Water Leakage Detector And Level Sensor Using Hc-Sr04 Sensor

Komal Priya[1], Akshada Badhe[2], Ankita Ghode[3], Prajakta Hule[4], Prof. Dnyandeo Khmenar[5]
[1, 2, 3, 4] Dept of Information Technology
[1, 2, 3, 4] DPCOE, Pune
[5]Savitribai Phule Pune University, Pune

Abstract- *This project focuses on an application of wireless sensor networks for leakage detection in underground water pipes to overcome the problem of water dispersion in water distribution networks. Leakage prevention and breaks identification in water distribution networks are fundamental for an adequate use of natural resources. To address this problem, and simplify the leakage identification process, the authors have designed a wireless network system making use of mobile wireless sensors able to detect breaks and save energy, time and cost with having Smart Water Leakage Detection (SWLD) in pipelines, measure water level in tank and control in pump to turn it on when water level is low. It focuses mainly on two parts: The first part is alarm based on IOT send data related to sensor on web server. The system is made up of basic components: sensors, IOT module, Arduino, relays to control the device. The second is the controlling part; it uses TDS SENSOR, ULTRASONIC SENSOR, LEVEL SENSOR The result of using the proposed system is improving the efficiency of operation, reducing delay time and cost of maintenance pipelines after leakage detection.*

Keywords *Embedded System, Arduino uno Microcontroller, TDS sensor, Ultrasonic sensor, Relay, ESP8266 Module.*

I. INTRODUCTION

Overview

Water is the most important natural resources in human's life. Human needs the water in almost all daily activities such as washing, cleaning, taking a bath, the irrigation, and the industry needs. However, the amount of clean water is decreasing, whereas the number of people in the world are always increasing. Water a precious thing required everywhere, but because of its excess use the time says to use it carefully so that the next will faced minimum problem. Our world and community is facing excessive water usage either for domestic or commercial purposes and it is a serious issue, which affects the sustainability of our environment. Water shortages or scarcity may be caused by the current climate change, such as altered weather-patterns (including droughts or floods), increased pollution, and increased human demand and overuse of water. As water is one of the scarce natural resources, it is important to properly use and manage our usage in different sectors. If we keep wasting water continuously it can be very dangerous problem in future. We should start saving a water from ourselves. There are various ways through which water get wasted. Consider a situation where water overflows when tank get full. so our approach is to reduce the wastage of water in this situation. Also, leakage is another concern i.e. whenever there is leakage somewhere we couldn't get it in initial stage but when it becomes a huge problem it causes large wastage of water. So it is better to take action immediately as soon as leakage takes place. In this paper the development of a wireless, multi- sensor network for measuring the level of water in tank and detection of leakage. All the data from the sensors are processed and analyzed, and transmitted wirelessly to a notification node.

Need

It is very clear that water is an inseparable part of not only humans but of every organism on this planet. One cannot even think of surviving without water. We as humans, utilize water not only for drinking purposes but also to perform our daily activities like bathing, washing, cleaning etc. Water is also needed by every industry or factory as a basic raw material to manufacture any kind of product. Water intended for drinking purposes should be safe and wholesome so that it should not cause any disease or discomfort after drinking.
So here we want to check parameter like salt level phvalue and metal particals. Also monitor data over thingspeak.

II. BASIC CONCEPTS

Goals and objectives

- Existing system consisting of PH sensor to detects only PH level of water like it is dirty or clean. So we are adding advanced TDS sensor to detect the salt level, any metal particals etc.
- The scope for this thesis will be the design of a method for the detection and localization of a leak in a system

consisting of a pipe. Two techniques are used for this purpose.

- Monitoring water level using Ultrasonic sensor. If level gets full then water motor will ON automatically. And update all sensor related data on Thing speak on web server.

Outcome

- A water leakage system used for irrigation department.

Applications

- Installed in a residential environment or water distribution company
- In agriculture field

III. LITERATURE SURVEY

[1] **A Novel Approach for Water Leakage Detection and Localization**

Author:- Anuj Purwar1, Mohit Patel2, Mohit Garg3, Karan Ahuja4

The 21st century era is witnessing continuous technological advancements and rapid degradation of our natural resources. Water, which is one of the basic necessities, is under scarcity. There is a need to find ways to conserve and save every single drop of water. To confront from scarcity of water and preserve it using a more efficient method, the idea has been presented in this paper. The idea focuses on developing and implementing an efficient and optimized water utilization system in which automation is done using the sensor data for the quantity of water supplied from the main supply tankto its respective subtanks with an efficient and optimized leakage detection system in the supply lines. Leakage amount in the supply lines is detected based on the concept of difference between water delivered to various nodes by the main tank and received by the various nodes, and the exact location of the leakage is determined using a new approach based on transmission line and circuit theory concepts. The main advantage of using the proposed leakage detection scheme is to reduce the cost to existing leakage detection schemes without comprising the accuracy of the system. While most of the schemes employ sensors and other costly elements thus causing the increase in the system cost, this scheme is very simple and practical as it does not require any sensors and other costly elements but only requires very simple hardware requirements such as coaxial cable, copper wire and waveform analyzer.

[2] **Smart Water for Leakage Detection: Feedback about the Use of Automated Meter Reading Technology**

Author:- Elias Farah, IsamShahrour

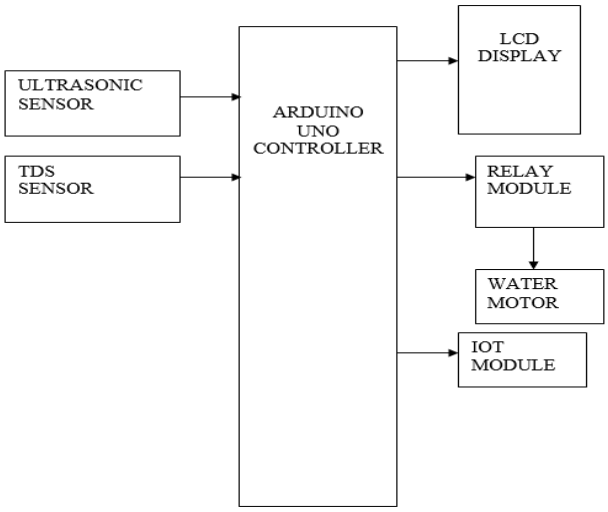
Recent advances in intelligent water meter technology have improved the quantitative monitoring in water supply and distribution. Smart meters using Automated Meter Reading (AMR) technology allowed water utilities to: i) provide clear consumption patterns which can help customers to track and control their water usage and ii) improve active leakage targeting and leak detection capability. This paper presents a feedback about the use of AMR system to detect leakage in a large-scale demonstration site, which is conducted at the Scientific Campus of the University of Lille, which is representative to a small town. This paper presents the demonstration site as well as its monitoring using AMR and how the recorded data allowed a rapid detection of water leakage in the campus.

[3] **A Design of Automatie Water Leak Deteetion Deviee**

Author:-KiatSiong Ng\ Pei-Yin Chen l , Yuan-Chi Tseng2

Water leakages in pipelines and water distribution systems are the major issues in many countries. In this paper, we propose an automatic water pipeline leak detection device to continuously monitor the water pipelines to reduce man power involvement. This device not only reduces human resource but also the time used to process collected information. Our device allows leak detection staff to remotely listen to leak sounds of any pipelines by focusing their attention on the suspicious area. The leak detection staffs can easily distinguish the real leakage from the false alarm by our system design. If leakage occurred, leak detection staffs will be able to determine the severity of the leak and its precise location. Our device is more effective and practicable for government agencies to implement to deal with the problem of water leakage.

IV. PROPOSED WORK



V. PROBLEM DEFINITION AND SCOPE

Problem Statement

Everything from water to crude oil even solid capsule is being transported through millions of miles of pipelines all over the world. Transport and distribution network is very elaborate and continuously growing. This network is prone to many risks .The pipelines are vulnerable to losing their functionality by internal and external corrosion, cracking, third party damage and manufacturing flaws[1]. However pipelines are among safest means for transportation. The major threat that occurs in pipelines is leakage. The effects of leakage go beyond repair expense and cost of lost oil or gas, it also significantly affects the human lives and environment. To impede these huge costs, designing a reliable leak detection technique is crucial. However, more information is required in order to achieve a reliable system. Before deciding on any corrective action the location and size of leakage should be known. Many researches have been done during last decades to find the location and size of the leakage with high accuracy.

Goals and objectives

- Monitoring:- Free from harmful chemical substances. Pleasant to the taste. Here we are using TDS sensor to check all the parameters.
- Usable for domestic purposes.
- Save the time no need to monitor when tank get overflow automatically water motor will off.
- All information will be displayed on LCD screen.
- Update data over web server if any sensor is detected.

Statement of Scope

No life can exist without water
It is as essential for life as air is
Objectives of protected water supply
To supply safe and wholesome water to consumers
To supply water in sufficient quantities
To supply water at convenient points and timings
To supply water at reasonable cost to the users
To encourage personal and house hold cleanliness of users.
No wastage of water using ultrasonic sensor if tank is full automatically motor will OFF Else motor will ON.

Proposed System

- Here we are using microcontroller through which we control all the operations.
- Here we can detect the level of water in tank using Ultrasonic sensor.
- If tank is full then water motor will off automatically using relay.
- TDS sensor is used to check the quality of water.
- If it detect the dirty water then all data will updated over web server using thingspeak.
- All information will be displayed on LCD.

VI. PROJECT PLAN

The designing of the system is in such a way that it is very easy for the user to interact with the application and use the services provided.

Project Task Sets

Major Tasks in the Project stages are:

- Task 1:Topic Finalization
- Task 2: Project design analysis
- Task 3: Project documentation for sem1
- Task 4: Project Development
- Task 5: Project documentation for sem2

Task Network

Project tasks and their dependencies are noted in this diagrammatic form.

Timeline Chart

Above figure shows the Plan of Project that will be the basis for the execution and tracking of all the project activities, which is used throughout the life of the project and kept up to date to reflect the actual accomplishments and plans of the project.

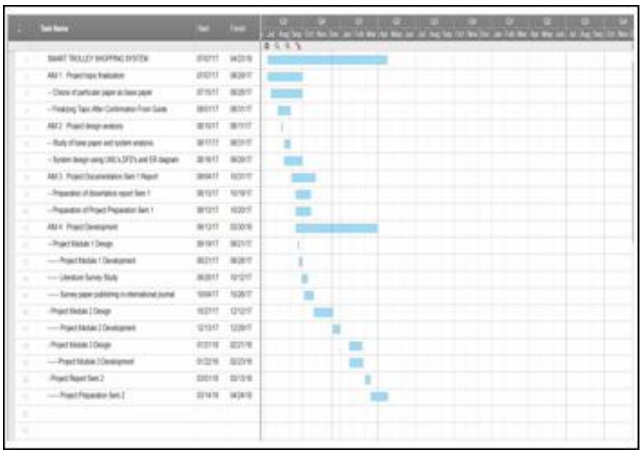


Figure 5.1: Project Plan

Team Organization

Whatever activities are done related to the project that we all showing all details log to our guide. All the reporting are noted to the guide.

Team Structure

The team structure for the project is identified. Roles are defined. Our team have four members. We select this topic after discussing with each other. All the members performing all the task whatever tasks are assign to the members.

Management reporting and communication

For developing this project, first finalize the project topic after reviewing the multiple project topics. After that we gather the requirements about this project. Then we made the synopsis, SRS, PPT and report for sem1. For all above requirements, our team member and our guide discuss with each other. Every time we maintain all the details about whatever activities are performed by us.

VII. ARCHITECTURAL DESIGN

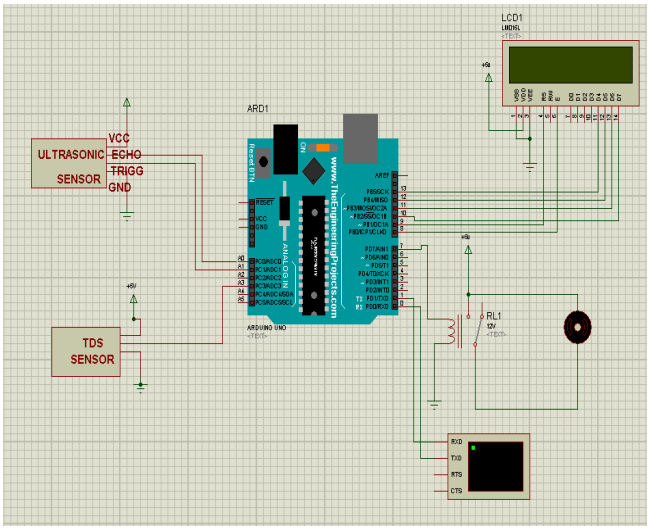


Figure 7.1: Leakage System Architecture

Technology Used

Hardware Resources Required

Arduino Module

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

The power pins are as follows: VIN. The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

- 5V. The regulated power supply used to power the microcontroller and other components on the board. This can come either from VIN via an on-board regulator, or be supplied by USB or another regulated 5V supply.

- 3V3. A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA. • GND. Ground pins.

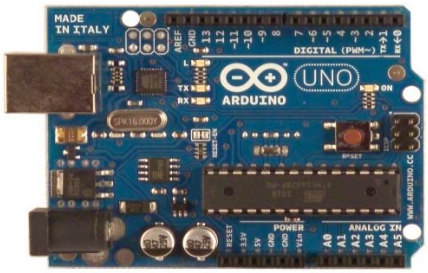


Figure 7.2: Arduino uno Board.

Ultrasonic Sensor

An Ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back. By recording the elapsed time between the sound wave being generated and the sound wave bouncing back, it is possible to calculate the distance between the sonar sensor and the object.

Figure 7.3: Ultrasonic sensor

IOT Module

Expressive Systems' Smart Connectivity Platform (ESCP) is a set of high performance, high integration wireless SOCs, designed for space and power constrained mobile platform designers. It provides unsurpassed ability to embed WiFi capabilities within other systems, or to function as a standalone application, with the lowest cost, and minimal space requirement.

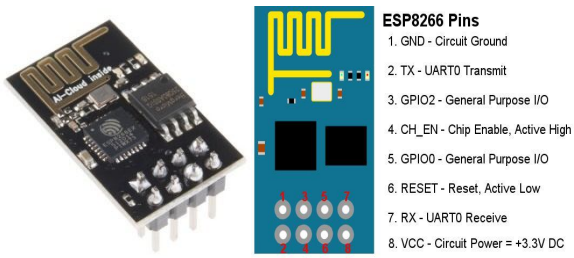


Figure 7.4: ESP8266(IOT module)

LCD

LCD has the ability to display numbers, characters and graphics. The display is interfaced to I/O port of micro controller (P0.0-P0.7). The display is in multiplexed mode i.e. only one display remains on at a time. Within 1/10th of a second the next display switches on. In this way sequentially on and off display will result in continuous display of count due to persistence of Vision.

Figure 7.5: LCD

RELAY Module

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

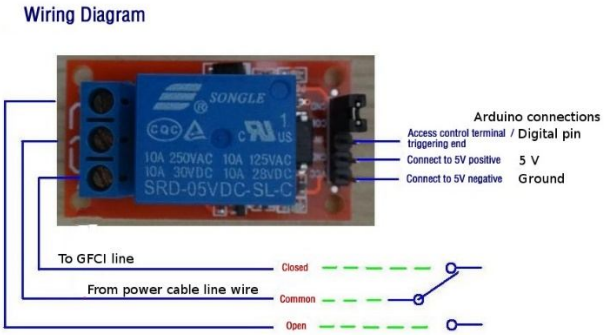


Figure 7.6: Relay

Water Motor

A submersible pump (or sub pump, electric submersible pump (ESP)) is a device which has a hermetically

sealed motor close-coupled to the pump body. The whole assembly is submerged in the fluid to be pumped. The main advantage of this type of pump is that it prevents pump cavitations', a problem associated with a high elevation difference between pump and the fluid surface. Small DC Submersible water pumps push fluid to the surface as opposed to jet pumps having to pull fluids. Submersibles are more efficient than jet pumps.

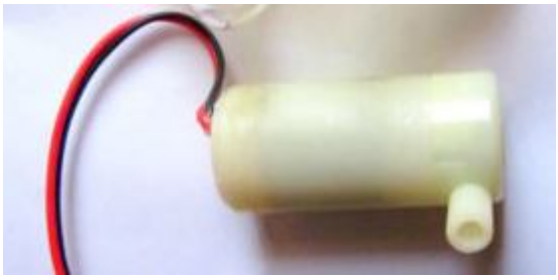


Figure 7.7: water motor

Software Resources Required

- Technology Used : ARDUINO IDE, Proteus.
- Operating System : Windows 8 or above

Flowchart

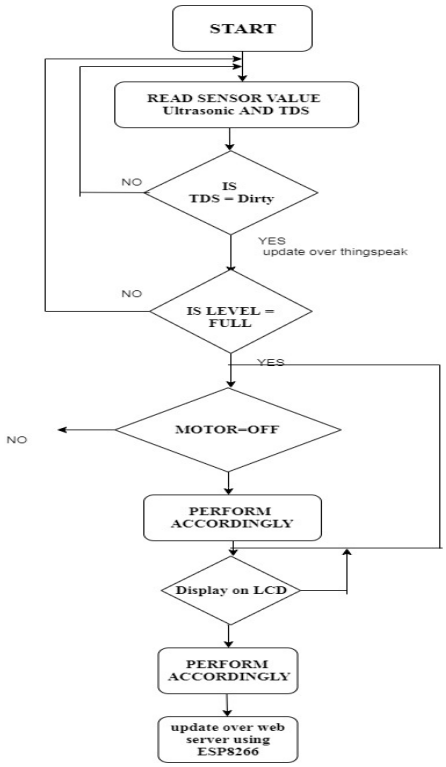


Figure 7.8: Flowchart

Modules

IOT Module(ESP8266)

Esp8266 is a wifi module. Sensor related all data will be updated over web server on thingspeak. Like TDS sensor data and Ultrasonic sensor check level of water in a tank if it gets full. We can monitor over thingspeak.

User Interface And Display Unit (UIDU)

All information will be displayed on 16*2 LCD Display. If any sensor is detected.

VIII. SOFTWARE REQUIREMENT AND SPECIFICATION

Software Requirements

1. Technology Used: Arduino IDE, Proteus
2. Operating System: Windows 8 or above.

Hardware Requirements

1. Hard Disk: 1TB.
2. RAM: 4GB or above.
3. Processor: Intel i3 or above.
4. ARDUINO UNO
5. TDS sensor
6. Ultrasonic sensor
7. LCD display
8. IOT Module(ESP8266)

MODEL IN UML

Use Case Diagram

A use case diagram at its simplest is a representation of a users interaction with the system that shows the relationship between the user and the different use cases in which the user is involved. A use case diagram can identify the different types of users of a system and the different use cases and will often be accompanied by other types of diagrams as well.

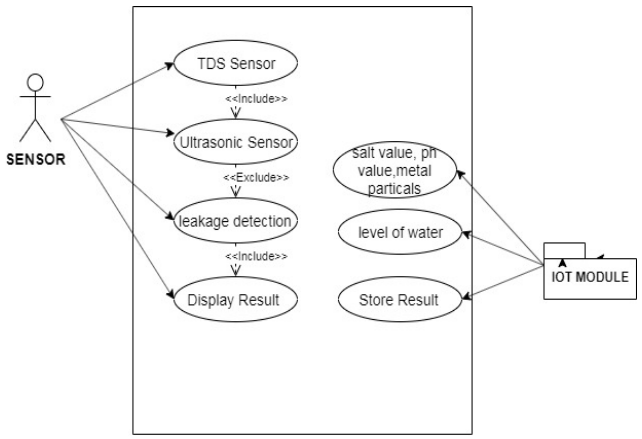


Figure 8.1: Use Case Diagram

Class Diagram

A class diagram in the Unified Modeling Language (UML) is a type of static structure diagram that describes the structure of a system by showing the systems classes, their attributes, operations (or methods), and the relation- ships among objects.

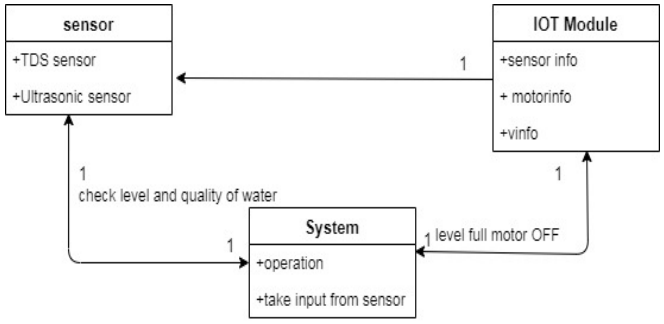


Figure 8.2: Class Diagram

Sequence Diagram

Sequence diagrams provide a graphical representation of object interactions over time. These typically show a user or actor, and the objects and com- ponents they interact with in the execution of a use case. One sequence diagram typically represents a single Use Case 'scenario' or own of events. Sequence diagrams are an excellent way of documenting usage scenarios and both capturing required objects early in analysis and verifying object use later in design. The diagrams show the own of messages from one object to another, and as such correspond to the methods and events supported by a class/object.

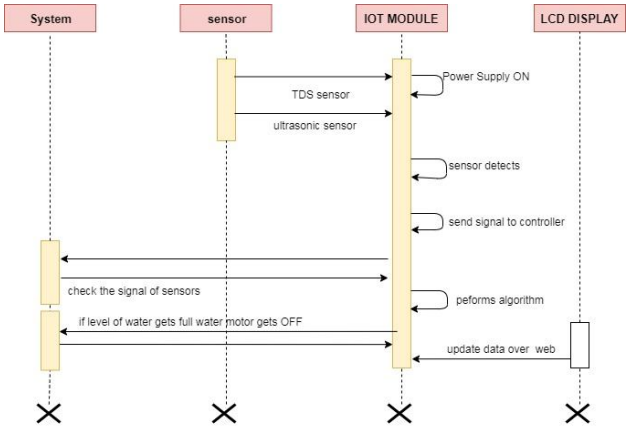


Figure 8.3: Sequence Diagram

Activity Diagram:

The Activity diagram represents the steps taken.

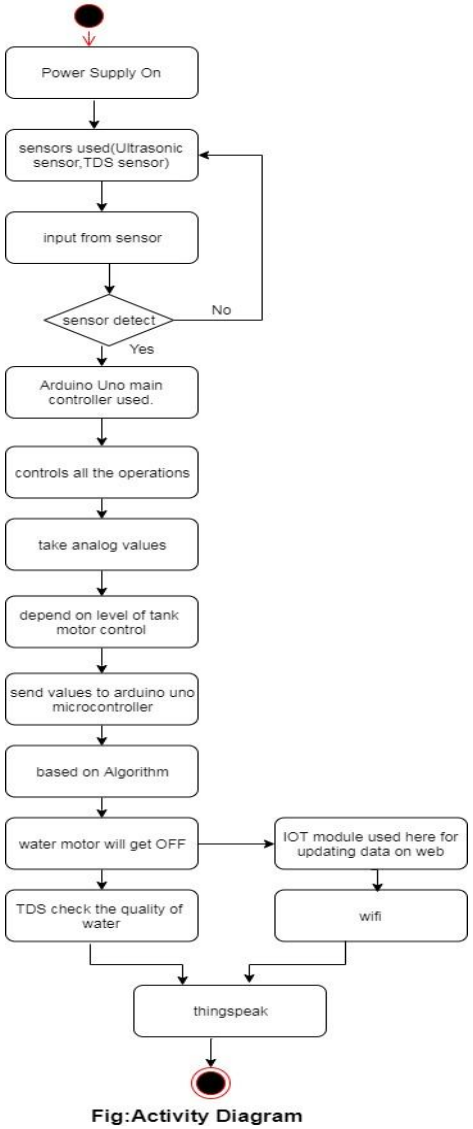


Figure 8.4: Activity diagram

State diagram

A state diagram is a type of diagram used in computer science and related fields to describe the behavior of systems. State diagrams require that the system described is composed of a finite number of states; sometimes, this is indeed the case, while at other times this is a reasonable abstraction. Many forms of state diagrams exist, which differ slightly and have different semantics.

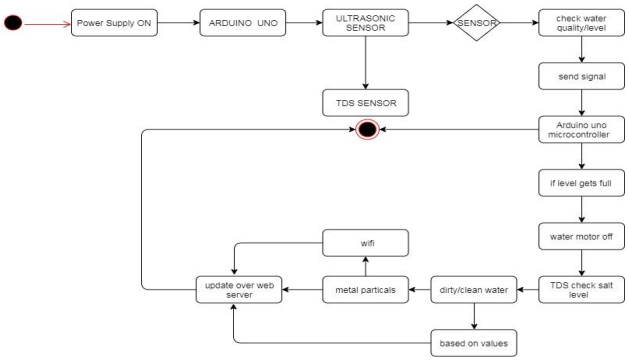


Figure 8.5: State diagram

DATA FLOW DIAGRAM

A data flow diagram (DFD) is a graphical representation of the flow of data through an information system, modelling its process aspects. A DFD is often used as a preliminary step to create an overview of the system without going into great detail, which can later be elaborated. DFDs can also be used for the visualization of data processing (structured design).

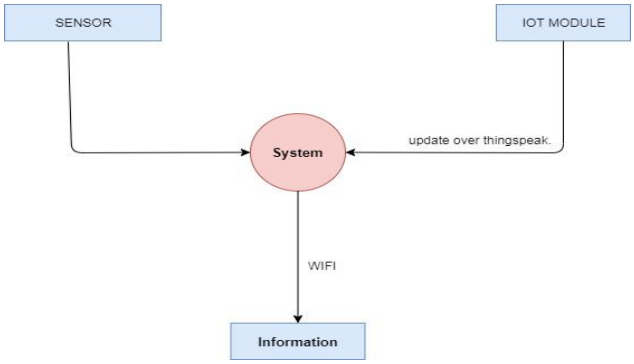


Figure 8.6: Level 0 Data Flow Diagram

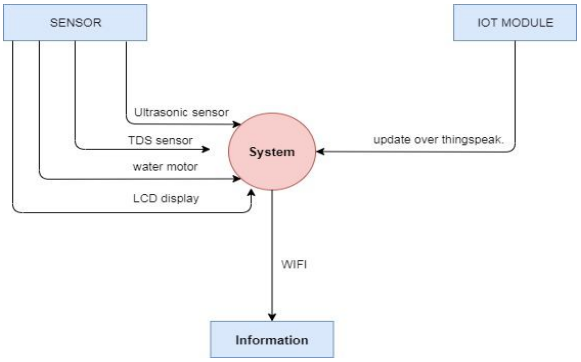


Figure 8.7: Level 1 Data Flow Diagram

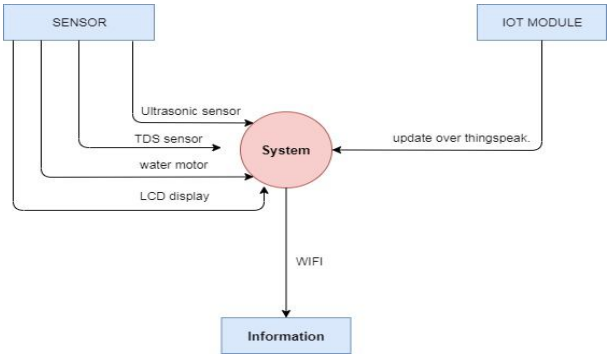


Figure 8.8: Level 2 Data Flow Diagram

IX. SOFTWARE TESTING

INTRODUCTION

Testing is a process of evaluating a system or its component with the intent of find whether it satisfies the specified requirements or not.

- To describe the principles of the system and unit testing
- To describes strategies to generating system test cases.
- To understand the essential characteristics of the tool used for automation.
- To discover any flaws or defects where its behaviour is incorrect or not in conformance with its specification.
- To demonstrate whether the project meets all its requirements.

While developing embedded C program for 8-bit microcontroller, there is a need for testing framework. The framework used here is a lightweight starting point that can be enhanced to provide output in any form useful to the user. Adding these classed to JUnit allows us to scan the classes and run the, all automatically. By running the test cases in AVR simulator we can view the test results by putting breakpoints

after each test is run, or after all tests have run. Further, JUnit is used to implement unit testing in Java and accelerate programming speed and increase the quality of code.

Testing Strategy

The performance of the front end will be verified by major functional areas using JUnit testing. It will be verified by following types of tests:

- User interface tests for testing username and passwords, identifying the unique cart ID.
- Role based login for admin, cashier, and the user so that they are redirected to their respective pages.
- Most relevant products should be displayed by clustering them according to their categories. Hence testing each classes of such products.
- AVR simulator for identifying each passive tag with unique hexadecimal code in AVR studio.
- Feeding product details such as price, colour, manufacturing date, etc. by identifying the code.
- Testing the user identification, for online payment

System Testing

System testing verifies the entire product, after having integrated all software and hardware components, and validates it according to the original project requirements.

Recovery Testing

This testing is performed to determine whether operations can be continued after a disaster or after the integrity of the system has been lost. Here, when total bill is generated and received at the RF receiver. But before sending it to the RF transmitter, the power supply is turned off. And after turning it ON, the data is recovered.

Security Testing

It is a testing technique to determine if an information system protects data and maintains functionality as intended. For online payment, there should be security in Virtual wallet. Secure login must be provided.

Stress Testing

Stress testing is the process of determining the ability of the program or device to maintain a certain level of effectiveness under unfavourable conditions. RFID reader must be able to scan the product tag even if the products are overlapped.

Performance Testing

Performance testing measures the quality attributes of the systems,such as scalability, reliability and resources usage. The accurate bill must be generated and sent wirelessly to the server through RF module. Moreover, performance is measured for the accuracy in re-ranking of the products when the user searches for them.

Test scenario	Test name	Purpose	Expected output	Status
TS01	Username and password	To identify each user with his/her cart used while shopping	Correct Username and password should redirect them to the Welcome page of the mall from where they can proceed to online payment	Pass
TS02	Role based-login	Admin should be redirected to respective database of users, and overall activities page. Cashier should be redirected to pages where they can retrieve the trolley bill.And user should be redirected their account.	All are redirected to their respective pages.	Pass
TS03	Identification of passive tags	There are number of passive tags which are not rewritable so they should be unique for every product. They can be identified by a unique hexadecimal number.	Tag must provide appropriate information of that product to the RFID Reader.	Pass
TS04	Bill generation	If the user decides not to buy a product after it has been added to the product, it should get deducted as soon as it is removed from the cart.	Total correct bill must be displayed at that moment on the LCD after that particular deduction.	Pass
TS05	Online payment	Identify the details of the virtual wallet, balance of the same. Admin can recharge it if the balance is null.	Online payment is successful and user is done with shopping.	Pass

Table 9.1: Unit Testing

X. CONCLUSION

This seminar describes a conceptual development of IoT and Big Data in the context of water supply systems highlighting its advantages and limitations. The paper advocates implementing IoT and Big Data technology for saving water resources and energy.

It is an imperative task to reduce several billion gallons of treated water loss.

XI. FUTURE SCOPE

In future we can use automatically shuts off the water supply after a predetermined period of time, whether the flow is intentional or unintentional, electrically operated water shut-

off valve located in the supply line pressure sensor located in the supply line to detect a drop in water pressure control center including the water demand indicator and a manually operated system reset function Wireless communication(not specify)

REFERENCES

[1] Dan Koo, Kalyan Piratla& John Matthews C, "Towards Sustainable Water Supply: Schematic Development of Big Data Collection Using internet of Things(IoT)," ScienceDirect Procedia Engineering, Vol.118(2015), pp. 489-497.

[2] JayavardhanaGubbia, Rajkumar Buyyab& Slaven Marusic , "Internet of Things (IoT): A vision, architectural elements, and future directions," ScienceDirect Future Generation Computer Systems,Vol. 29 (2013), pp. 1645-1660.

[3] PrachetVerma,Akshay Kumar &Nihesh Rathod , "Towards an IoT based Water Management System For a Campus ", IEEE Publication, Vol.978 , E.(2015), pg. 1-1473

[4] ProsantaGope and Tzonelih Hwang, "Untraceable Sensor Movement in Distributed IoT Infrastructure", IEEE sensor Journal, Vol. 15 , No. 9. SEPTEMBER 2015

[5] Guodong Sun, Tao Hua, Gaoxiang Yang , Jianbo Jia , "Real-time and clock-shared rainfall monitoring with a wireless sensor network " , ScienceDirect Computers and Electronics in Agriculture, Vol.119 ,pp. 1-11 ,22 Octomber 2015.

[6] Mutchek, M. and Williams, "Moving Towards Sustainable and Resilient Smart Water Grids, Challenges," Vol. 5, E. (2014). Pp. 123-13

[7] United States Government Accountability Office, "Energy Water Nexus: Amount of Energy Needed to Supply, Use, and Treat Water Is Location-Specific and Can Be Reduced by Certain Technologies and Approaches", March 2011 , (GAO-11-225)