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Smart Water Metering System – Using NB-IOT

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Abstract:-

The traditional way of manual water meter reading is more problematic and time consuming, and it wastes resources. A new method to accomplishment automated water meter reading for update of consumption information from field to the Utility office is described in this paper. The smart water metering has been proposed differs from present commercial methods by making use of low cost IOT hardware and software. This method permits both Meter Reader as well as individual domestic / industrial consumers to use regular smartphones to perform consumption of water and update the database at control room. This scheme is also unable to manage the justifiable water resources effectively since it requires efficient, precise and reliable monitoring techniques that enable the utilities sector and consumers to know the level of water consumption in real-time. The Real-time smart water meters that can be monitored by the consumer are essential and constitute a key component of the water management system. A smart water monitoring system will make consumer aware of their water consumption and help them to decrease their water usage. At the same time, consumer will be warned to abnormal water usage to reduce water loss. This method reduces overheads on Utilities in handling meter reading and billing for water distribution in urban and metropolitan cities.

Keywords:-IOT, water-meter, water distribution system, smart cities, software.

I. Introduction:-

The importance of water sustainability has been well familiar. The Frequent initiatives addressing the contests posed by its dwindling quantity and declining quality are currently under way and many of these are supported by substantial funding investments. The world is more and more looking onward to adaptation and use of new technologies to increase quality of life as well as reduce influence of human activities and consumption patterns on environment. The Availability of clean water, its increasing demand from urbanization [1] and increasing population in cities, cost for management of water transmission, storage, treatment, distribution and billing for usage are severe problems in underdeveloped and developed countries. Fastly changes in lifestyle and increased paying capacity have impacted usage of water and related overheads on sewerage requirements. Water Utilities have traditionally looked at managing water distribution as a sensitive task with humanitarian method which sometimes result in uneconomically high cost of water management and skewed cost-sharing arrangements among

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different categories of consumers. Utilities try to meet most of their expenditure on Capital for new installations, operations, maintenance, etc. from consumption metering and billing.

This paper proposes an implementation of smart water metering approach especially suited to third-work countries with limited investments in infrastructure and growing populations and amoeboid extensions to urban habitats. The prototype system relies on the use of simple Narrow Band Internet of Things (NB-IoT) approach for Water-metering in conjunction with a freeboard page. Metering data communication and update to freeboard, dynamic checks for water leakages at consumer end and Utility monitoring of hourly consumption from individual or group of meters for suspected leakages/tampering, etc. are potential advantages using this approach. The paper describes a Smart meter implementation architecture that permits both online and offline methods especially for areas with poor/unreliable cellular network coverage.

This paper focuses on implementing a smart water management system to assist users in obtaining real-time data for real-time analysis. The system provides the consumer with real-time data for water consumption since it monitors consumption as a whole data. The smart meter also creates many visual graphs of the collected data and represents them in a readable manner to the customer. The scope of the paper does not allow for it to focus on the unremitting development of analogue water meters for greater accuracy [2]. There are adequate reasons for introducing smart water meter systems.

In old time data was collected by hand by a representative of a company using pen and paper, but lately, the use of hand-held computers (also known as meter readers) become common. However, the increase in the population, which results in more domestic areas being constructed, industry sites constantly expanding and utility companies seeking billing systems for residential and industrial environments to needless human interface necessitates a reduction in the cost of implementing a water-metering system. Smart water meter systems increasing time efficiency and adequacy since bills are delivered timely and more accurately. Another advantage is that the system can be adapted for use in other domains such as electricity or gas [3-5].

II. Related Work:-

A narrowband system, named Narrowband Internet of Things (NB-IOT), has been presented to provide low-power, low-cost, wide-area connectivity for the Internet of Things. This system, is based on Long Term Evolution (LTE) technology, supports most LTE functionalities although with essential simplifications to reduce device complexity. Further optimizations to increase coverage, reduce overhead and reduce power consumption less while increasing capacity have been introduced. The Unique possible technique to obtain the meter reading and send the data to a gateway device (concentrator) is by using a dedicated serial line. However, the water meter should have a suitable physical connector (e.g. USB). Though a wired system may provide low levels of the interference and high data security, the time and cost of its installation and maintenance make it impractical in various scenarios. Another option for establishing a dedicated serial line is by using a wireless system where a wireless sensor is attached to both

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water meter and gateway device. This provides a low-cost and energy efficient solution for a sensor network with a range from 10 Km to 15 Km. Different types of technologies are used for communication on smart water meter systems and are dependent on the various network topology and infrastructure such as wireless packet data services (GSM and GPRS), Radio Frequency (RF) technology [6], satellite and broadband. Other systems that are proposed are based on hybrid systems that can make use of robust networking topologies such as the GSM and ZigBee [7-9]. The wireless smart meter-reading system basically consist of a lower network that connects the water meters ad an upper network that is mainly used for visualizations, creating reports and information management. Other systems that are proposed are based on hybrid systems that can make use of robust networking topologies such as the GSM and ZigBee [7-9]. Bidirectional broadband communication [10, 4] can be achieved by merging BPL technology and smart water meter systems.

III. Smart Meter System:-

Smart water Metering is defined in the 2014 Review of Smart Metering and Intelligent Water Networks in Australia and New Zealand as [11] the integration of meter data into business systems (e.g. Billing System) and the sharing of information with customer. The main aim of a smart water management system is to build a consistent relationship between the customer and the utilities [12]. The Well-implemented and visual application is beneficial to the customer and service provider to detect any flaws that might exist in respect of the servicerendered. The developing system enables the mesh networking among the meter interfacing nodes within a radius of 10Km. This gateway collects the data sent by the meter interfacing node and sends it directly to the server. A web-based application is also developed to provide more graphical meaning to the collected data, which also can be used to build a billing system and other services can be used. However the currently paper focuses more on the meter interfacing node and the data monitoring applications.

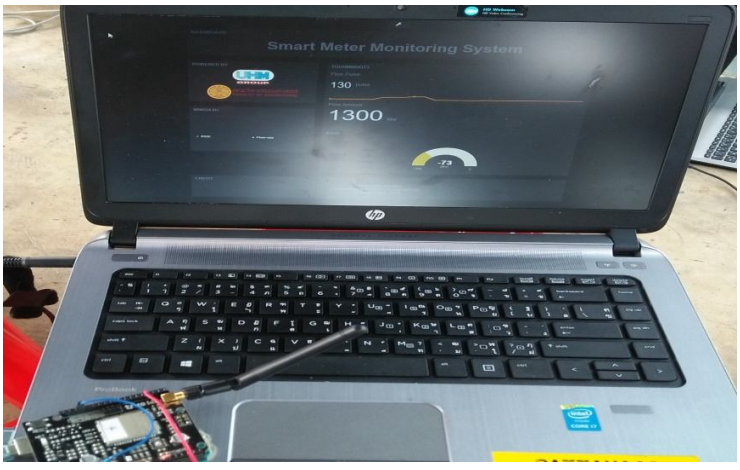

Fig.:- Monitoring Flow of Water

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The developed scheme consists of three major components; meter interfacing, Gate way device and back-end system. The software and hardware architecture of these components, will be explained in the rest of this section. The meter interface node is attached to the digital meter to collect the meter reading, which will be sent through the gateway device to the freeboard. In the back-end system, the data is processed and archived within the database. The web-based interface is used to provide many kinds of graphs and tools to enable the monitoring and analysis of water usage.

A. Meter Interface Module:-

There are several wireless sensor nodes were developed to be used in several kinds of applications, such as [13, 14]. Similarly, To get the meter reading and send it wirelessly to the main server for further analysis, a wireless meter interface sensor was designed and attached to a digital water meter, as shown in Fig. 1. The sensor itself is attached to the analogue Reed switch, which generates pulses from the meter each time a particular volume of water flows through the water meter.

We ported freeboard OS on the meter interface as a Real Time Operating System (RTOS). The freeboard OS is an open source operating system [15] that incorporates a 6LowPAN (IPv6 over Low Power Wireless Area Network) protocol stack intended for devices that conform with the IEEE 802.15.4 standard with low power usage, short transmission range, low bit rate and a low expense cost [16].

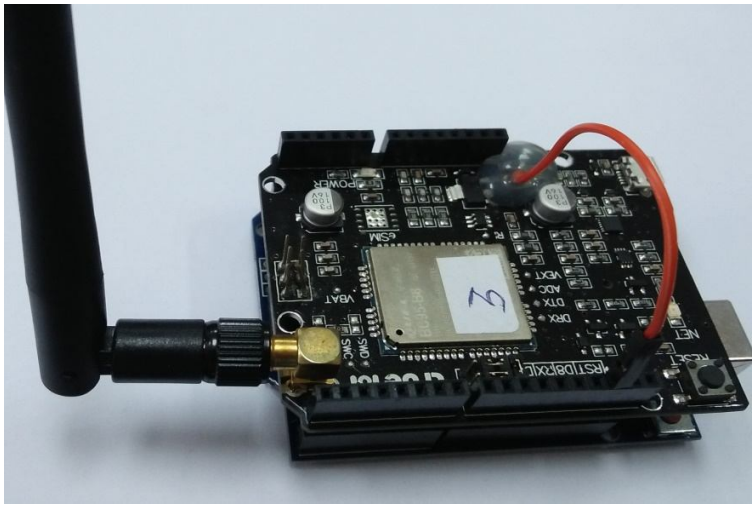

Fig.:- Meter Interfacing Node

The sensor can be easily programmed by connecting a USB to the serial interface cable and connecting it to the sensor via the USB/UART header connectors. The interface node communicates with the gateway over a distance of 10 to 15 Km along a clear line of sight. The first prototype was designed with two microprocessors, the Arduino and the Arduino Shield. The reason for this initial prototype was to use the second processor as an external interrupt to deal with the pulse signals from the Reed switch and to monitor the pulse. TheArduino Shield will enable the inclusion of the wired and wireless m-bus protocol to communicate with other hand-

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held water meter readers. The Shield has an internal programmable flash memory that could store enough data, which eliminates the need to include an external flash memory. The processor would be in a inactive stage, while the external interrupt triggered with pulses generated from the water meter. The processor would activated only in one condition when the data was stored on the internal Flash.

B. Communication System:-

The communication infrastructure connects different components of the system. The meter interfacing nodes are attached to the digital water meter through a Reed switch as they collecting the data and send it to the freeboard. The data is sent to the back-end system for further analysis and visualization application. On freeboard easily observed that how much water is flowing through the meter. By using this technology, the graph can be easily measured.

C. Data Monitoring:-

The data monitoring system constitutes a critical component as it is necessary to notify the user of any changes on the system. Therefore, a web-based monitoring application has been developed for measuring the data. Now, many tools have been implemented to enable the user to envisage various graphs of real-time and historical data. The customer are able to view the real-time water consumption, as well as the historical data for instantaneous and monthly and accumulative daily water consumption and can compare the water consumption between two selected days.

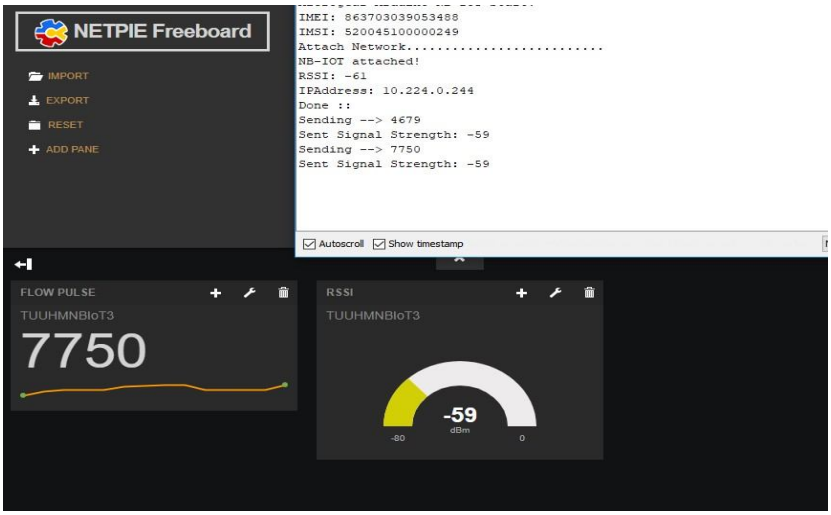

Fig.:-Sample of Water Consumption

This scheme would enable the user to identify any water leakage in actual water flow system. The NETPIE freeboard web-based application interacts with the sensor node interface through a gateway. The application enables the customer to detect when the sensor node is connected to the network and when not.

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IV. Conclusion and Future Work

The water meter interface node was developed that makes use of open source tools. This meter enables the user to modify the source code to suit the own needs or those of the service provider. The developed scheme provides the user with a real-time monitoring system for water consumption, but this technology can also be used for other services such as leakage detection and localization. The system provides a short-range communication of 10km, though with more households using the same system, the coverage range will be increased since the system supports mesh network topology.

The features this system and the benefits are discussed in this paper. The web-based interface is also developed that visualizes real-time usage and historical water consumption. Moreover, this water monitoring system can serve to help customers change their water usage and reduce water consumption, as well as to identify and fix abnormal water consumption. In Future, The work is being extended to cover a range of Distribution metering and Unaccounted for Water issues faced by utilities while giving direct and imperceptible gains to the consumers in the changing smart structure scenario in urban areas. Finally, an intelligent leakage detection and localization algorithm will be implemented to detect abnormal water consumption in different areas, e.g. pipe leakage, and alert the customers to it. This scheme will reduce the time to detect the water leakage.

Applications:-

- Smart water metering system
- Smart Electricity metering system
- Soil pH moisture
- Weather Station
- Vehicle sensing
- Smart waste management
- Machinery monitoring
- Environmental monitoring
- Vehicle Tracking

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