

Nb-Iot Based Water Meter

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Abstract: This paper is based on maintenance of water in the public distribution system using the water meter based on the flow of water which is measured and calculated in real time using the relation between pressure and the cross sections of the carrier pipe and using a narrow band IOT based communication channel to record and monitor the water that are consumed in the daily basis by the customer. This device is used to minimize the usage of water by the customer through automated control water supply. This meter will read the basic parameters that ensure the quality of the water and the usage quantity that can be viewed by the user with an application software. Here NB-IOT SIM7020E is used as a communication module between the metering module and the server and an android app has been developed to monitor the metering activities with online bill payment for the consumption.

I. INTRODUCTION

Generally, as of now there is no proper water measuring device that is used in real time system. This module play a better roll in implementing the real time water metering module. This water meter measuring the quantity of water consumed through water flow which is detected using the cross section of the pipe through which the water flow instead of flow meter of different technology. Regardless of the flow of the water the meter also detects the quality of the water that is the PH value of the water. These data are transmitted to a remote server through a wireless communication module that is "SIM 7020E" which is Narrow band IOT module. The main aim of this project is to reduce the usage of water by the consumer by imposing the control over their usage of water using this water meter. The control over the usage means by regulating the usage of water through limitations and by setting up threshold for the monthly consumption. These data's are monitored though monitoring system established using remote web server. This web server connected to database is used to gather and store the data from the smart meter and also retrieves the data from the database whenever required and analyse the data for further process. These information gathered has to be communicated to the remote web server through internet. This is done using the NB-IOT technology that is interfaced to the smart meter directly. There are many protocols and technologies used nowadays for communication but there are cons all over the technologies and as the time grow new technologies with advancement in the cons of preceding technologies are established.

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One such prevailing technology is the Narrow band IOT. This NB-IOT is more efficient when compared to other technologies and more suitable for a long standalone devices with concern of battery consumption.

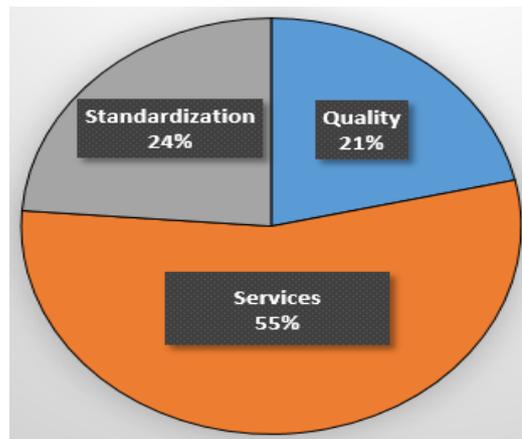
II. PROBLEM STATEMENT

A. Objective

There is a say: "You can't manage unless you measure". There are enough water resources over the world which is not used efficiently due to the lack of maintenance and the measurement of the usage and the resources availability. The main problem that arise is the maintenance and control over the usage of water. Therefore it depends on all the factor including consumption of water by the consumer and also the wastage of water and loss of water as a major concern. In order to gain the efficient use of water resources and to determine the present and the future leakage there is a need the monitoring system.

B. Public Survey

There was a public survey conducted to get the detailed information on the problems faced in the reality on the water and its usage.



There was a public survey conducted through the google form and a people of 200 numbers responded with each varying results almost such as quality issues and the service issues of water distribution and the lack of standardization on the water distribution and the usage which increases the scarcity of water. Based on the survey a chart has been created stating the percentage of people opting for the different problems majorly Standardization, Quality and services.

III. DESIGN AND ARCHITECTURE

This design is totally based on the typical concern of scarcity of water and to overcome it.

Nb-Iot Based Water Meter

This module measure the water flow with basic details of the cross-section of the pipe and use necessary calculation to detect the flow and consumption of water and to calculate the cost of usage of water. It also measure few parameters such as temperature, PH of the water that is supplied to the customer.

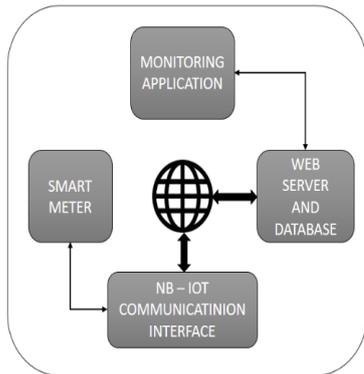


Fig 2.0

This entire system is divided into 3 modules, the water meter with a communication interface to establish connectivity, a backend server with database and front end web application and android app to monitor and track the user's usage. The communication device that is used over this module is Narrow Band IOT which establishes connectivity between the water meter and the remote web server[1].

The smart meter measure the data and shares to the remote web server through internet using NB-IOT and these data can be viewed by the used at the application end through an android app with special credentials provided to them.

IV. WATER METER MODULE

This water meter is used to gather information on the usage of water that has been installed to the consumers. It logs the data such as amount of water that has been used and the quality of the water using the PH level of the water that is been used.

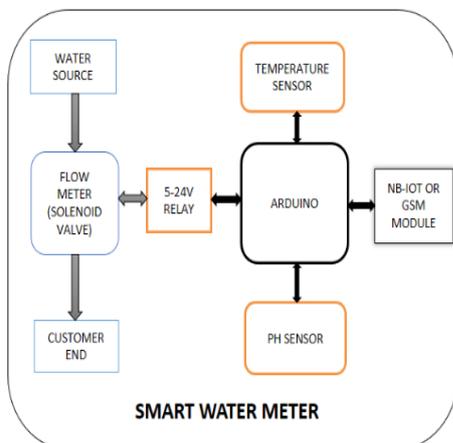


Fig 3

The water meter is developed with the major concern of providing a quality water resource with the limitation in order to reduce the further scarcity of the water in future. This module consist of sensor modules to record the data accurately and perform actions accordingly. This module

consist of the Temperature sensor that detect and measure the temperature of the water that is supplied. The PH meter detects the PH level of the water and intimate the quality of the water so that necessary measures can be taken.

1) Equation

The water flow calculation is done with the help of the formula using the parameters such as pressure, density, time and measuring the quantity of water that has been used by the costumer day to day. This is mainly concerned on finding the flow rate of water using the E-Valve.

$$\text{Flow Rate} = (1/4) * (\pi) * (d^2) * (V) \text{ Litres/meter} \quad (1)$$

$$V = \sqrt{2P/\rho} \quad (2)$$

Where P= Pressure (MPa)

ρ = Density (g/ml)

d = Diameter of the pipe

V = Velocity

This module of water meter is cable of calculating the quantity of water that has been consumed efficiently with minimal cost investment [4]. This module is capable of sending data to the server and receive inputs from the remote server.

V. NARROW BAND IOT

This module of water meter is more efficiently only with the usage of NB-IOT. Narrow band IOT is the trending technology development in the current telecommunication industry with major service providers playing around. The usage of this NB-IOT supports this module of water meter to act smarter and efficient. The NB-IOT uses a narrow bandwidth that is small confining bandwidth of frequency to communicate effectively at high data rates. Low-power WAN is the technology which enhances the performance with higher power consumption and NB-IOT is among these technologies. Generally the GSM, HSPA these uses the licenced bandwidth for the communication similarly this NB-IOT is also licensed band [6].

Generally the entire frequency spectrum is divided with intermediate frequency and corresponds to lower and higher frequency. These technologies uses these bandwidth for the communication purpose. These bandwidths which are used for the communication is are separated by small frequency which is unused which is known as guard band. This guard band is in between all these usable bandwidth spectrum which is not utilized in order to avoid interference of the other different spectrum. Generally the usable bandwidth spectrum is divided into parts of bandwidth separated by this guard band.



Fig 4

The fig 4 shows the frequency of the used and the guard band in the bandwidth spectrum. The Bu is the useful band that is used for the communication as depicted and BG is the guard band that separates to useful band in order to avoid the channel interference of these useful frequency. The main concept is that to use the guard band in the LTE bandwidth spectrum for the purpose of communication.

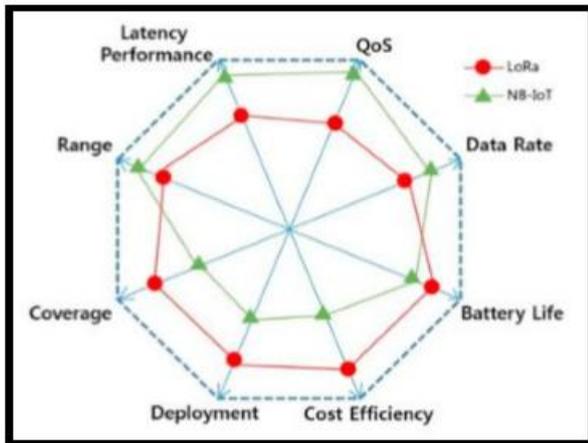


Fig 5

Generally narrow band is very thin layer of bandwidth with frequency spectrum in kHz. The LTE spectrums guard band is around 160-200 KHz which serves has a guard band. The effective use of these frequency range specifically for the IOT and IOT based devices and communication is NB-IOT. Here the properties that depicts the performance and sustainability of the technology are discussed. The NB-IOT is the LPWAN technology which is mainly concerned on power consumption. The discussed properties are the comparison of different LPWAN based technology. According to the discussion it is clear that the NB-IOT has a large range and is about 15-20 km and also based on the deployment of the base station [3]. The data rate is high with low power consumption which is a key factor for a technology to be efficient and when implemented in standalone device to provide stable and sustained system.

VI. WEB SERVER AND APPLICATION

A server is created with some processor such as raspberry pi is and apache version 2 server. The data base is created using the PHP 5 and is maintained using My PHP admin and all the data stored and retrieved in the server is carried out using the SQL [5]. An android application is created with the basic GUI presenting all the details that is collected from the water meter which is regularly updated in the server with

NB-IOT communication channel. The application provides details of the meter and usage to the customer with basic log in credentials. This application is also used to remotely access and control the water meter with special authentications which ensures the limited and controlled usage of the water or the due of payment [2].

VII. CONCLUSION

Based on the study and the design the water meter designed here is more efficient and cost effective when compared to the other existing module. This is because of the interface of the new technology NB-IOT that has been developed in order to have high rage and data rates with minimal consumption of power. This module will provide the end consumer a quality water resource that can be relied on with minimum cost input and continuous monitoring. This module provide greater hope in establishing a controlled usage of water with the monitoring of all the data in real time and serve the purpose effectively in the narrow band IOT bandwidth.

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