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DIGITAL WATER MANAGEMENT AND AUTOMATIC BILL GENERATION SYSTEM

Dr. S. Uma Maheswari[1], S. Akkila[2], V. Grace[3], S. Gracia Angeline[4], M. Jennifer Monica[5]

[1]*Professor, Dept. of ECE, Panimalar Engineering College, Poonamalle, Tamilnadu, India*
[2,3,4,5]*UG Students, Dept. of ECE, Panimalar Engineering College, Poonamalle, Tamilnadu, India*

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Abstract - *Water is the elixir of life. For this core factor we need to conserve water in all the aspects possible .The constant development of the world's technologies and the way they become more accessible, enable a transformation in living standards of society. In order to avoid wasting natural and financial resources, water consumption in homes and industries has been the target of consciousness and reduction policies. This paper describes the development of a microcontroller system for telemetric measurement of water consumption using open sources and following the increasing trend of Internet of Things. The proposed system collects data from a water meter, which is equipped with a flow sensor, and sends such information over the internet to a server, dispensing manual reading of the water meter. This method allows live monitoring of water flow consumption patterns of each and every inlets of the flat though the flow meter and to generate the accurate water consumption bill for each flat. And it has an added advantage of leakage detection, open tap detection and no flow detection signalled through SMS. In this study we suggest including cloud storage as well as live monitoring through the website for monitoring live data of water usage and conservation.*

Key Words: Telemetry, Microcontroller, Water Flow Sensor, Consumption, Automatic Billing Generation.

I. INTRODUCTION

Accurate flow measurement is an essential step both in the terms of qualitative and economic points of view. Previously a technique known as ultrasonic flow measurement a non-invasive type of measurement is widely used to calculate flow, because of its capability to avoid noise interferences in its output[2]. Water metering is particularly important for municipalities since it forms the basis for much of their income through the sale of water to their consumers. Many countries currently lack proper water meter management, with many municipalities and bulk water suppliers not having the capacity to undertake and manage optimal and integrated meter calibration, replacement, reading and information management systems[6]. Often the divided responsibility between billing and meter man agreement (typical of the institutional arrangements within most municipalities) results in poor billing, incorrect information capture, and poor maintenance. This is further compounded by the fact that where initiatives of water demand management and conservation are required, the data is not easily accessible to the departments responsible for this task, leading to the frequent lack of integration between domestic and bulk water metering[5].

Conserving water is becoming increasingly important in the world as it faces a widening gap between ever reducing water supplies due to climate change, inefficiencies in agriculture, poor water governance, industrialization, urbanization and increased demand from population growth. It results in many environmental, political, economic, and social forces. There are number of major predictions that III world war might happen because of water. They say: "if you can't measure, you can't manage". So, what exactly happening to the customer is where the associated water bill is managed to linked to the volume consumed, rather than a flat rate or a fee based on the size of property serviced. So, the one who is not using the water most of time have to pay the same amount that of the person using the water at max[4]. This project solves the existing problem economically and efficiently.

1.1 Existing System

In order to avoid wasting natural and financial resources, water consumption in homes and industries has been the target of consciousness and reduction policies[5]. This paper describes the development of a micro controlled system for telemetric measurement of water consumption using open sources and following the increasing trend of Internet of Things[1]. The demerits of the existing system are as follows

- Traditional water meter is used. So only one digital pulse will come out for every 100 ltrs. So live monitoring not possible.
- Maximum of 2 sensors only can able to interface with it.
- Open tap and no flow detection is not available[2].
- Day wise and monthly wise consumption with billing is not available.

1.2 PROPOSED SYSTEM

In this paper, we propose that this system will help us in effective water conservation. In this study we suggest to include cloud storage as well as live monitoring through the website for monitoring live data of water usage and conservation[9]. And also, it has a special advantage of leakage detection, open tap detection and no flow detection alarm. So that we can able avoid the complete leakage of water. We can also be able to monitor the data wirelessly using webpage[3]. And also this project will help us to do effective water conservation. The merits of proposed system

- Up to 32 sensors we can connect with microcontroller.
- Leakage, Open tap and no flow detection is available.
- We are using Hall Effect based water meter, so for minimum flow also we get the pulses out from it.
- Day wise and monthly wise consumption, comparison and bill can be given to promote more water conservation.
- Automatic solenoid valve closing in case of bill not paid.

II. LITERATURE SURVEY

Approximate computing has received vital attention as a promising strategy to decrease power consumption of inherently error tolerant applications. In this paper, It automates the billing system using a low power wireless technology, ZigBee. Water consumption is monitored in real time and the data is transmitted to the data central via ZigBee for storage, billing and maintenance purposes. A human machine interface is designed using NI LabVIEW [2]. The processing the data in real time and automatically is already possible, since sensors and actuators interact which one each other and exchange information through the wired or wireless network wherein times, to connect, the devices use the Internet Protocol (IP), that is called Internet of Things or IoT[16]. This paper proposes alternatives to promote the rational consumption of water. The project presents a solution that adopts: the Wi-Fi protocol - because it is a wireless communication network that has several advantages such as: mobility, compatibility, sharing, accessibility, low maintenance cost, security and popularity[17].

III. MODULE EXPLANATION

3.1 BLOCK DIAGRAM

This paper describes the development of a microcontroller system for measurement of water consumption using open sources and following the increasing trend of Internet of Things[3]. The proposed system collects data from a water meter, which is equipped with a flow sensor, and sends such information over the internet to a server[11], dispensing manual reading of the water meter. This method allows live monitoring of water flow consumption patterns of each and every inlets of the flat though the digital flow meter and to generate the accurate water consumption bill for each flat[4]. And it has an added advantage of leakage detection, open tap detection and no flow detection alarm.

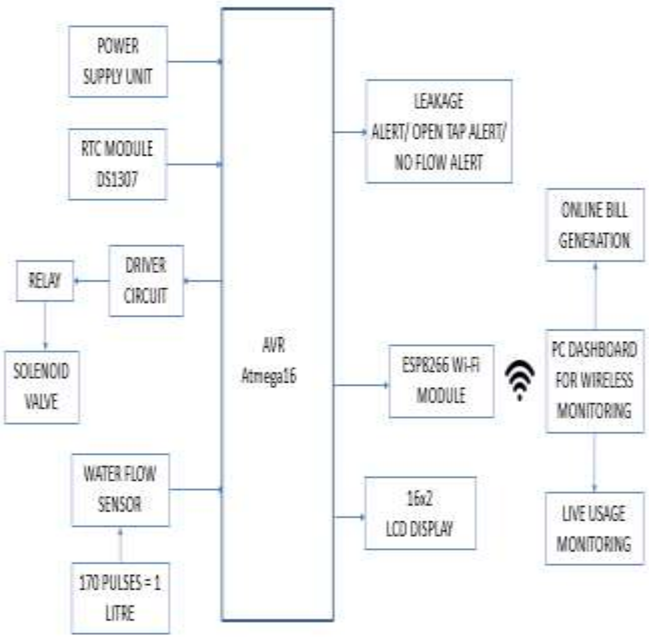

Fig -1: Block Diagram for the Digital Water Management and Automatic Billing System

3.2 METHODOLOGY

The automated measurement system presented here uses a microcontroller that collects consumption data from a pulsed water meter. This information will be transmitted over the Internet to a server[11], where the data will be stored and analyzed, providing the total volume consumed dynamically for the consumer and the distributor. Also, this measuring system makes recognition of a possible leakage easier. And it is possible to eliminate reading made in person, besides making this data available in real time. In addition, the user also can check the measurement history remotely[7], associated with other benefits such as: day-wise, month-wise reliable readings and sensor liability detection.

The sensor is activated by a magnetic field applied on it (a simple magnet, fixed to a disc that rotates as water flows), generating an electrical signal (pulse) that is used in the electronic measurement of the volume of water. To capture process and send the pulses, the ESP8266 module[10] and AVR microcontroller [13] was chosen. The sensor will generate a pulse for each cubic decimetre of volume passed through the water meter. So, the duration of this pulse depends directly on the water flow on the system.

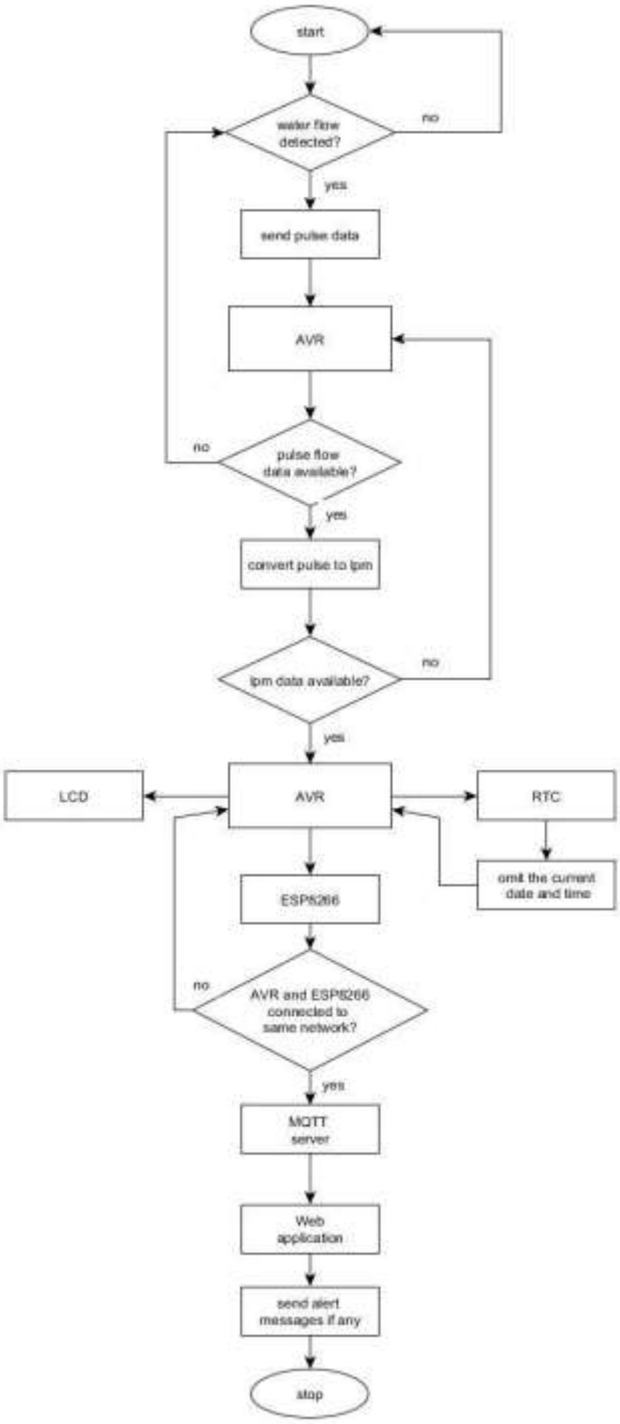

Fig -2: Workflow

3.3 Hardware requirements

ATmega16 AVR Microcontroller

ATmega16 is an 8-bit high performance microcontroller of Atmel's Mega AVR family with low power consumption. Atmega16 is based on enhanced RISC (Reduced Instruction Set Computing, Know more about RISC and CISC Architecture) architecture with 131 powerful instructions. Most of the instructions execute in one machine cycle. Atmega16 can work on a maximum frequency of 16MHz[13].

ATmega16 has 16 KB programmable flash memory, static RAM of 1 KB and EEPROM of 512 Bytes. The endurance cycle of flash memory and EEPROM is 10,000 and 100,000, respectively.

ATmega16 is a 40 pin microcontroller. There are 32 I/O (input/output) lines which are divided into four 8-bit ports designated as PORTA, PORTB, PORTC and PORTD.

ATmega16 has various in-built peripherals like USART, ADC, Analog Comparator, SPI, JTAG etc. Each I/O pin has an alternative task related to in-built peripherals[13].

Paddle Wheel Water Flow Sensor

This is classified as a turbine flow meter. Paddle wheel flow meters are generally divided into two mechanical classes as described below:

(1) Tangential-flow paddle wheel flow meters, with a water wheel structure.

(2) Axis-flow paddle wheel flow meters, with a windmill structure.

The flow and the revolutions of the paddle wheel are proportional to each other. Thus, by spinning the paddle wheel with the force from the flowing fluid, it becomes possible to measure the rate of this flow from the number of revolutions. By embedding a magnet in the rotation axis and on the edge of the paddle, pulses can be extracted as signals, converting the number of revolutions into the flow rate[8].

Fig -3: Water Flow Sensor

FLOW CALCULATION METHODS

$$\text{Instantaneous Flow} = \frac{\text{Flow per single pulse} \times \text{amount of pulses}}{\text{Time}}$$

Table-1: Alert in accordance with LPM

LITRES PER MINUTE	ALERTS
1.5<	Leakage
2.5-3.5	No Alert/Normal Flow
>3.5	Open Tap/Overflow

3.4 SOFTWARE REQUIREMENTS

- **Simulation Tool**
  - Proteus
- **Dashboard Tool**
  - XAMPP
- **Languages**
  - Embedded C, Node JS
- **Development tool**
  - Code VisionAVR
  - Extreme Burner

IV. EXPERIMENTAL ANALYSIS

4.1 USER REGISTRATION SETUP

The following figures illustrate the User Registration Details of the proposed system

Fig -4: Node Authentication

Fig -5: Login Page

The following figure illustrates the home page after the system is online.

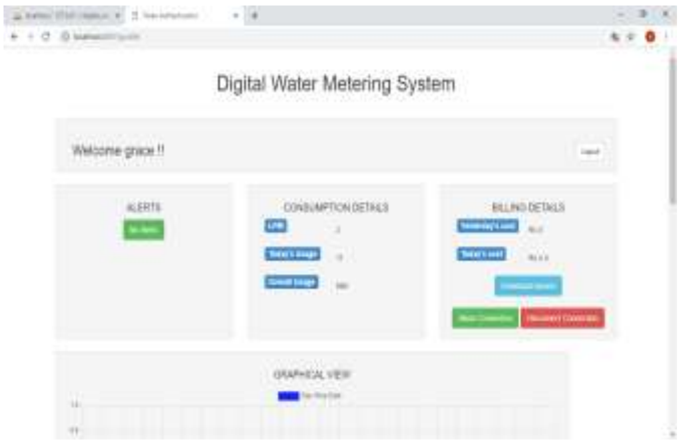

Fig -6: Live Monitoring

4.2 SIMULATION RESULTS

The following figures illustrate the alert detection in accordance with LPM

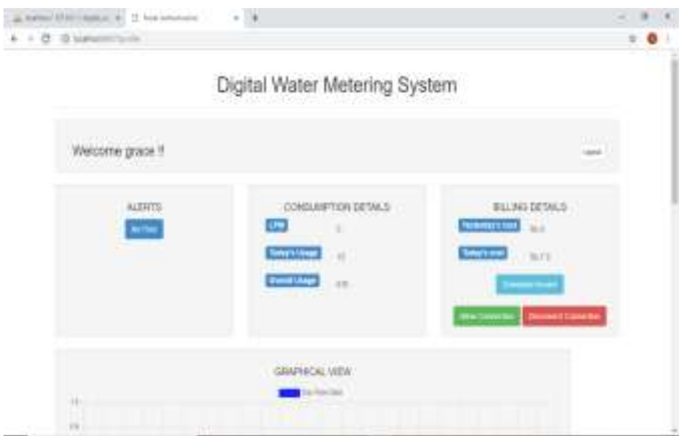

Fig -7: No Flow Alert Indication

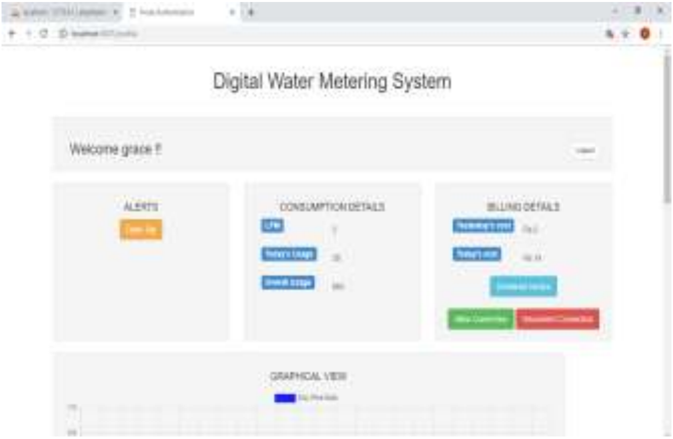

Fig -8: Open Tap Alert Indication

Fig -9: Normal Flow without any Alerts

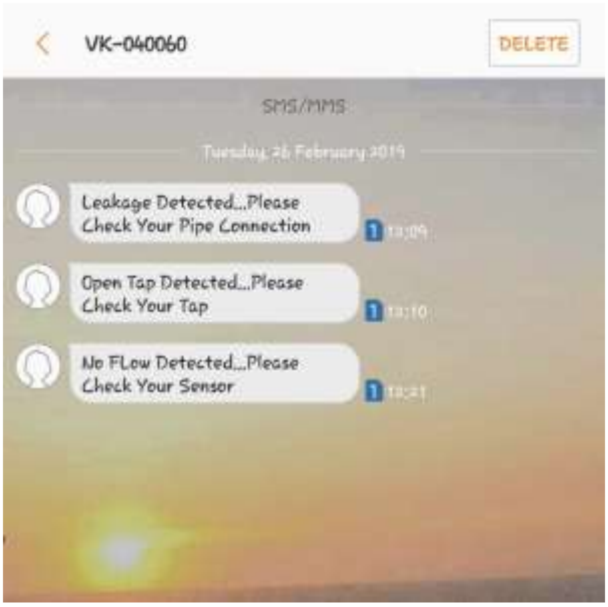

Fig -10: Offline SMS Alert

4.3 COMSUMPTION DATA GRAPH

The following figures illustrate the water consumption day-wise as well as month-wise

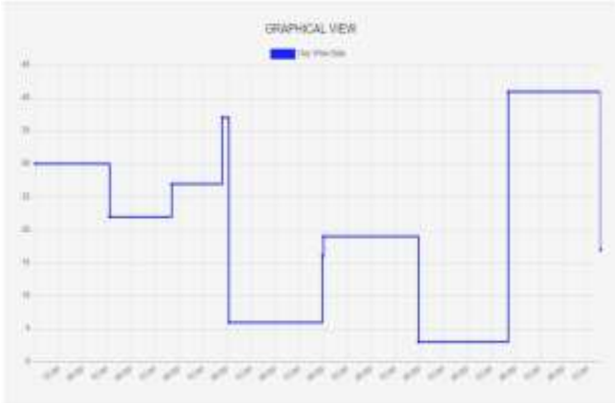

Fig -10: Day-wise Data Consumption

Fig -11: Month-wise Data Consumption

V.CONCLUSION

The proposed work dealt with the development of a microcontroller system for measuring individual domestic water consumption. For this purpose, validation tests were performed in an experimental environment, where the system presented accuracy in its measurement. In this context, it can be concluded that this technology is effective for reading the flow of a water meter. The primary goal has been achieved since the consumer can have graphs reporting the total volume consumed both in day-wise graph and month-wise graph, obtaining more reliable and frequent readings. The concessionaire may also have access to this information to calculate the amount to be paid by the user without the need for a presential reading, eliminating repetitive tasks, reducing the occurrence of reading errors and making it easier to identify possible anomalies.

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