REAL TIME STAGNANT WATER MONITORING SYSTEM IN STREETS USING IOT AND ANDROID

A Project Report

Submitted by,

ASHWIN N [REGISTER NO: 211417104025]

ENTURI SHANMUKHA SAI [REGISTER NO: 211417104059]

ESWARRAJ B [REGISTER NO: 211417104060]

In partial fulfilment or the award of the degree

Of

BACHELOR OF ENGINEERING

IN

COMPUTER SCIENCE AND ENGINEERING

PANIMALAR ENGINEERING COLLEGE, CHENNAI-600123.

ANNA UNIVERSITY: CHENNAI 600025

APRIL 2021

BONAFIDE CERTIFICATE

Certified that this project report "**REAL TIME STAGNANT WATER MONITORING SYSTEM IN STREETS USING IOT AND ANDROID**" is the bonafide work of "**ASHWIN N (2017PECCS367), ENTURI SHANMUKHA SAI (2017PECCS387) and ESWARRAJ B (2017PECCS388)**" who carried out the project work under my supervision.

SIGNATURE

Dr.S.MURUGAVALLI, M.E.,Ph.D.,
HEAD OF THE DEPARTMENT
DEPARTMENT OF CSE,
PANIMALAR ENGINEERING COLLEGE
NAZARATHPETTAI,
POONAMALLEE,
CHENNAI-600 123

SIGNATURE

Dr.S.BALAJI, B.TECH., M.E., Ph.D.,
ASSOCIATE PROFESSOR,
DEPARTMENT OF CSE,
PANIMALAR ENGINEERING COLLEGE
NAZARATHPETTAI,
POONAMALLEE,
CHENNAI-600123

Certified that the above candidate(s) was/ were examined in the Anna University Project Viva-Voce Examination held on ……

INTERNAL EXAMINER

EXTERNAL EXAMINER

ACKNOWLEDGEMENT

We express our deep gratitude to our respected Secretary and Correspondent **Dr.P.CHINNADURAI, M.A., Ph.D.** for his kind words and enthusiastic motivation, which inspired us a lot in completing this project.

We would like to express our heartfelt and sincere thanks to our Directors **Tmt.C.VIJAYARAJESWARI, Dr.C.SAKTHIKUMAR, M.E., Ph.D.,** and **Tmt. SARANYASREE SAKTHIKUMAR B.E., M.B.A.,** for providing us with the necessary facilities for completion of this project.

We also express our gratitude to our Principal **Dr.K.Mani, M.E., Ph.D.** for his timely concern and encouragement provided to us throughout the course.

We thank the HOD of CSE Department, **Dr. S.MURUGAVALLI, M.E.,Ph.D.,** for the support extended throughout the project.

We would like to thank my Project Guide **Dr.S.BALAJI, B.TECH., M.E., Ph.D.,** and all the faculty members of the Department of CSE for their advice and suggestions for the successful completion of the project.

ASHWIN N,
ENTURI SHANMUKHA SAI,
ESWARRAJ B.

ABSTRACT

In the latest of times due to heavy monsoons roads and houses are flooded with water. Mainly due to poor drainage systems and also because of the unregulated constructions in low-lying areas. As a result of this, water stagnation is a major concern as blocked roads, flooded streets could cause distress to many ongoing commuters and sometimes may lead to accidents. It also acts as an incubator for different parasites and breeding ground for mosquitoes which indeed could lead to the spread of malaria, dengue. We propose an IOT device that would help detect stagnant water in streets and alert the public and the water resources department with the exact location using which necessary measures can be taken by the department in the areas and roads to clear out the water and also to provide real-time updates to the public regarding the routes that are blocked due to excessive water

LIST OF FIGURES

TABLE OF CONTENT

CHAPTER 1

INTRODUCTION

1.1 OVERVIEW

Even in today's modern world water stagnation is a main problem which causes several problems to the public which interrupts their day today life. Stagnant water can also be a major environmental hazard.

The term water stagnation is a phenomenon when the water can't reach the surface of the soil because its empty spaces are already occupied. Water stagnation can be on the surface of the soil and in the macro pores under the surface
The main reason for water stagnation is flood which is nothing but overflow of water that submerges the land which is usually dry. There are also some other reasons which cause the water stagnation such as poor sewer system, construction is low lying areas and also heavy rainfall.

As a result of this water stagnation is a major concern as it could become an incubator for different parasites, bacteria and a breeding ground for mosquitoes which indeed could lead to the spread of malaria, dengue and also accidents. Which may cause their life.

We propose a solution in which if the streets are flooded an alert message is sent stating the exact location of the flooded street to the respective department in the real time so that they can take immediate actions in order to clear the stagnant water in the street as soon as possible.

The device that we propose is built using an Arduino Nano, a water sensor and also a NRF module. Here the Arduino acts as a microcontroller and the water sensor is used to find out whether the street is flooded or not, And finally a NRF module in order to communicate with other devices which are placed in all the street lights present in the street. To know whether the street is flooded or not if

the with more accuracy a threshold value is fixed, The threshold value will calculated on the basis of the length of the street and number of street lamp present in that particular street. Now if the street is flooded the water sensor in each device picks up and sends the signal to the microcontroller communicate with each other using the NRF module, Now if the generated value is greater than the threshold value, Then the a alert message is transmitted to the respective department stating the current location of the flooded street.

CHAPTER 2

LITERATURE SURVEY

Multi-sensor Remote Sensing Technologies in Water System Management - Shu Shibu.

To learn how knowledge and technology can be used to improve water management, smart grid technology has been introduced in the water industry. To achieve the objectives of efficient use of the water distribution network, and to provide quality services to consumers, the Advanced Metering Infrastructure (AMI) is proposed. A collection of online monitoring sensors including smart flow and pressure meters, water quality sensors, smart water meters and leak monitoring sensors are integrated into the water distribution networks connected to the SCADA system. Internet mobility, pressure and water quality data are important for hydraulic and water quality measurements that make water system management digital and sensible.

Internet of Things (IOT) Enabled Water Monitoring system - Thinagaran Perumal, Md Nasir Sulaiman, C. Y. Leong.

Water is always a crucial part of everyday life. Due to the global environmental situation, water management and conservation is vital for human survival. In recent times, there were huge needs of consumer based humanitarian projects that could be rapidly developed using Internet of Things (IoT) technology. In this paper, we propose an IoT based water monitoring system that measures water level in real-time. Our prototype is based on the idea that the level of the water can be a very important parameter when it comes to the flood occurrences especially in disaster prone areas. A water level sensor is used to detect the desired parameter, and if the water level reaches the parameter, the signal will be fed in real time to social networks like Twitter. A cloud server was configured as

a data repository. The measurement of the water levels are displayed in a remote dashboard.

Smart Water Monitoring System for Real-Time Water Quality and Usage Monitoring - Manish Kumar Jha, Rajni Kumari Sah, M. S. Rashmitha, Rupam Sinha, B. Sujatha, K. V. Suma

This paper aims to design a Smart Water Monitoring System (SWMS) for real-time water quality and monitor usage. It consists of two parts: Smart Water Quantity Meter and Smart Water Quality meter. The purpose of building a Smart Water Quantity Meter is to ensure water conservation by monitoring the amount of water used by the family, informing the consumer and the authorities. The three-lab payment system produces a utility bill based on the amount used. Smart Water Quality Meter tests the purity of the portable water a consumer receives, by measuring five limits of water quality viz. pH, temperature, turbidity, dissolved oxygen and mobility. The plan ensures the prevention of any health hazards or potential threats arising from accidental sewage contamination or the release of the farm from contaminated water. An online monitoring system to provide this data to the cloud in real time. Any violation of the usage limit or water quality is immediately notified to the consumer and the official via SMS and a warning signal generated by the system.

Development of a Wireless Sensor Network Based Water Quality Monitoring and Notification System - M. P. P. Sithole, N. I. Nwulu, E. M. Dogo

In this paper, we introduce a water quality monitoring and awareness system. It is also integrated with the WHO's water safety awareness system in line with

WHO's water quality standards. The consumer warning system is equipped with a notification buzzer, a red-Light Emitting Diode (LED) and a green-LED as an indicator of unsafe water and safe water respectively. Five sources of water pollution, namely, soil, chlorine, vinegar, salt, washing powder and its compounds have been used in this process to ensure the effectiveness of the system. Wireless communication between the measurement system and the underlying analysis and information system was established to move using radio frequency modules. Errors in estimates and risks of using each water parameter are calculated in MS Excel as part of the analysis and presented in this document. This paper also introduces additional functionality using the Light Dependent Resistor (LDR) to measure the flexibility of LEDs and LEDs in the notification system below. The notification system accommodates people with disabilities as the buzzer is audible to the blind, and LEDs are visible to the deaf. The improved system was compared with performance and performance using the quality of the results measured against the expected results.

CHAPTER 3

SYSTEM ANALYSIS

3.1 EXISTING SYSTEM

When the streets are flooded then in order to clear the stagnant water people who belong to the respective area or street had to call the respective department, So that the respective department will take necessary Action for clearing the water.

3.2 PROPOSED SYSTEM

To clear the stagnant water in an easier and efficient way, We propose an IOT device which is connected to the application which shows and stores status of the system (active or inactive). If the device gets active due to water stagnation the location is shared to the respective department and thus action is stored in the database, and if it's not active then it continues monitoring.

3.2.1 ADVANTAGES:

1. It saves Time Complexity
2. Happens in real time
3. More effective and efficient
4. The alert will be sent automatically.

3.3 REQUIREMENT ANALYSIS AND SPECIFICATION:

The requirement engineering process of feasibility study, requirements elicitation and analysis, requirement specification, requirements validation and requirement management. Requirement elicitation and analysis is am iterative process that can be represented as a spiral of activities, namely requirements discovery, requirements classification and organization, requirement negotiation and requirements documentation.

3.3.1 INPUT REQUIREMENT

The input requirement at the base requires data from the iot devices which is shared to the database automatically using a hub. The data is used to find out whether the given device is active or not.

3.3.2 OUTPUT REQUIREMENT

In the mobile application the output is displayed as a database which stores the device status whether the device is active or inactive and also the location of the device which states the location of the stagnant water.

3.4 FEASIBILITY STUDY

A feasibility study is carried out to select the best system that meets performance requirements. The main aim of the feasibility study activity is to determine that it would be financially and technically feasible to develop the product.

3.4.1 TECHNICAL FEASIBILITY

A technical feasibility study is carried out in order to showcase that the specifying software will successfully satisfy the user requirement. Open source and business-friendly and it is truly cross platform, easily deployed and highly extensible.

3.4.2 ECONOMIC FEASIBILITY

Economic analysis is the most frequently used technique for evaluating the effectiveness of a proposed system. We try to propose a system that is both cost effective and highly efficient. The creation of mobile Application and the

programming of IOT devices is done through open source applications such as android studio and Arduino ide . Hence it is cost efficient.

3.5 HARDWARE REQUIREMENT:

3.5.1 ARDUINO NANO:

Arduino Nano is one type of microcontroller board, and it is designed by Arduino.cc. It can be built with a microcontroller like Atmega328. This microcontroller is also used in Arduino UNO. It is a small size board and also flexible with a wide variety of applications. Other Arduino boards mainly include Arduino Mega, Arduino Pro Mini, Arduino UNO, Arduino YUN, Arduino Lilypad, Arduino Leonardo, and Arduino Due. And other development boards are AVR Development Board, PIC Development Board, Raspberry Pi, Intel Edison, MSP430 Launchpad, and ESP32 board. This board has many functions and features like an Arduino Duemilanove board. However, this Nano board is different in packaging. It doesn't have any DC jack so that the power supply can be given using a small USB port otherwise straightly connected to the pins like VCC & GND. This board can be supplied with 6 to 20volts using a mini USB port on the board

Fig 3.5.1 Arduino nano

3.5.2 NODE MCU:

The NodeMCU (*N*ode *M*icro*C*ontroller *U*nit) is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains the crucial elements of a computer: CPU, RAM, networking (WiFi), and even a modern operating system and SDK. That makes it an excellent choice for the Internet of Things (IoT) projects of all kinds.

However, as a chip, the ESP8266 is also hard to access and use. You must solder wires, with the appropriate analog voltage, to its pins for the simplest tasks such as powering it on or sending a keystroke to the "computer" on the chip. You also have to program it in low-level machine instructions that can be interpreted by the chip hardware. This level of integration is not a problem using the ESP8266 as an embedded controller chip in mass-produced electronics. It is a huge burden for hobbyists, hackers, or students who want to experiment with it in their own IOT projects.

Fig 3.5.2 Node MCU

3.5.3 WATER SENSOR:

Water sensor brick is a device that is designed for water detection, which can be widely used in sensing rainfall, water level, and even liquid leakage. Connecting a water sensor to an Arduino is a great way to detect a leak, spill, flood, rain, etc.

It can be used to detect the presence, the level, the volume and/or the absence of water. While this could be used to remind you to water your plants, there is a better Grove sensor for that. The sensor has an array of exposed traces, which read LOW when water is detected.

Fig 3.5.3 Water sensor

3.5.4 NRF MODULE:

The nRF24L01 is a wireless transceiver module, meaning each module can both send as well as receive data. They operate in the frequency of 2.4GHz, which falls under the ISM band and hence it is legal to use in almost all countries for engineering applications. The modules when operated efficiently can cover a distance of 100 meters (200 feet) which makes it a great choice for all wireless remote controlled projects.

The module operates at 3.3V hence can be easily used with 3.2V systems or 5V systems. Each module has an address range of 125 and each module can communicate with 6 other modules hence it is possible to have multiple wireless units communicating with each other in a particular area. Hence mesh networks or other types of networks are possible using this module. So if you are looking for a wireless module with the above properties then this module would be an ideal choice for you.

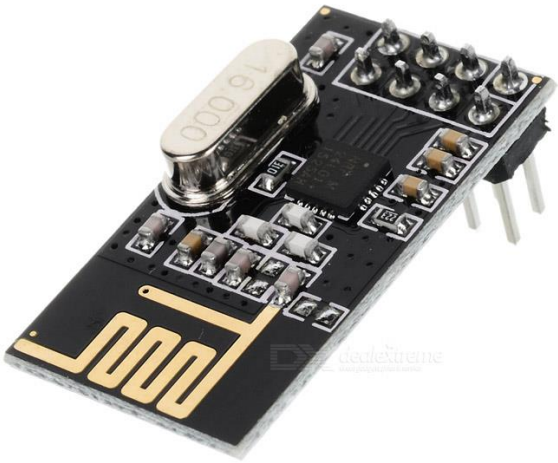


Fig 3.5.4 NRF Module

3.6 SOFTWARE SPECIFICATION:

3.6.1 ANDROID STUDIO:

Android Studio is the official integrated development environment (IDE) for Android platform development. It was announced on May 16, 2013 at the Google I/O conference. Android Studio is freely available under the Apache License 2.0. Google provides an IDE called Android Studio to develop android applications. Android applications require specific configuration files. The application logic is primarily written in Java programming. The android developing tool converts

these files into an android application. The tooling allows compiling, packaging, deploying and starting applications which are developed. The Android Software Development Kit (Android SDK) and gradle tooling contains the necessary tools for this. The android SDK contains the android debug bridge (ADB). ADB is a tool that allows you to connect to a virtual or real android device. This allows managing the device or debugging your application. Most androids configuration files are based on XML. The android tools provide special specialized editors for android specific files. These editors typically allow switching between the XML representation of the file and structured user interface.

3.6.2 JAVA:

Java is a class-based, object-oriented programming language that is designed to have as few implementation dependencies as possible. It is a general-purpose programming language intended to let application developers *write once, run anywhere* (WORA), meaning that compiled Java code can run on all platforms that support Java without the need for recompilation. Java applications are typically compiled to bytecode that can run on any Java virtual machine (JVM) regardless of the underlying computer architecture. The syntax of Java is similar to C and C++, but has fewer low-level facilities than either of them. The Java runtime provides dynamic capabilities (such as reflection and runtime code modification) that are typically not available in traditional compiled languages. As of 2019, Java was one of the most popular programming languages in use according to GitHub, particularly for client-server web applications, with a reported 9 million developers.

Java was originally developed by James Gosling at Sun Microsystems (which has since been acquired by Oracle) and released in 1995 as a core component of Sun

Microsystems' Java platform. The original and reference implementation Java compilers, virtual machines, and class libraries were originally released by Sun under proprietary licenses. As of May 2007, in compliance with the specifications of the Java Community Process, Sun had relicensed most of its Java technologies under the GNU General Public License. Oracle offers its own HotSpot Java Virtual Machine, however the official reference implementation is the Open JDK JVM which is free open source software and used by most developers and is the default JVM for almost all Linux distributions.

As of March 2021, the latest version is Java 16, with Java 11, a currently supported long-term support (LTS) version, released on September 25, 2018. Oracle released the last zero-cost public update for the legacy version Java 8 LTS in January 2019 for commercial use, although it will otherwise still support Java 8 with public updates for personal use indefinitely. Other vendors have begun to offer zero-cost builds of Open JDK 8 and 11 that are still receiving security and other upgrades.

Oracle (and others) highly recommend uninstalling outdated versions of Java because of serious risks due to unresolved security issues. Since Java 9, 10, 12, 13, 14, and 15 are no longer supported, Oracle advises its users to immediately transition to the latest version (currently Java 16) or an LTS release.

3.6.3 USES OF JAVA IN APP DEVELOPMENT:

The mobile edition of Java is called Java ME. Java ME is based on Java SE and is supported by most smartphones and tablets. The Java Platform Micro Edition (Java ME) provides a flexible, secure environment for building and executing applications that are targeted at embedded and mobile devices. The applications

that are built using Java ME are portable, secure, and can take advantage of the native capabilities of the device. Java ME addresses the constraints that are involved in building applications that are targeted at mobile devices. In essence, Java ME addresses the challenge of executing applications on devices that are low on available memory, display, and power.

There are various ways to build applications for Android devices, but the recommended approach is to leverage the Java programming language and the Android SDK. You can explore more about the Android SDK Manager from here

3.6.4 XML

Extensible Markup Language (XML) is a markup language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable. The World Wide Web Consortium's XML 1.0 Specification of 1998 and several other related specifications—all of them free open standards—define XML. The design goals of XML emphasize simplicity, generality, and usability across the Internet. It is a textual data format with strong support via Unicode for different human languages. Although the design of XML focuses on documents, the language is widely used for the representation of arbitrary data structures such as those used in web services. Several schema systems exist to aid in the definition of XML-based languages, while programmers have developed many application programming interfaces (APIs) to aid the processing of XML data.

3.6.5 ARDUINO IDE:

The Arduino IDE (Integrated Development Environment) is used to write the computer code and upload this code to the physical board. It is also a cross-platform application (for Windows, macOS, Linux) that is written in functions from C and C++. The Arduino IDE is very simple and this simplicity is probably one of the main reasons Arduino became so popular. We can certainly state that being compatible with the Arduino IDE is now one of the main requirements for a new microcontroller board. Over the years, many useful features have been added to the Arduino IDE and you can now manage third-party libraries and boards from the IDE, and still keep the simplicity of programming the board.

3.6.6 C LANGUAGE:

C is a general-purpose, procedural computer programming language supporting structured programming, lexical variable scope, and recursion, with a static type system. By design, C provides constructs that map efficiently to typical machine instructions. It has found lasting use in applications previously coded in assembly language. Such applications include operating systems and various application software for computer architectures that range from supercomputers to PLCs and embedded systems.

A successor to the programming language *B*, C was originally developed at Bell Labs by Dennis Ritchie between 1972 and 1973 to construct utilities running on UNIX. It was applied to re-implementing the kernel of the UNIX operating system. During the 1980s, C gradually gained popularity. It has become one of the most widely used programming languages, with C compilers from various vendors available for the majority of existing computer architectures and

operating systems. C has been standardized by the ANSI since 1989 (ANSI C) and by the International Organization for Standardization (ISO).

C is an imperative procedural language. It was designed to be compiled to provide low-level access to memory and language constructs that map efficiently to machine instructions, all with minimal runtime support. Despite its low-level capabilities, the language was designed to encourage cross-platform programming. A standards-compliant C program written with portability in mind can be compiled for a wide variety of computer platforms and operating systems with few changes to its source code.

3.6.7 FIREBASE:

Firebase is a platform developed by Google for creating mobile and web applications. It was originally an independent company founded in 2011. In 2014, Google acquired the platform and it is now their flagship offering for app development. The Firebase platform has 18 products split into three groups: Develop, Quality, and Grow. Firebase has been claimed to be used by Google to track users without their knowledge. On July 14, 2020, a lawsuit was filed accusing Google of violating federal wiretap law and California privacy law. It stated that through Firebase, Google collected and stored user’s data, logging what the users are looking at in many types of apps, despite the user following Google's own instructions to turn off the web and app activity collected by the company.

CHAPTER 4
SYSTEM DESIGN

4.1 ER DIAGRAM FOR STAGNANT WATER ALERT SYSTEM:

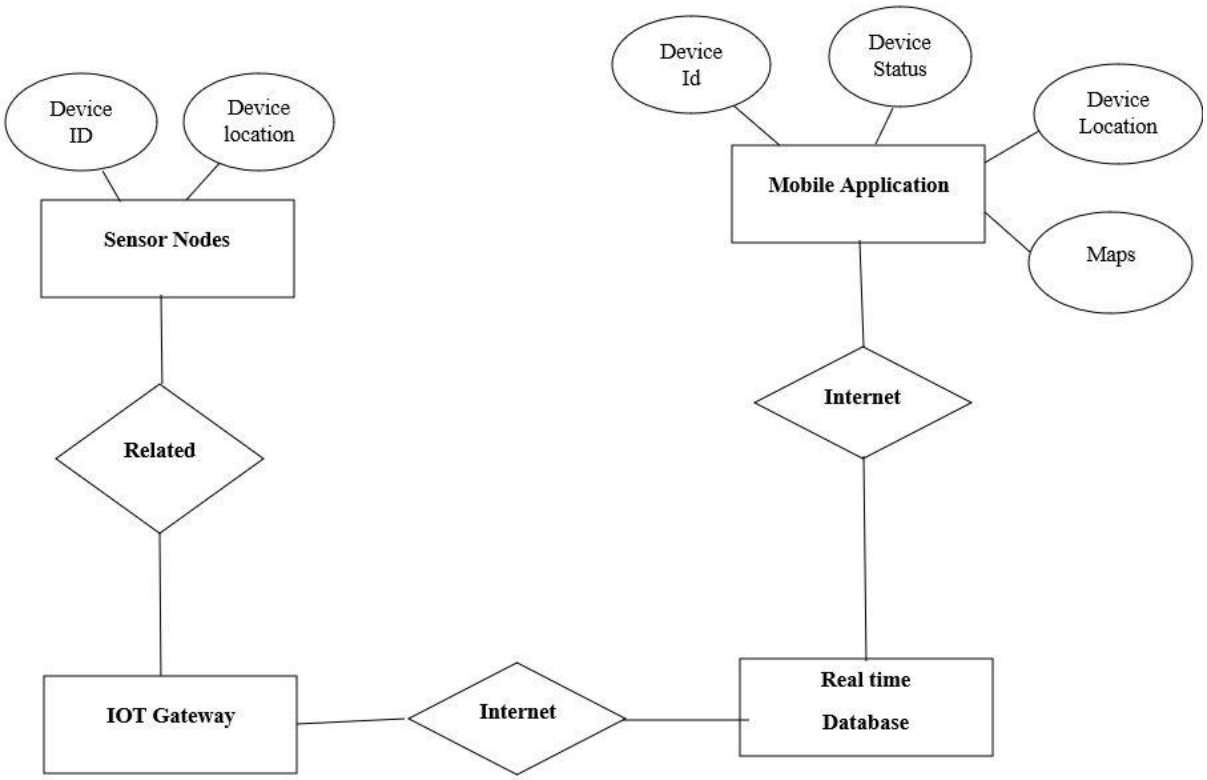


Fig 4.1 ER Diagram

4.2 DATA FLOW DIAGRAM:

A picture is worth a thousand words. A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict a good amount of the system requirements graphically. It can be manual, automated, or a combination of both. It shows how information enters and leaves the system, what changes the information and where information is stored. The purpose of a DFD is to show the scope and boundaries of a system as a whole. It may be used as a communications tool between a systems analyst and any person who plays

a part in the system that acts as the starting point for redesigning a system.It is usually beginning with a context diagram as the level 0 of DFD diagram, a simple representation of the whole system. To elaborate further from that, we drill down to a level 1 diagram with lower level functions decomposed from the major functions of the system. This could continue to evolve to become a level 2 diagram when further analysis is required. Progression to level 3, 4 and so on is possible but anything beyond level 3 is not very common. Please bear in mind that the level of details for decomposing function really depends on the complexity of that function.

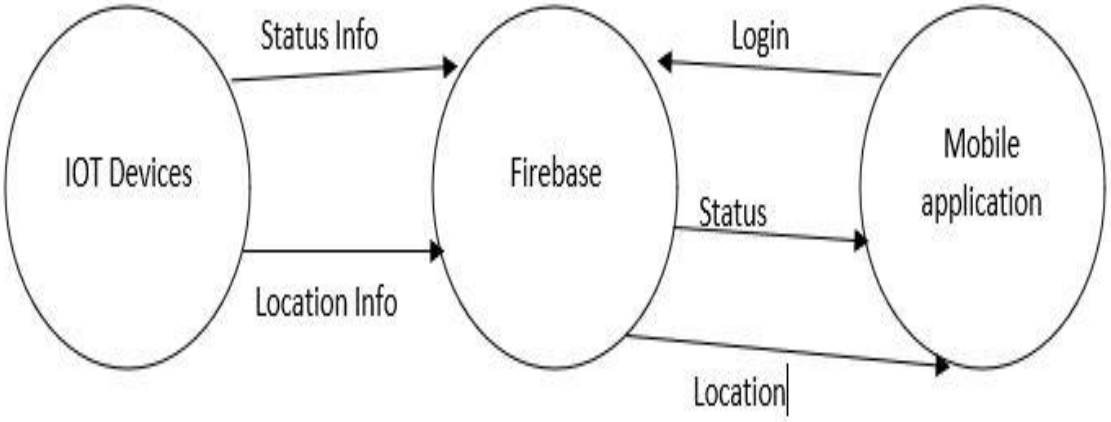


Fig 4.2 Data Flow Diagram (DFD 0)

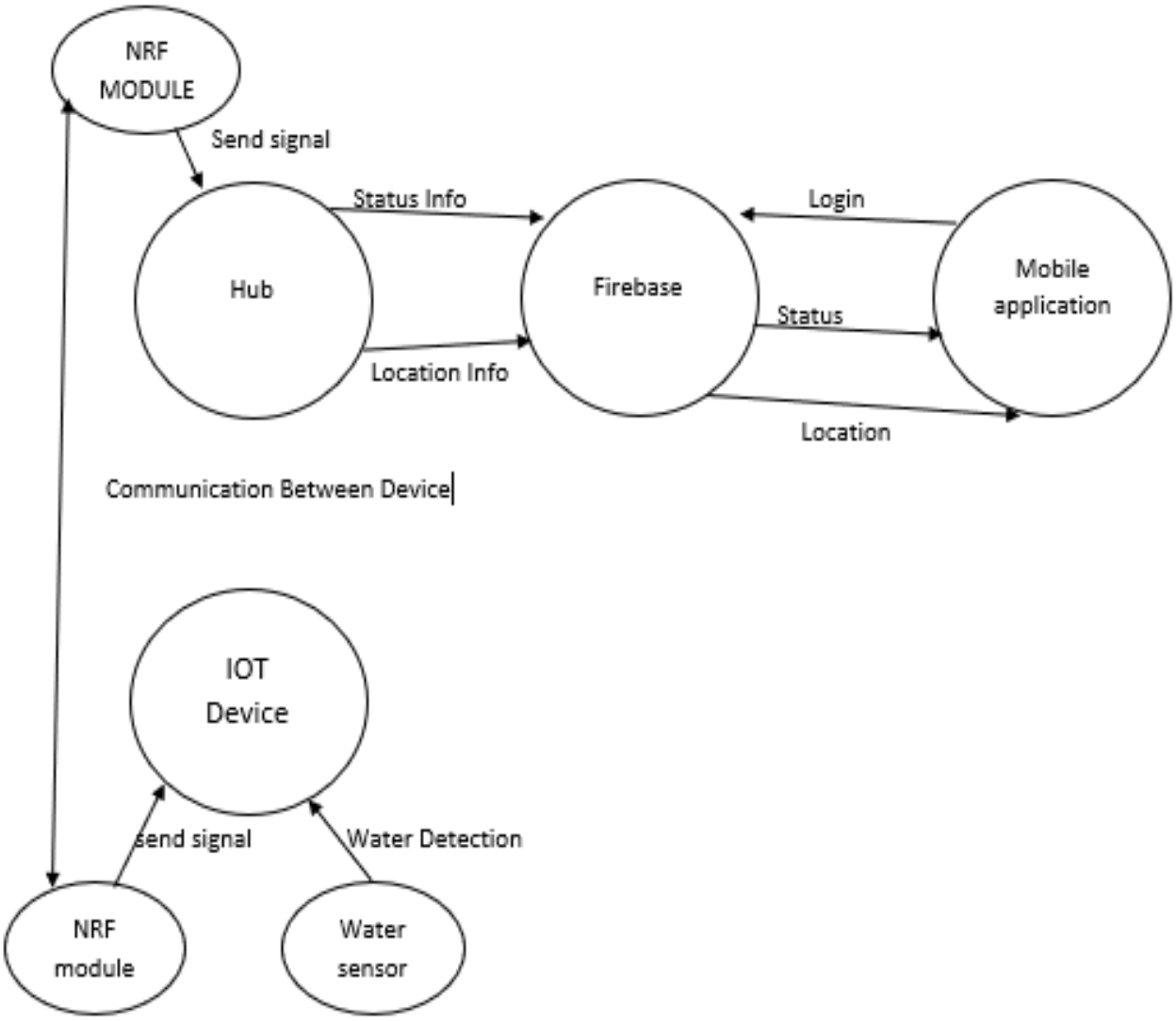


Fig 4.2 Data Flow Diagram (DFD 1)

4.3 UML DIAGRAMS:

UML stands for Unified Modelling Language. It's a rich language to model software solutions, application structures, system behaviour and business processes. There are 14 UML diagram types to help you model these behaviours. Unified Modelling Language™ (UML®) is a standard visual modelling language intended to be used for

- modelling business and similar processes,
- analysis, design, and implementation of software-based systems

UML is a common language for business analysts, software architects and developers used to describe, specify, design, and document existing or new business processes, structure and behaviour of artifact's of software systems.

Specification explained that process:

- provides guidance as to the order of a team's activities,
- specifies what artifacts should be developed,
- directs the tasks of individual developers and the team as a whole, and
- offers criteria for monitoring and measuring a project's products and activities.

UML is intentionally process independent and could be applied in the context of different processes. Still, it is most suitable for use case driven, iterative and incremental development processes. An example of such process is Rational Unified Process (RUP).UML is not complete, and it is not completely visual. Given some UML diagram, we can't be sure to understand depicted part or behaviour of the system from the diagram alone. Some information could be intentionally omitted from the diagram, some information represented on the diagram could have different interpretations, and some concepts of UML have no graphical notation at all, so there is no way to depict those on diagrams. For example, semantics of multiplicity of actors and multiplicity of use cases on use case diagrams

is not defined precisely in the UML specification and could mean either concurrent or successive usage of use cases.

Name of an abstract classifier is shown in italics while final classifier has no specific graphical notation, so there is no way to determine whether classifier is final or not from the diagram.

4.3.1 LIST OF UML DIAGRAM:

So, what are the different UML diagram types? There are two main categories; structure diagrams and behavioural diagrams. Click on the links to learn more about a specific diagram type.

4.3.2 STRUCTURE DIAGRAM:

Structure diagrams show the things in the modeled system. In a more technical term, they show different objects in a system. Behavioral diagrams show what should happen in a system. They describe how the objects interact with each other to create a functioning system.

4.3.3 CLASS DIAGRAM:

Class diagrams are the main building block of any object-oriented solution. It shows the classes in a system, attributes, and operations of each class and the relationship between each class. In most modeling tools, a class has three parts. Name at the top, attributes in the middle and operations or methods at the bottom. In a large system with many related classes, classes are grouped together to create class diagrams. Different relationships between classes are shown by different types of arrows.

4.3.4 COMPONENT DIAGRAM

A component diagram displays the structural relationship of components of a software system. These are mostly used when working with complex systems with many components. Components communicate with each other using interfaces. The interfaces are linked using connectors. The image below shows a component diagram.

4.3.5 DEPLOYMENT DIAGRAM

A deployment diagram shows the hardware of your system and the software in that hardware. Deployment diagrams are useful when your software solution is deployed across multiple machines with each having a unique configuration. Below is an example deployment diagram.

4.3.6 PACKAGE DIAGRAM

As the name suggests, a package diagram shows the dependencies between different packages in a system. Check out this wiki article to learn more about the dependencies and elements found in package diagrams.

4.3.7 COMPOSITE STRUCTURE DIAGRAM

Composite structure diagrams are used to show the internal structure of a class. For a detailed explanation of composite structure diagrams

4.4.8 USE CASE DIAGRAM

As the most known diagram type of the behavioral UML diagrams, use case diagrams give a graphic overview of the actors involved in a system, different functions needed by those actors and how these different functions interact. It's a great starting point for any project discussion because you can easily identify the main actors involved and the main processes of the system. You can create use case diagrams using our tool and/or get started instantly using our use case templates.

4.3.9 ACTIVITY DIAGRAM

Activity diagrams represent workflows in a graphical way. They can be used to describe the business workflow or the operational workflow of any component in a system. Sometimes activity diagrams are used as an alternative to State machine diagrams. Check out this wiki article to learn about symbols and usage of activity diagrams.

4.3.10 SEQUENCE DIAGRAM

Sequence diagrams in UML show how objects interact with each other and the order those interactions occur. It's important to note that they show the interactions for a scenario. The processes are represented vertically, and interactions are shown as arrows. This article explains the purpose and the basics of Sequence diagrams. Also, check out this complete Sequence Diagram Tutorial to learn more about sequence diagrams. You can also instantly start drawing using our sequence diagram templates.

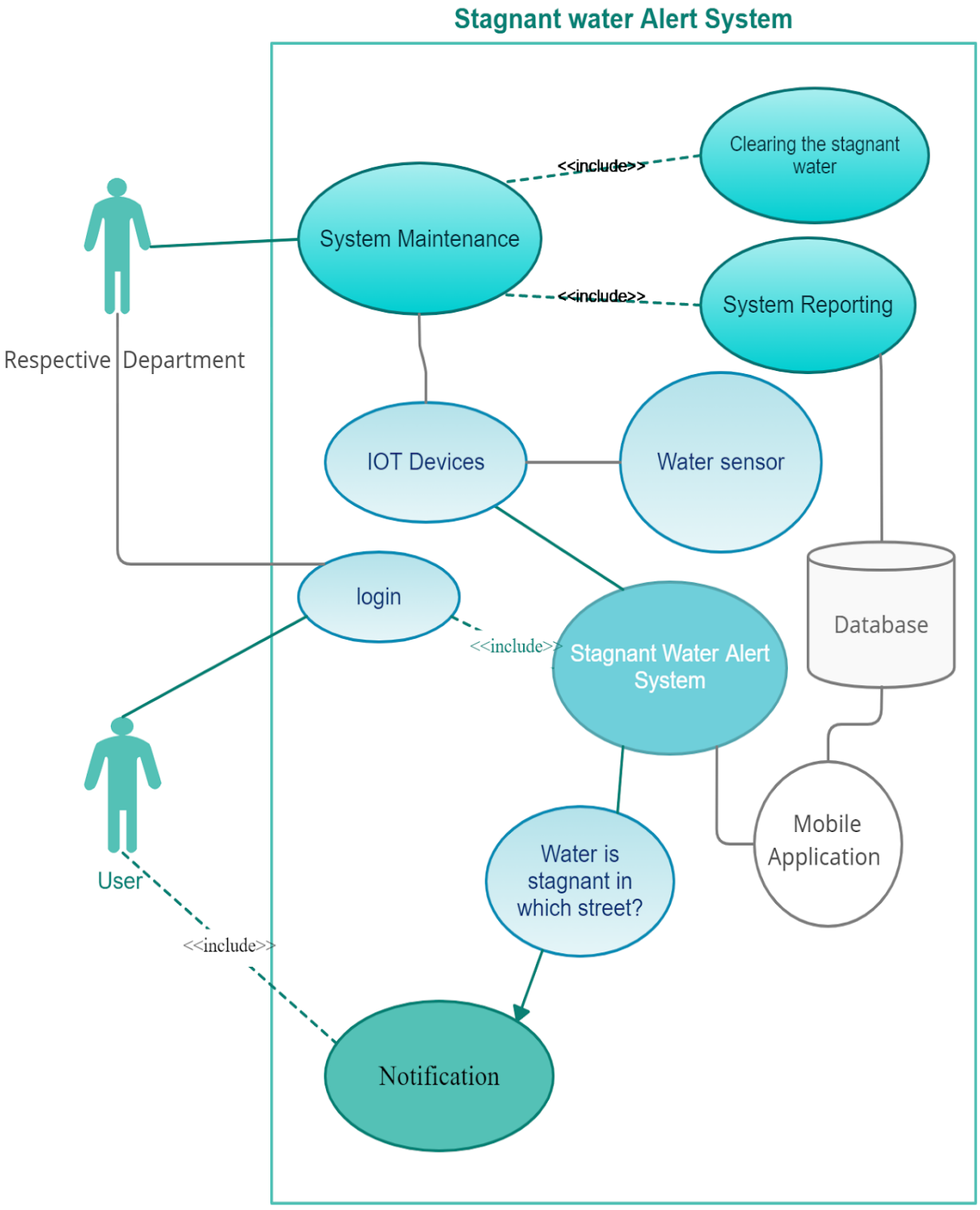


Fig 4.3 Use case diagram

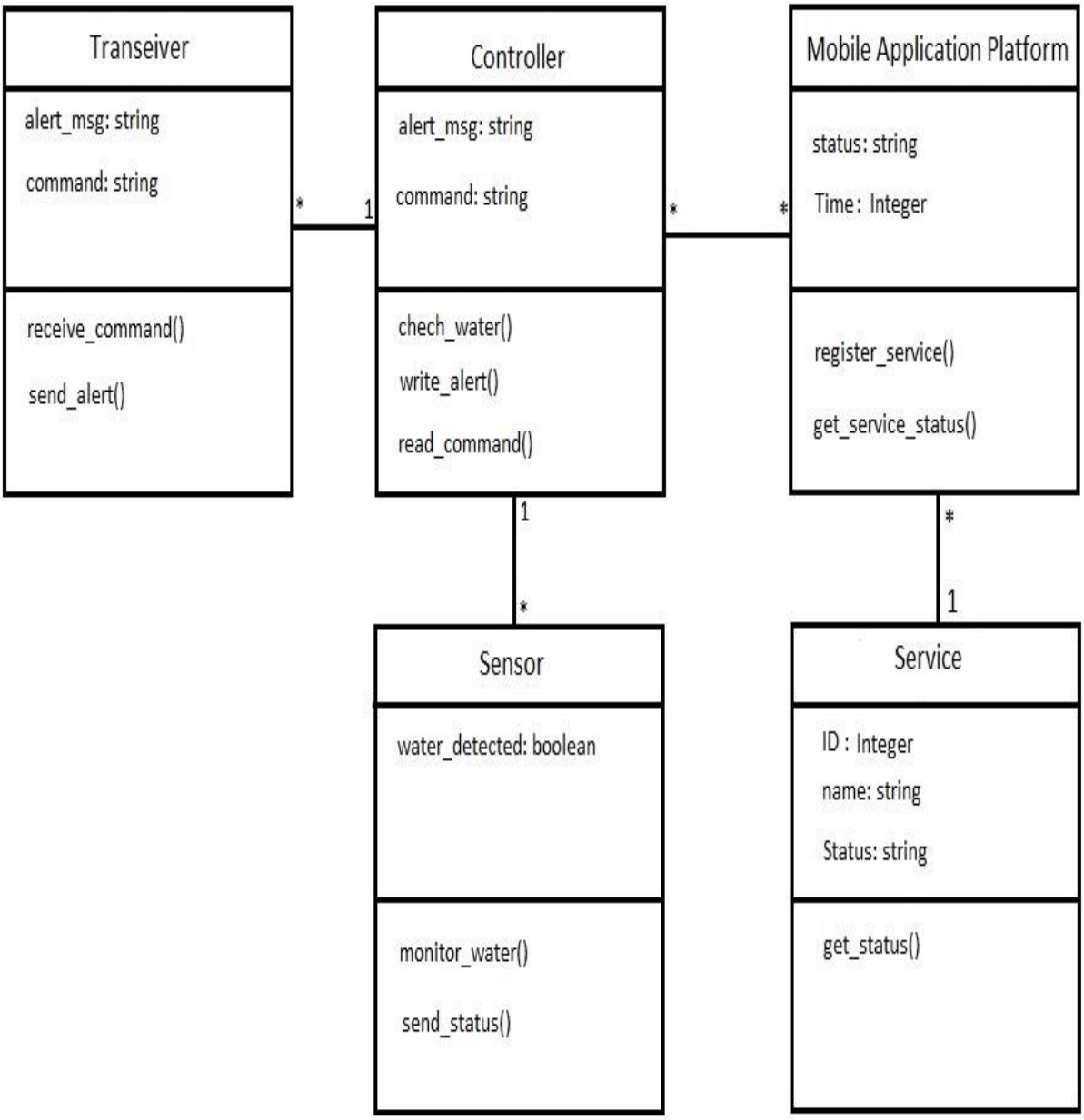


Fig 4.4 Class diagram

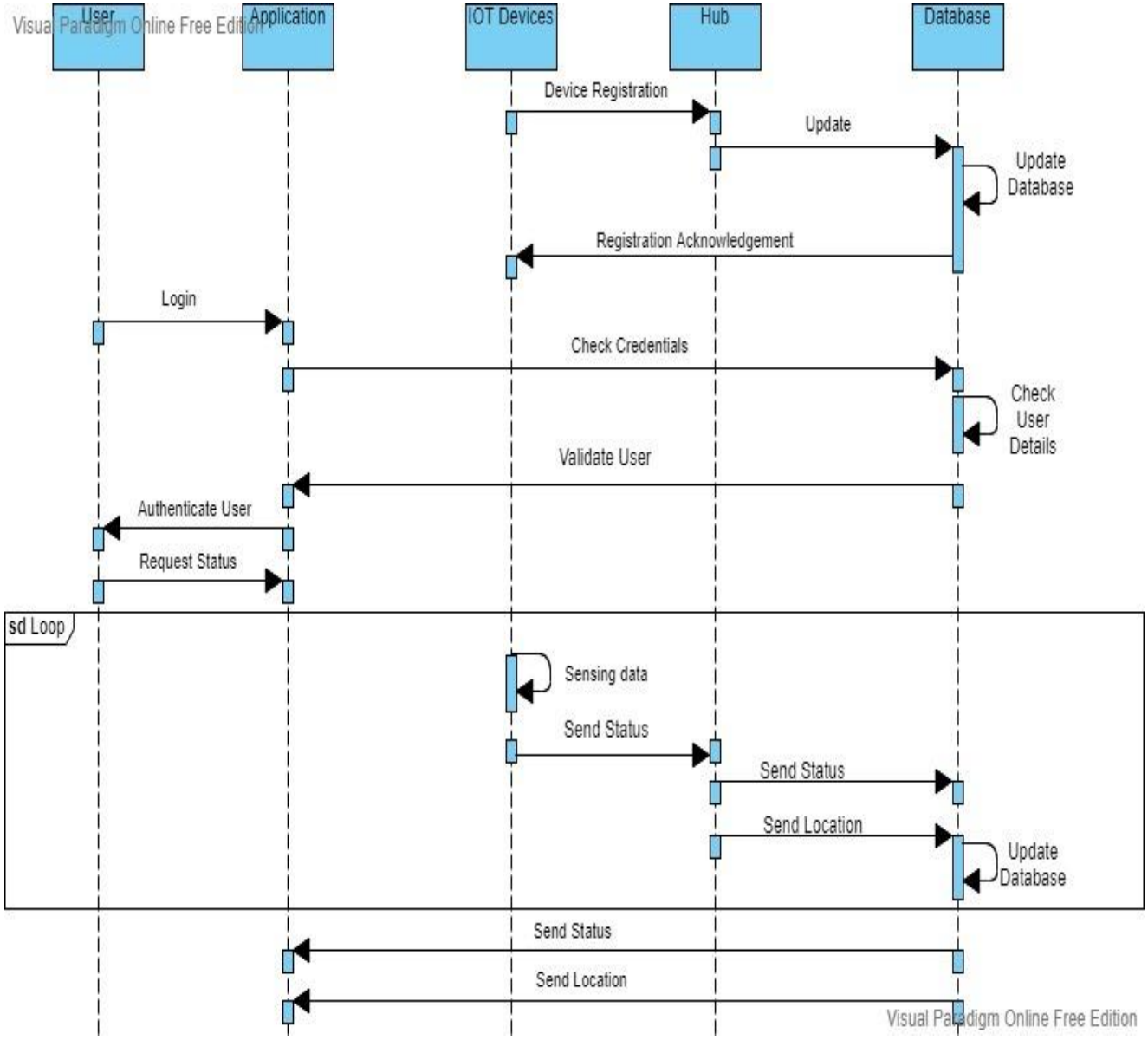


Fig 4.5 Sequence diagram

CHAPTER 5

SYSTEM ARCHITECTURE

5.1 ARCHITECTURE

The IOT architecture for the proposed system consists of three layers: physical, communication, and application. The first layer features an adhoc network where each individual device evaluates real time data readings of the water sensor and transmits the data to a centralized hub. The second layer includes OT devices that collect the information gathered by the sensors, also a device acts as a hub is included in the second layer .Translate it into meaningful data streams and transfer them to a database. The third layer is where data is received, stored, and processed using firebase and displayed in the mobile application.

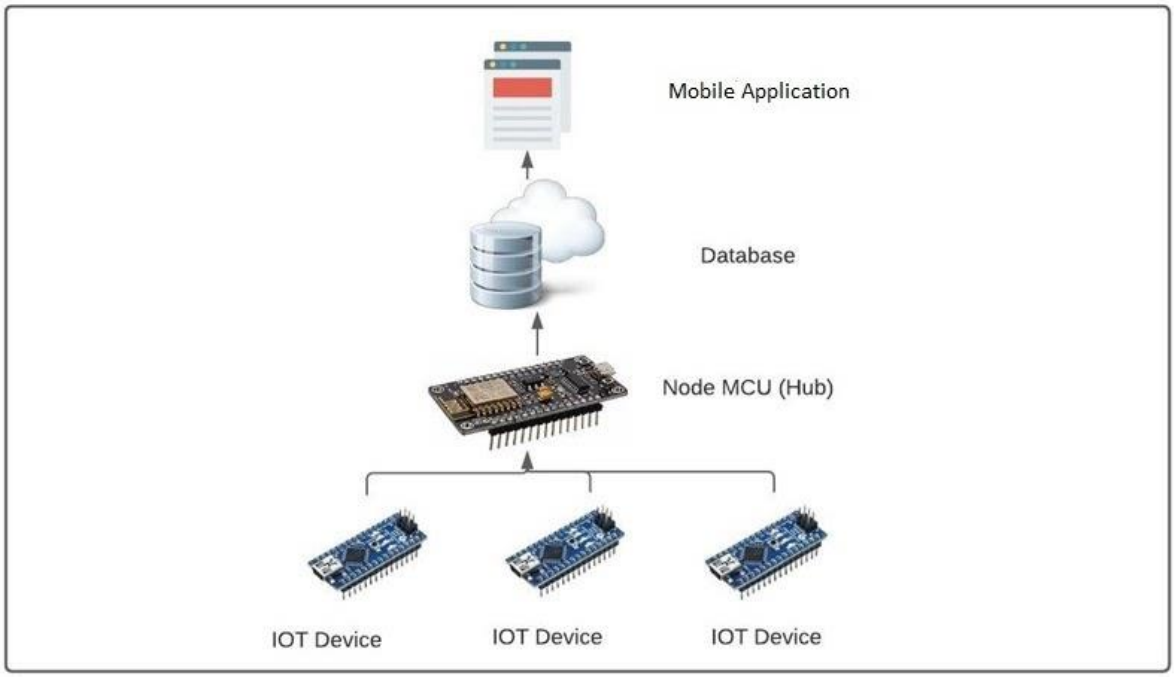


Fig 5.1 System Architecture

5.2 SYSTEM MODULE

The Stagnant Water Alert System contains three modules functions namely:

- **IOT Device**
- **Hub**
- **Mobile Application**

5.2.1 MODULES EXPLAINATION:

IOT Device:

Devices consist of water sensor, Transmitter (433Hz), Arduino Nano. When water reaches a certain level, the water sensor detects water level in the streets and sends the data to a central hub.

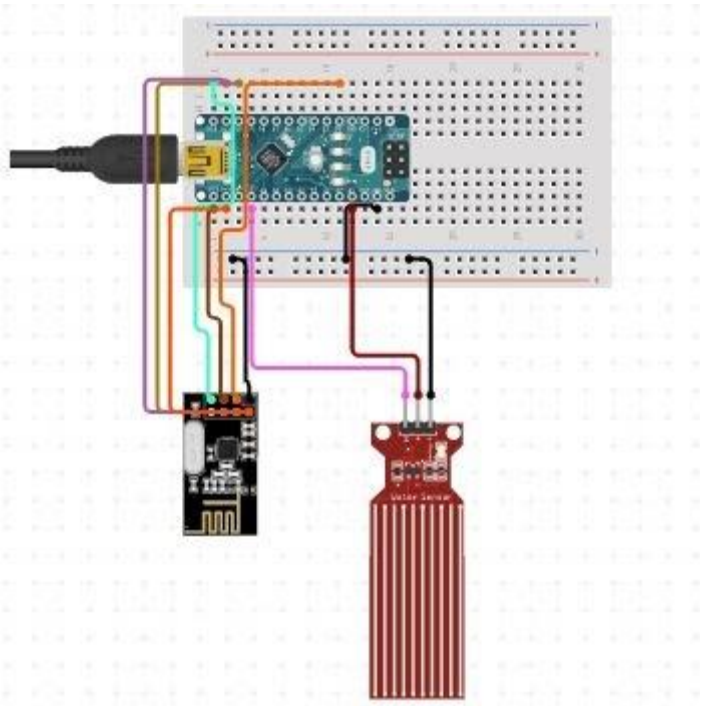


Fig 5.2 IOT Device

Hub:

Hub is connected to the internet, which is used for receiving data from the multiple IOT devices nearby. The received real time data is transmitted via internet and processed and viewed in a mobile application.

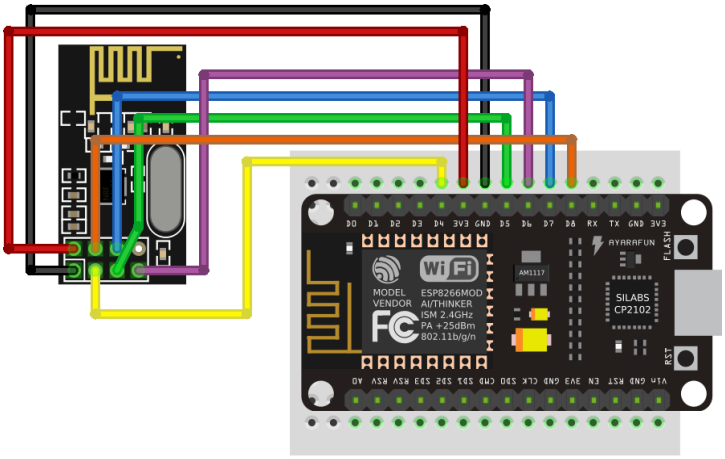


Fig 5.3 Hub

Mobile Application:

The data received from the hub is stored in the database and can be accessed any time. The department officials can see the device status (active, inactive) and also the accurate location of the flooded.

CHAPTER 6

TESTING

6.1 SYSTEM TESTING

The testing approach document is designed for Information and Technology Services' upgrades to PeopleSoft. The document contains an overview of the testing activities to be performed when an upgrade or enhancement is made, or a module is added to an existing application. The emphasis is on testing critical business processes, while minimizing the time necessary for testing while also mitigating risks. It's important to note that reducing the amount of testing done in an upgrade increases the potential for problems after go-live. Management will need to determine how much risk is acceptable on an upgrade by upgrade basis. System testing is simply testing the system as a whole; it gets all the integrated modules of the various components from the integration testing phase and combines all the different parts into a system which is then tested. Testing is then done on the system as all the parts are now integrated into one system the testing phase will now have to be done on the system to check and remove any errors or bugs. In the system testing process the system will be checked not only for errors but also to see if the system does what was intended, the system functionality and if it is what the end user expected. There are various tests that need to be conducted again in the system testing which include:

- Test plan
- Test case
- Test data

6.2 Unit Testing

In computer programming, unit testing is a software testing method by which individual units of source code, sets of one or more computer program modules together with associated control data, usage procedures, and operating procedures are tested to determine if they are fit for use. In object-oriented programming, a unit is often an entire interface, such as a class, but could be an individual method. Unit tests are short code fragments created by programmers or occasionally by white box testers during the development process. Ideally, each test case is independent from the others. Substitutes such as method stubs, mock objects, fakes, and test harnesses can be used to assist testing a module in isolation. Unit tests are typically written and run by software developers to ensure that code meets its design and behaves as intended.

6.3 Iot testing

IOT testing is a type of testing to check IOT devices. Today there is an increasing need to deliver better and faster services. There is a huge demand to access, create, use and share data from any device. The thrust is to provide greater insight and control, over various interconnected IOT devices. Hence, IOT testing framework is important

6.3.1 Usability Testing:

There are so many devices of different shape and form factors are used by the users. Moreover, the perception also varies from one user to another. That's why checking usability of the system is very important in IoT testing.

6.3.2 Compatibility Testing:

There are lots of devices which can be connected through IOT system. These devices have varied software and hardware configuration. Therefore, the possible combination are huge. As a result, checking the compatibility in IOT system is important.

6.3.3 Performance Testing:

Performance testing is important to create a strategic approach for developing and implementing an IOT testing plan.

Test Case Id	Test Cases	Priority	Input Test Data	Test Case Description	Expected Results	Actual Results	Pass/Fail
TU01	User login	A	Enter mail id & password	Check user with DB	User present in DB	Active	Pass
TU02	Status	A	-	Check with DB	Device active	Active	Pass

TU03	Maps Location	A	On click view map	Display Map	Pinpoint device location	Pinned location of device	Pass
TU04	Status	A	-	Check with DB	Device Inactive	Inactive	Pass

Table 6.1 test case for mobile application

CHAPTER 7

CONCLUSION AND FUTURE ENHANCEMENT

7.1 CONCLUSION

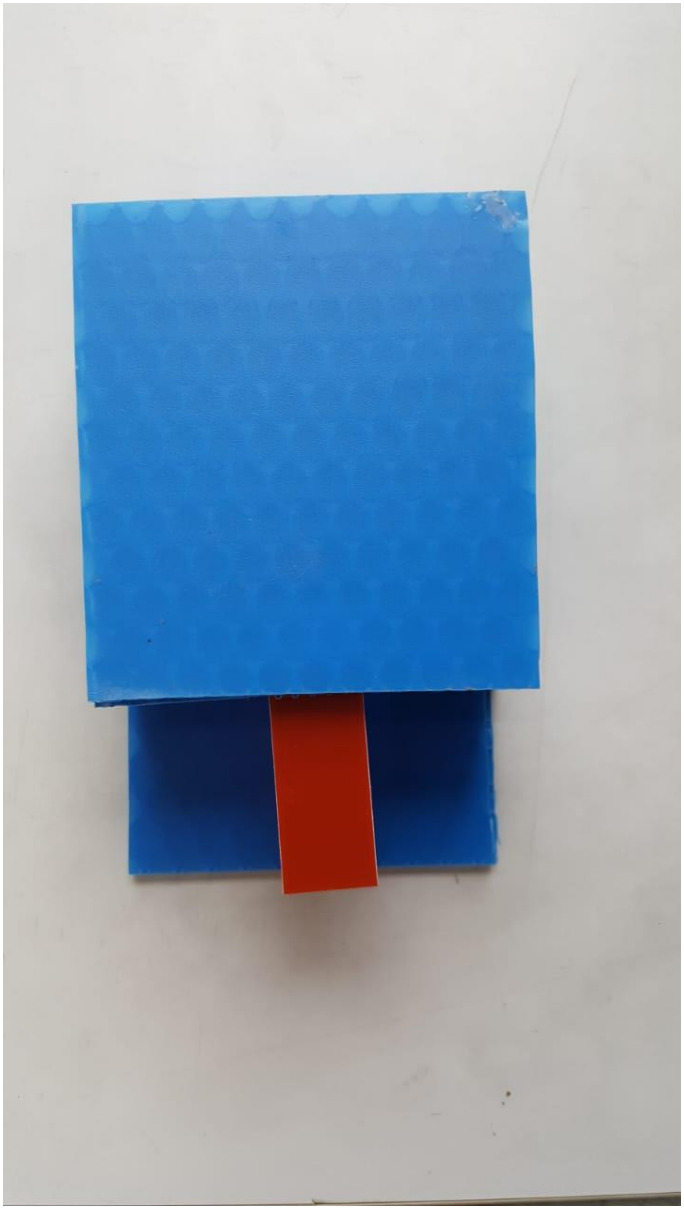
In this project, our propose device is used to detect the Stagnant water in the streets / Roads which are flooded, When the Sensor is Active it sends an alert message to the Respective Departments and also sends the location of flooded streets to the respected department and pin the location in maps for the public to view it. The Real time information and Device status are displayed in the application.

7.2 FUTURE ENHANCEMENT

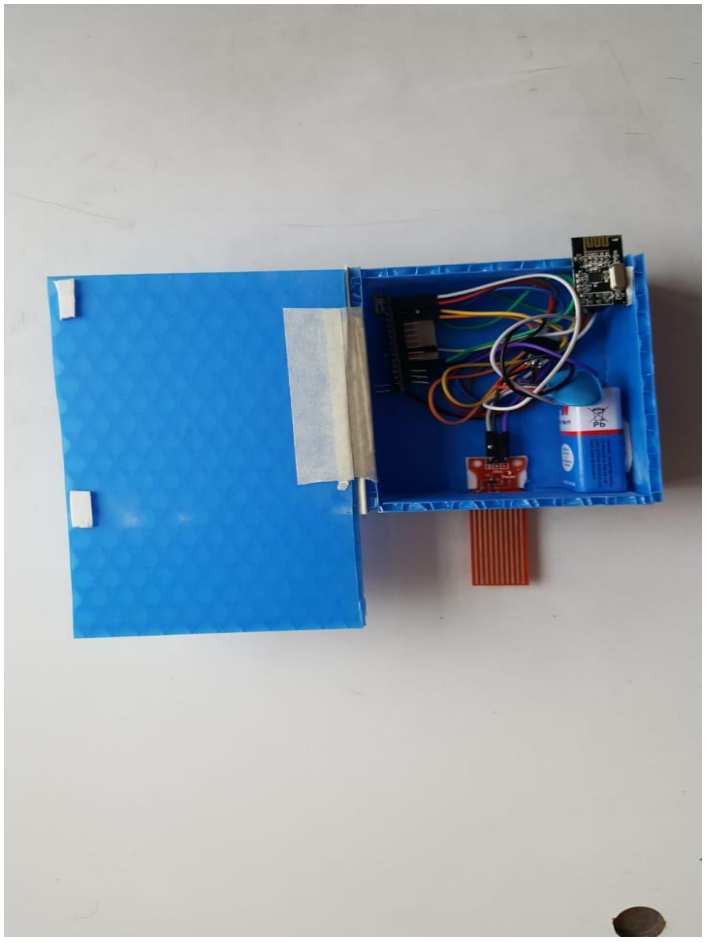
In future we are planning to add features such as a Website for the Stagnant water alert system and use machine learning models to predict and divert commuters to alternative routes, Enhancement in Real time Information Updates and more user-friendly features.

APPENDICES:

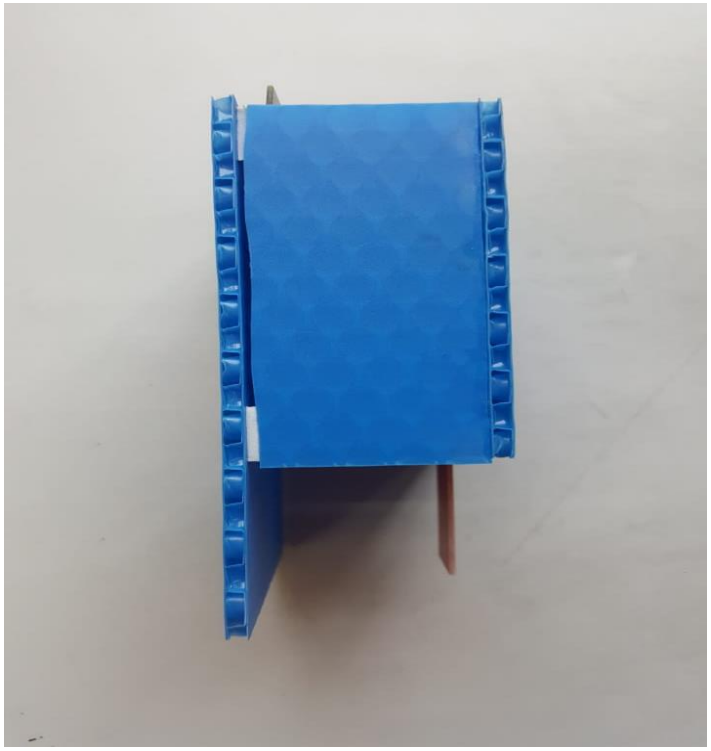
PROTOTYPE:



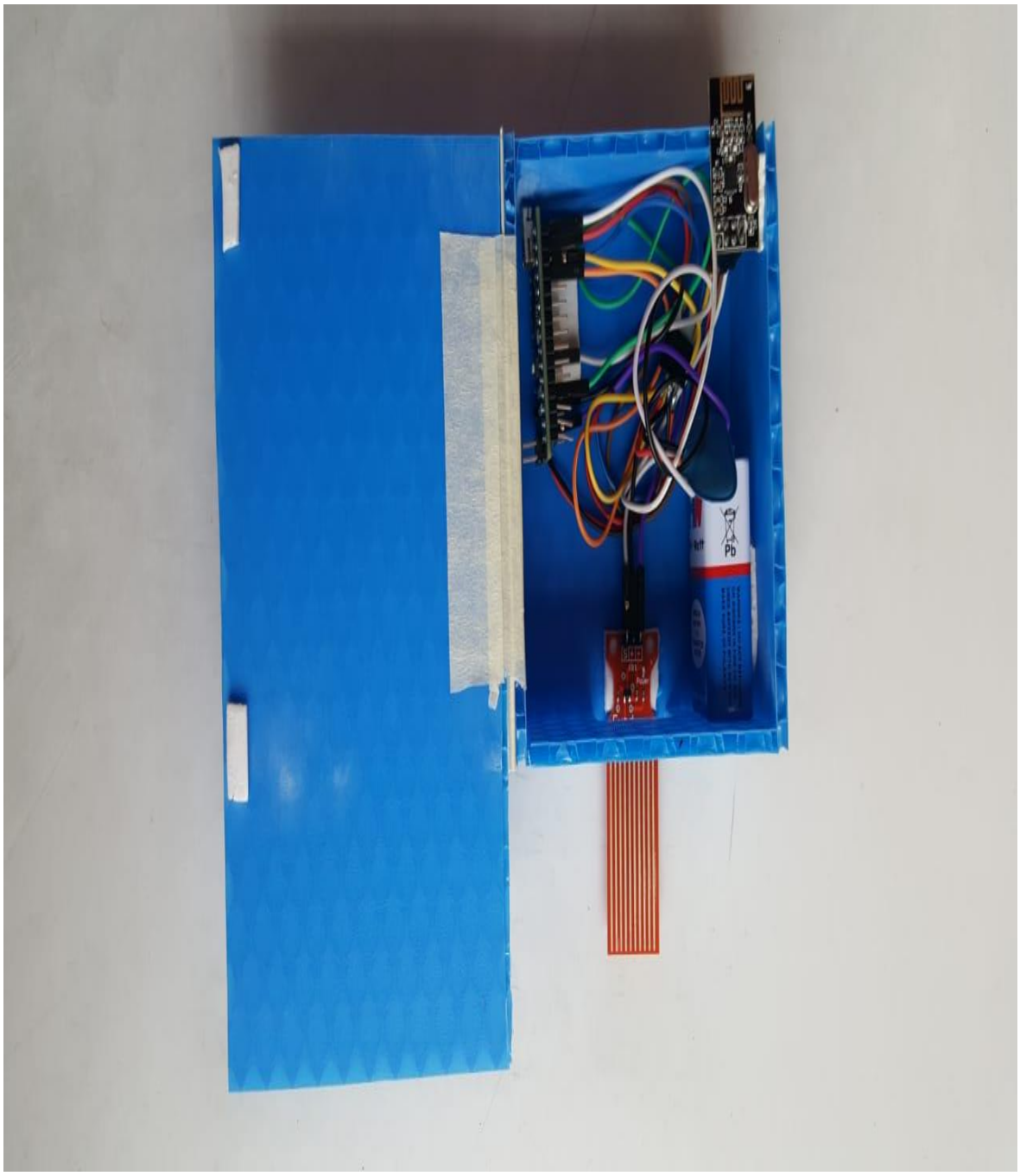
PROTOTYPE 1.1



PROTOTYPE 1.2

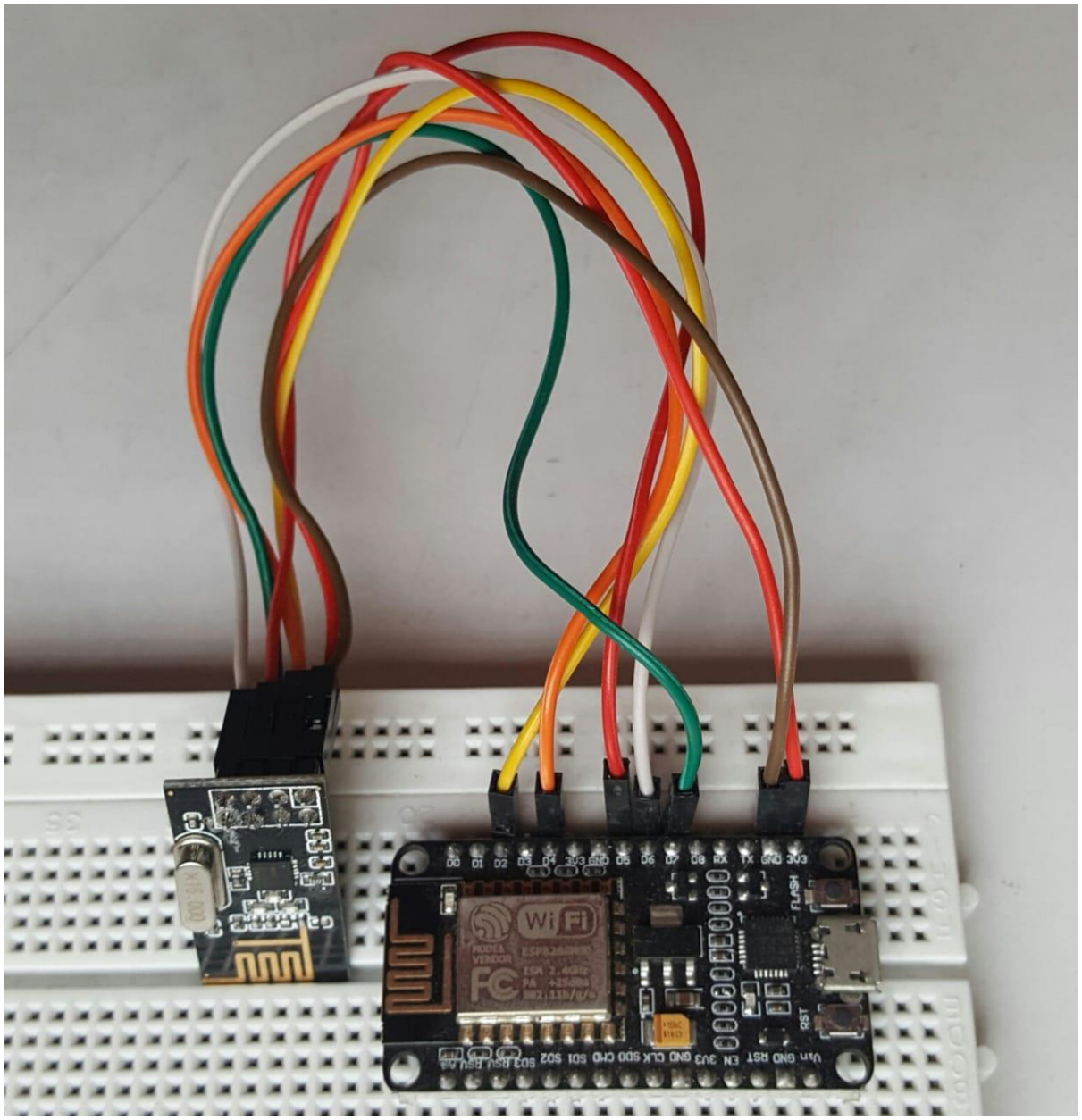


PROTOTYPE 1.3



PROTOTYPE 1.4

HUB:

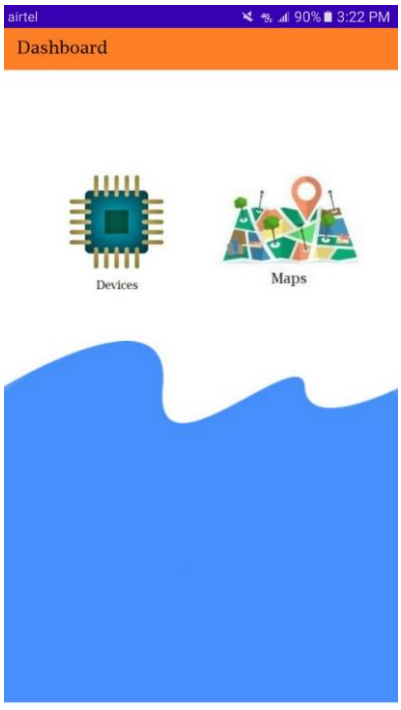


GATEWAY

SCREENSHOTS:

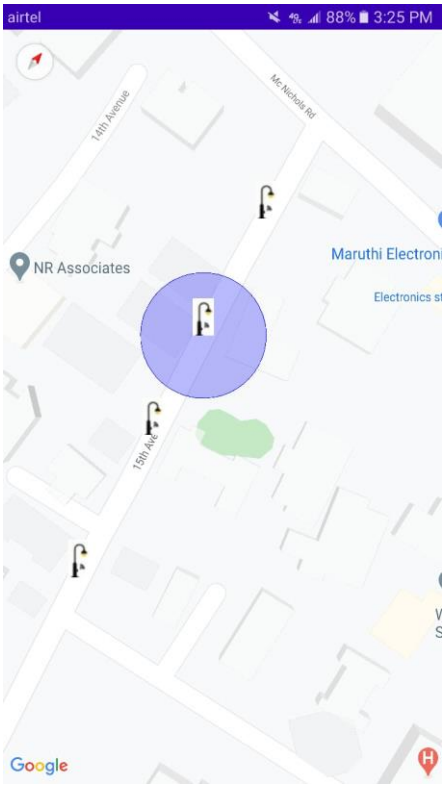
A.1.

Screenshot 1



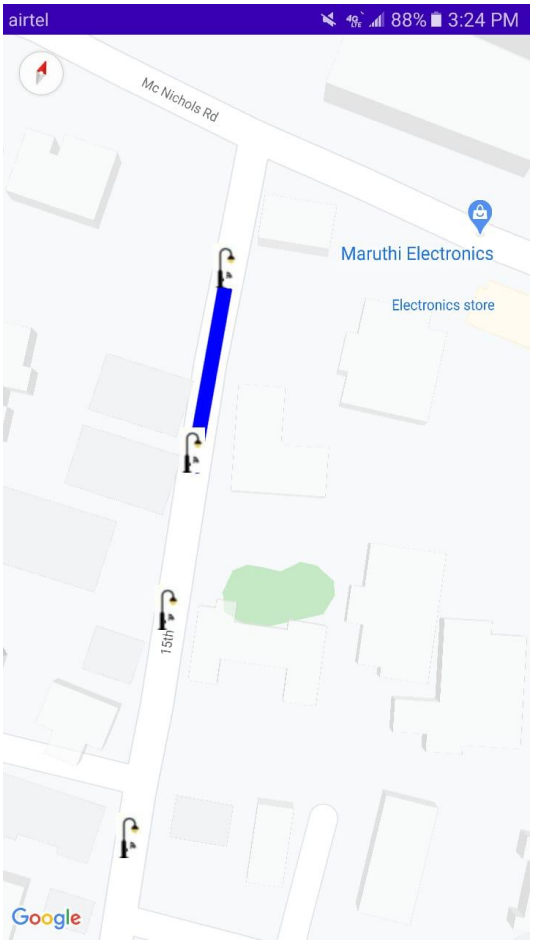
Screenshot 2


airtel
89% 3:22 PM
Devices
Device 1
Device id : #001
Current Status :
Inactive
Lat:13.071263 , Lng:80.239612
AREA : XYZ
Device 2
Device id : #002
Current Status :
Inactive
Lat:13.070965 , Lng:80.239672
AREA : ABC
VIEW MAP->
Screenshot 3
airtel
89% 3:23 PM
Devices
Device 1
Device id : #001
Current Status :
Active
Lat:13.071263 , Lng:80.239612
AREA : XYZ
Device 2
Device id : #002
Current Status :
Inactive
Lat:13.070965 , Lng:80.239672
AREA : ABC
VIEW MAP->
Screenshot 4



Screenshot 5

Screenshot 6



Screenshot 7

REFERENCE:

1. Shu Shibu. Multi-sensor Remote Sensing Technologies in Water System Management. Procedia Environmental Sciences, 2011 Volume 10, Part A, Pages 152-157.
2. Thinagaran Perumal, Md Nasir Sulaiman, C. Y. Leong. Internet of Things (IOT) Enabled Water Monitoring system. 2015 IEEE 4th Global Conference on Consumer Electronics (GCCE), 27-30 Oct 2015.
3. Manish Kumar Jha, Rajni Kumari Sah, M. S. Rashmitha, Rupam Sinha, B. Sujatha, K. V. Suma. Smart Water Monitoring System for Real-Time Water Quality and Usage Monitoring. 2018 International Conference on Inventive Research in Computing Applications (ICIRCA), 11-12 July 2018.
4. M. P. P. Sithole, N. I. Nwulu, E. M. Dogo. Development of a Wireless Sensor Network Based Water Quality Monitoring and Notification System. 2019 International Artificial Intelligence and Data Processing Symposium (IDAP), 1-22 Sept. 2019.