

**PREVENTION OF WATER WASTAGE IN HOUSEHOLD
PIPELINES USING IOT**

Submitted in partial fulfillment of the requirements
for the award of
Bachelor of Engineering degree in
Computer Science and Engineering with Internet of Things

By

HARISANKAR J D (Reg. No - 40732003)

J RAMASAMY (Reg. No - 40732006)



**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
SCHOOL OF COMPUTING**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

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JEPPIAAR NAGAR, RAJIV GANDHISALAI,**

CHENNAI – 600119

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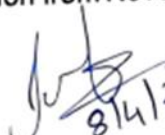
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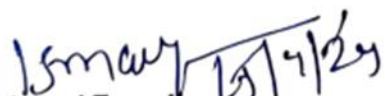
This is to certify that this Project Report is the bonafide work of **HARISANKAR J D** (40732003) and **J RAMASAMY (40732006)** who carried out Project entitled **"PREVENTION OF WATER WASTAGE IN HOUSEHOLD PIPELINES USING IOT"** under my supervision from November 2023 to April 2024.

for 
8/4/24.
Internal Guide

Dr A.Viji Amutha Mary, B.E., M.Tech., Ph. D


Head of the Department
Dr. L. LAKSHMANAN, M.E., Ph.D.
SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)
Jeppiaar Nagar, Rajiv Gandhi Salai,
Chennai - 600 119.

Submitted for Viva-voce Examination held on 15-04-2024


Internal Examiner


External Examiner

DECLARATION

I, **HARISANKAR J D (Reg.No- 40732003)**, hereby declare that the Project Report entitled "**PREVENTION OF WATER WASTAGE IN HOUSEHOLD PIPELINES USING IOT**" done by me under the guidance of **Dr A.Viji Amutha Mary, B.E. ,M.Tech., Ph D** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in **Computer Science and Engineering with Internet of Things**.

DATE: 15-04-2024.


HARISANKAR J D

PLACE: Chennai

SIGNATURE OF THE CANDIDATE

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CONFERENCE CERTIFICATE

					
(A Christian Minority Institution) Jeppihaar Nagar, Rajiv Gandhi Salai, Chennai - 600119					
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ABSTRACT

Water pipe leakage is a big problem around the world of which most of the water distribution authorities faces difficulties to detect the location of the fault. This problem of leakage can be caused by several factors such as breakage of the pipelines due to aging or ongoing constructions in urban cities like Dar es salaam, consequently due to that case, the distribution authorities face hardship to identify the cause and enable them to take action. Therefore, the aim of this project was to develop an IoT-based system for water leakage detection, quality monitoring and level monitoring. The prototype was developed comprising two sensors embedded at the source and destination points to measure the flow rate of water. The result indicated that the volume of water generated at the start point can be compared with the other end to determine if there is any leakage. A greater focus on distance calculation could produce interesting findings that account for more research on IoT monitoring systems.

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CHAPTER 1

INTRODUCTION

In the 21st century, there were lots of inventions, but at the same time were pollutions, global warming and so on are being formed, because of this there is no safe drinking water for the world's pollution. Nowadays, water quality monitoring in real time faces challenges because of global warming limited water resources, growing population, etc. Hence there is need of developing better methodologies to monitor the water quality parameters in real time[1]. The water quality parameters pH measures the concentration. of hydrogen ions. It shows the water is acidic or alkaline. Pure water has 7pH value, less than 7pH has acidic, more than 7pH has alkaline. The range of pH is 0-14 pH. For drinking purpose it should be 6.5-8.5pH. Turbidity measures the large number of suspended particles in water that is invisible. Higher the turbidity higher the risk of diarrhoea, collera. Lower the turbidity then the water is clean. Temperature sensor measures how the water is, hot or cold. Flow sensor measures the flow of water through flow sensor. The traditional methods of water quality monitor involves the manual collection of water samples from different locations. The rest of this paper is organized as follows: section II review the related work of this project, section III describes the proposed system with the modules explanation, section IV provides the Schematic circuit with it working, Section V shows the results and discussion, section VI the conclusion with future scope.

The quality of water has an impact on the living beings. Water quality testing is an important part of environmental monitoring. Water quality refers to the chemical, physical, biological, and radiological characteristics of water. It is a measure of the condition of water relative to the requirements of one or more biotic species and or to any human need or purpose. In this project, the main parameters that define water quality are monitored and observed. To monitor the parameters different sensors like pH, IR, Temperature and Conductivity sensors are used. All the measured parameters are compared with the threshold value that defines the purity. Once the parameters are measured they are sent to authority in the form of alert messages. According to Human Rights Watch, twenty million people in our country are still drinking water contaminated with arsenic. The World health Organization (WHO) has also stated this

crisis as "the largest mass poisoning of a population in history". To reduce the water related diseases and prevent water population, we have to measure water parameters such as ph, turbidity, conductivity, temperature etc. Traditional methodology of water monitoring requires collecting data from various sources manually. Afterwards samples will be sending to laboratory for testing and analyzing. In order to save time consumption and decrease manual effort my testing equipments will be placed in any water source. As a result this model can detect pollution remotely and take necessary actions. The main goal of this paper to build a Sensor- based Water Quality Monitoring System. Arduino Mega 2560 act as a base station and data from sensor nodes will be send to it. For the academic purpose, this paper presents a small prototype of sensor networks consisting of temperature, water level, flow and ph. Then ph and temperature sensor values were sent cloud platform (ARTIK cloud) and displayed as a graphical representation on a local PC. Moreover GSM shield (SIM808) is connected to Arduino Mega which compares sensor values to threshold values and sends a text alert to the agent if the obtained value is above or below the threshold value. The results of this project are discussed in the result section of the paper. We tested three water samples from three different water sources (such as industrial water, tap water and swimming pool water). Three water samples collected from three different swimming pools.(Except one sample) Ph value found in rest of the samples were in normal range (temperature value between 26-27°C). Result section (in page 20) explains our project findings in details.

MOTIVATION

With the rapid development of the economy, more and more serious problems of environment arise. Water pollution is one of these problems. Routinely monitored parameters of water quality are pH, turbidity and conductivity. The most common method to detect these parameters is to collect samples manually and then send them to laboratory for detecting and analysing. This method wastes too much manpower and material resource, and has the limitations of the samples collecting .Long-time analysing, the aging of experiment equipment and other issues. Sensor is an ideal detecting device to solve these problems. It can convert non-power information into electrical signals. It can easily transfer process, transform and control signals, and has many special advantages such as good selectivity, high sensitivity, and fast response speed and so on.

According to these characteristics and advantages of sensors, automatic Measurement and reporting system of water quality is designed and developed. It bases on SMS (Short Messaging Service) in the GSM (Global System for Mobile Communications) network to instantaneously transfer the collected data. It also can remotely monitor the water quality on line. The system implements automation, intelligence and network of water quality monitoring, and uses manpower, material and financial resources sparingly. Over the past decade, online water quality monitoring has been widely used in many countries known to have serious issues related to environmental pollution. The water is limited and essential resource for industry, agriculture, and all the creatures existing on the earth including human being. Any imbalance in water quality would severely affect the health of the humans, animals and affect the ecological balance among species [5]. In the 21st century there were lots of inventions, but at that time were pollutions, global warming and so on are also being formed, because of this there is no safe drinking water for the world's population [1]. The drinking water is more precious and valuable for all the human beings so the quality of water should be monitored in real time. Nowadays water quality monitoring in real time faces challenges because of global warming, limited water resources, growing population, etc. Hence, there is a need of developing better methodologies to monitor the water quality parameters in real time. The WHO (world health organization) estimated, in India among 77 million people are suffering due to not having safe water. WHO also estimates that 21% of diseases are related to unsafe water in India. Also, more than 1600 deaths alone. cause due to diarrhoea in India daily. Therefore, various water quality parameters such as dissolved oxygen (DO), conductivity, pH, turbidity and temperature should be monitored in real time. The water quality parameter pH show water is acidic or basic. Pure water has 7 pH value, less than 7 values indicate acidity and more than 7 indicate alkalinity. The normal range of pH is 6 to 8.5. In drinking water if the normal range of pH is not maintained then it causes the irritation to the eyes, skin and mucous membranes. Also, it causes the skin disorders. The dissolved oxygen (DO) indicates the oxygen that is dissolved in water. It makes the drinking water taste better. The conductivity indicates the ability of water to pass an electrical current. In water various dissolved solids such as chloride, nitrate, sulphate, sodium, calcium, etc affect it. Turbidity has indicated the degree at which the water loses its transparency. It is considered as a good measure of the quality of water. The deterioration of water resources becomes a common human problem [3]. The traditional methods of water quality monitor involve the manual collection of water sample from different locations. These water samples tested in the laboratory using the analytical

technologies. Such approaches are time consuming and are no longer considered efficient. Moreover, the current methodologies include analysis of various kinds of parameters of water quality such as physical and chemical. Traditional methods of the water quality detection have the disadvantages like complicated methodology, long waiting time for results, low measurement precision and high cost [4]. Therefore, there is a need for continuous monitoring of water quality parameters in real time.

RELATE WORKS:

Environment around us consists of five key elements. These are soil, water, climate, natural vegetation and land forms. Among these water the most essential element for human to live. It is also important for the survival of other living habitants. Whether it is used for drinking, domestic use, and food production or recreational purposes, safe and readily available water is must for public health. So it is highly imperative for us to maintain water quality balance. Otherwise it would severely damage the health of the humans and at the same time affect the ecological balance among other species.

In the 21st century providing pure drinking water is becoming a major challenge worldwide. International governing bodies such as United Nations (UN) and World Health Organization (WHO) also recognized human right to sufficient, continuous, safe, and acceptable, physically accessible, and affordable water for personal and domestic use. According to research of WHO 844 million people lack even a basic drinking –water service, including 159 million people who are dependent on surface water. Impure drinking can cause life threatening disease such diarrhea, cholera, dysentery, typhoid, and polio. The research alarmingly estimates that every year diarrhea alone is causing around death of five lakh people. Figure 1 illustrates how water crisis becoming an epidemic in twenty first century.

Now a day's Internet of things is a revolutionary technological phenomenon. It is shaping today's world and is used in different fields for collecting, monitoring and analysis of data from remote locations. Internet of things integrated network if everywhere starting from smart cities, smart power grids, and smart supply chain to smart wearable. Though internet of things is still under applied in the field of

environment it has huge potential. It can be applied to detect forest fire and early earthquake, reduce air pollution, monitor snow level, prevent landslide and avalanche etc. Moreover it can be implemented in the field of water quality monitoring and controlling system. We can design a water quality monitoring system in smart city where there will be a network of devices connected to remote stations and the parameters from the water sources will be stored in a microcontroller via WSN. City dwellers can easily get notified about the quality of the water via SMS or they can view it on webpage and also local authority can take necessary actions.

OBJECTIVE AND METHODOLOGY

Since water quality is an important aspect in human life, this project contributes in the direction of monitoring the quality of water. The system proposed here is a water quality monitoring system in the Arduino platform that measures the pH, conductivity, temperature, and presence of suspended items on the water bodies like lakes and rivers using sensors. These sensed parameters are sent to the authorized person via GSM system in the form of messages, so that proper action can be taken by the authority in cleaning the water bodies to reduce the possible health problem that could occur. The block diagram describing the proposed system and its interconnection along with the stages involved is as described below.

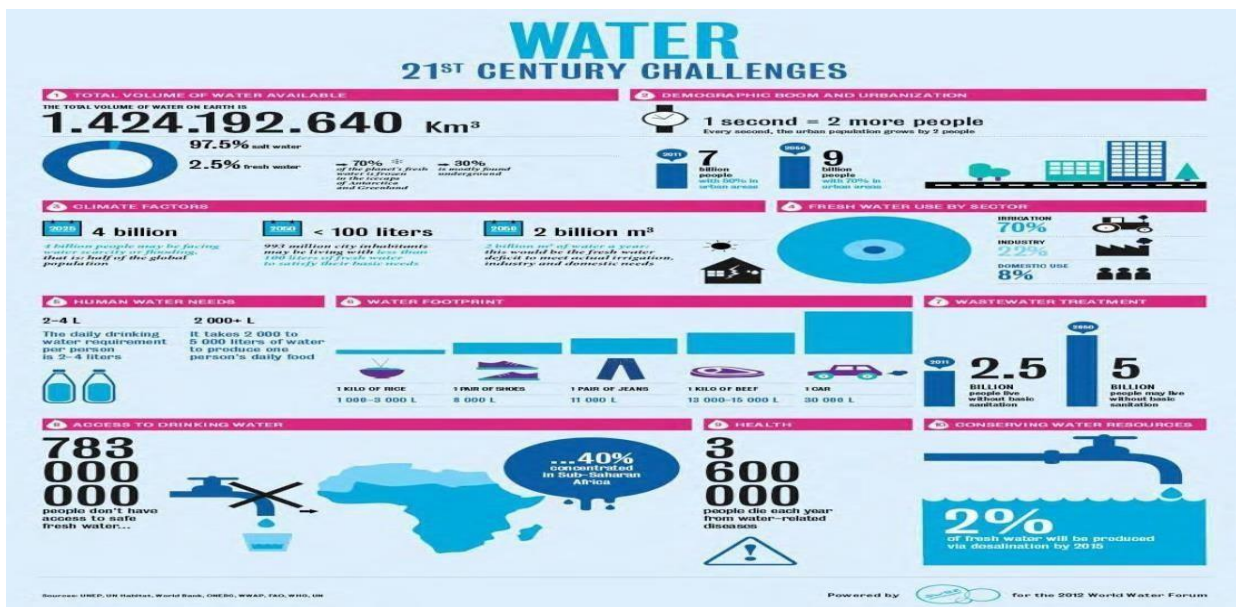


Fig:1.1 among all the pollutions in Dhaka city

In the Bangladesh rural area is mostly expose to water pollution. As we can see from **Figure: 1** among all the pollutions in Dhaka city, water pollution is the contiguous. My motivation for doing this project is to design a prototype which will be feasible and cost effective for poor people. This way I can contribute to my countries development and enrich my knowledge in the field of internet of things. There is no better incentive than saving a children's life and ensure him or her healthier life.

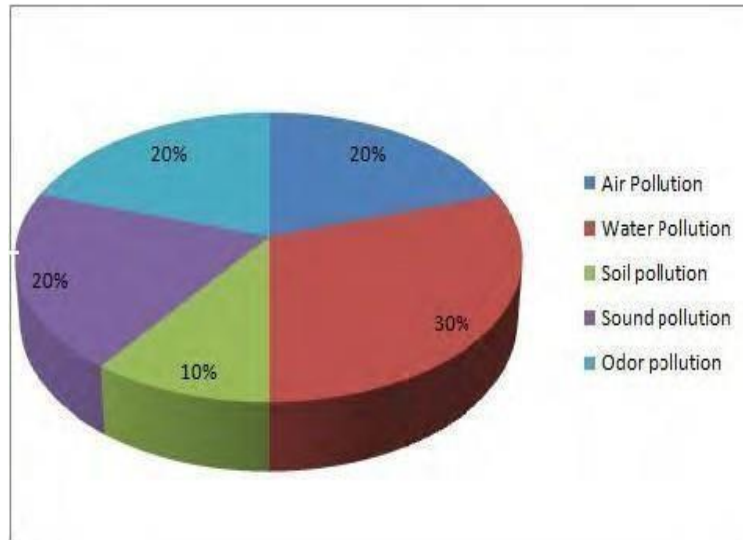


Fig 1.2: Statistical representation of pollution in Dhaka city (Courtesy of pollutionindhakacity.weebly.com).

The main aim of this project is to develop a real time internet of things based small scale, cost effective prototype with the help of available sensors.

Objective

The population of our world is growing rapidly and percentages of drinkable water sources are dropping down very fast. As a result of that meeting the need of ever growing people, major water sources like rivers, ponds, seas, canals etc are being filled up and large industrial in fractures are made. According to World Health Organization (WHO) by 2025, half of the world's population will be living in water- stressed areas. For the developing country like Bangladesh, where people cannot afford high cost water purifier this system can provide affordable solution to water crisis.

Thesis Outline

This paper is summarized as below:

- i) The first section gives overview of internet of things, a brief introduction of water population and previous work done in this field.
- ii) The next section describes system architecture, hardware implementation and software part.
- iii) Last section describes results of this experiment, further work scope in this field, conclusion and references.

CHAPTER 2

LITERATURE SURVEY

Water quality monitoring has gained more interest among researchers in this twenty first century. Numerous works are either done or ongoing in this topic focusing various aspects of it. The main theme of all the projects was to develop an efficient, cost effective, real time water quality monitoring system which will integrate wireless sensor network and internet of things. A brief digest of previous works in this field is given bellow.

Nasser, Ali, Karim and Belhaouari (2013) [52] proposed paper institute and developed a self- configurable, reusable and energy efficient WSN- based water quality monitoring system. Existing frameworks though have the applicability in water monitoring system, cannot be reused in other monitoring applications because of its static nature. Moreover, this dynamic framework also improves the network life time, monitor the water quality real time, and store the information in a portal.

B O'Flyrm, R Martinez, J.Cleary, C.Slater, F.Regan, D.Diamond and H. Murphy (2007)[8] developed a multisensory system measuring water parameters such as temperature, dissolved oxygen, conductivity, ph, turbidity, phosphate and water level for water quality monitoring. The market demand for novel, miniaturized, intelligent monitoring systems for freshwater catchments, transitional and coastal waters is high very across worldwide. Moreover they also work on building custom sensors and integration of Tyndall based integrated sensor network.

Yue and Ying [7] presented novel system architecture of distributed sensor nodes and a base station which collects real –time sample from different field sites. They

used wireless sensor network for collecting data and solar power panel for power supply. Low CO₂ emission, low power consumption and flexibility are few noticeable pros of this system.

Barabde and Danve (2015) [20] paper presented three layers of system architecture of water quality monitoring system. Those three are nodes for data monitoring, a base station and a remote station. They connected all the layers with wireless communication protocol and data being sent to the base station from data monitoring nodes via microcontroller. Collected data was displayed on a local host PC. Matlab was used to create a GUI (graphical User Interface) for data visualization and water parameters such as pH, turbidity, conductivity were displayed. If the compared value exceeds standard value a SMS will be sent to the client.

Kamble, Kakade, Mahajan and Bhosale worked on arduino based mechanized water quality monitoring system.

Wang, Ma and Yang (2011) [19] focus on theoretic issues such as routing algorithm, network lifetime, and so on and apply wireless network into online zigbee and GPRS based water monitoring system. Data transmission was done by zigbee protocol and data collected by GPRS shield. MySQL was employed in the database side.

Yazhini and Maruthi (2017) proposed model showed us how internet of things platform can be used for water management. Remote Sensing techniques and Internet of things can be applicable for wider spectrum of research domain for monitoring, collecting and analyzing data.

Rao, Marshal, Gubbi, Palaniswami, Sinnott and Pettirogrove [51] in their research, a low cost wireless sensor network for sensing physical and chemical parameters is proposed. This system observes the behaviors of aquatic animals due to water population using data analysis.

Zhenan, kai and Bo (2013) developed an intelligent system combining remote sensing technology and control applications. In this system they monitored and controlled river and lake water quality. They overcome the technical challenges such as sensor selection and control over wireless network by adopting appropriate algorithm for system design.

Wadekar, Vakare and Prajapati [10] in their paper, design a system to limit the usage of water. They set up this system in residential societies and continuously monitor the level of water tank. Home owner will install an android application in his smart phone for getting regular information of water level. The data will be stored on the cloud and if he or she is connected to Wi-Fi then he or she will have access to data. There will be a motor submerge into the tank and according to the level of water and requirement it can be switched on or off.

N.Vijay Kumer, R Ramya [2013] [40] developed a system for real time monitoring of the water quality parameters. In their research they measure the water parameter such as turbidity, conductivity, temperature, ph and dissolved oxygen. Instead of arduino they used the raspberry pi b+ model as core controller and send the sensor data on cloud platform.

Rajurkar C, Prabakaran and Mutulakshmi in their project monitor the usage of water in a flat system. In the flat system pipelines generally diverted into different blocks. In their study they consider one particular block and place a flow sensor at each pipe which gives the usage of water at one block ideally. This way they minimize the wastage of water and prevent the domino effect cycle arises as wastage of water. The residence will have a mobile application installed in their phone and they will get real time reporting of water used. The data will be send to cloud platform and it will be used as a statistical data for use of water at every seasons that is winter, summer and

monsoon.

Brinda D and Jain P.C. [50] in their paper designed a wireless sensor network using zigbee module. This module transfers the sensor data wirelessly to the microcontroller. Then a GSM module sends that data to the pc or smart phone. Additionally they used proximity sensors to alert the regulatory body by sending a SMS via GSM module in case someone tries to pollute the water body.

Cloete, Malekain and Nair [43] in their paper they designed and developed a water quality monitoring system which measures the physicochemical parameters of water such as flow, temperature, ph, conductivity, and the oxidation reduction potential. They detect the contamination of water by measuring the parameters and then send notification to the user. Sensors are connected to a microcontroller- based measuring node which processes and analyzes the data. In their paper, they used a zigbee transmitter and receiver module for communication between the measuring and notification nodes.

In our project, we work on developing an automated arduino based water quality monitoring system. We proposed a model where sensors are connected to arduino. Thus sensor values are sent to a core micro controller and displayed on a LCD. Arduino is also interface with GSM module in order to send text notification to user.

2.1 WATER QUALITY MONITORING SYSTEM USING ZIGBEE BASED WIRELESS SENSOR NETWORK

The application of wireless sensor network (WSN) for a water quality monitoring is composed of a number of sensor nodes with a networking capability that can be deployed for an ad hoc or continuous monitoring purpose. The parameters involved in the water quality determination such as the pH level, turbidity and temperature is measured in the real time by the sensors that send the data to the base station or control/monitoring room. This paper proposes how such monitoring system can be setup emphasizing on the aspects of low cost, easy ad hoc installation and easy handling and maintenance. The use of wireless system for monitoring purpose will not only reduce

the overall monitoring system cost in term of facilities setup and labor cost, but will also provide flexibility in term of distance or location. In this paper, the fundamental design and implementation of WSN featuring a high power transmission Zigbee based technology together with the IEEE 802.15.4 compatible transceiver is proposed. The developed platform is cost-effective and allows easy customization. Several preliminary results of measurement to evaluate the reliability and effectiveness of the system are also presented.

Conductivity, PIC microcontroller, GSM module and LCD. The water quality measuring system uses pH, turbidity, conductivity device to measure the standard of water. This device then measures the corresponding values of the water. Since the outputs of the sensors measured are analog in nature and microcontroller will handle solely digital signals thus there's a necessity of a tool that converts analog signals into digital signals. The system makes use of ADC for this purpose. The outputs of sensors are directly given to ADC, which converts the analog signals into the corresponding digital signals. These digital signals are then given to the PIC microcontroller. System uses GSM module for communication. GSM module makes use of interface of the PIC microcontroller for communication. Microcontroller sends the measured values to the watching centre by SMS via the GSM module. Since it is a true time system, thus microcontroller can send the measured values to the watching centre after the particular time as per the program. With the information to the watching centre, the microcontroller conjointly displays the values of the measured quantities on the LCD. It is a true time system thus it does not need any man machine interaction for activity the standard of water. This model uses sensors, GSM module (SIM900), LCD and a PIC 16F877 microcontroller. The GSM module is connected to PC through RS232 cable. The system model is shown in Figure which says about the connectivity of all mentioned devices. The LCD is attached to PIC 16F877 to simultaneously display the measured values, through which we can experimentally check whether the data that is being sent is correct.

This paper presents the implementation of Wireless Sensor Network for water quality tracking using Zigbee. For continuous monitoring a number of sensor nodes with networking ability can be installed using wireless sensor network for water quality monitoring. In water quality monitoring the parameters involved are pH, and turbidity. These parameters are measured in real time by the sensors that send the data to monitoring room/control station (Base station). Such monitoring system can be setup on the aspect of low cost, low power consumption, easy handling, installation

and maintenance. The system consists of sensor nodes (pH Sensor, Turbidity Sensor), a microcontroller, a Zigbee radio, and a base station (Zigbee radio and microcontroller). For comparing routing results of different topologies OPNET simulator is used.

A) Overall Design of the System The system consists of multiple water detection sensors, single-chip microcontroller data acquisition module, information transmission module, monitoring centre and other accessories. Other water quality sensors transform the detected chemical signals into electrical signals, amplified by the signal conditioning circuit. The multiplexers select one road signal and send to A/D converter. Then it is converted into a digital signal. Single-chip reads and processes the digital information. It also controls the GSM module sending the collected data to the monitoring centre in the form of SMS by GSM network instantaneously. Monitoring centre receives the data and then analyses, classifies, saves them and draws corresponding graphs. That can instantaneously monitor and alarm the situation of water quality. If the water quality is abnormal, single-chip will control the GSM module to send data to the monitoring centre in the form of short message. The alarm in the monitoring centre is activated. At the same time, the data are sent to management mobile phone in this way. It is easy for management to take corresponding measures immediately. The system can do allweather real-time monitor to water's pH, conductivity, turbidity. The design is beneficial for management to know the real-time water quality information, and make man-machine interaction with the system by mobile . B) Water Detection Sensors Water detection sensors determine the system's accuracy and cost. Generally, they are very expensive on the market. In order to reduce the cost, we choose DS18B20, make conductivity sensors, turbidity sensors and pH sensors by ourselves, and purchase dissolved oxygen sensor of U.S. Global Water... Conductivity sensors are generally divided into two types: two electrodes or multiple electrodes. Conductivity of two electrodes is commonly used interiorly. Generally, two conductivity electrodes in laboratory can be made by using two platinised platinum to sinter on two parallel glass, or inner wall of the round glass tube. Changing the size of platinum pieces and adjusting the distance between them can make different constant value of two conductivity electrodes. Turbidity is caused by suspended particles in water. Suspended particles block a lot of incident light and scattered light. It also diffuses the incident light. Therefore, photo electricity sensor is used to detect turbidity. PH value is tested by the method of electric potential. Primary cell made by a constant potential reference electrode and measuring electrode is used in the method. A pH glass probe, which is sensitive to pH, is on measurement electrode. It is made

of a special glass that can conduct electricity and permeate hydrogen ion. The potential can be produced when the glass probe touch the hydrogen ion. Different pH in the water generates corresponding potential. It can be converted into 4~20mA output by the transmitter. Conductivity sensors are generally divided into two type's two electrodes or multiple electrodes. Conductivity of two electrodes is commonly used interiorly conductivity measurements are used routinely in many industrial and environmental applications as a fast, expensive and reliable way of measuring the ionic content in a solution.

2.2 WATER QUALITY MONITORING USING Bluetooth low energy (BLE)

ZigBee

ZigBee is a WPAN standard that has been layered on top of the IEEE 802.15.4 specification to include the networking and application layers. ZigBee devices are capable of creating star, cluster tree and mesh network topologies and can communicate over hundreds of meters with a maximum data rate of 250 kbps (Gungor et al., 2009, Lee et al., 2007).

Bluetooth low energy (BLE)

BLE is an ultra-low power version of the Bluetooth specification which allows data rates of up to 1 Mbps in the 30–80 m range context (Gungor et al., 2009, Lee et al., 2007).

Long range wide area network (LoRaWAN)

LoRaWAN is a technology that has been designed for applications that need to send small amounts of data over long distances a few times per day. Its low power features offers the capability to achieve autonomy of up to 10 years (Machina Research, 2015, Marketing Workgroup, 2015LoRa Alliance, 2015a, LoRa Alliance, 2015b).

SigFox

SigFox is the world's first cellular network dedicated to low bandwidth Machine-to-Machine and Internet of Things applications. Its patented Ultra Narrow Band (UNB) technology utilizes unlicensed frequency bands to transmit data over a very narrow spectrum. Sigfox has a range capability of up to 40 km in open space (SigFox, n.d.).

2.3 Water Quality Monitoring System Using Zigbee Based Wireless Sensor Network

The application of wireless sensor network (WSN) for a water quality monitoring is composed of a number of sensor nodes with a networking capability that can be deployed for an ad hoc or continuous monitoring purpose. The parameters involved in the water quality determination such as the pH level, turbidity and temperature is measured in the real time by the sensors that send the data to the base station or control/monitoring room. This paper proposes how such monitoring system can be setup emphasizing on the aspects of low cost, easy ad hoc installation and easy handling and maintenance. The use of wireless system for monitoring purpose will not only reduce the overall monitoring system cost in term of facilities setup and labor cost, but will also provide flexibility in term of distance or location. In this paper, the fundamental design and implementation of WSN featuring a high power transmission Zigbee based technology together with the IEEE 802.15.4 compatible transceiver is proposed. The developed platform is cost-effective and allows easy customization. Several preliminary results of measurement to evaluate the reliability and effectiveness of the system are also presented.

Nikhil Kedia entitled “Water Quality Monitoring for Rural Areas-A Sensor Cloud Based Economical Project.” Published in 2015 1st International Conference on Next Generation Computing Technologies (NGCT-2015) Dehradun, India. This paper highlights the entire water quality monitoring methods, sensors, embedded design, and information dissipation procedure, role of government, network operator and villagers in ensuring proper information dissipation. It also explores the Sensor Cloud domain. While automatically improving the water quality is not feasible at this point, efficient use of technology and economic practices can help improve water quality and awareness among people.[1] Jayti Bhatt, Jignesh Patoliya entitled “Real Time Water Quality Monitoring System”. This paper describes to ensure the safe supply of drinking water the quality should be monitored in real time for that purpose new approach IOT (Internet of Things) based water quality monitoring has been proposed. In this paper, we present the design of IOT based water quality monitoring system that monitor the quality of water in real time. This system consists some sensors which measure the water quality parameter such as pH, turbidity, conductivity, dissolved oxygen, temperature. The measured values from the sensors are processed by microcontroller and this processed values are transmitted remotely to the core controller that is raspberry pi using Zigbee protocol. Finally, sensors data can view on internet browser application

using cloud computing.[2] Michal Lom, Ondrej Pribyl, Miroslav Svitek entitled “Industry 4.0 as a Part of Smart Cities”. This paper describes the conjunction of the Smart City Initiative and the concept of Industry 4.0. The term smart city has been a phenomenon of the last years, which is very inflected especially since 2008 when the world was hit by the financial crisis. The main reasons for the emergence of the Smart City Initiative are to create a sustainable model for cities and preserve quality of life of their citizens. The topic of the smart city.

cannot be seen only as a technical discipline, but different economic, humanitarian or legal aspects must be involved as well. In the concept of Industry 4.0, the Internet of Things (IoT) shall be used for the development of so-called smart products. Subcomponents of the product are equipped with their own intelligence. Added intelligence is used both during the manufacturing of a product as well as during subsequent handling, up to continuous monitoring of the product lifecycle (smart processes). Other important aspects of the Industry 4.0 are Internet of Services (IoS), which includes especially intelligent transport and logistics (smart mobility, smart logistics), as well as Internet of Energy (IoE), which determines how the natural resources are used in proper way (electricity, water, oil, etc.). IoT, IoS, IoP and IoE can be considered as an element that can create a connection of the Smart City Initiative and Industry 4.0 – Industry 4.0 can be seen as a part of smart cities.[3] Zhanwei Sun, Chi Harold Li, Chatschik Bisdikian, Joel W. Branch and Bo Yang entitled “QOI-Aware Energy Management in Internet-of-Things Sensory Environments”. In this paper an efficient energy management frame work to provide satisfactory QOI experience in IOT sensory environments is studied. Contrary to past efforts, it is transparent and compatible to lower protocols in use, and preserving energy-efficiency in the long run without sacrificing any attained QOI levels. Specifically, the new concept of QOI-aware “sensor-to-task relevancy” to explicitly consider the sensing capabilities offered by a sensor to the IOT sensory environments, and QOI requirements required by a task. A novel concept of the “critical covering set” of any given task in selecting the sensors to service a task over time. Energy management decision is made dynamically at runtime, as the optimum for long-term traffic statistics under the constraint of the service delay. Finally, an extensive case study based on utilizing the sensor networks to perform water level monitoring is given to demonstrate the ideas and algorithms proposed in this paper, and a simulation is made to show the performance of the proposed algorithms.[4] Sokratis Kartakis, Weiren Yu, Reza Akhavan, and Julie A. McCann entitled “Adaptive Edge Analytics for Distributed Networked Control of Water Systems” This paper presents the burst detection and

localization scheme that combines lightweight compression and anomaly detection with graph topology analytics for water distribution networks. We show that our approach not only significantly reduces the amount of communications between sensor devices and the back end servers, but also can effectively localize water burst events by using the difference in the arrival times of the vibration variations detected at sensor locations. Our results can save up to 90% communications compared with traditional periodical reporting situations

CHAPTER 3

SYSTEM DESIGN

3.1 EXISTING METHOD

- there are limitless possibilities of ZigBee in wireless sensor network application. Solution providers of ZigBee offer various kinds of platform in the market based on user requirement.
- For this paper, we exploit the low power consumption and long battery life ZigBee platform. Central Water Commission (CWC) monitors water quality, by collecting samples from representative locations within the processing & distribution system.
- These samples are analyzed at the well equipped laboratories. At these laboratories samples from raw water, filter water and treated water are taken for analysis. The estimation of water parameters like turbidity, pH, dissolved oxygen, etc is done with the help of meters. So the disadvantages of this existing system are that; there is no continuous and remote monitoring, human resource is required, less reliable, no monitoring at the source of waters i.e. no on field monitoring and the frequency of testing is very low.
- Due to these disadvantages of the existing system it is required to develop a system that will allow real time and continuous monitoring of water quality

DISADVANTAGES

- **Water tank monitoring systems are only provided for PC environment**
- **Manual operations.**
- **We need a pc to monitor the water level**
- **High cost**
- **Low efficiency.**
- **Complex installations.**

3.2 PROPOSED SYSTEM

- In this paper, a flow sensor-based system integrated with microcontroller to detect the leak due to breakage has been discussed. This system is designed to prevent the further leakage of water flowing through the pipe line.
- This paper is organized in the order of methodology which explains the working of the system, components used to build the system and the results which signify the efficient leakage prevention based on a prototype
- The aims of our proposed work are to develop a real-time prototype pipeline leakage alert system whether it is a water leak or not, an mail alert and an location of the leakage spot will be updated in the IoT website.
- Water flow sensor, ph sensor, water level sensor are connected with arduino to detect flow rate, ph level and level of water. The pump motor is used to the pump the water from tank.
- These data's are uploaded to the IOT with mail alert and location update.

ADVANTAGES:

- **Easy installation.**
- **Low maintenance.**
- **Compact elegant design.**

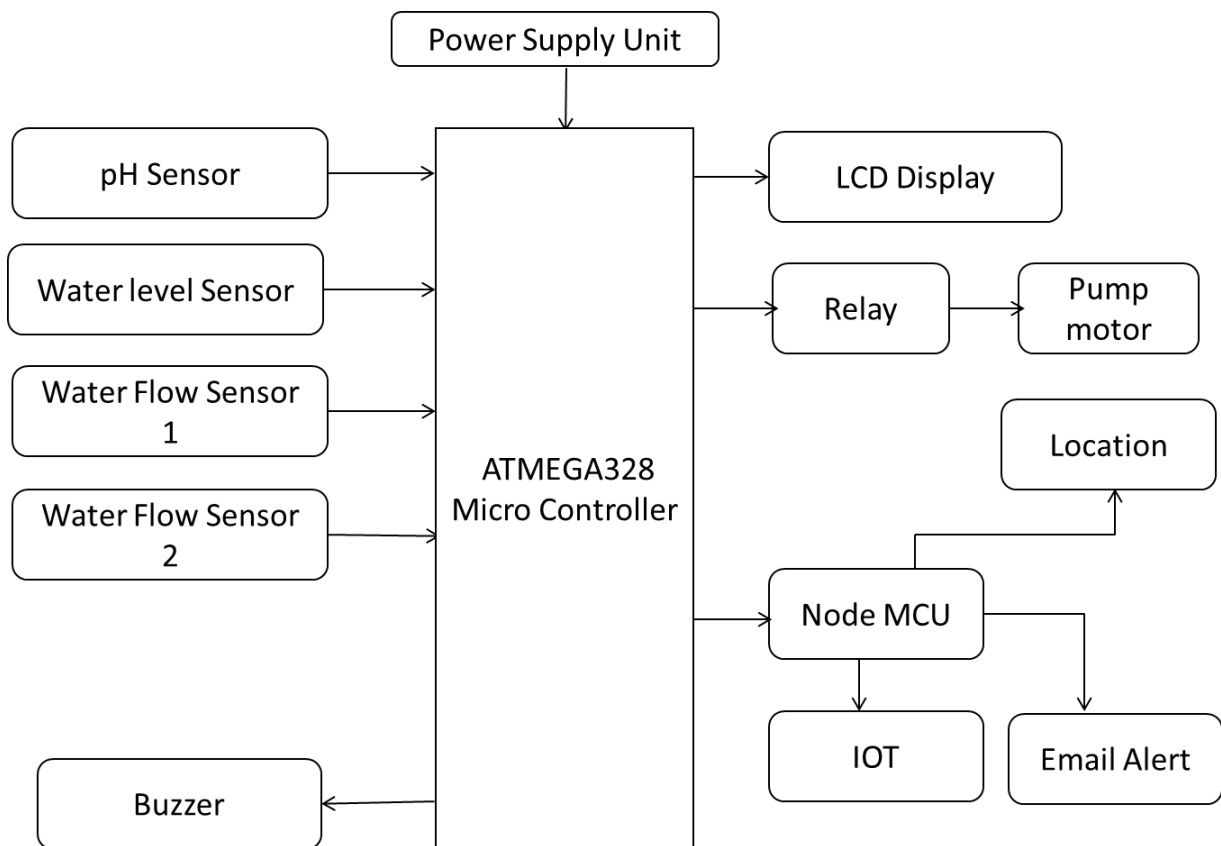


Fig 3.1: BLOCK DIAGRAM

HARDWARE REQUIREMENTS

- **Arduino**
- **Water flow sensor**
- **Ph sensor**

- **Water level sensor**
- **Buzzer**
- **Node MCU**
- **LCD display**
- **Relay**
- **Pump motor**
- **Node MCU**

SOFTWARE REQUIREMENTS

- **Embedded c**
- **Arduino IDE**
- **Proteus simulation**

3.3 PROJECT DESCRIPTION:

The pH of a solution is the measure of the acidity or alkalinity of that solution. The pH scale is a logarithmic scale whose range is from 0-14 with a neutral point being 7. Values above 7 indicate a basic or alkaline solution and values below 7 would indicate an acidic solution. It operates on 5V power supply and it is easy to interface with arduino. The normal range of pH is 6 to 8.5

The unit that we use to measure the **acidity** of a substance is called **pH**. The term “H” is defined as the negative log of the hydrogen ion concentration. The range of pH can have values from 0 to 14. A pH value of 7 is neutral, as pure water has a pH value of exactly 7. Values lower than 7 are acidic and values greater than 7 are basic or alkaline.

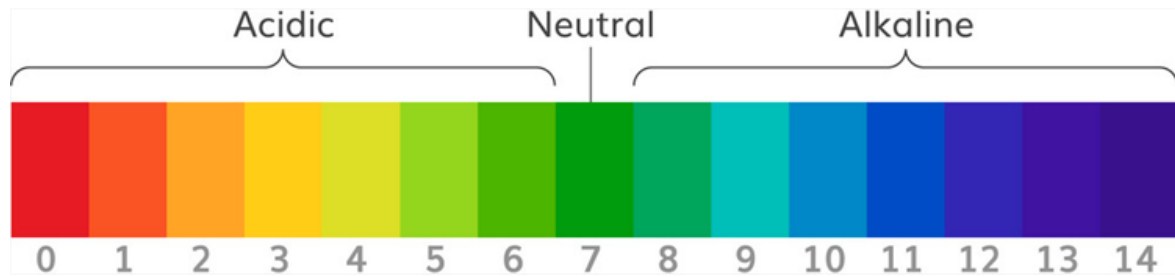


Fig 3.2: How Does Gravity Analog pH Sensor work?

Analog pH sensor is designed to measure the pH value of a solution and show the acidity or alkalinity of the substance. It is commonly used in various applications such as agriculture, wastewater treatment, industries, environmental monitoring, etc. The module has an on-board voltage regulator chip which supports the wide voltage supply of 3.3-5.5V DC, which is compatible with 5V and 3.3V of any control board like Arduino. The output signal is being filtered by hardware low jitter. We previously used a PH sensor with Arduino to measure the pH value of liquid solution.

Circuit diagram for this Arduino based Smart Water Quality Monitoring System is given below:

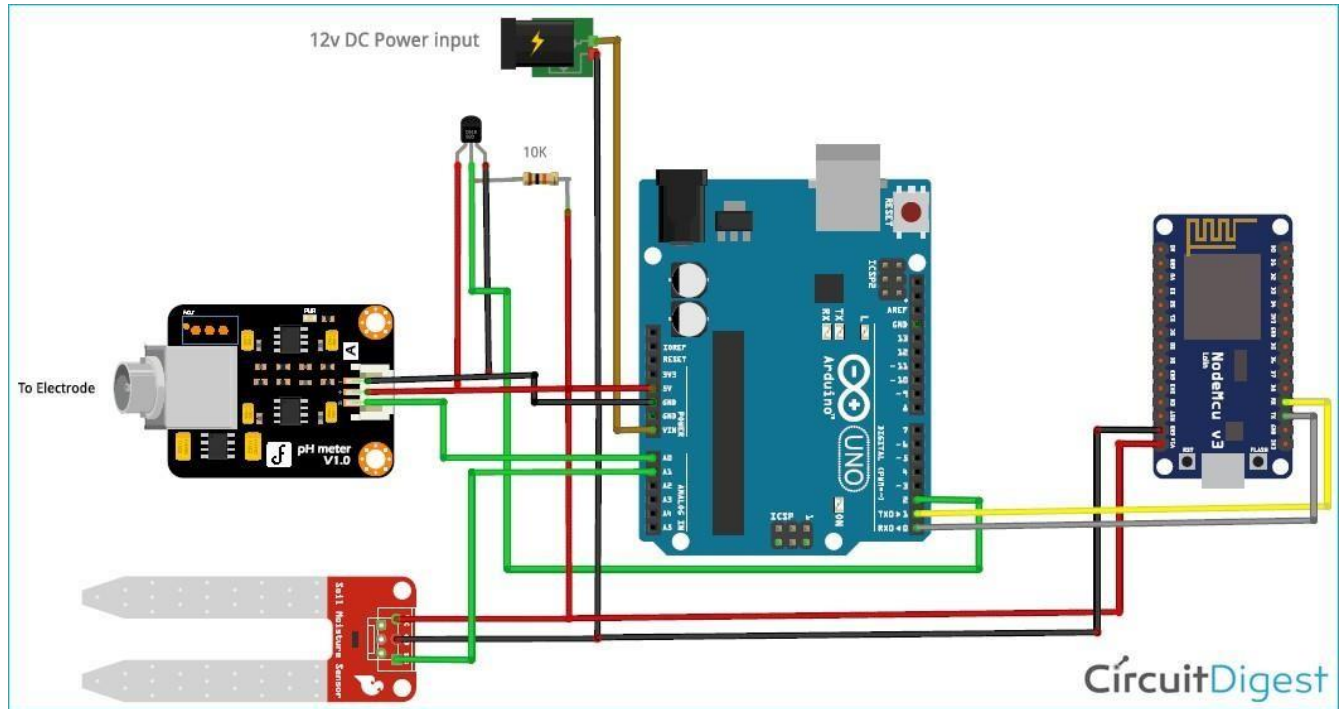


Fig 3.3: Circuit Diagram

Table 1: Connection of PH Signal Conversion Board with Arduino:

The connection between Arduino and PH signal conversion board is shown in the table below.

Arduino	PH Sensor board
5V	V+
GND	G
A0	Po

Programming for Soil Monitoring using IoT

There are two parts of programming in this Smart Water Monitoring System using IoT. In the first part, Arduino is programmed and in the second part, NodeMCU will be programmed. Complete code for both Arduino and NodeMCU along with the video is given at the end of this tutorial. The stepwise description of the code is given below.

Arduino Programming:

First of all, include all the header files, which will be required throughout the code. Here we are using **on wire** and **Dallas Temperature** library for a DS18B20 temperature sensor. This can be downloaded from the links given and included in the Arduino library. Similarly, we are using **Arduino Json** library for sending JSON data from the transmitter to the receiver side.

CHAPTER 4

SOFTWARE DESIGN

PROTEUS

PROTEUS SOFTWARE:

Proteus 8 is a best simulation software for various designs with microcontroller. It is mainly popular because of availability of almost all microcontrollers in it. So it is a handy tool to test programs and embedded designs for electronics hobbyist. You can simulate your programming of microcontroller in Proteus 8 Simulation Software. After simulating your circuit in Proteus 8 Software you can directly make PCB design with it so it could be a all in one package for students and hobbyists. So I think now you have a little bit idea about what is proteus software.

Proteus is a Virtual System Modelling (VSM) that combines circuit simulation, animated components and microprocessor models to co-simulate the complete microcontroller based designs. This is the perfect tool for engineers to test their microcontroller designs before constructing a physical prototype in real time. This program allows users to interact with the design using on-screen indicators and LED and LCD displays and, if attached to the PC, switches and buttons.

Proteus comes with extensive debugging features, single stepping and variable display for a neat design prior to hardware prototyping. Proteus is the program to use when you want to simulate the interaction between software running on a microcontroller and any analog or digital electronic device connected to it.

Proteus was initially created as a multiplatform (DOS, Windows, Unix) system utility, to manipulate text and binary files and to create CGI scripts. The language was later focused on Windows, by adding hundreds of specialized functions for: network and serial communication, database interrogation, system service creation, console applications, keyboard emulation, ISAPI scripting (for IIS). Most of these additional functions are only available in the Windows flavour of the interpreter, even though a Linux version is still available.

Proteus was designed to be practical (easy to use, efficient, complete), readable and consistent.

Its strongest points are:

- powerful string manipulation;
- comprehensibility of Proteus scripts;
- Availability of advanced data structures: arrays, queues (single or double), stacks, bit maps, sets, AVL trees.
- The language can be extended by adding user functions written in Proteus or DLLs created in C/C++.

GET PROTEUS 8 SOFTWARE?

After getting introduction about what is proteus software if you wish to download and give a try to proteus 8 software then labcenter is giving latest version of proteus, proteus 8 demo version for free of cost. The latest Proteus Software version is Proteus 8. You can download it from here.

EXPLANATION:

If you have clear idea about what is proteus 8 simulation software then you can start proteus 8 simulations at this point of time. I am sure that you have your proteus 8. If you don't have then download from above link. To learn Proteus 8 You can start with a series of video tutorials or you can download a Proteus 8 Software Tutorial PDF. But main and most important thing with this software is hands on experiments. the more you work the better you become There is no shortcut.

After making your Schematic you have to do PCB designing so here is the video tutorial which describes Single layer auto routing.

At first sight, Proteus may appear similar to Basic because of its straight syntax, but similarities are limited to the surface:

LANGUAGE FEATURES:

Proteus has a fully functional, procedural approach; variables are untyped, do not need to be declared, can be local or public and can be passed by value or by reference; all the typical control structures are available (if-then-else; for-next; while-loop; repeat-until; switch-case); new functions can be defined and used as native functions.

Data types supported by Proteus are only three: integer numbers, floating point numbers and strings. Access to advanced data structures (files, arrays, queues, stacks, AVL trees, sets and so on) takes place by using handles, i.e. integer numbers returned by item creation functions.

Type declaration is unnecessary: variable type is determined by the function applied – Proteus converts on the fly every variable when needed and holds previous data renderings, to avoid performance degradation caused by repeated conversions.

There is no need to add parenthesis in expressions to determine the evaluation order, because the language is fully functional (there are no operators).

Proteus includes hundreds of functions for:

- accessing file system;
- sorting data;
- manipulating dates and strings;
- interacting with the user (console functions)
- Calculating logical and mathematical expressions.

Proteus supports associative arrays (called sets) and AVL trees, which are very useful and powerful to quickly sort and lookup values.

The functional approach and the extensive library of built-in functions allow to write very short but powerful scripts; to keep them comprehensible, medium-length keywords were adopted. The user, besides writing new high-level functions in Proteus, can add new functions in C/C++ by following the guidelines and using the templates available in the software development kit; the new functions can be invoked exactly the same way as the predefined ones, passing expressions by value or variables by reference. Proteus is an interpreted language: programs are loaded into memory, pre-compiled and run; since the number of built-in functions is large, execution speed is usually very good and often comparable to that of compiled programs. One of the most interesting features of Proteus is the possibility of running scripts as services or ISAPI scripts. Running a Proteus script as a service, started as soon as the operating system has finished loading, gives many advantages: no user needs to login to start the script; a service can be run with different privileges so that it cannot be stopped by a user. This is very useful to protect critical processes in industrial environments (data collection, device monitoring), or to avoid that the operator inadvertently closes a utility (keyboard emulation). The ISAPI version of Proteus can be used to create scripts run through Internet Information Services and is equipped with specific functions to cooperate with the web server.

For intellectual property protection Proteus provides:

digital signature of the scripts, by using the development key (which is unique); the option to enable or disable the execution of a script (or part of it) by using the key of the customer. Proteus is appreciated because it is relatively easy to write short, powerful and comprehensible scripts; the large number of built-in functions, together with the examples in the manual, keep low the learning curve.

The development environment includes a source code editor with syntax highlighting and a context-sensitive guide. Proteus does not need to be installed: the interpreter is a single executable (below 400 Kb) that does not require additional DLLs to be run on recent Windows systems.

5.1 HOW TO SETUP PROTEUS?

1. Start-up the Microsoft Windows.
2. Place the ECOM 4315 CD into CD ROM drive.

3. Double click on the software tools folder and then choose Proteus Simulator after that double click Proteus 7.1 folder and run the setup.
4. Press next until you reach the window which ask for the key.
5. From browse for key; browse until you reach the same folder where the setup exists, and then open the second folder and chose the MAXIM_LICENCE folder.
6. Then click on the top icon which is MAXIM and then press install.
7. Then choose yes and then close the window, after that browse and install the program.
8. After that run the patch which exist in the same folder where the MAXIM_LICENCE exists.
9. Then browse for c:\Program files\Labcenter electronics \Proteus.
10. Finally chose next, and then finish.

GET STARTED TO PROTEUS

1. From start menu chose the PROTEUS, and then chose ISIS(blue).
2. To get a part click on Devices (P).
3. Write the name of the PIC16F84A.
4. To get LED write led then chose green led.
5. To get a resistor write 1k and chose the first part. Device Libraries

Proteus capture comes with pre-supplied libraries for TTL, CMOS, ECL, Microprocessor, Memory and Analogue ICs plus libraries with hundreds of named Bipolar, FET and Diode discrete semiconductors. Also included are manufacturer specific libraries from National Semiconductor, Philips, Motorols, Teccor, Texas Instruments, Dallas and Zetex amongst others - an expanding total, currently over 10,000 parts.

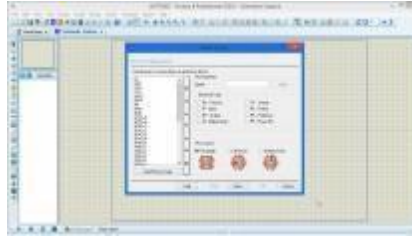


Fig 4.1: Importing Components from BSDL

Direct import of BSDL (Boundary Scan Description Library) files provides a semi-automatic way to quickly create and package larger components.

Libraries provided with Proteus also contain default properties for PCB packaging and/or simulator models. Both homogenous and heterogeneous multi-element devices are supported so you can place a relay's coil and contacts on separate parts of the drawing. Connector pins can also be distributed. Device editing is performed directly on the drawing using the general editing tools. Devices may be constructed from lines, boxes, circles, arcs, text and special pin objects. Non-electrical symbols may also be created for use in small mechanical or block diagrams.

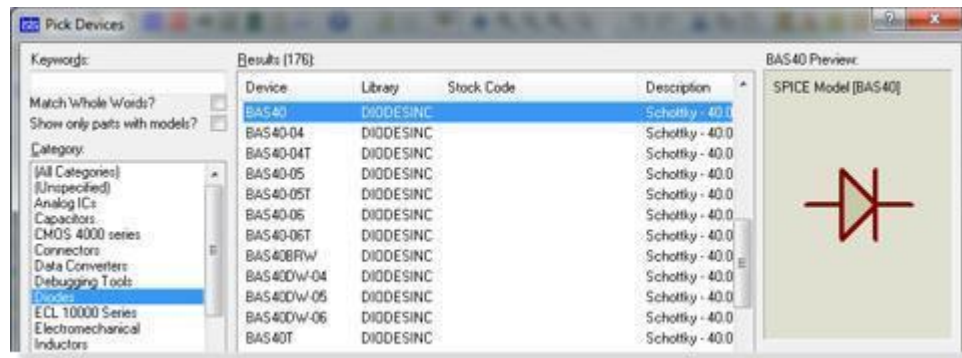


Fig 4.2: A summary listing of included embedded peripheral libraries can be found here.

CHAPTER 5

RESULTS AND DISCUSSIONS

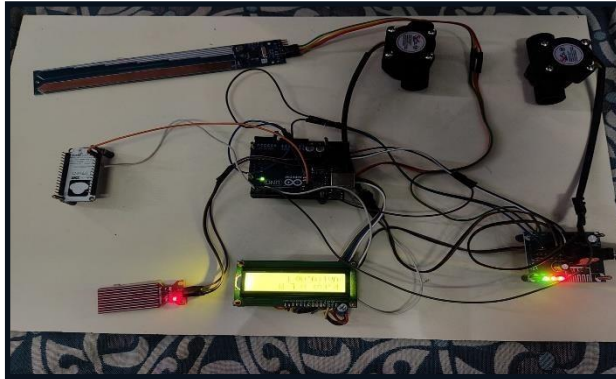


Fig 5.1: Working Model

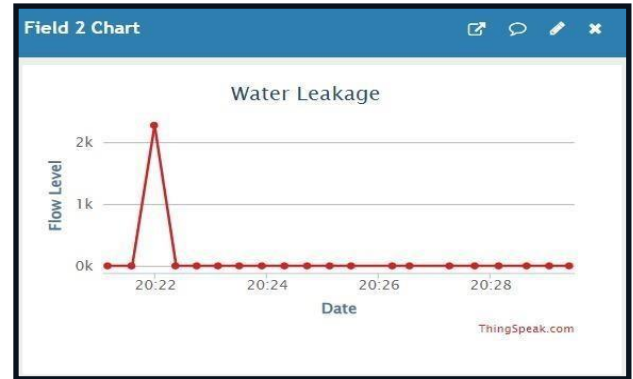


Fig 5.2: Thing Speak Output

- After finishing all the water leakage Detection system connections and programming, system gives good response to the sensor and sends mail when it detects leakage in water where the water sensor was fixed.
- The time taken by the system to deliver the mail is dependent on the coverage area or range of the specified wifi network.
- An important conclusion drawn from this work is that employing an IoT based water leakage detection system offers the efficient and proper utilization of this scarce resource for human life.
- The prototype connection is done in our electrical drives and automation laboratory. The interfacing of arduino with the LCD is done initially. The working solenoid valve is initially checked by connecting it to a 24 V DC supply. The water flow sensor is checked separately with the arduino coding.



Fig 5.3: Display Output

- Initially the flow rate in the two-water flow sensor I displayed through the LCD. It shows that the flow rate is 4 liters/ minute in both the water flow sensor. This the flow rate is equal and there is no leakage across the pipe.
- Then a hole is created in the pipe. Due to this there occurs a difference in the flow rate. That is the flow rate across water flow sensor 1 is 4 Liters /Minute but the flow rate in water flow sensor 2 is 2Litres/Minute. Hence a difference of 2 Liters occurs which is depicted as leakage detected.
- Once the leakage is detected the relay will be energized through the power supply and it will disconnect the supply send to the solenoid valve. So, the solenoid valve will get closed. Thus, the flow of water is fully stopped at the sending end itself. The quality of the water is monitored through the pH sensor

Future Scope

The capability of water quality monitoring system can be enhanced to obtain more efficient reliable results. The number of parameters to be sensed can be increased by the addition of multiple sensors to measure dissolved oxygen (DO), chemical oxygen demand (COD), biochemical oxygen demand (BOD), ammonia nitrogen, nitrate, nitrite, phosphate. The system can be further upgraded using wireless sensor networks. The system can be expanded to monitor hydrologic, air pollution, industrial and agricultural production and so on. It has widespread application and extension value. Work can be carried on to include controlling the supply of water.

CHAPTER 6

CONCLUSION

- Water for domestic purposes is always very essential and it is mandatory to prevent it from getting wasted due to any pipeline leaks. Hence the designed prototype is an effective solution for monitoring the flow of water as well as detecting for leaks in the pipelines.
- The smart water leakage detection system can help in water distribution process by remote activation of solenoid valves. Usage of cloud logging technique enables the data acquisition and analysis in any point of the pipeline. This system makes cost efficient and simple.
- The flow of water through the domestic pipeline can be monitored, forecasted and visualize from anywhere in the world using internet through computer or Smartphone.
- The collected data can be analyzed for making predictions to the users for demand management, asset management, and leakage management. With water as a flowing liquid the system has been tested successfully.
- The work can be extended to forecast data for larger communities with customer satisfaction involving low cost and better performance of the overall system.

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APPENDIX

A. SOURCE CODE

(i) Source Code of Working Model:

```
#include <SoftwareSerial.h>
SoftwareSerial mySerial(18,19);

volatile int flow_frequency1,flow_frequency2; // Measures flow sensor pulses

// Calculated litres/hour
int waterlevel = A0;
float vol1, minute1;
float vol2, minute2;
unsigned char flowsensor1 = 2; // Sensor Input
unsigned char flowsensor2 = 3; // Sensor Input

unsigned long currentTime1,currentTime2;

unsigned long cloopTime1,cloopTime2;

#include <LiquidCrystal.h>
const int rs = 4, en = 5, d4 = 6, d5 = 7, d6 = 8, d7 = 9;
LiquidCrystal lcd(rs, en, d4, d5, d6, d7);

void flow1 () // Interrupt function
{
    flow_frequency1++;
}
void flow2 () // Interrupt function
{
    flow_frequency2++;
}

const int waterpump = 10;
int phvalue =0;

void setup()
{
    Serial.begin(9600);
    pinMode(flowsensor1, INPUT);
    pinMode(waterpump,OUTPUT);
    pinMode(flowsensor2, INPUT);
    digitalWrite(flowsensor1, HIGH); // Optional Internal Pull-Up
    digitalWrite(flowsensor2, HIGH); // Optional Internal Pull-Up
```

```

lcd.clear();
lcd.setCursor(0,0);
lcd.print("Water Flow Meter");
lcd.setCursor(0,1);
lcd.print("Circuit Digest");
currentTime1 = millis();
cloopTime1 = currentTime1;

currentTime2 = millis();
cloopTime2 = currentTime2;

digitalWrite(waterpump,LOW);
}
void loop ()
{
  currentTime1 = millis();
  currentTime2 = millis();

  String data = String(waterlevel)+"@"+String(minute2)+"#";
  Serial.println(data);
  if(data != "")
  {

    lcd.clear();
    // lcd.setCursor(1, 1);lcd.print("pH:");lcd.setCursor(4, 1);lcd.print(phvalue);
    // lcd.setCursor(8, 0); lcd.print("pH:");lcd.print(phvalue);
    Serial.print("pH Sensor:"); Serial.print(phvalue);Serial.print(" ");
    mySerial.print(phvalue);mySerial.print(",");
  }

  int waterlevel = analogRead(A0);
  Serial.print("water_level Sensor:"); Serial.print(waterlevel);

  // Every second, calculate and print litres/hour
  if(currentTime1 >= (cloopTime1 + 1000))
  {
    cloopTime1 = currentTime1; // Updates cloopTime
    if(flow_frequency1 != 0){
      // Pulse frequency (Hz) = 7.5Q, Q is flow rate in L/min.
      minute1 = (flow_frequency1 / 7.5); // (Pulse frequency x 60 min) / 7.5Q = flowrate in
L/hour
      lcd.clear();
      lcd.setCursor(0,0);lcd.print("Rate_1: ");lcd.print(minute1);lcd.print(" L/M");

      Serial.print("RATE: ");Serial.print(minute1); Serial.print(" L/M");Serial.print(" ");
      minute1 = minute1/60;

```

```

lcd.print("Vol_1:");lcd.print(vol1);lcd.print(" L");

    flow_frequency1 = 0; // Reset Counter

    Serial.print("WATERFLOW_1:"); Serial.print(minute1, DEC); Serial.println(" L/Sec");
    mySerial.print(minute1);mySerial.print(",");
    delay(1000);
}

}

if(currentTime2 >= (cloopTime2 + 1000))
{
    cloopTime2 = currentTime2; // Updates cloopTime
    if(flow_frequency2 != 0){
        // Pulse frequency (Hz) = 7.5Q, Q is flow rate in L/min.
        minute2 = (flow_frequency2 / 7.5); // (Pulse frequency x 60 min) / 7.5Q = flowrate in
L/hour
        lcd.clear();
        lcd.setCursor(0,0);lcd.print("Rate: ");lcd.print(minute2);lcd.print(" L/M");
        Serial.print("RATE: ");Serial.print(minute2); Serial.print(" L/M");Serial.print(" ");
        minute2 = minute2/60;

        lcd.setCursor(0,1);

        vol2 = vol2 +minute2;

        lcd.print("Vol_2:");lcd.print(vol2);lcd.print(" L");

        flow_frequency2 = 0; // Reset Counter
        Serial.print("WATERFLOW_2:"); Serial.print(minute2,DEC); Serial.println(" L/Sec");
        mySerial.print(minute2);mySerial.print(",");
        //Serial.print(2_minute, DEC); // Print litres/hour

        // Serial.println(" L/Sec");
        delay(1000);
    }

}

if (waterlevel <100)
{
    digitalWrite(waterpump,HIGH);
}
else if((waterlevel >100)&&(waterlevel <980))
{

```

```

    lcd.setCursor(0,1);lcd.print(" pH-level: ");lcd.print(phvalue);
    Serial.print("RATE: ");Serial.print(minute2); Serial.print(" L/M");Serial.print(" ");
    mySerial.print(waterlevel);mySerial.println(",");
/* else
{

    Serial.println(" flow rate_1 = 0 ");
    Serial.println(" flow rate_2 = 0 ");*/

    lcd.clear();

    lcd.setCursor(0,0);

    lcd.print("Rate: ");

    lcd.print( flow_frequency1 );

    lcd.print(" L/M");

    lcd.setCursor(0,1);

    lcd.print("Vol:");

    lcd.print(vol1);

    lcd.print(" L");
    delay(1000);

    // lcd.setCursor(0, 0); lcd.print("TDS:");lcd.print(tdsValue); lcd.setCursor(8, 0);
    lcd.print("pH:");lcd.print(phvalue);
    // lcd.setCursor(0, 1);lcd.print("Temp:");lcd.print(temp1);lcd.setCursor(9, 1);
    lcd.print("WL:");lcd.print(water);
    digitalWrite(waterpump,LOW);
}

```

(ii) Source Code of Node MCU:

```
#include "ThingSpeak.h"
#include <ESP8266WiFi.h>

char ssid[] = "CSK"; // your network SSID (name)
char pass[] = "haridhoni"; // your network password
int keyIndex = 0; // your network key Index number (needed only for WEP)
WiFiClient client;

unsigned long myChannelNumber = 2406864;
const char * myWriteAPIKey = "PDS32VV837VRW14G";
String myStatus = "";

void setup()
{
  Serial.begin(9600); // Initialize serial
  WiFi.mode(WIFI_STA);
  ThingSpeak.begin(client); // Initialize ThingSpeak
  // Connect or reconnect to WiFi
  if (WiFi.status() != WL_CONNECTED)
  {
    Serial.print("Attempting to connect to SSID: ");
    Serial.println(ssid);
    while (WiFi.status() != WL_CONNECTED)
    {
      WiFi.begin(ssid, pass); // Connect to WPA/WPA2 network. Change this line if
using open or WEP network
      Serial.print(".");
      delay(5000);
    }
    Serial.println("\nConnected.");
  }
}

void loop()
{
  String data;
  while (Serial.available())
  {
    data = Serial.readStringUntil('@');
    data.trim();
    String waterlevel = data;
    data = Serial.readStringUntil('#');
    data.trim();
    String minute2 = data;
```

```

    Serial.print("Gas level :");
    Serial.println(waterlevel);
    Serial.print("Liter_per_hour:");
    Serial.println(minute2);

    // set the fields with the values
    ThingSpeak.setField(1, waterlevel);
    ThingSpeak.setField(2, minute2);

    ThingSpeak.setStatus(myStatus);

    // write to the ThingSpeak channel
    int x = ThingSpeak.writeFields(myChannelNumber, myWriteAPIKey );
    if (x == 200)
    {
        Serial.println("Channel update successful.");
    }
    else
    {
        Serial.println("Problem updating channel. HTTP error code " + String(x));
    }

    delay(10000); // Wait 20 seconds to update the channel again
}
}

```

B. SCREENSHOTS:

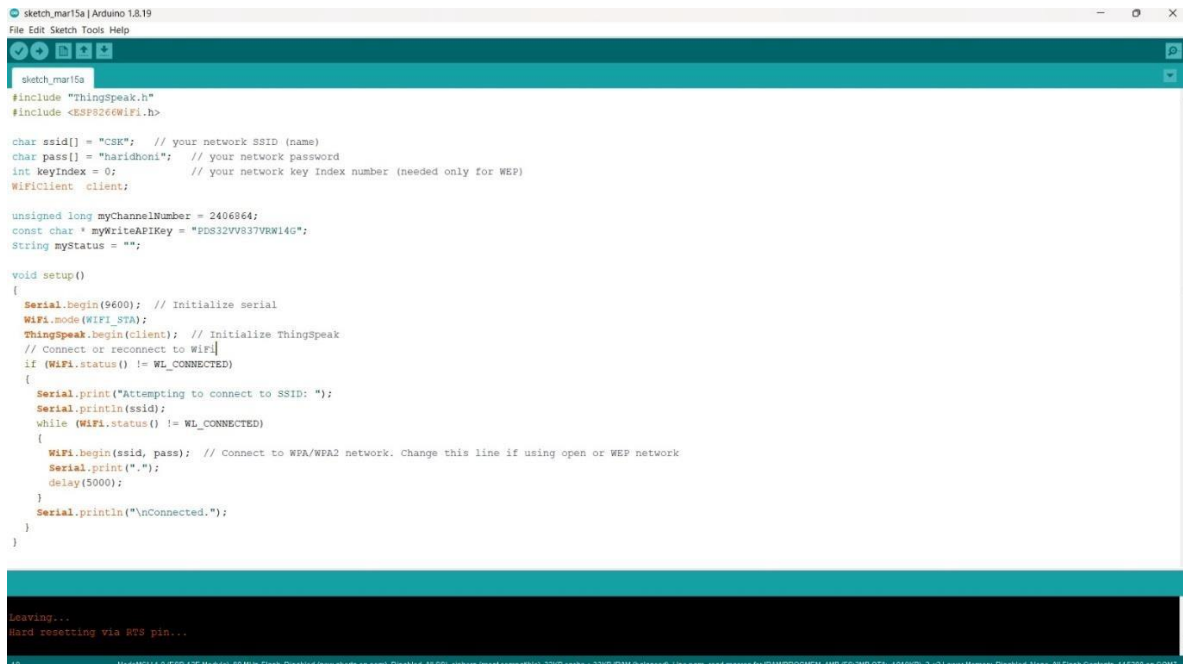


Fig B.1: The Arduino IDE execution

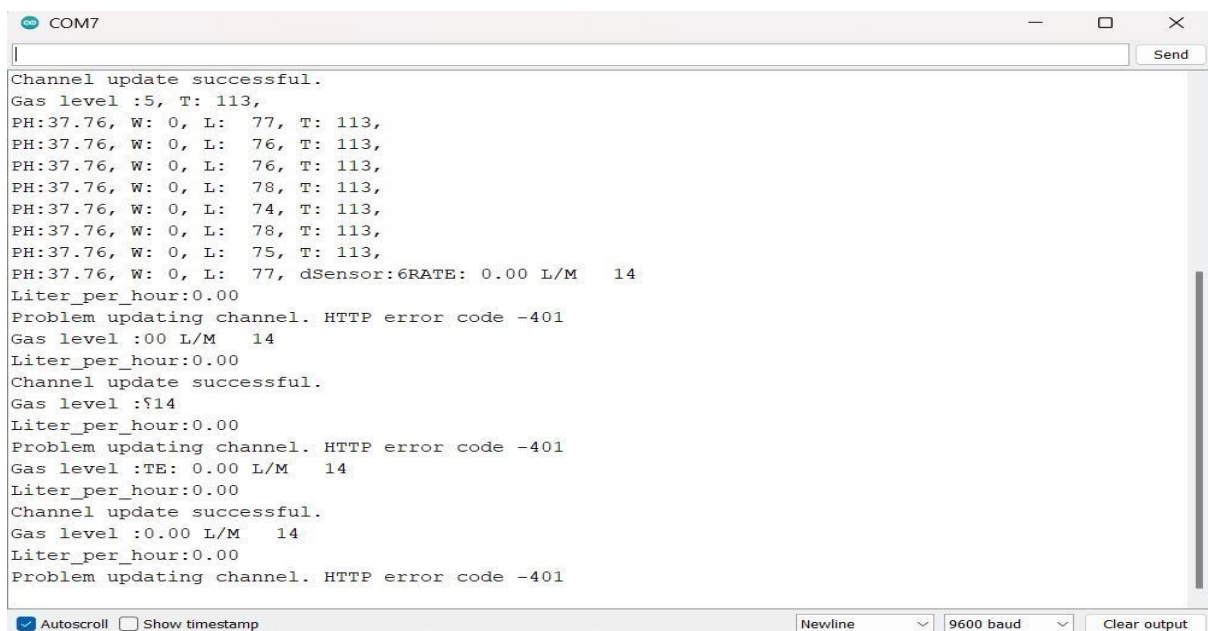


Fig B.2: The Arduino Output

PREVENTION OF WATER WASTAGE IN HOUSEHOLD PIPELINES USING IOT

A.Viji Amutha Mary [1], Harisankar J D [2], J Ramasamy [3]

¹ Associate Professor, Sathyabama Institute of Science and Technology, Chennai, India
vijiamuthamary.cse@sathyabama.ac.in

^{2,3}, Under Graduate, Sathyabama Institute of Science and Technology, Chennai, India

Abstract

Water pipe leakage poses a significant challenge for water distribution authorities worldwide, as pinpointing the exact source of the problem becomes a daunting task. This issue can arise due to various factors, including pipeline deterioration due to age or ongoing urban construction projects like those in Dar es Salaam. Consequently, these distribution authorities encounter immense difficulties identifying the cause of the leak and implementing appropriate measures. Hence, the objective of this endeavour was to produce an Internet of Things based framework to find water leaks, monitor water quality, and track water levels. The prototype consisted of two sensors embedded at the source and destination points, enabling the measurement of water flow rate. The findings revealed that comparing the volume of water generated at the starting point with that at the endpoint facilitated the identification of leaks. Considering a more comprehensive approach to distance calculation could yield intriguing insights, promoting further research into IoT monitoring systems.

1. Introduction

In the 21st century, numerous technological innovations have surfaced, contributing to environmental challenges like pollution and global warming. As a result, ensuring having access to clean drinking water has emerged as a significant concern. Monitoring of water quality in real time faces hurdles because of limited water resources exacerbated by global warming and population growth. Consequently, there is an urgent need to enhance methodologies for real-time monitoring of water quality parameters [1]. One vital that is pH, measuring the amount of hydrogen ions present in water to determine its acidity or alkalinity. Pure water has a pH of 7, where a value of 7 indicates alkalinity and a value of less than 7 indicates acidity. The pH range should ideally fall between 6.5 and 8.5 for drinking purposes. Turbidity is another crucial parameter, gauging the presence of invisible suspended particles in water. Elevated turbidity levels pose a higher risk of diseases like diarrhea and cholera, while lower levels indicate cleaner water. The growing global population has increased the demand for fresh water, intensifying challenges in water supply.

Consequently, effective water management has become a critical issue worldwide. Awareness among scientists, technicians, politicians, and the public is rising regarding these challenges. The constant threat of pollution endangers water supplies, and the scarcity of this essential resource requires immediate attention. Freshwater sources, including lakes, rivers, and subterranean reservoirs, make approximately 3 percent of the water on Earth. To streamline processes and reduce manual effort, testing equipment can be deployed in water sources to remotely detect pollution and initiate necessary actions.

temperature, and water level sensors. The results from pH and temperature sensors are transmitted to the ARTIK cloud platform and visually represented on a nearby personal computer. Additionally, the Arduino Mega is linked to the GSM shield (SIM808), allowing it to compare sensor values with predetermined threshold values. If the obtained value exceeds or falls below the threshold, a text alert is sent to the designated agent. The project's outcomes are discussed in the results section of the paper.

2. Related Works

The environment comprises soil, water, climate, natural vegetation, and landforms, with water being a critical element for human survival and the survival of other organisms. It serves essential purposes such as drinking, household use, food cultivation, and recreation. Ensuring access to safe and easily accessible water is vital for public health, necessitating the maintenance of water quality to prevent negative impacts on human health and ecological balance.

Addressing the challenge of providing clean drinking water has become a global priority in the 21st century. International organizations like the The World Health Organisation (WHO) and the United Nations (UN) acknowledge that everyone has the fundamental right to reasonably priced, readily available, safe, and uninterrupted access to water for household and personal use. According to WHO study, 159 million people depend on surface water sources, and a startling 844 million people do not even have access to basic drinking water services. Consumption of contaminated water can lead to severe and life-threatening diseases, including cholera, dysentery, diarrhoea, typhoid, and polio. It is concerning to note that research indicates that diarrhoea alone accounts for almost 500,000 deaths annually, illustrating the growing water crisis that has reached epidemic proportions in the twenty-first century.

In the contemporary world, the Internet of Things (IoT) has emerged as a revolutionary technological phenomenon, significantly influencing various domains for data collection, tracking and evaluating from a distance. Applications for the Internet of Things (IoT) include wearable technology, smart cities, intelligent power grids, and efficient supply networks. While its full utilization in the environmental sector is pending, the IoT holds immense potential. It can be effectively employed for detecting forest fires and early earthquakes, mitigating air pollution, monitoring snow levels, and preventing landslides and avalanches. Moreover, Systems for monitoring and controlling water quality can use the Internet of Things. In a smart city, for example, a water quality monitoring system can be designed, connecting a network of devices to distant stations, using a microcontroller to store water source characteristics Wireless Sensor Networks (WSN). This enables municipal authorities to swiftly take the required action the quality of the water on a webpage.

3. Proposed Work

This paper provides a comprehensive exploration of a microcontroller-integrated system utilising flow sensors for the effective detection of leaks caused by breakages in a pipeline. The primary aim is to prevent further water leakage within the pipeline. The structure of the paper is organized logically, commencing with an in-depth explanation of the methodology employed in the system. This is followed by a description of the components utilized for its construction, and finally, the results obtained are presented, illustrating the system's efficacy in preventing leaks based on a prototype.

This work's primary goal is to provide a real-time prototype pipeline leakage alert system capable of accurately identifying water leaks and sending email alerts. Simultaneously, it updates the location of the leakage spot on an IoT website. To accomplish this, water flow sensors, pH sensors, and water level sensors are connected to an Arduino board to measure the flow rate, pH level, and water level, respectively. Additionally, a pump motor is employed to pump water from a tank. Subsequently, all collected data is uploaded to the IoT platform, including email alerts and location updates.

BENEFITS:

- Straightforward installation.
- Minimal upkeep required.
- Streamlined and elegant design.

HARDWARE REQUIREMENTS

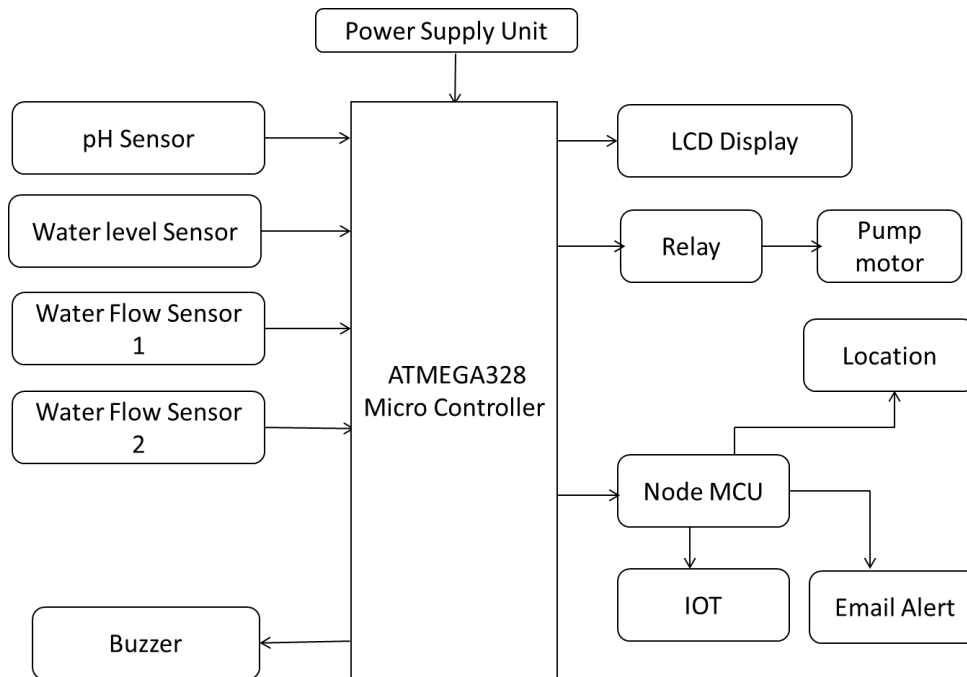
- Arduino
- Water flow sensor
- Ph sensor
- Water level sensor
- Buzzer
- Node MCU
- LCD display

SOFTWARE REQUIREMENTS

- Embedded c
- Arduino IDE
- Proteus simulation

3.1 Design of System Architecture

Figure 1 shows the architectural layout of the system.



3.2 Sensor Data Acquisition

The identification of water leakage typically involves using sensors to get information about the presence of water in areas where it shouldn't be. A system integrating a flow sensor and a microcontroller has been investigated for detecting leaks resulting from pipe breakage. The main goal of this system is to prevent further water leakage within the pipeline. Our proposed project aims to create a prototype real-time pipeline leak alarm system that can determine if a leak is a genuine water leak. Moreover, it will send an email alert and update the location of the leakage spot on the IoT website.

3.3 Arduino Programming

To begin with, it is essential to incorporate all the necessary header files that will be utilized in the code. In this particular case, the `onewire.h` and `DallasTemperature.h` libraries are employed for the DS18B20 temperature sensor. These libraries can be obtained from the provided links and subsequently added to the Arduino library. Additionally, the `ArduinoJson.h` library is utilized for transmitting JSON data from the transmitter to the receiver side.

3.4 Energy Source

The Arduino Uno allows power input via an external power supply or a USB connection; the system chooses the power source automatically based on what is available. In the case of external power, it can be sourced either through an AC-to-DC converter, often referred to as a wall-wart, or a battery. For the adapter, connecting involves inserting a center-positive 2.1 mm connector into the board's power jack. Alternatively, if a Rechargeable is used, Its leads can be fitted into the POWER connector's Gnd and Vin pin headers. The external supply range for the panel's operation is 6 to 20 volts. It's important to understand, though, that the 5V pin may give less than five volts if the supply voltage is below 7V, which could cause board instability. On the other hand, should the voltage exceed 12V, the voltage regulator might overheat, posing a risk of damage to the board. Hence, it is advisable to use a power supply within the recommended range of 7 to 12 volts.

3.5 Data analysis

Efficient transmission and analysis of data play a critical role in water leakage detection systems. The sensors in these systems communicate wirelessly with a central hub, utilizing protocols such as Zigbee or Wi-Fi. This central hub, often equipped with Internet of Things (IoT) capabilities, enables real-time monitoring and control, while ensuring the implementation of secure measures. To ensure reliable communication, redundancy measures are put in place. In terms of data analysis, various methods are employed, including threshold-based and pattern recognition techniques, as well as machine learning algorithms. Historical data is utilized to identify trends, while the use of multiple sensors aids in localizing leaks. Users are promptly notified of potential issues through alerts delivered via different channels. Automation features allow for actions such as shutting off water valves when necessary. To facilitate analysis and monitoring, the system maintains a log of activities. Remote monitoring is made possible through web interfaces or mobile applications. Regular maintenance and calibration are crucial to maintain accuracy and ensure the reliability of the system.

4. Result and Discussion

Upon the successful establishment of connections and the programming phase for the water leakage detection system, the system demonstrates a prompt and affirmative response to the sensor, triggering an immediate email notification when water leakage is detected in the sensor-installed area. The coverage area of the designated WiFi network determines how long it takes the system to send the email. A key deduction from this investigation is that implementing a water leak detection system based on the Internet of Things (IoT) enables the efficient and judicious utilization of this limited resource crucial for human existence. Figure 3 illustrates the water leakage system subjected to testing.

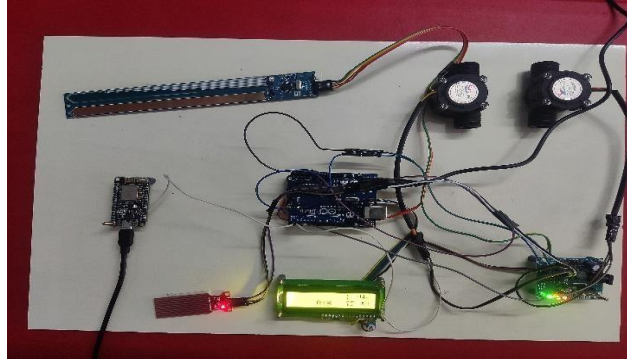


Fig 2. Working of water leakage detection

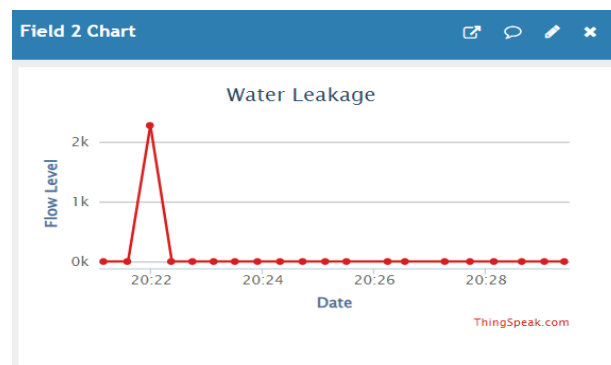


Fig 3. Representation of water leakage in graph

5. Conclusion

The developed prototype presents a practical solution for monitoring the flow of water and identifying leaks in household pipelines, thereby ensuring that water is not wasted unnecessarily. This intelligent system for detecting water leakage allows users to activate solenoid valves remotely, which in turn facilitates efficient distribution of water. By utilizing cloud logging, the system enables data collection and analysis from any point along the pipeline, thereby making it both cost-effective and user-friendly. Through the use of a computer or smartphone, users are able to monitor, predict, and visualize water flow on a global scale via the internet. The data that is collected is then analyzed to make predictions concerning demand management, asset management, and leakage management. Upon conducting successful tests with flowing water, there is potential to expand the system's capabilities so as to generate forecasts for larger communities. By prioritizing customer satisfaction and employing a cost-effective and high-performance system, this overall solution aims to meet the needs of users efficiently.

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