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Automated Water Billing For Flow Conservation Using IOT

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Abstract — Water is the basic need of all living organisms and human mankind. In recent days the rapid population growth has caused insufficiency and wastage of drinking water which has led to to scarcity of water and uneven distribution of drinking water. The primary goal of this project is to check and maintain the even distribution of water to all homes ensuring that there is no wastage and block in the supply of water and to generate the water bills to the individual households using IoT platforms. In order to implement this system, we will make use of Arduino. Water flow sensors and a value to control the flow of water from the tank. Flow sensor generates a series of electric pulses through which water utilized by the user, flow rate and the amount of water supplied can be calculated. This project is proposed to solve issues by supplying water in a proper channelized manner using embedded technology and IoT platforms. 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. Message and WiFi (IOT) 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

Keywords - Water Management, Internet of Things(IoT), Water Distribution, Water Monitoring, Troubleshooting.

I. INTRODUCTION

In the last few years, India has seen a dramatic rise in need for water due to various socioeconomic processes. As a result, most water bodies and groundwater resources are over exploited leading to water scarcity. It is essential we know how much water we have access to. Water resource management and distribution is a very important issue as it involves ways to protect water bodies from pollution and over exploitation. The biggest issue in India is water availability. quality and management. In developed urban areas, the usage of water is outweighed by the supply which leads to diminished availability of water and therefore proper management is a must. Supply of water to various places requires manpower. In such cases, the amount of water distributed and the water bills are not monitored. Industries that extensively use water are unaware when the pipes are damaged which causes wastage and leakage of water.This project aids in efficient supply of water without causing leakages and unnecessary wastage of the same. It is an intelligent system that uses flow sensors to generate a series of electric pipes through which water utilized by the user, flow rate and the amount of water supplied can be calculated. The proposed system continuously controls the water level of the main tank and automatically switches ti motors ON/OFF according to the

water level. The water flow through the pipe is regulated by a control valve and a flow sensor. This process can be carried out through the IoT platform-Think Speak. The administrator can obtain the data at different time intervals and it can be used for automated billing, resource analysis and approximation for later consumption. Tank water level and the bills will be visualized in the monitor so that the Admin can view the same.

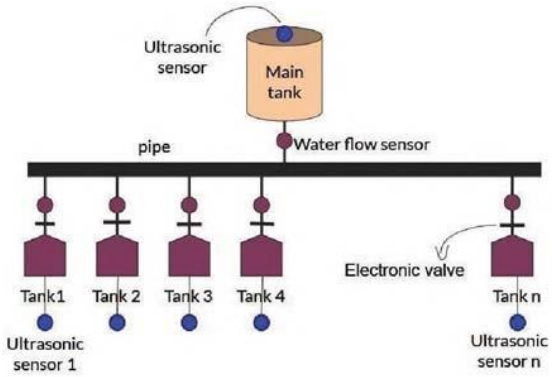

Fig 1:Intelligent Water Distribution and Management System.

Water loss that happens during distribution is considered as the major waste. Measurements of per capita water availability indicate that India is currently water stressed and the further projections indicate that India might have water scarcity by the year 2050. In such a case, leakages in the water distribution system can have a huge impact on the water availability. Water flow conservation contains the policies, strategies and activities to manage fresh water as a sustainable resource, to protect the water environment and to meet the current and future human demand. It also deals with 'digitally noting' the energy meter readings which eliminates the traditional 'paper and pen' method of noting down the reading and the errors associated with it. Automatic Meter Reading(AMR) makes the data recording fast and saves time. Its existence turned the energy meters intelligent and deployed the use of micro controllers in the energy meters. Water covers 70% of the Earth's surface, and out of this only 3% of the water is potable. Population growth causes insufficient and uneven distribution of drinking water. The rapid development of science and technology improved the sensors and the flow meter designs to achieve proper water supply through storage tanks, pipes and etc. Water is a primary source in the industries and hence there is a need of accurate measurement of water flow, also water is used for all household activities. Thus, excessive usage of water needs to be avoided and a system is required to monitor the over usage of water.The present water billing system is tedious and time consuming process. It requires the water board representative to travel to the customer's premises to read and generate the analog water bill on a monthly basis. This might as well cause faults in billing. Automation in the water billing reduces the process time and avoids human errors.Water flow conservation contains the policies, strategies and activities to manage fresh water as a sustainable resource, to protect the water environment and to meet the current and future human demand and thus make use of water efficiently.

Existing System

T.REHMAN, T.AHMED, I.HASAN, MD.ALAM:

This team proposed a system called Automated Household Water Monitoring and Billing System which was published in IEEE Xplore ICISC 2018. The paper describes our research in household water supply monitoring & billing. Arduino mega 2560 was utilized in this project along with double relay for automation of the switching feature and water level sensors and water flow sensors was used to detect the level and the amount of water used respectively. The feature of this project is automatic switching of the DC water motor based on the level of water present in reservoir along with display of the amount of water used in each block. For the display, an LCD Alphanumeric display was used. We have also included a set capacity of usage for each floor and billing according to usage.

M.JHA, R.SAH, M.RASHMITA, SUJATHA B, SUMA K:

This team proposed Smart Water Monitoring System for Real Time Water and Usage Monitoring which was published in ICIRCA IEEE Xplore 2018. The objective of designing Smart Water Quantity Meter is to ensure water conservation by monitoring the amount of water consumed by a household, notifying the same to the consumer and the authority. A three-slab billing system generates consumption bill according to the quantity consumed. The Smart Water Quality meter checks the purity of potable water that the consumer receives, by measuring five qualitative parameters of water viz. pH, temperature, turbidity, dissolved oxygen and conductivity. The system ensures to prevent any health hazards or potential threats caused due to accidental seepage of sewage or farm release into the portable water. An online monitoring system is to provide these data on the cloud in real-time.

G.GAWADE, G.GOSAVI, GAUYAM GOSAVI:

This team proposed Smart Water Flow Monitoring and Forecasting System which was published in IEEE 2017.The paper proposes a method to watch and forecast the consumption of the water in the domestic pipeline through a web server. There are many systems to do the same, but this is about monitoring consumption of water using the

Internet with the help of Raspberry pi and Arduino. The flow rate of the water is measured by Hall Effect sensor based flow meter. Raspberry Pi a micro-computer receives the data from Arduino micro-controller which is connected to the flow meter. The Raspberry pi uploads the data onto cloud infrastructure where database is setup. The web base solution also depicts the day to day consumption of the water to its users and water distributors. The paper also aims at predicting the consumption of the water in future for its users using advance data analytics.

There is an increase in the population and thus there is also an increase in the demand for water. Also due to an increase in the pollution and its poor management there is a lot of stress in the availability of fresh water.Overuse of water causes scarcity to the future generation and therefore conserving water becomes an important matter.The biggest issue in India is water availability. quality and management. In developed urban areas, the usage of water is outweighed by the supply which leads to diminished availability of water and therefore proper management is a must. Supply of water to various places requires manpower. In such cases, the amount of water distributed and the water bills are not monitored. Industries that extensively use water are unaware when the pipes are damaged which causes wastage and leakage of water.This project aids in efficient supply of water without causing leakages and unnecessary wastage of the same.

Proposed System

The feature of the proposed system is to control the water leakage that happens majorly through the water taps by automatically switching off the supply. To stop the water supply for that day if the usage of water reaches the threshold value. This is very much necessary in the world that is going water scarce today. This model also checks the purity of water in the tank and notifies the same to the consumer. Having notified, the consumer can clean the water tank. 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. 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. AMR system is divided into four basic units. These are: Reading unit, Communication unit & leakage detection, Data receiving and processing unit, billing unit.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. 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.

II REQUIREMENTS SPECIFICATION

Software Requirements

i. Arduino IDE

ii. Embedded C

ARDUINO IDE:

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them. Programs written using Arduino Software (IDE) are called sketches.

Fig 2: An Arduino IDE

EMBEDDED C:

Embedded C is most popular programming language in software field for developing electronic gadgets. Each processor used in electronic system is associated with embedded software. Embedded C programming plays a key role in performing specific function by the processor. In day-to-day life we used many electronic devices such as mobile phone, washing machine, digital camera, etc. These all device working is based on micro controller that are programmed by embedded C. In embedded system programming C code is preferred over other language. Due to the following reasons:

- Easy to understand
- High Reliability
- Portability
- Scalability

Embedded C is generally used to develop micro controller-based applications. C is a high-level programming language. Embedded C is just the extension variant of the C language. This programming language is hardware independent.

Hardware Requirements:

i. Arduino UNO
ii. LCD Display
iii. Conductivity Sensor
iv. Temperature Sensor
v. Flow Sensor
vi. Power Supply
vii. NODEMCU

ARDUINO UNO:

The Arduino UNO is the best board to get started with electronics and coding. If this is your first experience tinkering with the platform, the UNO is the most robust board you can start playing with. The UNO is the most used and documented board of the whole Arduino family.

Features of Arduino Uno Board

- The operating voltage is 5V.
- The recommended input voltage will range from 7v to 12V.
- The input voltage ranges from 6v to 20V.
- Digital input/output pins are 14.
- Analog i/p pins are 6.
- DC Current for each input/output pin is 40 mA.
- DC Current for 3.3V Pin is 50 mA.
- Flash Memory is 32 KB.

Fig 3: An Arduino UNO

LCD DISPLAY:

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.The 16×2 LCD pinout is shown below:

- Pin1 (Ground/Source Pin): This is a GND pin of display, used to connect the GND terminal of the microcontroller unit or power source.

- Pin2 (VCC/Source Pin): This is the voltage supply pin of the display, used to connect the supply pin of the power source.
- Pin3 (V0/VEE/Control Pin): This pin regulates the difference of the display, used to connect a changeable POT that can supply 0 to 5V.
- Pin4 (Register Select/Control Pin): This pin toggles among command or data register, used to connect a microcontroller unit pin and obtains either 0 or 1(0 = data mode, and 1 = command mode).
- Pin5 (Read/Write/Control Pin): This pin toggles the display among the read or writes operation, and it is connected to a microcontroller unit pin to get either 0 or 1 (0 = Write Operation, and 1 = Read Operation).
- Pin 6 (Enable/Control Pin): This pin should be held high to execute Read/Write process, and it is connected to the microcontroller unit & constantly held high.
- Pins 7-14 (Data Pins): These pins are used to send data to the display. These pins are connected in two-wire modes like 4-wire mode and 8-wire mode. In 4-wire mode, only four pins are connected to the microcontroller unit like 0 to 3, whereas in 8-wire mode, 8-pins are connected to microcontroller unit like 0 to 7.
- Pin15 (+ve pin of the LED): This pin is connected to +5V
- Pin 16 (-ve pin of the LED): This pin is connected to GND.

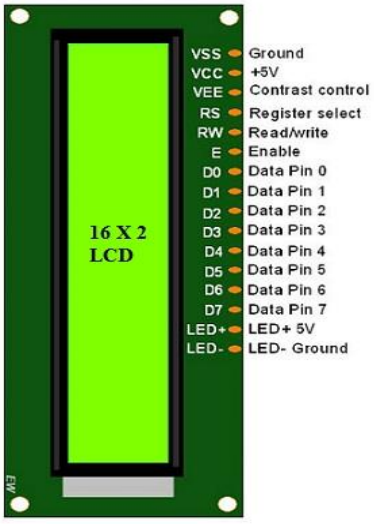

Fig 4: An LCD Display

CONDUCTIVITY SENSOR:

When the probe attached to the conductivity meter is inserted into the solution, an electrical current flows between the electrons inside the probe. If the ion concentration of the solution being tested is high, the higher the conductance will read, which results in a faster current, and vice versa.A conductivity sensor measures the ability of a solution to conduct an electrical current. It is the presence of ions in a solution that allow the solution to be conductive: the greater the concentration of ions, the greater the conductivity.Conductivity sensors measure the ability of a water sample to conduct an electrical current.Such application examples are WIFI, demineralize water, RO water, percent concentration, boiler and TDS. In general, the measurement of conductivity is a rapid and inexpensive way of determining the ionic strength of a solution.

Fig 5: Conductivity Sensor

Conductivity is a measure of how well a solution conducts electricity. To carry a current a solution must contain charged particles, or ions. Most conductivity measurements are made in aqueous solutions, and the ions responsible for the conductivity come from electrolytes dissolved in the water.Available conductivity ranges are 0-200µS/cm, 200-2000µS/cm, 2-20mS/cm, 20-200mS/cm and 200-2000mS/cm. The conductivity sensor's temperature output has a measurement range of -5°C to +70°C. Purified water is low conductivity (typically 5 microSiemen/cm or less).

TEMPERATURE SENSOR:

Fig 6: Temperature Sensor

A temperature sensor is an electronic device that measures the temperature of its environment and converts the input data into electronic data to record, monitor, or signal temperature changes.Temperature sensors work by providing readings via electrical signals. Sensors are composed of two metals that generate an electrical voltage or resistance when a temperature change occurs by measuring the voltage across the diode terminals. When the voltage increases, the temperature also increases.They are used within industrial applications and have many more commercial uses. Most of the temperature sensors we supply monitor temperature by measuring the change in resistance of an electrical current.Here, the temperature sensor is used to measure the temperature of water inorder to measure its purity.

FLOW SENSOR:

A flow sensor (more commonly referred to as a “flow meter”) is an electronic device that measures or regulates the flow rate of liquids and gasses within.Flow sensors utilize both mechanical and electrical subsystems to measure changes in the fluid's physical attributes and calculate its flow.The flow sensor working principle is based on Bernoulli's principle. This principle states that the drop of pressure across the meter is simply proportional to the square of the rate of flow. The most common way to determine the measurement of a flow is by using the pressure drop across the cross-section of the pipe.The Flow Rate Sensor measures the velocity of water in studying the discharge, flow patterns, and sediment transport of a stream or river.The device used to sense the flow of water is the flow meter.

Fig 7 : A Flow Meter

NODEMCU:

NodeMCU is an open-source LUA based firmware developed for the ESP8266 wifi chip. By exploring functionality with the ESP8266 chip, NodeMCU firmware comes with the ESP8266 Development board/kit i.e. NodeMCU Development board. NodeMCU Development Board/kit v0.9"NodeMCU" combines "node" and "MCU" (micro-controller unit). Strictly speaking, the term "NodeMCU" refers to the firmware rather than the associated development kits. It allows you to program the ESP8266 WiFi module with the simple and powerful LUA programming language or Arduino IDE.This feature of Node MCU is used in here to get the wifi messages regarding the water level, leakage detection, water purity inside the water tank. The notifications are received through Telegram.

Fig 8: NODEMCU

III IMPLEMENTATION

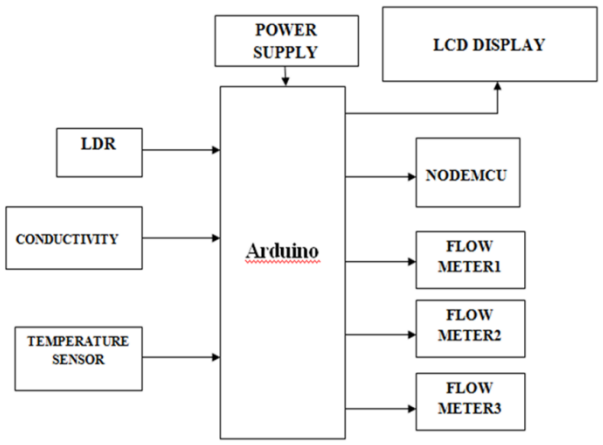

Fig 9: Block Diagram for the implementation

The prototype for the flow conservation is to measure the 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.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.

IV CONCLUSION

As discussed in this project, 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.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.Detecting leaks helps saving water resources, cost and energy. More water is available to consumers and can be billed.

REFERENCES

[1]. T. Rehman, T. Ahmed, I. Hasan and Md. Alam, "Automated Household Water SupplyMonitoring & Billing System", Proceedings of the Second International Conference on Inventive Systems and Control (ICISC 2018) IEEE Xplore.

[2]. M. Jha, R. Sah, M. Rasmitha, R. Sinha, Sujatha B.and Suma K., "Smart Water Monitoring System for Real-time water quality and usage monitoring", Proceedings of the International Conference on Inventive Research in Computing Applications (ICIRCA 2018) IEEE Xplore,

[3].G. Gawade, G. Gosavi, and Gauyam Gosavi, "Smart Water Flow Monitoring and Forecasting System", 2nd IEEE International Conference On Recent Trends in Electronics Information & Communication Technology (RTEICT), 978-1-5090-3704-9/17, pp. 1218-1222, 2017.

[4]. N. Satiya, V. Varu, A. Gadagkar, D. Shaha, "Optimization of Water Consumption Using Dynamic Quota based Smart Water Management System", IEEE Region 10 Symposium (TENSYMP), 978-1-5090-6255-3/17, 2017.

[5]. R. E. Sorace, V. S. Reinhardt, and S. A. Vaughn, "High-speed digital- to-RF converter," U.S. Patent 5 668 842, Sept. 16,1997 The IEEE website. [Online]. Available:http://www.ieee.org/

[6]. "PDCA12-70 data sheet," Opto Speed SA, Mezzovico,Switzerland.

[7]. A. Karnik, "Performance of TCP congestion control with rate feedback: TCP/ABR and rate adaptive TCP/IP," M. Eng. thesis, Indian Institute of Science, Bangalore, India, Jan.1999.

[8]. P. Deshpande and B. Iyer, "Research directions in the Internet of Every Things(IoET)," 2017 International Conference on Computing, Communication and Automation (ICCCA), Greater Noida, 2017, pp. 1353-1357, doi: 10.1109/CCAA.2017.8230008.

[9]. Iyer, B., Patil, N. IoT enabled tracking and monitoring sensor for military applications. Int J Syst Assur Eng Manag 9, 1294–1301 (2018). https://doi.org/10.1007/s13198-018-0727-8

[10]. Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specification, IEEE Std. 802.11,1997.

[11]. Sajith Saseendran and V. Nithya, "Automated Water Usage Monitoring System", 2016 IEEE International Conference on Communication and Signal Processing, April 6-8, 2016. Zhu, Z. Hao and Q. Ju, "Management Decision System of Regional Water Resources," 2008 ISECS International Colloquium on Computing. Communication, Control, and Management, Guangzhou, 2008, pp. 481-484

[12] Joy Shah. An Internet of Things Based Model for Water Distribution with Quality Monitoring". Vol. 6, Issue 3, March 2017 in International Journal of Innovative Research in Science, Engineering and Technology.

[13] Perumal, "Internet of Things (IoT) Enabled Water", Monitoring System, 4th Global Conference on Consumer Electronics IEEE,2015.

[14] Ian F. Akyildiz, Erich P. Stuntebeck, "Wireless underground sensor networks", Research challenges Science Direct - Computer Networks, pp. 669-686, 2016.

[15] Peng Cheng, X-Li Wang. "The Design Implementation of Remote-sensing Water Quality Monitoring and System Based on SPOT-5," Second IITA International Conference on Geoscience and Remote Sensing, 2010.

[16] Sureshkumar Natarajan, Shashar, Roy. Arjun Singh, Aniket Bhosale, Smart water management stem using cloud computing and IoT, International Journal of Current Research, Vol. 9, Issue. 10, pp.60136-60139, 2017.

[17]R. E. Sorace, V. S. Reinhardt, and S. A. Vaughn, "High-speed digital- to-RF converter," U.S. Patent 5 668 842, Sept.16,1997 The IEEE website. [Online]. Available:http://www.ieee.org/

[18]. "PDCA12-70 data sheet," Opto Speed SA, Mezzovico,Switzerland.

[19]. A. Karnik, "Performance of TCP congestion control with rate feedback: TCP/ABR and rate adaptive TCP/IP," M. Eng. thesis, Indian Institute of Science, Bangalore, India, Jan.1999.

[20]. P. Deshpande and B. Iyer, "Research directions in the Internet of Every Things(IoET)," 2017 International Conference on Computing, Communication and Automation (ICCCA), Greater Noida, 2017, pp. 1353-1357, doi: 10.1109/CCAA.2017.8230008.

[21]. Iyer, B., Patil, N. IoT enabled tracking and monitoring sensor for military applications. Int J Syst Assur Eng Manag 9, 1294–1301 (2018). https://doi.org/10.1007/s13198-018-0727-8

[22]. Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specification, IEEE Std. 802.11,1997.

[23]. Sajith Saseendran and V. Nithya, "Automated Water Usage Monitoring System", 2016 IEEE International Conference on Communication and Signal Processing, April 6-8, 2016.