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Automated Drinking Water Supply System and Theft Identification Using Embedded Technology

Sagar Khole[1], Tushar Kolape[2], Mrs.A.P.More[3]

Student, Department of Electronics and Telecommunication Engineering, PES's Modern College of Engineering, Pune, India [1].

Student, Department of Electronics and Telecommunication Engineering, PES's Modern College of Engineering, Pune, India [2].

Asst.Prof, Department of Electronics and Telecommunication Engineering, PES's Modern College of Engineering, Pune, India[3].

ABSTRACT: In urban areas the water supply to residence and commercial establishments are provided at a fixed flow rate. There are incidents of excess water drawn by certain customers/users by connecting motor-pump sets to the waterlines which is considered as water theft. In this project it is proposed to develop an embedded based remote water monitoring and theft prevention system by recording the flow rates at the consumer/user end. In order to implement the proposed water supply system, each consumer should be provided with an embedded based water flow monitoring system consisting of a microcontroller to record the flow rate using a flow sensor and to transmit the same to a remote monitoring station using wireless transmitter and it is also provided with an electrically operated solenoid valve to supply water to the consumers. The valve turns on/off to stop the water supply whenever the flow rate exceed a predefined limit. The solenoid valves are also controlled using real time clock to control flow of water accordingly for a fixed duration of time. It is proposed to employ a gsm modem for wireless communication so that the information can be passed to particular responsible officer's cell phone for immediate action.

KEYWORDS: GSM; Hall Effect Sensor; MySQL; Solenoid Valve; Theft identification

I. INTRODUCTION

With the continuous economic growth, the water demand of enterprises is also increasing. The monitoring of water resource for these enterprises can prevent the occurrence of stealing water and leaking water effectively. Therefore, the monitoring system of urban water supply has aroused extensive attention in recent years. Urban water supply networks form the link between drinking water supply and drinking water consumers. These large-scale networks are vital for the survival of urban life, for maintaining a healthy level of economic development, and for the continuous operation of factories and hospitals.

In world, urban water supply systems are public enterprises, usually part of a local government, and the recent increased interest in privatizing public enterprises has not led to reforms of water systems. Nevertheless, in about 50 cities in the developing world, the water system either has been privatized or franchised to a non-governmental entity for its operation and maintenance.

In existing system, urban water is supplied to the home with the help of some man power. The person in charge will go to the place and then open the valve to that particular area. Once the time is over the person will go again to that place and close the valve. This type of operation needs man power. This is waste of time to go to that place and come back often. Also the people may take excess water for their personal use with the help of motor or some other equipment. Due to this many people will not receive sufficient water for their use.

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II. RELATED WORK

The rapid growth of wide urban residential areas imposes the expansion as well as modernization of water supply facilities.Along with this one more problem is identified in the water supply channels, some people use ½ HP to 1 HP pump to suck the water directly from the channel of their home street[1].In [2] authors used PLC and SCADA systems for water distribution network. Their system included remote terminal units, specific transducers and actuators distributed on a wide geographical area and control and power panels for the pump stations. In [3] authors improved the earlier work by using GSM modules to send message regarding theft or leakage to responsible officer's in the control room. In[4] the authors have implemented the system using ARM controller. The solenoid valve is driven using TRIAC and the controller was responsible for signal to intimate to water supply board.

III. PROPOSED SYSTEM

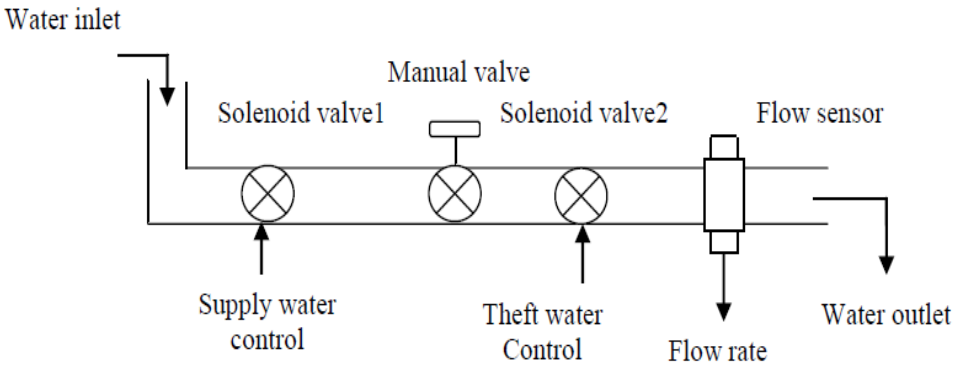

Fig.1.Proposed system

The system is provided with an electrically operated solenoid valve to supply water to the consumers. The valve turns on/off by the central processing station PC to supply the water for a particular time period. The system is provided with another electrically operated solenoid valve to stop the water supply whenever the flow rate exceeds a predefined limit. The microcontroller will switch ON/OFF the solenoid valve using a transistor as a switch. It is proposed to employ a GSM modem for wireless communication so that the information can be passed to particular responsible officer's cell phone for immediate action as well as to the central processing database.

IV. SYSTEM DESCRIPTION

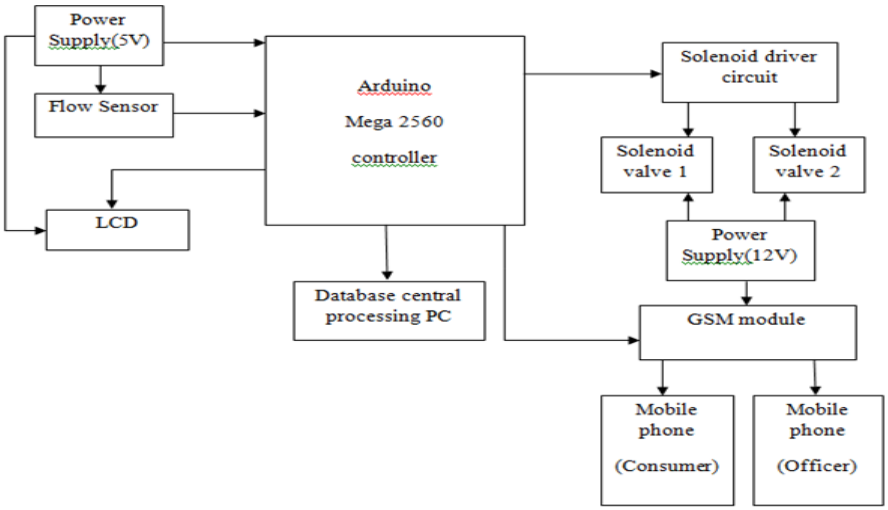

Fig.2.Block Diagram

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The components of the system are:-

4.1. Flow Sensor

In our paper work we are using turbine flow sensor to record the flow rates at the consumer end because of its measurement accuracy, cost efficiency and its usage as seen from Fig.1.

The turbine flow meter translates the mechanical action of the turbine rotating in the liquid flow around an axis into a user-readable rate of flow.The turbine wheel is set in the path of a fluid stream. The flowing fluid impinges on the turbine blades, imparting a force to the blade surface and setting the rotor in motion. When a steady rotation speed has been reached, the speed is proportional to fluid velocity. Water flow sensor consists of plastic valve body, rotor and Hall Effect sensor. The Hall Effect sensor outputs the signal pulses corresponding to rate of flow.The sensor was selected based on the following specifications: availability, cost, power consumption.

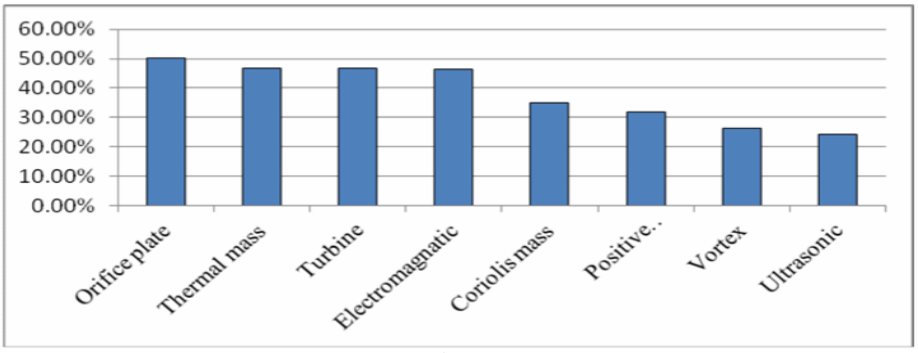

Fig.3.Industrial flow meter usage [1]

4.2. Solenoid Valve

The valve that has been selected here is 2/2 way Normally Open (NO) Valve. It enables the water flow in its resting position. It has two ports (one inlet port and one outlet port) and only one orifice seat. A short electrical impulse enables the solenoid valve to be opened or closed. The residual effect of a permanent magnet is sufficient for maintaining the valve in a particular working position with no electrical energy consumption. The opposite polarity of the electrical impulse will make the valve to retain its original position (i.e.,) to open the valve.

4.3. The Microcontroller Unit

The microcontroller used is Atmega 2560.Some of its features are high speed flash memory of 512KB, SRAM of 8KB, 16Mhz clock. The microcontroller is responsible for counting the flow sensor pulses and determine flowrate. When flowrate exceeds predefined limit, the solenoid valve for theft is turned off by the microcontroller. The microcontroller is also programmed to turn on/off supply water control solenoid valve according to the time of the day. At the end of fixed duration of time the microcontroller sends required data to central database via GSM. When theft is identified appropriate message is sent to particular responsible officer's mobile phone.

4.4. Solenoid Driver Circuit: The TIP102 medium power switching transistor was used to drive solenoid valve as shown in Fig.3.

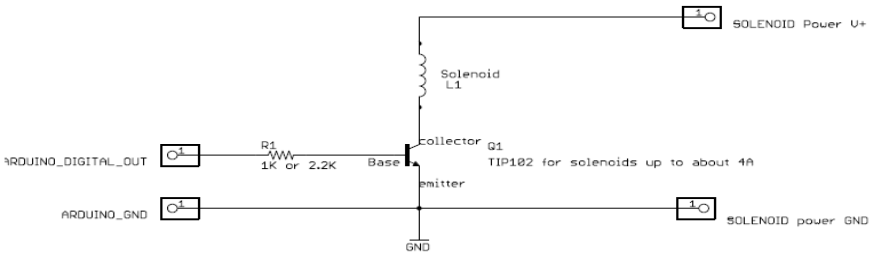

Fig.4.Solenoid driver circuit

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4.5. Gsm Module

The SIM 300 GSM module has been chosen to achieve the SMS functionality. Featuring an industry standard interface, the SIM300 delivers GSM/GPRS 900/1800/1900Mhz performance for voice, SMS, data and fax with low power consumption.

Following AT commands were used:

AT - This command is used to check communication between the module and the computer.

+CMGF - This command is used to set the SMS mode. Either text or PDU mode can be selected by assigning 1 or 0 in the command.

+CMGS - This command is used to send a SMS message to a phone number.

4.6. Central Database Processing Pc

In our system we have used MySQL software to create database. MySQL is an open source database management system. We are using MySQL software to create relational database to store consumer information in the form of tables. MySQL has advantages such as it is open source, fast, reliable, client-server model and works in embedded system.In our system, we are using eclipse software to create java based GUI and for using JDBC (Java database connectivity) concept for interaction with SQL server database.

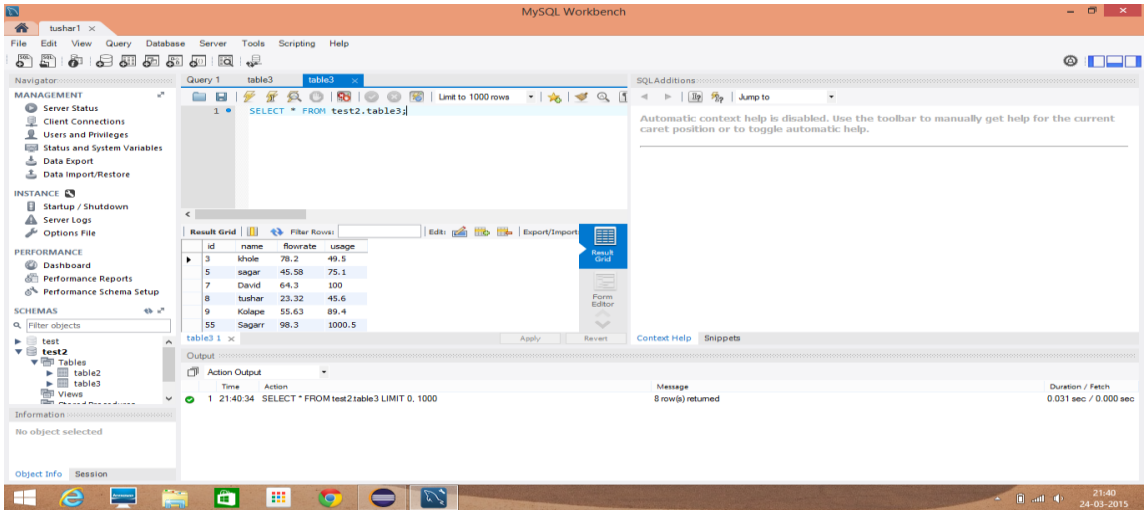

Fig.5.MySQL workbench screenshot with database

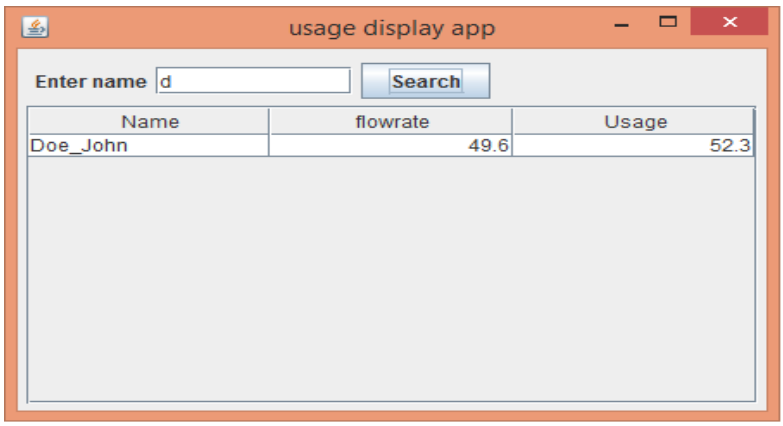

Fig.6.Screenshot of java gui displaying searched name

The fig.6 shows java based gui(graphical user interface) application, showing searched consumer information.

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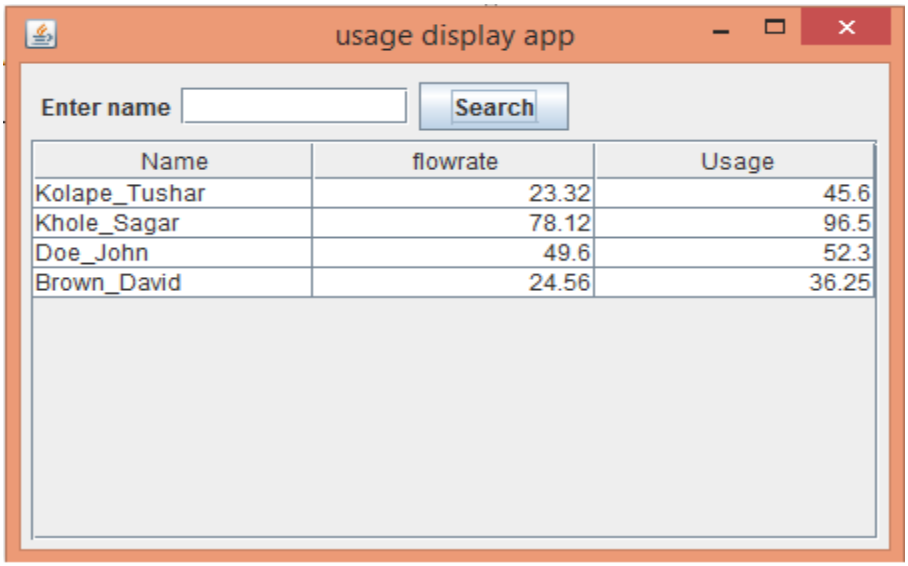

Fig.7.Screenshot of java gui displaying whole list of names

The fig.7 shows java based gui(graphical user interface) application, showing list of all consumer with information stored in database.

V. RESULTS

System will automatically turn on/off the solenoid valve of supply water control so that for a certain amount of time consumer can use the water. For given time, if any consumer uses motor pump to draw excess amount of water then system will automatically identify theft.If theft has been identified, system will take appropriate action such as turning off the solenoid valve of theft.At the end of a fixed duration of time gsm module will send message regarding average flow rate and usage of particular consumer to the central database. also when theft is identified gsm module will send message to particular responsible officer's mobile phone.

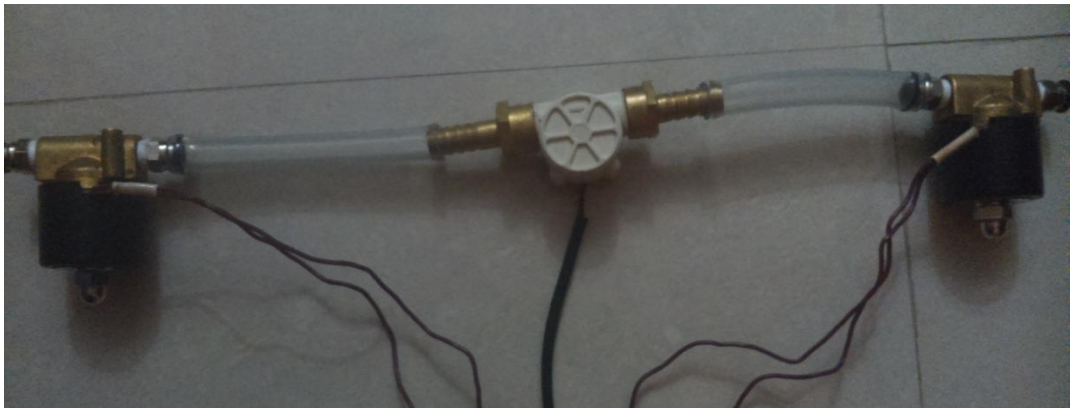

Fig.8.Pipeline unit

The Fig.8.shows the pipeline arrangement. It has two solenoid valves(one input side and another at output side) and one turbine flow sensor.

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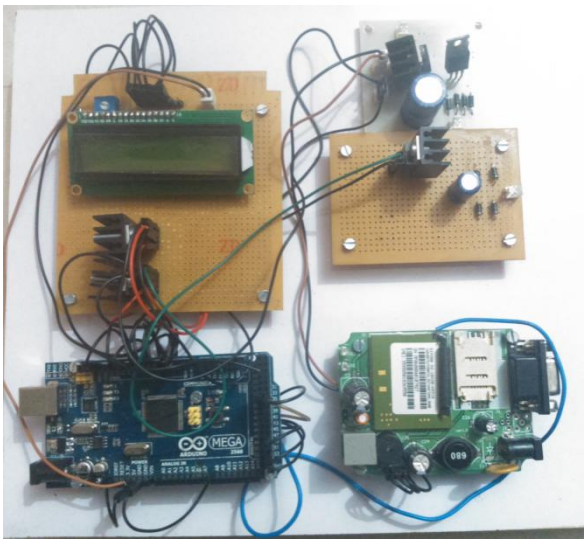

Fig.9.Microcontroller unit

The Fig.9.shows the microcontroller unit of the proposed system. It consists Arduino Mega 2560 controller, LCD, GSM module and power supply sections.

VI. CONCLUSION AND FUTURE WORK

Thus, water supply monitoring and theft detection system was built.Using proposed system, we can make centralized water control and theft detection system. We can ensure fair water supply to all users by preventing water theft and ensuring by taking necessary action. The disadvantage of the existing system that required manpower was eliminated. This real time automation implemented in thesystem avoids wastage of water and reduces time.Due to database, it is possible to monitor the whole system from central office and produce daily, monthly and yearly reports for quantitative analysis of supply water.

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