EARLY FLOOD WARNING SYSTEM FOR DISASTER MANAGEMENT

PROJECT REPORT

Submitted by

S. GOWTHAM	**19DC07**
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Under the guidance of
Ms.D. Priya

In partial fulfilment of the requirements for the award of

DIPLOMA IN COMPUTER NETWORKING

STATE BOARD OF TECHNICAL EDUCATION
GOVERNMENT OF TAMILNADU

July 2022

DEPARTMENT OF COMPUTER NETWORKING

PSG POLYTECHNIC COLLEGE

(Autonomous and an ISO 9001 certified Institution)

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CERTIFICATE

S. GOWTHAM	**19DC07**
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This is to certify that the Project Report entitled

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Has been submitted by

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Of the State Board of Technical Education,

Government of Tamil Nadu.

During the academic year 2021-2022

Ms.D. Priya	**Dr.S. Brindha**
Faculty guide	Head of the Department

Certified that the candidate was examined by us in the Project viva-voce examination held on…….

(Internal Examiner) (External Examiner)

Bloom Electronics (Pvt) Ltd.

Date: 02.06.2022

CERTIFICATE

TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Mr. Kaliraj.M (19DC09)** studying **III year Diploma in Computer Networking** at **PSG Polytechnic College, Coimbatore** has successfully completed project on **Early Flood Warning System for Disaster Management** in our company from **September 2021** to **June 2022**.

We wish him good luck and success in all his future endeavors.

With Regards

For Bloom Electronics (P) Ltd.,

Authorized Signatory

Venkatakrishnan

General Manager-Bloom Electronics

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This is to certify that **Mr. B.karan Babu (19DC10)** studying **III year Diploma in Computer Networking** at **PSG Polytechnic College, Coimbatore** has successfully completed project on **Early Flood Warning System for Disaster Management** in our company from **September 2021** to **June 2022**.

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ACKNOWLEDGEMENT

We would like to express our gratitude to **Dr.B. GIRIRAJ,** Principal, PSG Polytechnic College for motivating us to take up this project.

We are really grateful to **Dr.S. BRINDHA,** Head of the Department of Computer Networking for her valuable support and encouragement.

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We are really grateful to **G. VENKATAKRISHNAN,** General Manager, Bloom Electronics for his valuable support and encouragement.

We also render our sincere thanks to **Teaching and Non-teaching** faculty of Computer Networking department for their encouragement to complete this project.

SYNOPSIS

There are several types of natural disaster and one of the most vulnerable is Flood Disaster, which will have large consequences for individuals & Communities. Whenever, flooding happens, people living near the riverbank and downstream area are affected severely than others. They need to be alerted much earlier to have extra time to evacuate immediately. The main objective of the proposed system is to develop an early warning system to detect flood and send notifications to the authority so that they can evacuate people earlier and avoid loss of life and property. This project is designed on the IoT based platform, where data from the sensor is collected at the Microcontroller and alert is generated and transmitted as SMS to smartphones.

Our proposed system provides such information so that people can avoid false news. Also the proposed system makes use of voice call as it is helpful for people who do not know how to read the text message. The main sensors used for our project are water level sensor and water flow sensor. Water level sensor is used to check whether the water reaches a certain level, and then it triggers the Arduino board to send the alerting messages. It consists of a circuit board, which can be programed (referred to as a microcontroller) and a ready-made software called Arduino IDE (Integrated Development Environment), which is used to write and upload the computer code to the physical board. Then it is passed to GSM module for generating SMS aware of the residents, as a warning to take care and take precautions. If the water continues to rise and reaches the edge level, it's considered now as dangerous, an alert SMS once more sent to the resident and authorities. Water flow sensor is used to measure the flow level of the water. And then the details are displayed in LCD display continuously and a copy of the data is sent to server and to the user mobile or laptop as a notification.

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CHAPTER 1

INTRODUCTION

River floods are caused when consistent rain or snow melt forces a river to exceed capacity. Early Flood Warning System for Disaster Management is focused with the safety and security of tracking flood level. This system is going to monitor the water level and water flow to track the flood.

1.1 EXISTING SYSTEM

The establishment of flood warning systems near any major waterway or body of water provides critical information that can protect property and save lives. The most effective flood warning methods extend beyond the installation of gages and telemetry equipment, and employ qualified staff and carefully designed procedures to provide the earliest warning about whether a flood should be expected, when it will occur, and how severe it will be. In the last decade or so, India has been caught unaware and under-prepared for natural disasters. Floods in Tamil Nadu, Bihar, Maharashtra, Orissa, Assam, Uttarakhand and Jammu and Kashmir have accounted for a massive loss of life and property in the recent past. The existing system is shown in Fig.1.1.

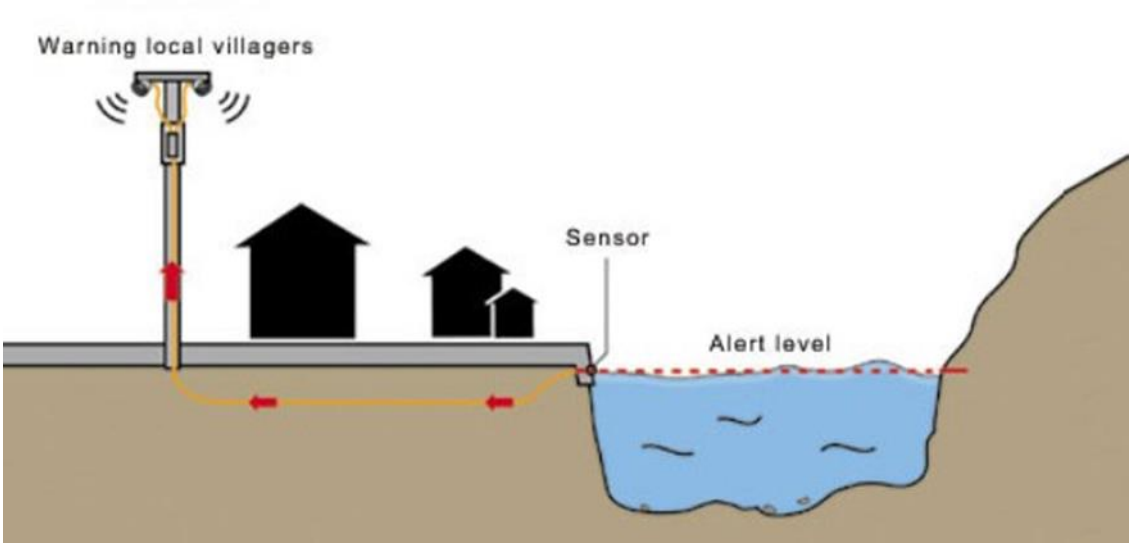

Fig.1.1 Early flood warning system

Here, the Flood Detection and Warning System (Flows) is existing in helping to monitor and manage this critical situation by providing crucial information (i.e., flood conditions, plan and preparation, and many others) to the public and the local authorities at a selected area.

Early flood warning systems are an important component of disaster risk management strategies. In contrast to flood forecasting systems, which assess flood risk, the main purpose of early flood warning systems is to issue warnings when a flood is imminent or already occurring.

1.2 PROBLEMS IN EXISTING SYSTEM

- Lack of prompt updating
- Usage of a manual system can cost money
- Tracking tools by hand is incredibly prone to error
- Event failure due to tool unavailability

1.3 OBJECTIVES OF PROPOSED SYSTEM

- To create high professional Early Flood Warning System for Disaster Management.
- To track the flood level and water flow rate.
- To monitor the humidity and temperature.
- To send quick messages via Short Message Service.
- To create a suitable mobile application.

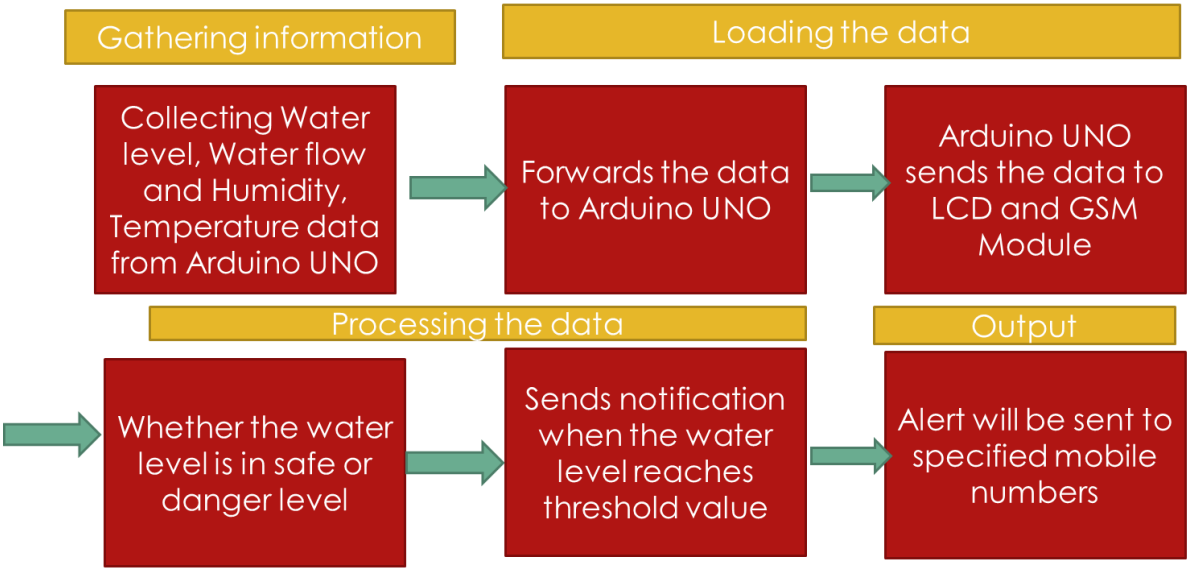

Fig.1.2 Proposed system methodology

1.4 ADVANTAGES

- Easy to track the water level
- Cost Effective
- Improved Efficiency
- Data can be monitored around the world
- More sensors can be added
- Long working life of the equipment

• Creation of historic data for Administrations.

1.5 SOFTWARE AND HARDWARE REQUIREMENTS

The following are minimum hardware and software requirements:

HARDWARE REQUIRED

- Arduino UNO
- NodeMCU
- GSM Module
- Water Level Sensor
- Water Flow Sensor
- Relay Module
- LCD

SOFTWARE REQUIRED

- Firebase
- ThinkSpeak
- Android Studio
- Arduino IDE

Programming Languages: C, Java, XML, HTML, CSS, JavaScript.

1.6 OVERVIEW OF REPORT

The Chapter 1 explains what the project is all about. It includes the objectives and advantages of the project, challenges of early flood warning system.

The Chapter 2 contains the concept of the project. It includes literature survey, working of proposed system.

The Chapter 3 contains the Client-side Design and Development. This chapter discusses the tool that are used in the design and development of end user application.

The Chapter 4 contains the Server-side Design and Development. This chapter discusses the tools that are used in the design and development of Backend server.

The Chapter 5 contains the Result of the project.

CHAPTER 2

EARLY FLOOD WARNING SYSTEM FOR DISASTER MANAGEMENT

Flooding is usually brought on by an increased quantity of water in a water system, like a lake, river overflowing. On occasion a dam fractures, abruptly releasing a massive quantity of water. The outcome is that a number of the water travels into soil, and 'flooding' the region. Rivers are involving river banks, in a station. Aside from lack of products and house and office property, streets infrastructure flood water consists of bacteria and sewage flow of waste sites and chemical spillage which leads to a variety of diseases afterwards.

2.1 INTRODUCTION

Disasters are the natural phenomenon that attracts major global interest. There are several varieties of natural disaster and one in every of the foremost vulnerable is flood disaster, which might have large consequences for people and communities. River flooding happens in the floodplains of bigger rivers. Also, urban flooding happens in towns, on flat or low-lying surfaces mostly where surface drainage more or less does not exist, or where existing drainage has been blocked with waste. Dams are among the most important human creations in the hydrological cycle built to impound water in reservoirs amid times of high flow, with the goal that it can be utilized to meet human water prerequisites amid times that natural flows are deficient in disasters.

Floods in Madras, Bihar, Maharashtra, Orissa, Assam, Uttarakhand and Jammu and Kashmir have accounted for an oversized loss of life and property. Whenever, flooding happens, people living near the riverbank and downstream area are affected severely than others. They need to be alerted much earlier to possess overtime to evacuate immediately. The most effective flood warning methods extend beyond the installation of gages and telemetry equipment, and use qualified staff and thoroughly designed procedures to produce the earliest warning about whether a flood should be expected. The foremost objective of the proposed system is to develop an early warning system to detect flood and send notifications to the authority so as that they shall evacuate people earlier and avoid loss of life and property.

2.2 EARLY FLOOD WARNING SYSTEM

The system uses GSM technology which refers to communicating through wireless electromagnetic signal with radio frequency that ranges from 3 kHz to 300 GHz. GSM Modules comprises of GSM transmitter and GSM receiver. The transmitter is placed within the system to be tracked and the receiver is the registered number. The transmitter and receiver communicate with each other through GSM signal. It is used to alert the person who is near the danger zone with a message and call. In addition, sound and vibration sensors are used to sense the danger level of the water. If the sensor reading exceeds threshold value, messages are sent to specified mobile numbers.

2.3 LITERATURE SURVEY

[1] This paper proposed an IoT based system that alerts the authorities about the flood. IR sensor has been used to detect water flow rate and an Ultrasonic sensor used for water level detection. If the received sensor values vary beyond a particular threshold, a SMS alert is sent to their mobile for notification. The proposed system also developed a website which provides the plot of the water levels and water flow rates. Also, the weather forecast information obtained from the Internet is provided in the website. This paper was published on IEEE Explore, 2015.

[2] This paper proposed and implemented an intelligent flood prediction and alerting system using IoT and Raspberry Pi. Water and rain sensors have been used for alerting the authorities and monitoring of water level in a lake or river. If the received sensor values vary beyond a particular threshold, they sent a notification alert to the people in nearby villages. They have also recommended the use of a global positioning system (GPS) that monitors device positioning in the target area and Solar power instead of conventional methods to save the power usage. This paper was published in ICRAEM 2020.

[3] In this proposed system, Raspberry Pi is used to collect data from the water sensor and transmit the data to GSM module for sending an alert via SMS. The analysis was to show how the Raspberry Pi would be integrated with the smartphone to give an alert. The project is an IoT based which significantly in line with the Industrial Revolution 4.0, supporting the infrastructure of Cyber-Physical System. This paper was published in (IJACSA) International Journal of Advanced Computer Science and Applications, 2018

[4] This paper consists of flood detection and avoidance system using the IoT technology. The sensors present in this are used to estimate the water levels, humidity, and temperature and send the real-time data to the cloud and the users can access the data via the mobile app. This model is widely used to alarm the people before a flood occurs and

necessary precautions could be taken. This paper was published in International Journal of Engineering and Advanced Technology (IJEAT) April 2021.

2.4 WORKING PRINCIPLE

The main sensors used in this proposed system are water level sensor and water flow sensor. Water level sensor is used to check whether the water reaches a certain level, and then it triggers the Arduino board to send the alerting messages. It consists of a circuit board, which can be programmed and Arduino IDE (Integrated Development Environment), is used to write and upload the computer code to the physical board. If the water continues to rise and reaches the threshold level, it's considered now as dangerous, an alert SMS once more sent to the resident and authorities through GSM module and authorities can make necessary arrangement according to the protocol.

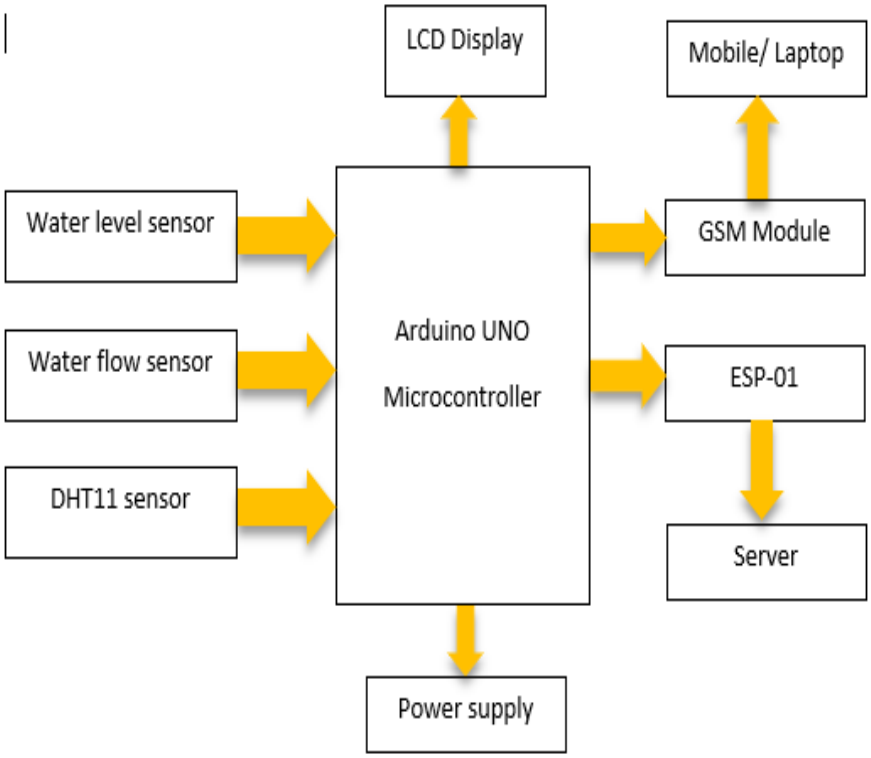

Fig.2.1 Block Diagram

Water flow sensor is used to measure the flow rate of the water. The sensor data are sent to Arduino Uno microcontroller and then the details are displayed in LCD display continuously. The sensor data also sent to the database server and stored. A suitable mobile application is also developed for viewing the data stored on the server. The Fig.2.1 shows the block diagram of the project.

2.5 IMPLEMENTATION

Early Flood Warning System is implemented at two phases, namely.

- Tracking phase and
- Monitoring phase.

2.5.1 TRACKING PHASE

The transmitter kit is placed with the Arduino to be tracked. The central microcontroller is connected with LCD display, sound sensor, GSM Module. LCD screen displays the proper functioning of device when the system is ON. Further, it also displays condition of the weather. The sound sensor and LED continuously read the sensors data. If the sensed value exceeds threshold value, call and alert messages indicating that the water level is in danger are sent to the specified mobile number through GSM Module.

The GSM Module at tracking phase communicate with the Arduino continuously by sending signals. The maximum threshold frequency range is 433MHz. When the level of water is crossed the danger level call and alert messages are sent to specified mobile numbers indicating that the water level is danger. Further, alert message is also sent when the water level is in danger.

2.5.2 MONITORING PHASE

The central Arduino UNO micro controller is connected with LCD display, GSM module and buzzer.

LCD screen displays an alert message stating that the water level is danger when the ultrasonic sensor data exceeds the maximum threshold frequency range. Further, buzzer sound is emitted to indicate an alert under such situation.

CHAPTER 3

CLIENT-SIDE DESIGN AND DEVELOPMENT

Client side refers to operations that are performed by the client in a client-server relationship user's (the client's) computer networking. This client-side design and development chapter discusses about the hardware used for the project development such as Arduino UNO, Ultrasonic sensor, GSM module, NodeMCU, etc….

3.1 INTERNET OF THINGS (IoT)

The Internet of Things, or IoT, is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

The number of IoT devices increased 31% year-over-year to 8.4 billion in the year 2017 and it is estimated that there will be 30 billion devices by 2021. The global market value of IoT is projected $7.1 trillion by 2021. The Internet of things is shown below in Fig 3.1.

Fig.3.1 Internet of Things

An IoT ecosystem consists of web-enabled smart devices that use embedded systems, such as processors, sensors and communication hardware, to collect, send and act on data they acquire from their environments. IoT devices share the sensor data they collect by connecting to an IoT gateway or other edge device where data is either

sent to the cloud to be analysed locally. Sometimes, these devices communicate with other related devices and act on the information they get from one another.

3.1.1 FEATURES OF IoT

Internet of Things (IoT) is a technology of connected smart devices that has incremental use cases across industries. With the increasing use across various industries, it is becoming a necessity to define a common standard of IoT ecosystems. As a design standard, any IoT device comes with some common set of features like connectivity, analytics, endpoint management, etc. each characteristic encompasses of a set of capabilities that can be dialled up or down depending on trade-offs and decisions made in design. The Features of IoT is shown below in Fig 3.2

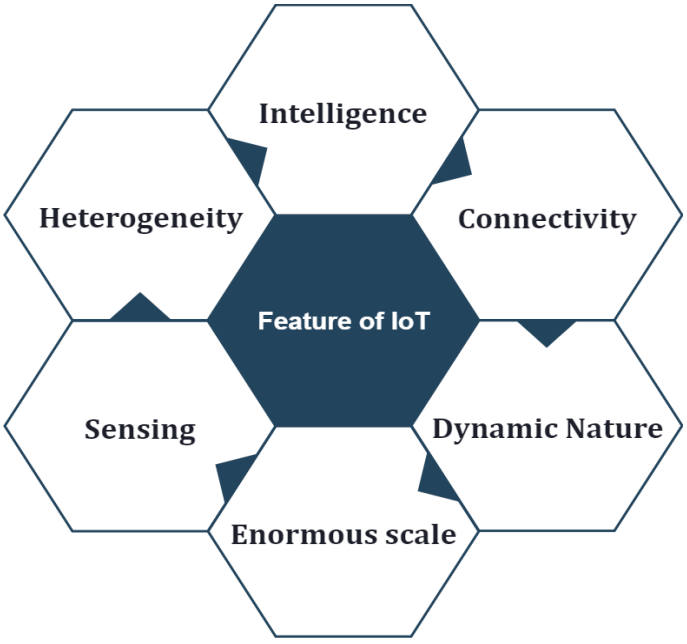

Fig.3.2 Features of IoT

3.1.2 THE SIX CHARACTERISTICS OF IoT

- Connectivity
- Intelligence
- Sensing
- Energy
- Expressing
- Safety

CONNECTIVITY

Connectivity is an important requirement of the IoT infrastructure. Things of IoT should be connected to the IoT infrastructure. Anyone, anywhere, anytime can connectivity should be guaranteed at all times without connection, nothing makes sense.

INTELLIGENCE

The extraction of knowledge from the generated data is very important. For example, a sensor generates data, but that data will only be useful if it is interpreted properly. Each IoT device has a unique identity. This identification is helpful in tracking the equipment and at times for querying its status.

SENSING

We humans can naturally understand and analyse our circumstances easily based on our past experiences with various things or situations. In the case of IoT in order to get the best of it, we need to read the analog signal, convert it in such a way that we can derive meaningful insights out of it. We use Electrochemical, gyroscope, pressure, light sensors, GPS, Electrochemical, pressure, RFID, etc. to gather data based on a particular problem. For example, for automotive use cases, Light detection sensors are used along with pressure, velocity and imagery sensors. To make a use case successful we need to choose the proper sensing paradigm.

ENERGY

From end components to connectivity and analytics layers, the whole ecosystems demand a lot of energy. While designing an IoT ecosystem, design methodology is need to be considered such that energy consumption is minimal.

EXPRESSING

Expressing enables interactivity with people and the physical world. Whether it is a smart home or a farm with smart agriculture technology, expressing provides us with a means to create products that interact intelligently with the real world. This means more than just rendering beautiful UIs to a screen. Edge computing enables data to be analyzed, processed, and transferred at the edge of a network.

SAFETY

One of the main features of the IoT ecosystem is security. In the whole flow of an IoT ecosystem, sensitive information is passed from endpoints to the analytics layer via connectivity components.

3.1.3 APPLICATIONS OF IoT

- Factory digitalization.
- Product flow monitoring.
- Inventory management.
- Safety and security.

- Quality control.
- Packaging optimization.
- Logistics and supply chain optimization.

3.2 ARDUINO

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. The DIY kits are created for teaching and as a practice tool for students.

The kit helps in understanding the fundamentals of programming, voltage, current, and digital logic. The concept of digital and analog signals can be understood by the implementation of actuators and sensors in the projects. Some of the Arduino projects are the Spaceship Interface (designing the control panel for spaceship), Keyboard Instrument, Knock Lock (a secret code, which is used to open the door), etc.

Fig.3.3 Arduino UNO Board

Arduino code is written in C++ with an addition of special methods and functions, which we'll mention later on. C++ is a human-readable programming language. When we create a 'sketch' (the name given to Arduino code files), it is processed and compiled to machine language.

3.2.1 DIFFERENT TYPES OF ARDUINO BOARDS

- Arduino UNO
- Arduino Nano
- ARDUINO MINI

- Arduino Pro Mini board
- Arduino Bluetooth

ARDUINO UNO (R3)

The Uno is a huge option for our initial Arduino. This Arduino UNO board is shown in Fig.3.3 depends on an ATmega328P based microcontroller.

It consists of 14-digital I/O pins, where 6-pins can be used as PWM (pulse width modulation outputs), 6-analog inputs, a reset button, a power jack, a USB connection, an In-Circuit Serial Programming header (ICSP), etc. It includes everything required to hold up the microcontroller; simply attach it to a PC with the help of a USB cable and give the supply to get started with an AC-to-DC adapter or battery.

Arduino Mega (R3) Board

The Arduino Mega is similar to the UNO's big brother. It includes lots of digital I/O pins (from that, 14-pins can be used as PWM o/ps), 6-analog inputs, a reset button, a power jack, a USB connection, and a reset button.

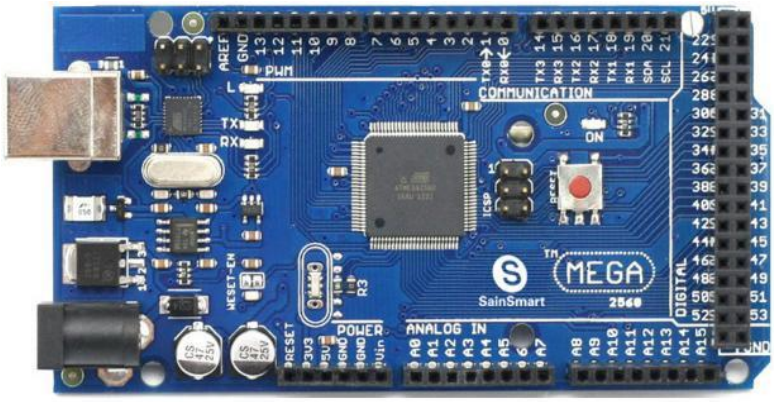

Fig.3.4 Arduino Mega Board

It includes everything required to hold up the microcontroller; simply attach it to a PC with the help of a USB cable and give the supply to get started with an AC-to-DC adapter or battery. The huge number of pins make this Arduino board very helpful for designing projects that need a bunch of digital i/ps or o/ps like lots of buttons. The Arduino Mega (R3) Board is shown in Fig.3.4. Arduino MEGA 2560. & Genuino MEGA 2560. The MEGA 2560 is designed for more complex projects. With 54 digital I/O pins, 16 analog inputs and a larger space for our sketch it is the recommended board for 3D printers and robotics projects. This gives our projects plenty of room and opportunities.

Arduino Leonardo Board

The first development board of an Arduino is the Leonardo board. This board uses one microcontroller along with the USB.

That means, it can be very simple and cheap also. Because this board handles USB directly, program libraries are obtainable which the Arduino board to follow a keyboard of the computer, mouse, etc.

ARDUINO MINI

This board comes up with Atmega328 microcontroller. We can differentiate this board from other in terms of PCB layout, voltage regulation, size and clock speed. Currently two versions of this board are available i.e. 3.3 V and 5 V**.** The Arduino Mini Board is shown in Fig.3.5.

Fig.3.5 Arduino Mini Board

The voltage regulator on this board makes a difference. We can check the label of regulator and if it is labeled as KB33 then it is 3.3 V model and if it is labeled as KB50 then it is 5 V model. If labeling is not given then we can check board version by measuring voltage between GND and VCC pins. KB33 runs at 8 MHz while KB50 runs at 16 MHz i.e. double frequency from KB33.

Arduino Pro Mini board

Arduino Pro Mini is quite similar to Arduino UNO in overall functionality however the main difference lies in its size and built-in programmer. This Bluetooth mainly depends on the microcontroller like ATmega168 and this board is also called Arduino BT.

This kind of board includes different components like digital pins-16, analog pins-6, crystal oscillator-16MHz, reset button, screw terminals, ICSP header. In this board, the screw terminals are mainly used for power.

The programming of this Bluetooth microcontroller can be done with Bluetooth like a wireless connection. The Arduino Pro Mini can be powered with an FTDI cable or breakout board connected to its six pin header, or with a regulated 3.3V or 5V supply (depending on the model) on the Vcc pin. There is a voltage regulator on board so it can

accept voltage up to 12VDC. If we are supplying unregulated power to the board, be sure to connect to the "RAW" pin on not VCC.

3.2.3 APPLICATIONS OF ARDUINO UNO

- Weighing machines
- Traffic light count down timer
- Parking lot counter
- Embedded systems
- Home automation
- Industrial automation
- Medical instrument
- Emergence light for railways

3.2.4 ARDUINO PIN CONFIGURATION

The pin configuration of Arduino UNO is shown in Fig.3.6.

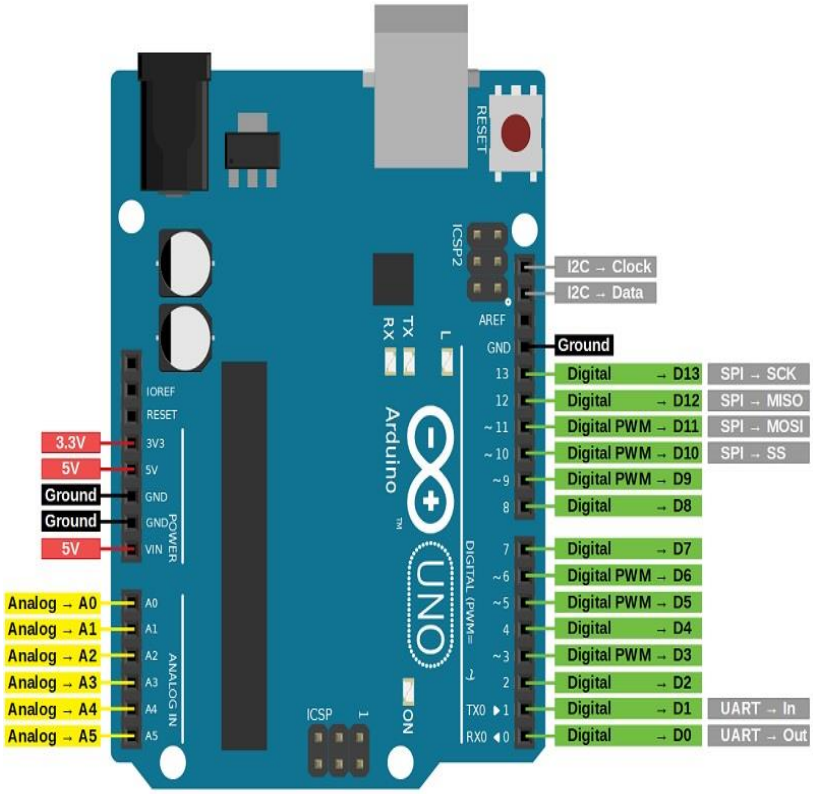

Fig.3.6 Arduino UNO Pin diagram

Vin: This is the input voltage pin of the Arduino board used to provide input supply from an external power source.

5V: This pin of the Arduino board is used as a regulated power supply voltage and it is used to give supply to the board as well as on board components.

3.3V: This pin of the board is used to provide a supply of 3.3V which is generated from a voltage regulator on the board

GND: This pin of the board is used to ground the Arduino board.

Reset: This pin of the board is used to reset the microcontroller. It is used to Resets the microcontroller.

Analog Pins: The pins A0 to A5 are used as an analog input and it is in the range of 0-5V.

Digital Pins: The pins 0 to 13 are used as a digital input or output for the Arduino board.

Serial Pins: These pins are also known as a UART pin. It is used for communication between the Arduino board and a computer or other devices. The transmitter pin number 1 and receiver pin number 0 is used to transmit and receive the data resp.

External Interrupt Pins: This pin of the Arduino board is used to produce the External interrupt and it is done by pin numbers 2 and 3.

PWM Pins: These pins of the board is used to convert the digital signal into an analog by varying the width of the Pulse. The pin numbers 3, 5, 6,9,10 and 11 are used as a PWM pin.

SPI Pins: This is the Serial Peripheral Interface pin, it is used to maintain SPI communication with the help of the SPI library. SPI pins include:

1. SS: Pin number 10 is used as a Slave Select
2. MOSI: Pin number 11 is used as a Master Out Slave In
3. MISO: Pin number 12 is used as a Master In Slave Out
4. SCK: Pin number 13 is used as a Serial Clock

LED Pin: The board has an inbuilt LED using digital pin-13. The LED glows only when the digital pin becomes high.

AREF Pin: This is an analog reference pin of the Arduino board. It is used to provide a reference voltage from an external power supply.

3.3 WATER LEVEL SENSOR

Water Level sensors are used to detect the level of substances that can flow. Such substances include liquids, slurries, granular material and powders.

Water Level measurements can be done inside containers or it can be the level of a river or lake. Such measurements can be used to determine the number of materials within a closed container or the flow of water in open channels.

3.3.1 TYPES OF WATER LEVEL SENSOR

There are five basics of commercially used water level sensor:

- Capacitive

- Ultrasonic
- Frequency
- Guided wave GWR
- Pressure transducers

3.3.2 ULTRASONIC SENOR

An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity. The sensor measures the time it takes between the emissions of the sound by the transmitter to its contact with the receiver. The formula for this calculation is D = ½ T x C (where D is the distance, T is the time, and C is the speed of sound ~ 343 meters/second).

Ultrasonic sensors work by emitting sound waves at a frequency which is too high for humans to hear. Sound is a mechanical wave travelling through the mediums, which may be a solid, or liquid or gas. The image of the ultrasonic sensor is shown in Fig.3.7.

Fig.3.7 Ultrasonic Sensor

Sound waves can travel through the mediums with specific velocity depends on the medium of propagation. The sound waves which are having high frequency reflect from boundaries and produce distinctive echo patterns.

3.3.3 FEATURES OF AN ULTRASONIC SENSOR

- Supply voltage: 5V (DC).
- Supply current: 15mA.
- Modulation frequency: 40Hz.
- Output: 0 – 5V (Output high when obstacle detected in range).
- Beam Angle: Max 15 degrees.
- Distance: 2 cm – 400 cm.

- Accuracy: 0.3cm.
- Communication: Positive TTL pulse.

3.3.4 ULTRASONIC SENSOR WORKING PRINCIPLE

Ultrasonic sensors emit short, high-frequency sound pulses at regular intervals. These propagate in the air at the velocity of sound. If they strike an object, then they reflected back as an echo signal to the sensor, Ultrasonic sensors work by sending out a sound wave at a frequency above the range of human hearing. It sends an ultrasonic pulse out at 40 kHz which travels through the air and if there is an obstacle or object, it will bounce back to the sensor. Which itself computes the distance to the target based on the time-span between emitting the signal and receiving the echo. Ultrasonic sensors are excellent at suppressing background interference. Virtually all materials which reflect sound can be detected, regardless of their colour.

FORMULAS:

Speed= Distance/Time

Distance= Speed*Time/2

Time= Distance/Speed

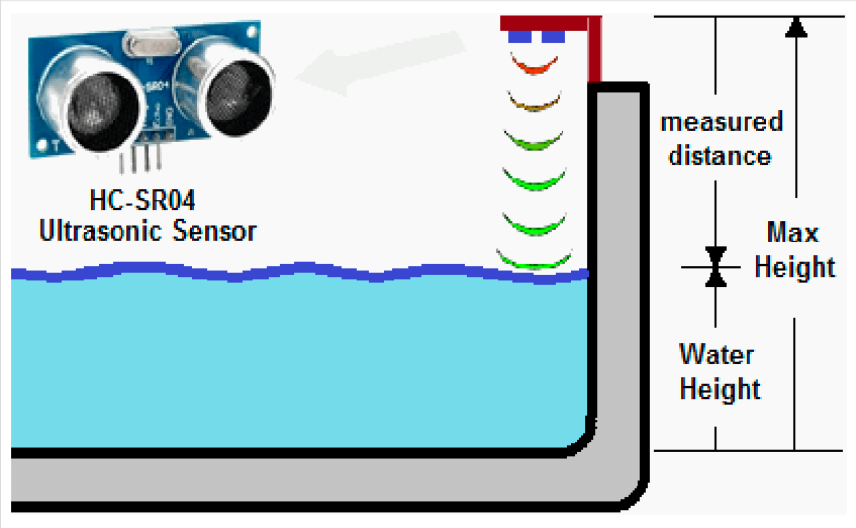

Fig.3.8 Working of Ultrasonic sensor

Even transparent materials or thin foils represent no problem for an ultrasonic sensor. The working of Ultrasonic sensor is shown in Fig.3.8. Ultrasonic sensors can see through dust-laden air and ink mists. Even thin deposits on the sensor membrane do not impair its function.

3.4 GSM MODULE

GSM (Global System for Mobile Communications, originally Group Special Mobile)**,** is a standard developed by the European Telecommunications Standards Institute

(ETSI). It was created to describe the protocols for second-generation (2G) digital cellular networks used by mobile phones and is now the default global standard for mobile communications – with over 90% market share, operating in over 219 countries and territories.

3.4.1 GSM MODULE TYPES

SIM900A

SIM900A GSM Module. The SIM900A is a readily available GSM/GPRS module, used in many mobile phones and PDA. The module can also be used for developing IoT (Internet of Things) and Embedded Applications. SIM900A is a dual-band GSM/GPRS engine that works on frequencies EGSM 900MHz and DCS 1800MHz.

SIM900

Some countries in Central and South America have allocated spectrum in the 900 MHz and 1800 MHz bands for GSM in addition to the common GSM deployments at 850 MHz and 1900 MHz for ITU-Region 2 (Americas).

The result therefore is a mixture of usage in the Americas that requires travelers to confirm that the devices they have are compatible with the bands of the network at their destination. Frequency compatibility problems can be avoided through the use of multi-band (tri-band or, especially, quad-band) device.

SIM450

It uses the same band as, and can co-exist with, old analog NMT systems. NMT is a first generation (1G) mobile system which was primarily used in Nordic countries, Benelux, Alpine Countries, Eastern Europe and Russia prior to the introduction of GSM. The GSM Association claims one of its around 680 operator-members has a license to operate a GSM 450 network in Tanzania. However, currently all active public operators in Tanzania use GSM 900/1800 MHz. There are no publicly advertised handsets for GSM-450 available.

3.4.2 GSM MODULE FEATURES

- International roaming
- Compatibility with integrated services digital network (ISDN)
- Support for new services.
- SIM phonebook management
- Fixed dialling number (FDN)
- High-quality speech
- Uses encryption to make phone calls more secure
- Short message service (SMS)

3.5 NODE MCU

NodeMCU is an open-source Lua based firmware for the ESP8266 Wifi SOC from Espressif and uses an on-module flash-based SPIFFS file system. NodeMCU is implemented in C and is layered on the Espressif NON-OS SDK. The firmware was initially developed as is a companion project to the popular ESP8266-based NodeMCU development modules, but the project is now community-supported, and the firmware can now be run on any ESP module. The NodeMCU programming model is similar to that of Node.js, only in Lua. It is asynchronous and event-driven. Many functions, therefore, have parameters for callback functions

3.5.1 DIFFERENT TYPES OF NODE MCU

- NODE MCU 01
- Node ESP-05
- Node ESP-12
- Node ESP-201
- Node MCU module V1.0

NODE MCU 01

The ESP8266 ESP-01 is a Wi-Fi module that allows microcontrollers access to a Wi-Fi network. The Fig.3.9 shows the NodeMCU 01 model.

Fig.3.9 NodeMCU 01

NODE ESP-05

This module is very simple and has one purpose only: use it as mini Wifi shield together with our Arduino or similar micro controller. There are different versions available: a four-pin version that only has 3.3V, GND, RX and TX. Another version has an additional reset pin which allows us to manually or programmatically reset the module.

This module nicely fits into a breadboard since the module has only one row of pin posts. But (and there is always a but) we are stuck with the delivered firmware unless we are willing to do some lead cutting and soldering of some pins. According to the forums not all boards come with the same AT firmware version.

NODE ESP-201

Originally named as ESP-12 this module has come to popularity as ESP-201 after the name clash had been discovered. In good old BASIC line addressing style the creators apparently wanted to make sure that no other name clash would occur and added a safety distance to the numbering scheme.

NODE MCU MODULE V1.0

It is breadboard friendly and offers similar access to the chip pins as the ESP-12 does. The first note is that the four pins at the head of the module keep us from directly plugging the module into a breadboard. But we can easily bend them to ninety degrees or unsolder them and place them on the upper side of the module. The second note is that the module itself hides many pins of the bread board for direct access and leaves only one row visible on each side of the module. If we need more, we will have to extend a 5-pin row by connecting it to another row on our breadboard. The board comes with a printed PCB antenna but also with a connector for an external one.

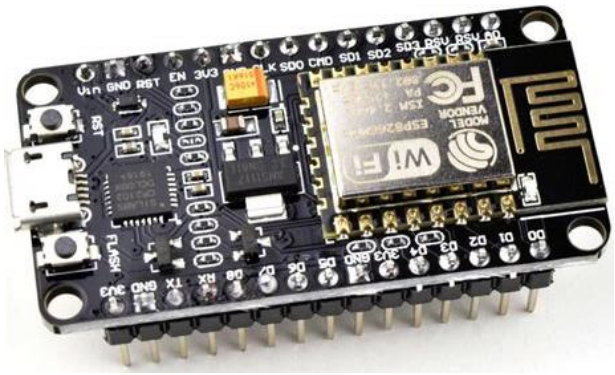

Fig.3.10 NodeMCU V1.0

It incorporates the new ESP-12E module with 4MB of flash memory and also has a few more pin-outs. Compared to the V0.9 variant the V1.0 is narrower and leaves one row of pins on each side on a standard breadboard which is just perfect for prototyping. Another nice feature is the fact that we don't even have to press the reset/flash button combination in the Arduino IDE to upload a new version of our code. Somehow the board or the software handle this automatically. And with the latest published version of the Arduino/ESP8266 board configuration we can configure upload speed to 921600 baud with which the upload finishes just within a few seconds.

3.6 INTERFACING ARDUINO UNO WITH SENSORS

Ultrasonic sensor is one of the main parts of numerous projects. Here we are going to interface an Ultrasonic sensor HC-SR 05 with Arduino Uno. The High-Level Design (HLD) of our project is shown in Fig.3.11.

This design (HLD) shows the architecture that was used to develop a system. The architecture diagram provides an overview of an entire system, identifying the main components that would be developed for the proposed system and their interfaces.

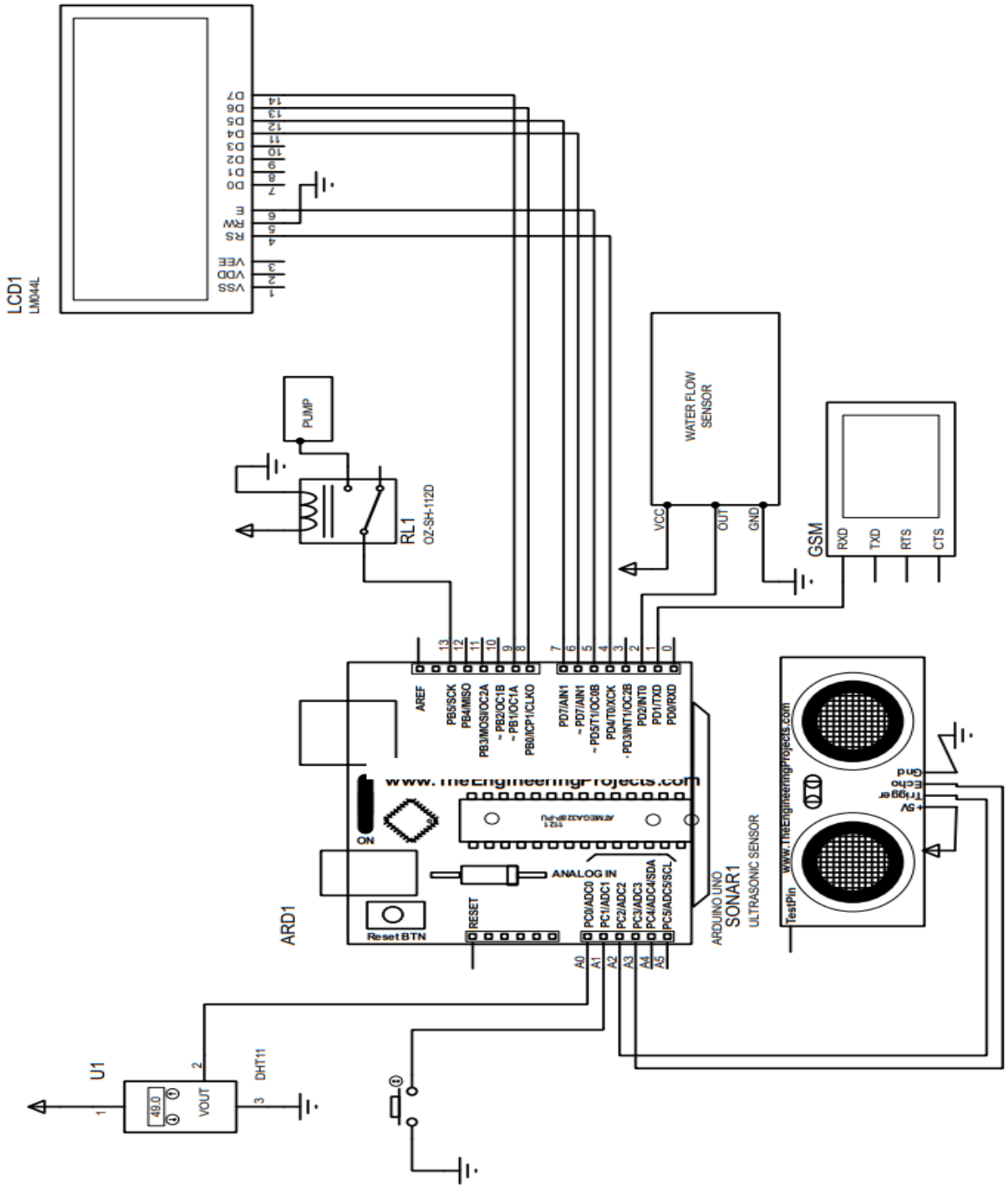

Fig.3.11 HLD of the project

There are three main processes of measuring the water level:

1. Connect an Ultrasonic Sensor HC-SR 05 to Arduino.
2. Read the sensor and convert it to length.
3. Print the length to the Serial Monitor.

3.6.1 ULTRASONIC SENSOR TO ARDUINO UNO

STEP 1: Connect the Ultrasonic Sensor **Vcc to 5V** Power Supply on Arduino UNO.

STEP 2: Connect the Ultrasonic Sensor **Trig to A2** Pin on Arduino UNO.

STEP 3: Connect the Ultrasonic Sensor **Echo to A3** Pin on Arduino UNO.

STEP 4: Connect the Ultrasonic Sensor **GND to GND** on Arduino UNO.

3.6.2 WATER FLOW SENSOR TO ARDUINO UNO

STEP 1: Connect the Water Flow Sensor **Vcc to 5V** Power Supply on Arduino UNO.

STEP 2: Connect the Water Flow Sensor **Digital Out to D2** Pin on Arduino UNO.

STEP 3: Connect the Water Flow Sensor **GND to GND** on Arduino UNO.

3.6.3 DTH11 SENSOR TO ARDUINO UNO

STEP 1: Connect the DTH11 Sensor **Vcc to 5V** Power Supply on Arduino UNO.

STEP 2: Connect the DTH11 Sensor **Digital Out to A0** Pin on Arduino UNO.

STEP 3: Connect the DTH11 Sensor **GND to GND** on Arduino UNO.

3.6.4 GSM MODULE TO ARDUINO UNO

STEP 1: Connect the GSM Module **RXD Pin to TXD Pin** on Arduino UNO.

STEP 2: Connect the GSM Module **TXD D7 Pin to RXD Pin** on Arduino UNO.

STEP 3: Connect the GSM Module **Power Adapter to 5V** Power Supply on Arduino UNO.

STEP 4: Connect the GSM Module **GND to GND** on Arduino UNO.

3.6.5 NODEMCU TO ARDUINO UNO

STEP 1: Connect the NodeMCU **RX Pin to RX Pin** on Arduino UNO.

STEP 2: Connect the NodeMCU **TX to TX Pin** on Arduino UNO.

STEP 3: Connect the NodeMCU **Vcc to 3.5V** Power Supply on Arduino UNO.

STEP 4: Connect the NodeMCU **GND to GND** on Arduino UNO.

CHAPTER 4

SERVER-SIDE DESIGN AND DEVELOPMENT

Server-side code can be written in any number of programming languages examples of popular server-side web languages includes Python, and JavaScript (NodeJS). The server-side code has full access to the server operating system and the developer can choose what programming language (and specific version) they wish to use. We have used the following tools for our server-side design and development ThinkSpeak, Firebase and Android Studio, etc...

4.1 CLOUD COMPUTING

Cloud computing is the on-demand delivery of compute power, database storage, applications, and other IT resources through a cloud services platform via the internet with pay-as-we-go pricing. It is the use of remote servers on the internet to store, manage and process data rather than a local server or our personal computer.

The Fig.4.1 shows the features of cloud computing.

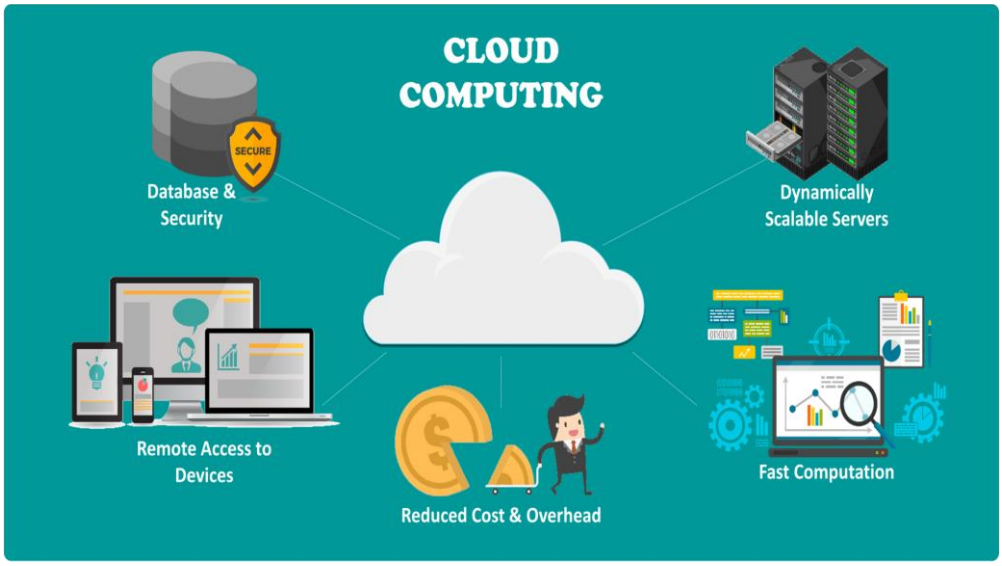

Fig.4.1 Cloud computing

Cloud computing allows companies to avoid or minimize up-front IT infrastructure costs to keep their applications up and running faster, with improved manageability and less maintenance, and that it enables IT teams, to adjust resources rapidly to meet fluctuating and unpredictable demand.

4.2 CLOUD COMPUTING ARICHITECTURE

The cloud computing architecture comprises two fundamental components, i.e. frontend and backend. Frontend works as a client in such architecture and communicates

with the backend via a network or Internet. In the cloud computing architecture, the client-side or frontend is visible to the end-user. The frontend sends queries to the backend via the middleware.

In a business setting, finding out the suitable software & hardware components that create the whole cloud environment is important. While the user can choose the hardware as off-the-shelf pieces and can choose the software as per business requirement & budget. The leading cloud service providers offer the whole package of paired hardware & software. Architecture of cloud is shown in Fig.4.2.

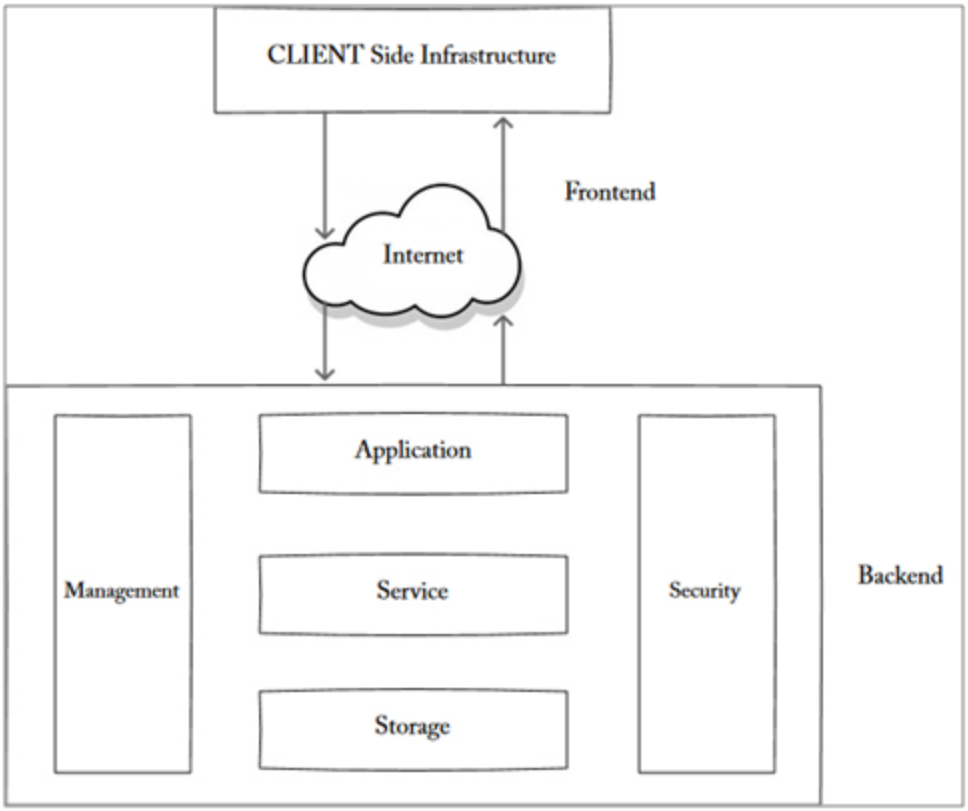

Fig.4.2 Architecture of Cloud

4.2.1 FRONT END CLOUD ARCHITECTURE

The front end infrastructure includes everything that the end-user interacts with. It is the broader assimilation of various sub-components that together offer the user interface. And it forms an essential part of how the end-user connects to the cloud computing infrastructure. The front-end cloud infrastructure includes components like local networks, web browsers, and web applications.

The main front-end cloud components are described below:

- **User Interface:** The user interface refers to all the things that end-user access to send requests or perform any task on the Cloud. Some of the popular cloud-based user interfaces are Google Doc, Gmail, etc.

- **Software:** The software architecture in the front end is the software that runs on the user's end. Frontend software architecture primarily comprises client-side applications or browsers.

Fig.4.3 Front-end Cloud

- **Client Device or Network:** Being a crucial part of the frontend architecture, Client Device or Network refers to the hardware at the end user's side. It can be any input device or PC. In cloud computing, the client-side device doesn't require extraordinary ability to process the heavy load. The cloud can take the entire heavy load and processes the same.

4.2.2 BACK-END CLOUD ARCHITECTURE

The backend architecture in the cloud empowers the frontend architecture. It comprises hardware & storage and they are located on a remote server. The cloud service provider controls and handles this backend cloud architecture.

Ideal backend cloud architecture always should be robust as it holds the whole infrastructure on the cloud. The prime components of backend cloud architecture are:

• **Application:** The Application is a substantial part of the backend architecture. It refers to the user interface that the backend offers to the end-user to send queries. This layer of the backend takes care of the client's requests and requirements.

- **Service:** This is a magical area of the backend cloud architecture. It adds utility to the entire backend architecture. The service handles every task that runs on the cloud computing system. Some of the cloud services are application development environment, storage, and web services. Besides, service can execute a wide Array of tasks on the cloud runtime.

- **Cloud Runtime:** The term 'Cloud Runtime' is the concept where the services run. It's like a cloud operating system where technology like virtualization is used. Virtualization as a key technology on the cloud which allows multiple runtimes on the same server. For instance, virtualization is a way via which we can create a base of software. In simple words, it's the virtual representation of apps, servers, storage as well as networks. When we create runtimes with the support of virtualization software, they are called as Hypervisors. Some of the leading hypervisors are Oracle Virtual Box, Oracle VM for x86, VMWare Fusion, etc.

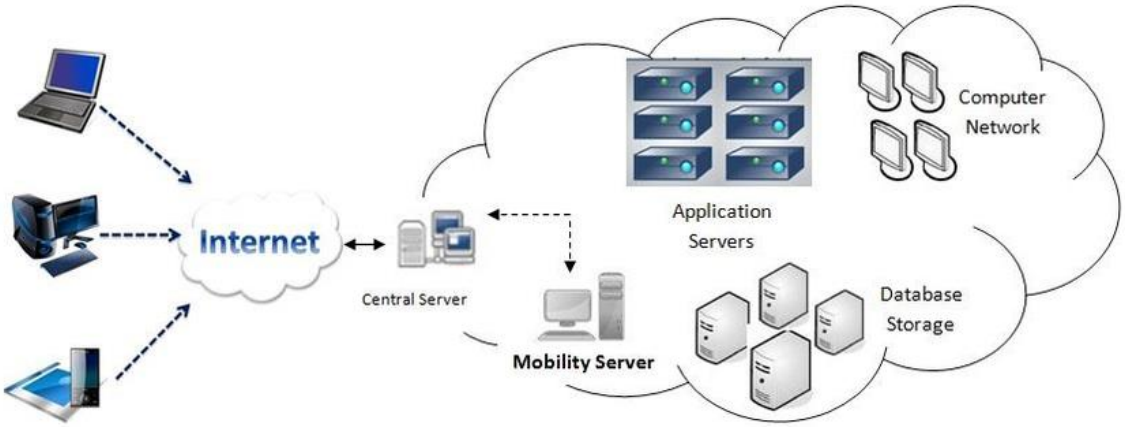

Fig.4.4 Back-end cloud

- **Storage:** Storage in the cloud is where the data resides of a cloud application. The data storage varies as per different cloud service provides. However, all of them have a common dedicated segment for cloud storage. Some of the examples of storage are solid-state drives, hard drives, Intel Optane DC Persistent storage, etc. The hard drives in the server bays form storage in the cloud backend architecture. And especially in a cloud computing system, the software partitions the drives as per the needs of the OS in the cloud to run myriad services.
- **Infrastructure:** The engine that steers all the cloud software services is called infrastructure. It includes CPU, Motherboard, Graphics Processing Unit (GPU), network cards, accelerator cards, etc. The infrastructure models always depend
  On the workloads of the clients.
- **Management:** The management software allocates specific resources to specific tasks and responsible for the flawless functioning of any cloud environment. In technical terms, management is the 'middleware' and it coordinates between the frontend and backend architecture in a cloud computing system.

- **Security:** Security is an integral and critical part of any cloud computing infrastructure. We create security infrastructure by keeping the debugging process in mind. In case of any issue, debugging should be easy. Regular storage backup is the first step to ensure security in a cloud computing system. And virtual firewalls are other crucial elements of the cloud security infrastructure.

4.3 CLOUD DATABASE

A cloud database is a database service built and accessed through a cloud platform. It serves many of the same functions as a traditional database with the added flexibility of cloud computing. Users install software on a cloud infrastructure to implement the database.

Key features:

- A database service built and accessed through a cloud platform
- Enables enterprise users to host databases without buying dedicated hardware
- Can be managed by the user or offered as a service and managed by a provider
- Can support relational databases (including MySQL and PostgreSQL) and NoSQL databases (including Mongo DB and Apache Couch DB)
- Accessed through a web interface or vendor-provided API

4.4 CONSIDERATIONS FOR CLOUD DATABASES

- **Control options**

  Users can opt for a virtual machine image managed like a traditional database or a provider's database as a service (DBaaS).

- **Database technology**

  SQL databases are difficult to scale but very common. NoSQL databases scale more easily but do not work with some applications.

- **Security**

  Most cloud database providers encrypt data and provide other security measures; organizations should research their options.

- **Maintenance**

  When using a virtual machine image, one should ensure that IT staffers can maintain the underlying infrastructure.

4.5 THINGSPEAK

ThingSpeak is a platform providing various services exclusively targeted for building IoT applications. It offers the capabilities of real-time data collection, visualizing the

collected data in the form of charts, ability to create plugins and apps for collaborating with web services, social network and other APIs. ThingSpeak IoT service is shown in Fig.4.5.

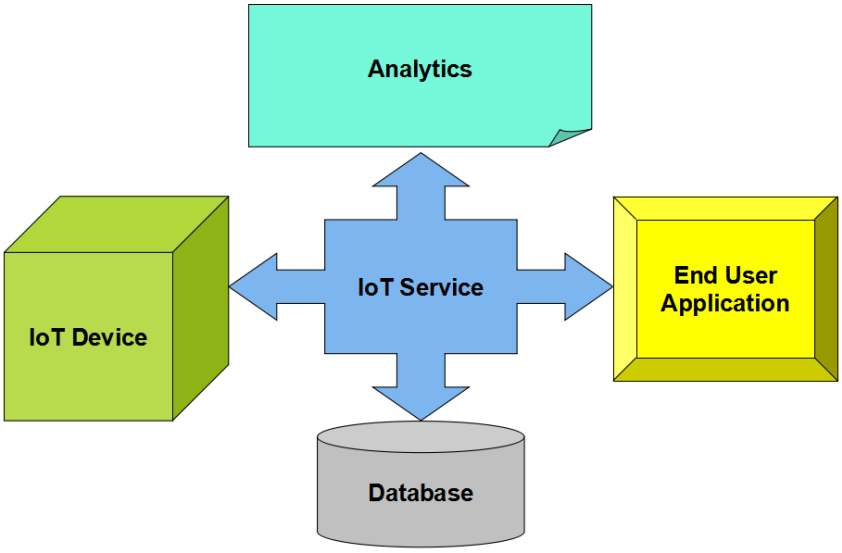

Fig.4.5 ThingSpeak IoT Service

The core element of ThingSpeak is a 'ThingSpeak Channel'. A channel stores the data that we send to ThingSpeak and comprises of the below elements:

- 8 fields for storing data of any type - These can be used to store the data from a sensor or from an embedded device.
- 3 location fields - Can be used to store the latitude, longitude and the elevation. These are very useful for tracking a moving device.
- 1 status field - A short message to describe the data stored in the channel.

4.5.1 THINGSPEAK KEY FEATURES

ThingSpeak allows us to aggregate, visualize and analyse live data streams in the cloud. Some of the key capabilities of ThingSpeak include the ability to:

- Easily configure devices to send data to ThingSpeak using popular IoT protocols.
- Visualize our sensor data in real-time.
- Aggregate data on-demand from third-party sources.
- Use the power of MATLAB to make sense of our IoT data.
- Run our IoT analytics automatically based on schedules or events.
- Prototype and build IoT systems without setting up servers or developing web software.
- Automatically act on our data and communicate using third-party services like Twilio or Twitter.

4.6 FIREBASE

Firebase is a development platform launched in April 2012 and acquired by Google in 2014 as a solution for back-end developer. The feature combination in Firebase accelerates the cloud database integration automatically in both web and mobile app, and directs to settle the required massive tasks which should be accomplished by developers.

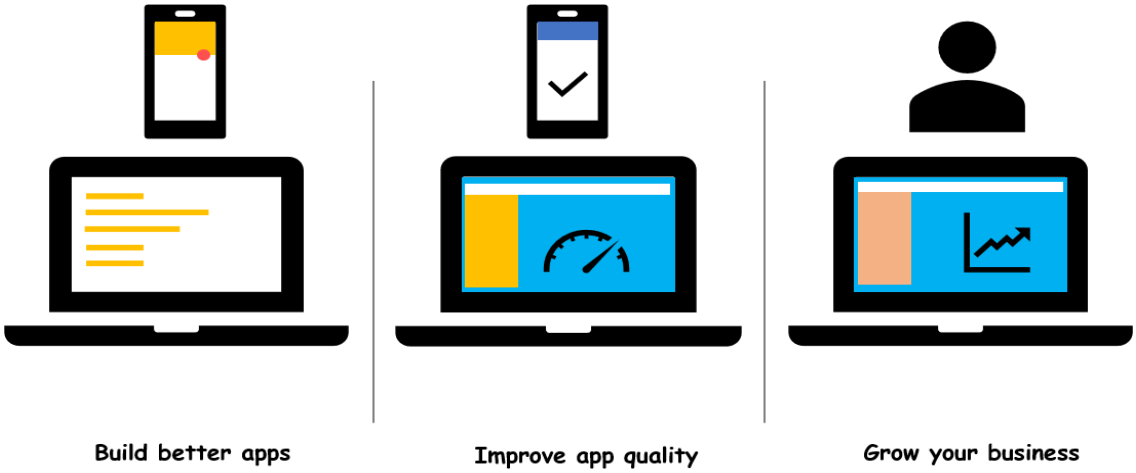

Fig.4.6 Firebase

Firebase is divided into 3 units: develop, earn and grow. Depending on the properties of the app, the client could deploy one of these 3 pillars or integrate all functionalities of Firebase to synchronize the essential data, resulting in the trouble-free experience for end users from the real-time database, analytics, messaging to dynamics link. By charging no cost under limited usage, Firebase is available to be commenced and clients are able to upgrade when the app tasks are requested to be equipped with more advanced features. Developers could uplift the Infrastructure on the Google-based app, focus on the app content and user's satisfaction in a secure system.

4.6.1 FIREBASE AUTHENTICATION

At present, many web services use authentication to identify users and secure the data by controlling access to their content. For instance, Google asks for account and password to log in some applications. The authentication is more complicated due to a third-party authentication – APIs. Hence, it is a goal of the Firebase team to complete the authentication to support developers by supplying with the convenient API which the users log in or sign in from federated providers.

The common federated providers are Google, GitHub, Facebook and Twitter. If developers manipulate Firebase, it is not necessary to repeat the sign-in process, because it is already integrated with the authentication system of these providers. If the user has an

existing account, it will instantly connect to the authentication system. The Fig.4.7 shows the authentication service of Firebase.

Firebase supports standard functions such as forgotten password, and users' verification via Firebase console. Users can anonymously sign in with temporary account and then the federated provider-base account is linked to that user. It also assists Smart Lock, which can automatically remember and sign-in by using the credentials. The email address is an essential credential to sign in, which then is passed to Firebase authentication SDK. Firebase back end server will verify these authentications, 12 then reply to the client. User's information can be determined when the user has the access to Firebase product or to control or verify their identity.

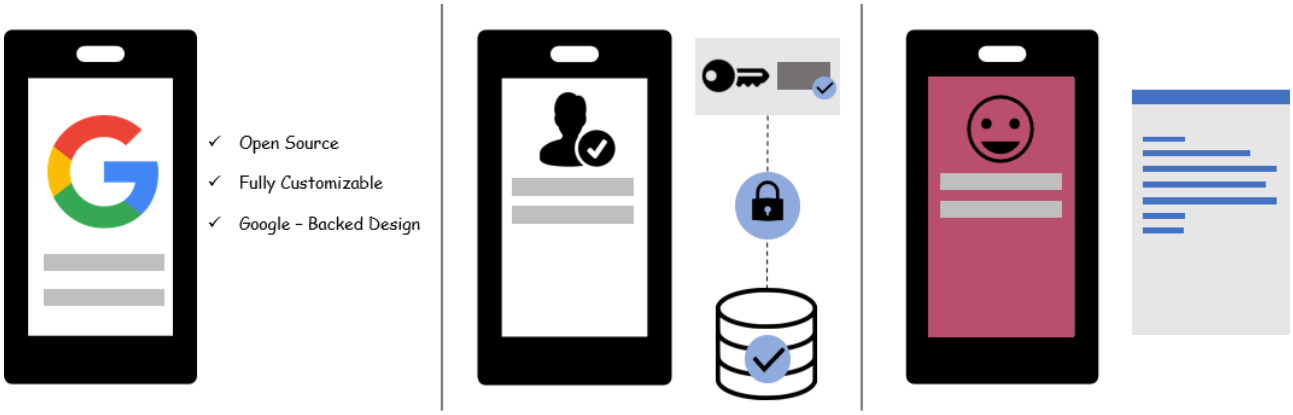

Fig.4.7 Firebase Authentication

4.6.2 THE REAL-TIME DATABASE

The classic real-time database demonstrates the database system that overcomes the real-time restriction to consolidate a reliable database system. This is the key product of Firebase since it is a simple feature utilizing API. It syncs new information as JSON across all devices, in which real-time database collaborates the web and mobile version in the same device and shares with another device in milliseconds. Additionally, this product optimizes the offline service to save and store user information in the local cache and uses database SDKs so when the user is online, the data is synced automatically.

The Real-time Firebase defines data structure and it is secured upon the Firebase Database Security Rules specifying people who can access particular information. With a few codes by clients, it describes who can see specific information. It is not necessary to exist operation or maintenance server because the cloud service hosts a real-time database (No SQL – based database). Like other products, the Real-time database is available for Android, IOS, Web, C++, Unity Platform and JavaScript. Real-time Database can scale up to 100 000 concurrent connections and 1 000/second for each database.

4.6.3 FIREBAE CLOUD STORAGE

Videos, photos and documents are stored online through Firebase Cloud Storage service that is backed up on Google Cloud Storage. A simple API is applied to build and manage an infrastructure to deal with large files. Hence, documents are shared with particular users with the Real- time Database Rule. It means this storage is cached since it is integrated with Firebase Authentication. Through Firebase SDK, it is effortless to upload and share files on mobile devices that are accessible for both Google Cloud and Firebase. Moreover, it is not necessary to transfer the document to another provider due to the automatic scale on Cloud Storage. The Fig.4.8 shows the firebase cloud storage.

Fig.4.8 Firebase cloud storage

Firebase declarative security is available according to file types, filename or size. Firebase SDK applies robust operation even when the network is dis- qualified, if a video is not successfully uploaded, when the internet connection is qualified, it will continue to transmit that video depending on where it stopped.

4.6.4 FIREBASE HOSTING

Firebase Hosting helps web app to host their static and dynamic sites by using files such as HTML, CSS,and JavaScript. It is an application that operates static web-hosting providers to serve several demands.Users have fast access to the sites and developers do not have to register a HTTPS connection certificate to run the web app since it has working principle with SSL. Based on Firebase Command Line Interface(CLI), Firebase is developed and processed in seconds.

The CLI is installed before applying Firebase hosting which requires node.js for developing a system. As applying Firebase Hosting into a modern website, the content is secured completely toward zero- configuration SSL. Because Firebase Hosting is cached on SSDs, and CDN edges, the substances are received fast. Furthermore, it furnishes with undo

function when the development has an error, so the Firebase hosting supplies full version of management. To execute Firebase Hosting, Firebase CLI is regarded as a tool with the complete version for sites, appsor Progressive Web App (PWA). The steps should be marked to implement the features, infrastructure and tailored tooling on front-end: Install the Firebase CLI, set up a project directory, and deploy the site.

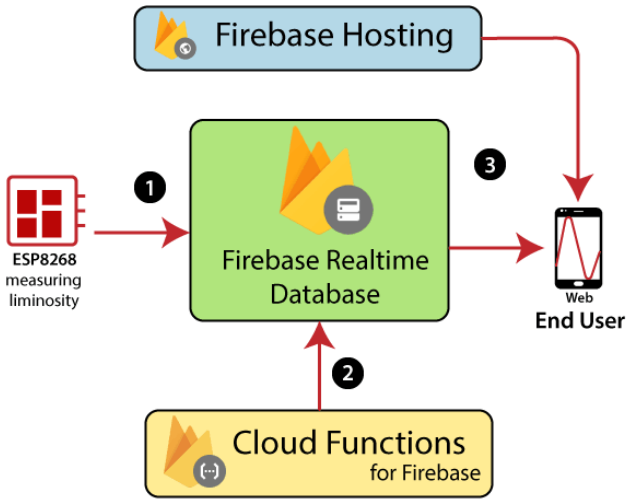

Fig.4.9 Firebase hosting

4.6.5 FIREBASE TEST LAB

The test lab is available for both IOS and Android version. Developers can recognize an error on the layout of a specific device via a Google data center.

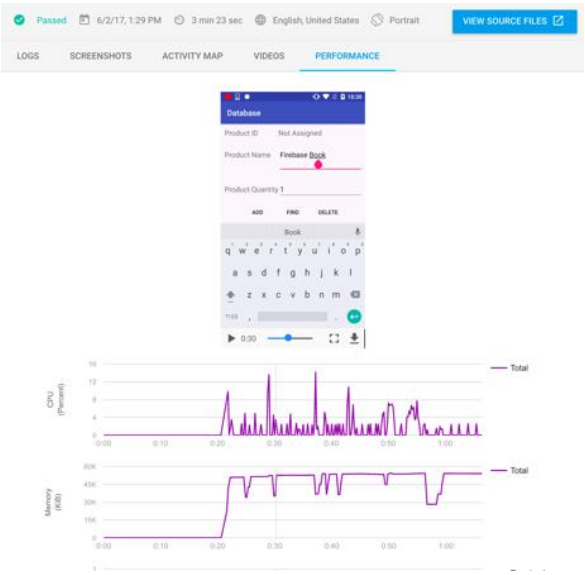

Fig.4.10 Firebase testlab

The Firebase console is already an integrated test lab, with forwards integration with test labs such as Continuous Integration (CI) system and Android Studio. A real device is flashed with the Google database center and APIs. It allows the developer to

check their app with functions and configurations in real life. A creator can customize settings to verify placement: get the app ready for testing, choose a test environment and a test matrix and run the test and review testresults.

4.7 ANDROID STUDIO

Android Studio is the official Integrated Development Environment (IDE) for android application development. Android Studio provides more features that enhance our productivity while building Android apps.

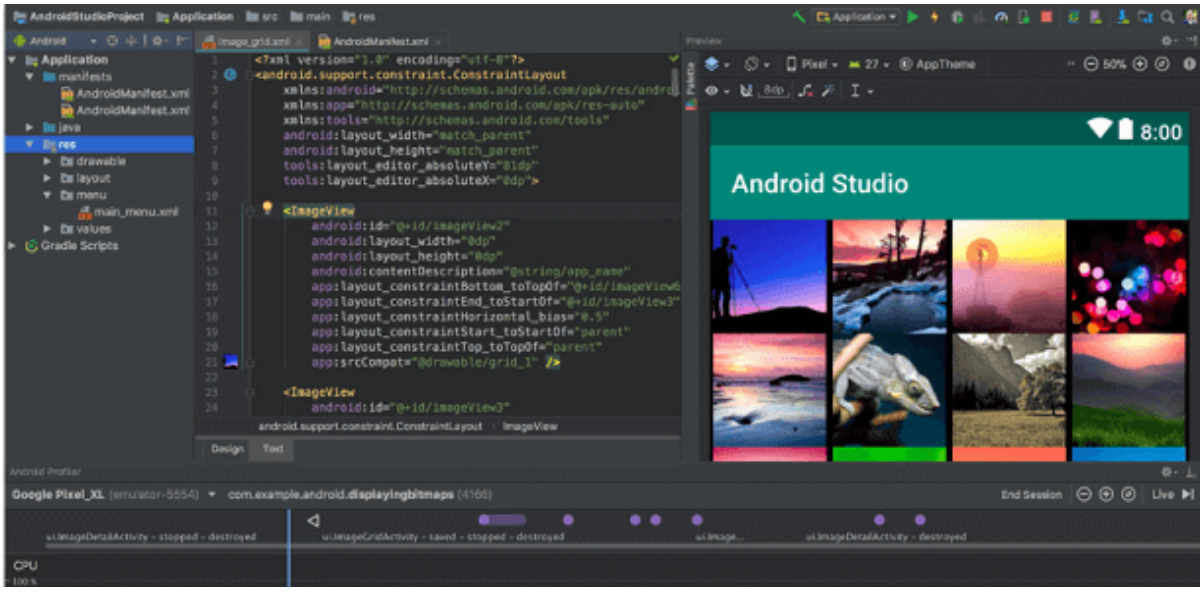

Fig.4.11 Android Studio

Android Studio was announced on 16th May 2013 at the Google I/O conference as an official IDE for Android app development. It started its early access preview from version 0.1 in May 2013. The first stable built version was released in December 2014, starts from version 1.0. The Fig.4.11 shows the android studio user interface.

4.7.1 FEATURES OF ANDROID STUDIO

- It has a flexible Gradle-based build system.
- It has a fast and feature-rich emulator for app testing.
- Android Studio has a consolidated environment where we can develop for all Android devices.
- Apply changes to the resource code of our running app without restarting the app.
- Android Studio provides extensive testing tools and frameworks.
- It supports C++ and NDK.
- It provides build-in supports for Google Cloud Platform. It makes it easy to integrate Google Cloud Messaging and App Engine.

4.7.2 ANDROID STUDIO PROJECT STRUCTURE

The Android Studio project contains one or more modules with resource files and source code files. These include different types of modules-

- Android app modules
- Library modules
- Google App Engine modules

These build files are visible to the top-level under Gradle Scripts. And the app module contains the following folders:

- **Manifests:** It contains the AndroidManifest.xml file.
- **Java:** It contains the source code of Java files, including the JUnit test code.
- **Res:** It contains all non-code resources, UI strings, XML layouts, and bitmap images.

4.7.3 ANDROID STUDIO USER INTERFACE

- The **toolbar** provides us a wide range of actions, which includes running apps and launching Android tools.
- The **navigation bar** helps in navigating our project and open files for editing. It gives a compact view of structure visible in the Project window.

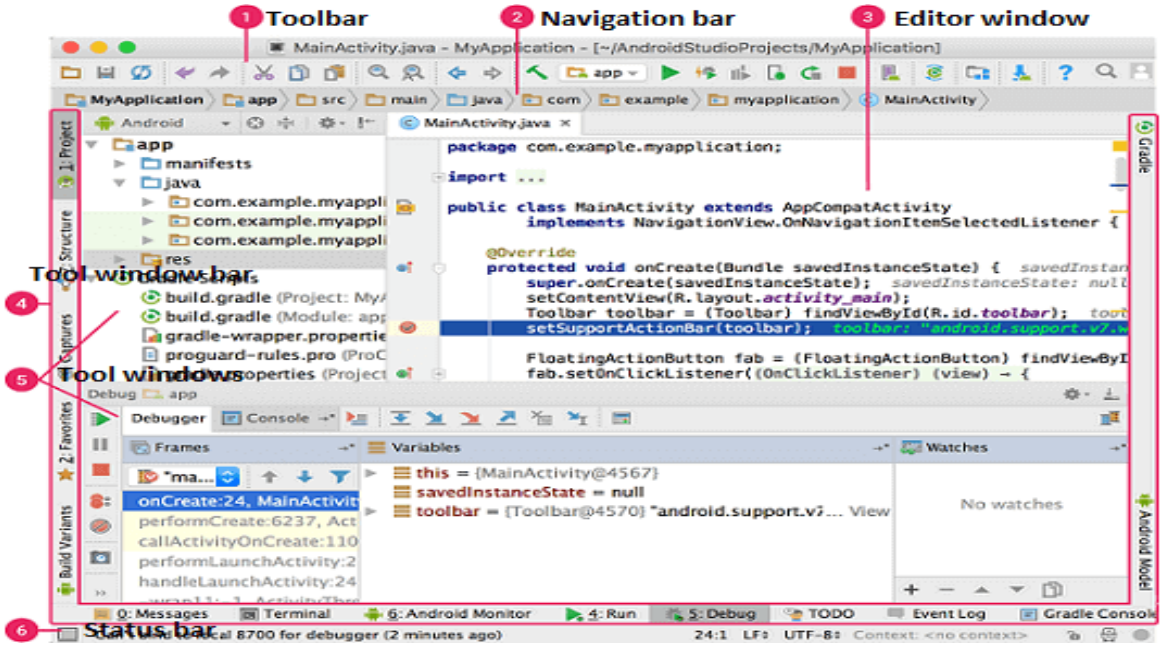

Fig.4.12 Android Studio user interface

- The **editor window** is a space where we can create and modify our code. On the basis of the current file type, the editor can change. While viewing a layout file, the editor displays the Layout Editor.

- The **tool window bar** runs around the outside the IDE window and contains buttons that allow as to expand and collapse individual tool windows.
- The **tool windows** provide us access specific tasks like search, project management, version control, and more. We can able expand and collapse them.
- The **status bar** displays the status of our project and IDE itself, as well as any messages or warnings.

The Android Studio main window contains the several logical areas which are shown in the Fig.4.12.

4.7.4 GRADLE BUILD SYSTEM

Gradle build used as the foundation of the build system in Android Studio. It uses more Android-specific capabilities provided by the Android plugin for Gradle. This build system runs independently from the command line and integrated tool from the Android Studio menu. We can use build features for the following purpose:

- Configure, customize, and extend the build process.
- We can create multiple APKs from our app, with different features using the same project and modules.
- Reuse resource and code across source sets.

4.7.5 IMPLEMENTING ANDROID APPLICATION USING ANDROID STUDIO

STEP 1: Open Android Studio and create a new project with empty activity.

STEP 2: Name the project and select language as JAVA.

STEP 3: Create a new XML file and name it as activity_main.xml.

STEP 4: Now type the XML code for Login screen.

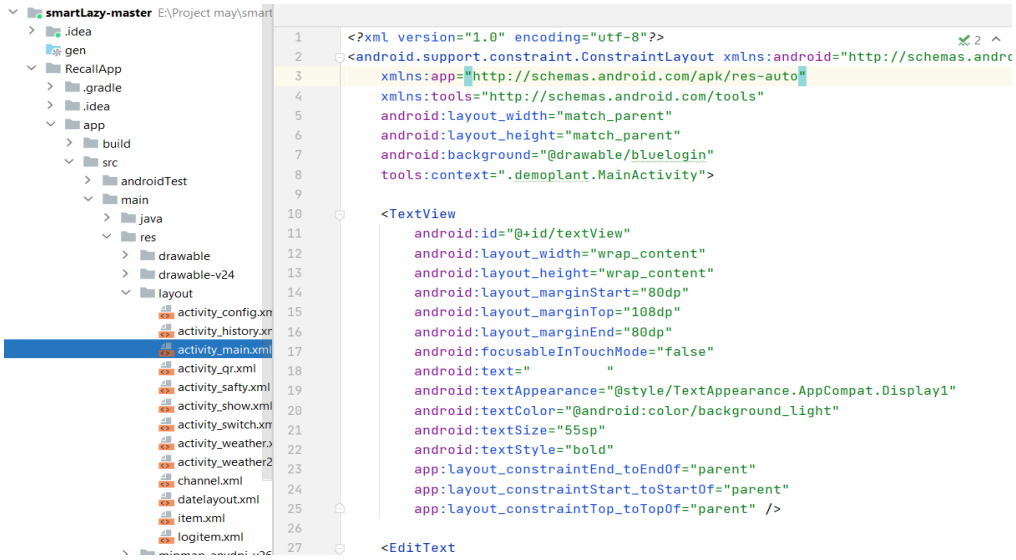

Fig.4.13 Designing XML file

STEP 5: Create a new xml file and name it activity_show.xml.

STEP 6: Create a new java file and name it as broadcast.java, include Read and Write API Key.

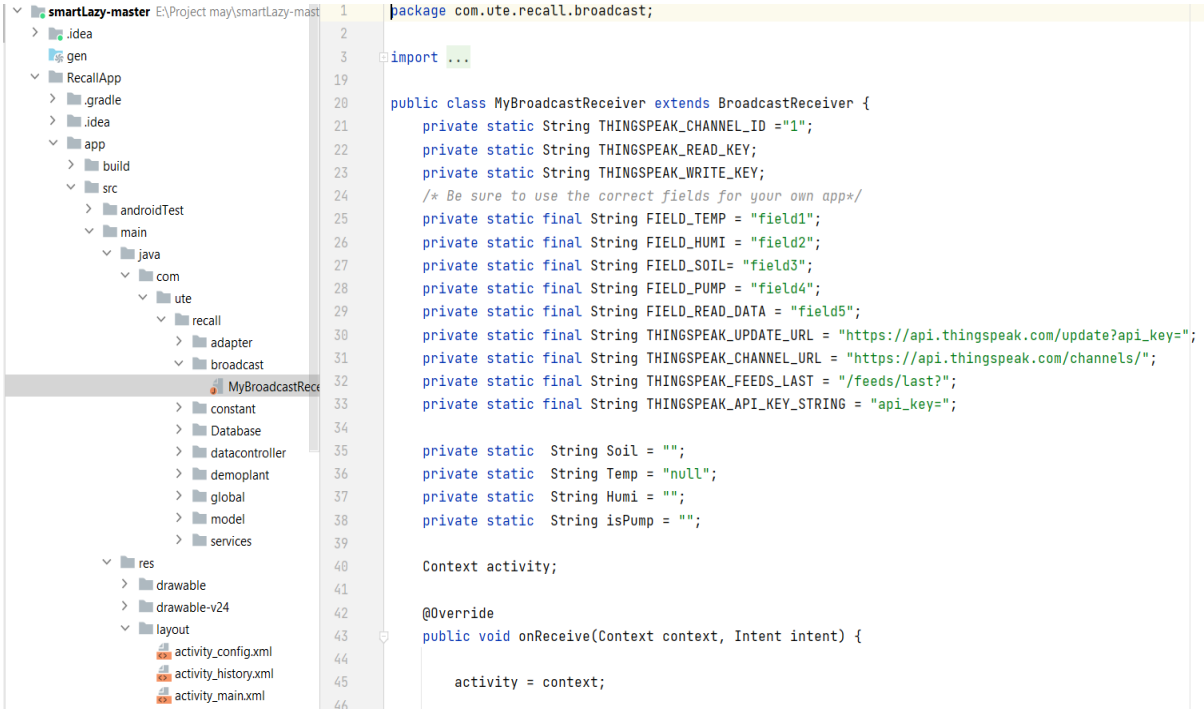

Fig.4.14 Broadcast.java file

STEP 7: Create a new XML file and name it as activity_history.xml, now link the XML file with MainActivity.java file.

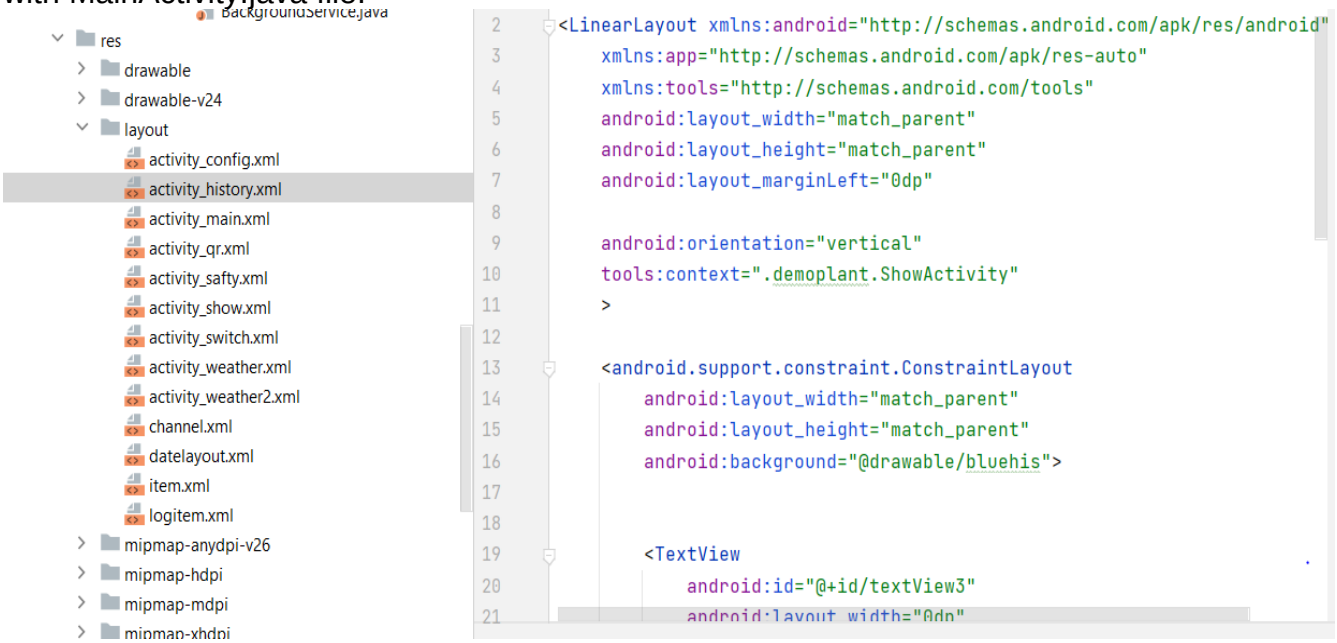

Fig.4.15 Designing history screen

STEP 8: Now enter the API key in the login screen of the Android Application to connect backend cloud.

CHAPTER 5

RESULT

IoT based Early Flood Warning System for Disaster Management is developed for tracking the water level and giving alert to the people. This project is developed & created by Arduino IDE, Water level Sensor, Water Flow Sensor, NodeMCU, Water pump, Relay module, GSM Module and DTH11 Sensor.

5.1 PROCEDURE

STEP 1:

Arduino UNO board is interfaced with Water Level Sensor, Water Flow Sensor, DTH11 Sensor, NodeMCU, Water Pump and LCD. The proto type of the proposed system is shown in Fig.5.1.

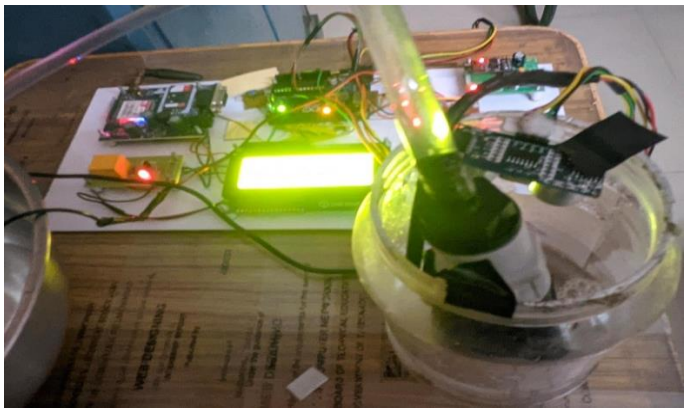

Fig.5.1 Arduino with Sensors

STEP 2:

When the water level (DISTANCE) is below the threshold value, the LCD displays "**WATER LEVEL NORMAL**" message as shown in Fig.5.2. If the water level crosses the threshold value, it displays "**WATER LEVEL FULL**" message on LCD display as in fig.5.3.

Fig.5.2 Water Level is normal

Fig.5.3 Water level is full

STEP 3:

The water flow rate (F) is also measured and displayed on LCD as shown in fig.5.4.

Fig.5.4 Water Flow rate

STEP 4:

The GSM module sends the humidity sensor (DTH11) data to ThingSpeak cloud and plotted it to a graph as shown in Fig.5.5.

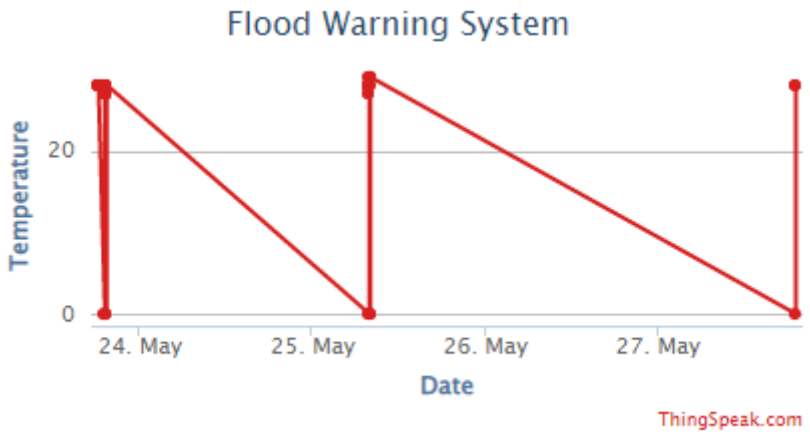

Fig.5.5 DTH11 graph

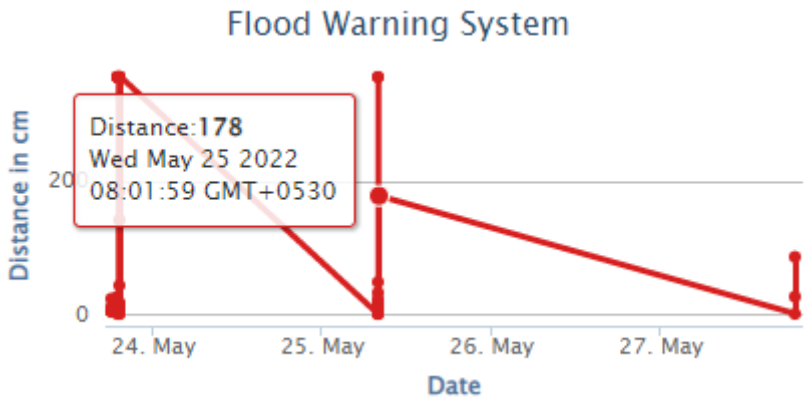

Fig.5.6 Water Level graph

STEP 5:

The GSM module sends the water level data to ThinkSpeak cloud and plotted it to a graph as shown in Fig.5.6.

STEP 6:

An android application is created to view the details of water level, water flow rate, temperature and humidity etc... As shown in Fig.5.7. The History logs can also be viewed as shown in Fig.5.8.

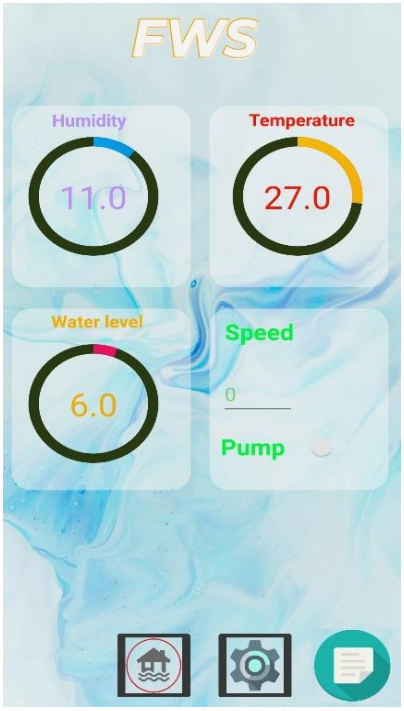

Fig.5.7 Application UI

Fig.5.8 Logs

STEP 7:

This page shows the daily weather report lively, we can filter the weather data by entering a particular city name on the search box. The Fig.5.9 shows the weather report.

Fig.5.9 Weather screen

STEP 8:

The excel sheet is exported from the ThinkSpeak, it contains Humidity, Water Level, Water Flow, Temperature data. The below Fig.5.10 shows the ThinkSpeak dataset.

81	2022-05-23	115	28	11	357	0.51:
82	2022-05-25	116	0	0	0	0.00:
83	2022-05-25	117	27	11	11	0
84	2022-05-25	118	27	11	12	0.00:
85	2022-05-25	119	28	11	19	6.62:
86	2022-05-25	120	28	11	3	6.62:
87	2022-05-25	121	28	11	9	6.62:
88	2022-05-25	122	28	11	22	6.62:
89	2022-05-25	123	28	11	16	16.01:
90	2022-05-25	124	28	11	357	16.01
91	2022-05-25	125	29	9	48	28.49:
92	2022-05-25	126	28	11	357	28.49:
93	2022-05-25	127	28	11	17	28.49:
94	2022-05-25	128	29	10	5	40.03:
95	2022-05-25	129	0	0	0	0.00:
96	2022-05-25	130	0	0	0	0.00:
97	2022-05-25	131	29	10	32	0.25:

Fig.5.10 ThinkSpeak dataset

STEP 9:

The sign up pages gets username, email ID, password from the user and stores it in the database which is located in the firebase account. The Fig.5.11 shows the sign up screen of the website.

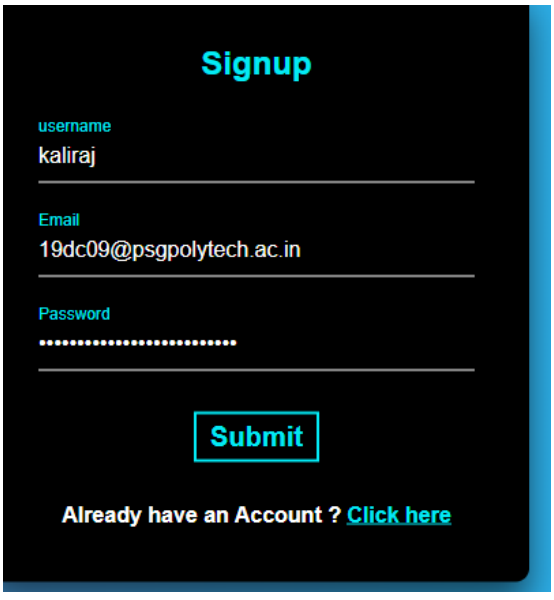

Fig.5.11 Sign up page

STEP 10:

The Fig.5.12 shows the login page that gets the user input such as username and password.

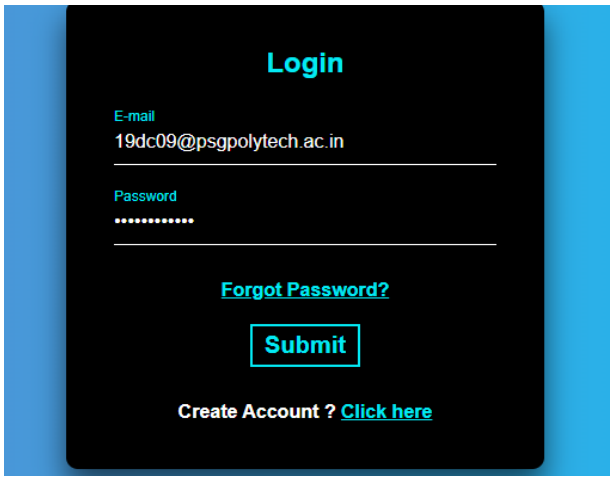

Fig.5.12 Login page

STEP 11:

If the username and password matches the firebase database the user is permitted to access the webpage. The Fig.5.13 shows the login success message.

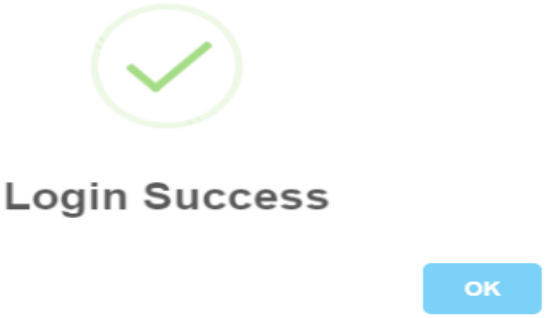

Fig.5.13 Login success message

STEP 12:

The firebase have in build real time database, it logs every new user data on excel format. The Fig 5.14 shows the firebase database.

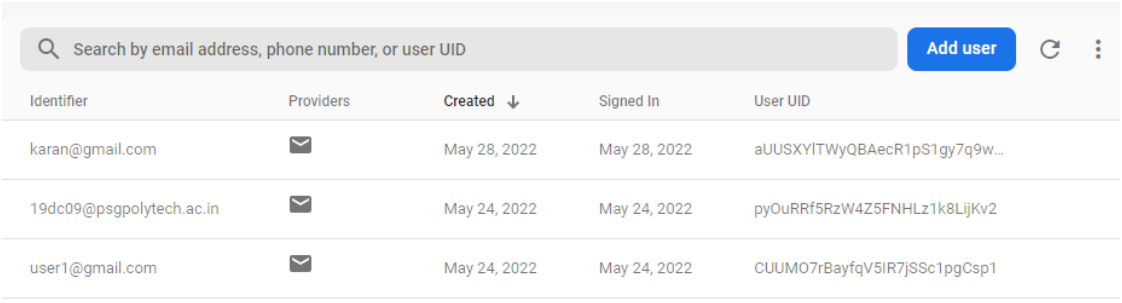

Fig.5.14 Firebase database

CONCLUSION

The proposed system is developed for disaster management system that can be formed on all over India. This project aims at monitoring and analysing the water level in one particular water tank. In future it may be enhanced to monitor multiple locations at the same time and the web site or application must be able to display the info based on the selection done by the authority. System consists of hardware and software applications to detect water level of rivers, dams etc. The real-time data can be collected from Arduino UNO microcontroller, using ML (Machine Learning) algorithm the rainfall can be predicted. In this project we can add more sensors in future.

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