Automated Water Billing with Detection and Control of Water Leakage using Flow Conservation

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Abstract- **This paper deals with automatically collecting the Water consumption by a customer and also detecting the leakages in the water distribution system. Water leakage is an important component of water losses. In addition to raising consumer awareness of their water use, metering is also an important way to identify and localize water leakage. A leak detection program can be highly proactive, helping water utilities automate water systems, detecting problem areas earlier, giving customers tools to monitor water use, providing more accurate rates and reducing demand**. **The objective is to overcome the disadvantages of using current meter technology and make the billing and troubleshooting process faster along with reducing the wastage of water. GSM and ZigBee technology automatically collects consumption, diagnoses, and collects status data from energy meter and transferring that data to a central database for billing, troubleshooting, and analyzing. This advancement saves utility providers the expense of periodic trips to each physical location to read a meter. Another advantage is billing can be based on near real time consumption rather than on estimates based on previous or predicted consumption. This timely information coupled with analysis, can help both utility providers and customers better control to the use and production of water consumption.**

Index Terms **- Flow conservation, Leakage detection, Transceiver, GSM, ZigBee**

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I. INTRODUCTION

Water loss during distribution is considered a major waste. It has been observed that a large amount of water loss happens close to the source of purified water, even before the distribution network. Measurements of per capita water availability indicate that India is currently water stressed; future projections indicate that India may have water scarcity by year 2050. In this scenario, leakages in the water distribution system can have a huge impact on the water availability. **Water flow conservation** encompasses the policies, strategies and activities to manage fresh water as a sustainable resource, to protect the water environment, and to meet current and future human demand.

It also deals with digitally "noting" the energy meter reading(s). This process eliminates the traditional **"paper and pen"** and the errors associated with manual reading/recording/processing of the meter data. AMR came into existence since energy meters turned intelligent which dates back to the deployment of microcontrollers in energy meters. Automatic Meter Reading also makes the data recording fast and saves on time and hence complies with the definition of automation.

II. LITERATURE SURVEY

This model has designed and implemented wireless sensor network for measuring utilities such as electricity, water. Because of disadvantages of traditional meter reading such as errors in reading, inaccuracy, external conditions affecting readings, delayed work we have implemented meter reading system based on latest Zig-Bee technology. This system performs tasks such as taking meter reading, distribution of bills, sending notice, cutting and reconnection of flow automatically.[1]

An automatic remote meter-reading system based on GSM is presented in this paper. This paper is useful to obtain meter reading when desired so meter readers don't need to visit each customer for the consumed data collection and to distribute the bill slips. Microcontroller can be used to monitor and record the meter readings. In case of a customer defaulter, no need to send a person of utility to cut-off the customer connection. Utility can cut off and reconnect the customer connection by short message service (SMS). Furthermore, the customer can check the status of consumption just by sending a simple SMS request. In this system energy meter readings are being transferred by making use of GSM.[2]

Water utility customers also have an important role in leakage control. It is essential that this resource can be captured– not only because it is an increasing scarce supply but also because of its embedded energy and the greenhouse gas footprint it represents. Although in many parts of the country water might be considered the cheapest utility commodity, water loss is still very costly to customers and water utilities.[6]

III. SYSTEM ANALYSIS

Existing System

Existing system is based on past and predicted consumption which is time consuming also there is no concern for preventing water wastage and therefore does not satisfy the business requirements of water utility providers. In addition to the large number of errors incorporated in the reading process which is highly person dependent there is also no leakage control system.

Proposed System

The prototype for the flow conservation is to measure inflow and outflow of water. Water supplied from water distribution authority is stored in ground level reservoirs and overhead tanks and is further distributed to rest of the consumers. This project installs flow measurement sensors at the input and then measure water volume in the water reservoirs. The volume of water inside the reservoir would give the accumulated difference between inflow and outflow of water. Hence, then the outflow can be calculated. If the volume of the water crosses the threshold level, the system will automatically stop the water supply. The water supply can start as soon as the leakage is rectified. Advances in water meter technology can automatically record and report leakage within customer-owned portion of the plumbing by detecting a constant flow of water. Automatic Reading and Management using Mobile Agents can be of great importance for municipalities and energy distribution companies so as to minimize the number of traditional visits required by the distribution company, hence decreasing the number of employees used in performing this traditional time consuming and high cost work. Such technology not only helps to conserve water, but helps the customer avoid unnecessarily high water bills. AMR system is divided into four basic units. These are: Reading unit, Communication unit & leakage detection, Data receiving and processing unit, billing unit.
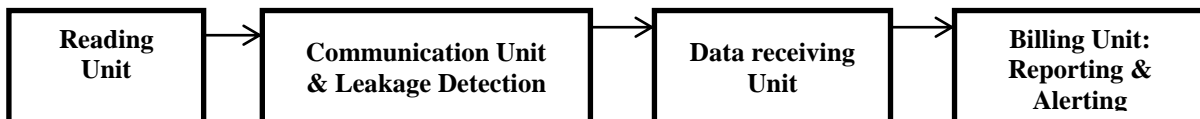

Fig. Block Diagram of whole AMR system.

Reading unit

In this part basically two important jobs have been done. At first the analog meter reading was converted to digital bits sequence (0 or 1). After that the data are available in the microcontroller for transmission.

Communication Unit &Leakage detection

This is one of the most important and challenging part of this system. This part is challenging in that sense, data is the most valuable part for meter reading and billing system. Data should be transmitted in an efficient manner without any loss of data. The prototype for the leakage detection is to measure inflow and outflow of water.

Data receiving and processing unit

This is the third part of the proposed system. In this part the received data is processed by the system for future purpose. For data processing purpose a computer application has been developed. The task of the application was to take a meter number form the user and give the address to the microcontroller through serial port. Then the microcontroller does the communication task. After communication part the microcontroller get the data form transceiver and the meter reading is available in the server end microcontroller. Then the data is sent to the computer and the computer application receives the data from the microcontroller. This data can be stored in the database and can be displayed to the requested user.
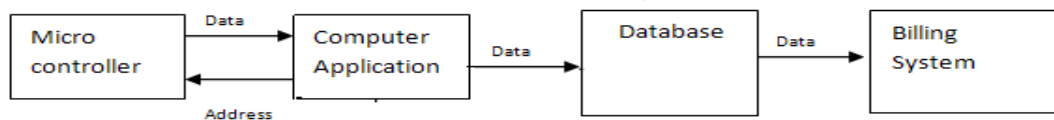

Fig. Block diagram of data receiving and processing unit.

Billing Unit

The billing system has been developed in our system which can take the meter number and can generate bill for that meter. It uses the data of the database those are collected from the meter reading through all the unit of our system.

Features of Proposed System

1. As GSM network is readily available so no need to design any special network.
2. Cost required to send SMS for reading is very less compared to traditional collection methods.
3. We can send bill amount with due date on same GSM module used for transmit reading.

IV. SYSTEM DESIGN

The scheme involves the use of a variety of innovative features. Firstly, the use of High Density Polyethylene pipes that requires fewer joints makes for a more durable system as well as reduces the loss of water through leakages. Secondly, the use of Automatic Meter Reading system has led to effective water auditing possible at any point of time and with cent per cent accuracy.

Proposed system block diagram
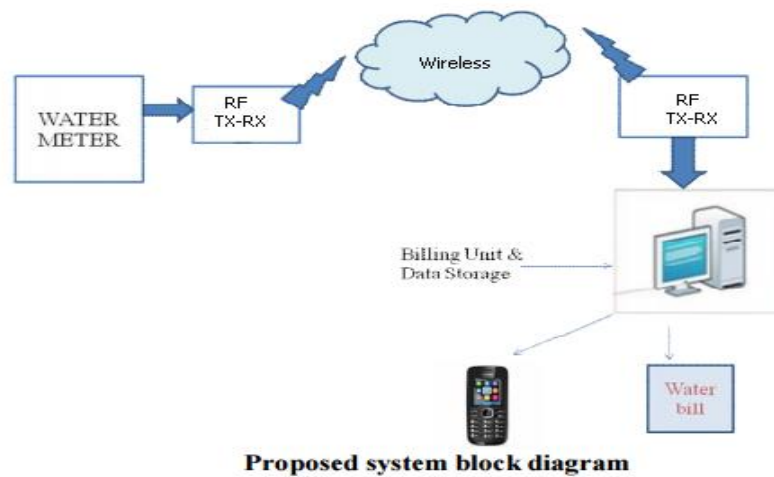
The block diagram of ZigBee and GSM based automatic water meter reading system. In which quantity of water used is measured with the help of flow sensor, which will give square waves output proportional to quantity of the water flow. Sensors output is given to the transceiver at user end through micro controller. The microcontroller sends the data to the database at central water utility provider through ZigBee via transceiver. This data is sent to the billing unit at the central end for calculating the bill. GSM modem then transmits data regarding quantity of water used in the form of SMS to the user. We can take its print or can send it via SMS or Email. Hence no man power is required, reading collection work is done automatically by transceiver.

There are various ways for detecting the water leakage. One of the efficient ways in leakage detection technology is formation of zones. Some systems are subdivided into separate "zones of supply" monitored by master meters that periodically measure water use in a particular area. Higher-than-expected water flow in the middle of the night is a tip-off that a certain spot requires further investigation Wireless sensor network setup for every zone- One cluster head and all other end user meter nodes in that zone. Operating cluster head in two modes:

1. Sending meter readings directly to central server for billing once in a month.
2. Performing all computations at local cluster head and sending computed results to central server in order to alert for water leakage in that zone.

V. CONCLUSION AND FUTURE ENHANCEMENT

As discussed in this paper, leak detection plays an increasingly important role in water conservation. Thus, adopting water conservation methods and technologies that support water preservation and management is an area of increased priority. By investing in such technologies and systems now, communities can significantly reduce consumption and ease the strain on our nation's water supplies.

The paper describes the design and working of Smart Energy Meter and represents how Smart Energy Meter can be used for Automatic Meter Reading. It is the most economical implementation to develop mankind in this era of technology. Detecting leaks helps saving water resources, cost and energy. More water is available to consumers and can be billed. Water recontamination after centralized treatment is less likely to happen in the pipes. With the present enhancement in the use of technology to facilitate mankind, it is an efficient and practical utilization of present networks. This paper also shows that how customer can manage the load by using Smart Energy Meter. It provides ease in taking the meter readings, accuracy, and detection of faulty readings.

The leakage control can be enhanced by incorporating sensors at the line connecting each and every house to detect the leakage. Provisions can be provided to the customers to send an alert message to the authority in case of any faults or damage occurs to the meter or the pipe can be reported to the utility providers by sending an alert message which will stop the water connection to that particular house.

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