor. The MODEM sends back a result after it receives a command. Different AT commands supported by the MODEM can be sent by the processor/controller/computer to interact with the GSM cellular network**.**

III. PRIOR APPROACH

Objectives

The main purpose of the water meter is of protection, control and monitoring of water supply. It has impelled the development and implementation of new technologies, tools and approaches for optimizing the operation of water distribution systems. It also provides Quick and efficient billing

Work Plan

Step I - Developing the structure of digital water meter.
Step II- Writing codes in ARDUINO and debugging.
Step III - Designing the PROTEUS model of the project.
Step IV- Implementing of codes and testing.
Step V – Making PCB layout on PCB Express and burning of PCB.
Step VI – Installing the codes on the microcontroller and running of project.

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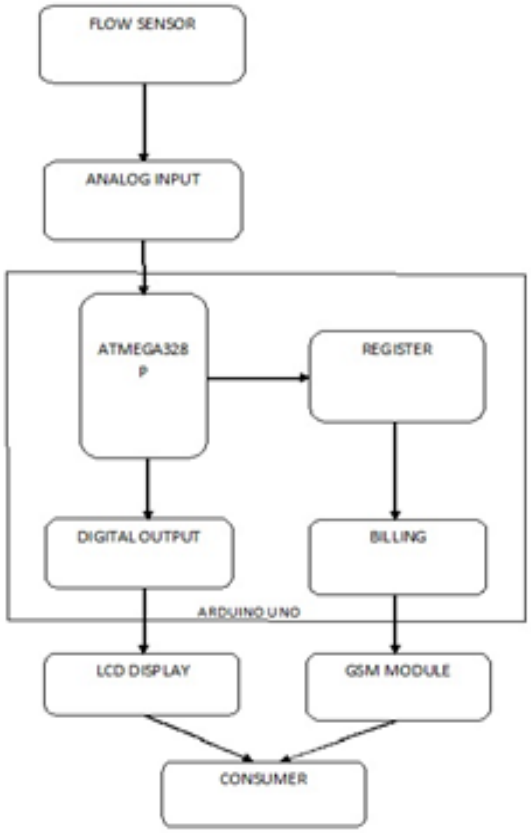


IV. OUR APPROACH

Water meters are used to measure the volume of water used by residential and commercial building that are supplied with water by a public water supply system. Thus by using this we can keep monitoring on the usage of water by different consumers.

Hardware used in the project:

1. Microcontroller (ATmega328)
2. Flow Sensor (Hall-Effect)
3. GSM Module (SIM800)
3. LCD Module (1602A)
4. Step down Transformer

How Does it Work?

The Arduino flow meter works on the principle of the Hall Effect. According to which, a voltage difference is induced in a conductor transverse to the electric current and the magnetic field perpendicular to it. Here, the Hall Effect is utilized in the flow meter using a small fan/propeller shaped rotor which is placed in the path of the liquid flowing. The liquid pushes against the fins of the rotor, causing it to rotate. The shaft of the rotor is connected to a Hall Effect sensor. It is an arrangement of a current flowing coil and a magnet connected to the shaft of the rotor, thus a voltage/pulse is induced as this rotor rotates. In this flow meter, for every liter of liquid passing through it per minute, it outputs about 4.5 pulses. This is due to the changing magnetic field caused by the magnet attached to the rotor shaft as seen in the picture below. We measure the number of pulses using an Arduino and then calculate the flow rate in liters per hour (L/hr) using a simple conversion formula.

Connecting the Arduino to the Flow Rate Sensor

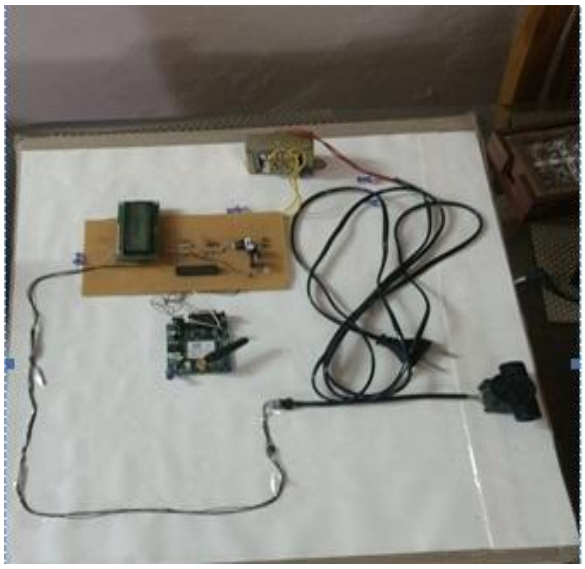
The connections required for this flow rate sensor with respect to the Arduino is very minimal. There are only three wires coming from the flow rate sensor the 5V Vcc (Red wire), the GND (Black wire) and the signal/pulse (Usually yellow) line. Connect the Vcc and GND of the flow meter to the Arduino's Vcc and GND. The pulse line of the flow rate sensor is connected to the Arduino's digital pin 2.

Connecting Arduino with GSM

Here are two ways of connecting GSM module to arduino. In any case, the communication between Arduino and GSM module is serial. So we are supposed to use serial pins of Arduino (Rx and Tx). So if you are going with this method, you may connect the Tx pin of GSM module to Rx pin of Arduino and Rx pin of GSM module to Tx pin of Arduino. **GSM Tx –> Arduino Rx** and **GSM Rx –> Arduino Tx**. Now connect the ground pin of arduino to ground pin of gsm module. Now you can load different programs to communicate with gsm module and make it work.

To send an SMS, we should set our GSM module to Text mode first. This is achieved by sending an AT Command "AT+CMGF=1" We send this command by writing this to SoftwareSerial port. To achieve this we use the my Serial. println() function. My Serial. println writes data to software serial port (the Tx pin of our Software Serial – that is pin 10) and this will be captured by GSM module (through its Rx pin). After setting the GSM module to Text mode, we should the the mobile number to which we shall send the SMS. This is achieved with AT command "AT+CMGS=\"+91xxxxxxxxxx\"\r" – where you may replace all x with the mobile number.

In next step, we should send the actual content of SMS. The end of SMS content is identified with CTRL+Z symbol. The ASCII value of this CTRL+Z is 26. So we send a char (26) to GSM module using the line my Serial. Println ((char)26); Each and every AT command may be followed by 1 second delay. We must give some time for GSM module to respond properly. Once these commands are send to GSM module, you shall receive an SMS in the set mobile number.



V. CONCLUSION

On the basis of analysis and design, the system provides a smart water meter with eco- friendly and energy efficient system. As the smart water meters are digitized and automated, high accuracy is maintained by decreasing human efforts. Water theft can be avoided since there are no mechanical parts that can be subjected to tamper. A hall effect sensor based water metering system was used for automated billing, eliminating the drawbacks of traditional water metering systems. The flow meter is giving the reading under tolerable error. All the power equipments are working properly. The GSM module is working satisfactory by sending the bill amount and amount of water used to the fed mobile number.

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