PHASE 2 : INNOVATION

PROJECT NAME	IOT FLOOD MONITORING AND EARLY WARNING
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GROUP	5
GITHUB REPOSITORY- LINK	https://github.com/priyadharsni/IBM-Naanmudhalvan-iot.git

IOT – FLOOD MONITOTING AND EARLY WARNING

1.ABSTRACT:-

The Flood Monitoring and Early Warning Project is a comprehensive initiative designed to mitigate the devastating impacts of flooding events in vulnerable regions. Flooding is a recurrent natural disaster that leads to loss of lives, destruction of property, and disruption of livelihoods. This project aims to leverage advanced technology, data analytics, and community engagement to enhance flood monitoring, prediction, and timely dissemination of early warnings.

2.PROPOSAL OF THE PROJECT:

The development of a flood monitoring system that can accurately predict and detect flood events, including ultrasonic sensor, float sensor, water temperature sensor, rain gauge, weather station, flow meter, camera and image sensor, LORA sensor. The objective of this proposal is to create an alert message to all the mobile phones .so our main aim is to alert the people before the flood.

2.1. SCOPE OF WORK:

2.1.1. SENSOR INTEGRATION: -

- We have a plan to utilize ultrasonic sensors for measure the moving water surface condition
- We have to plan to implement float sensor to detect the water level in the dam.
- We have to use the flow meter for measuring the flow rate and volume of water in dams.
- We have a plan to implement camera and image sensor in this project for They provide visual information that complements other data sources, such as flow meters, weather stations, and radar, to enhance flood monitoring, prediction, and response efforts.

2.1.2. MOBILE APPLICATION DEVELOPMENT: -

- We have a plan to develop a user-friendly mobile application to provide users can easily access SMS message and view flood-related information.
- Real-time Flood Alerts: Push notifications or SMS alerts for flood warnings and updates.

2.1.3. SENSOR PLACEMENT AND NETWORK DEVELOPMENT: -

- We plan to establish a wireless communication network using LORA for sensor data transmission to a central hub.
- We want to ensure sensors are weather-resistant and durable for outdoor use and we need to place the sensor secure.

2.1.4.DATA PROCESSING AND CLOUD INTEGRATION: -

- We develop a machine learning algorithm for processing data from ultrasonic, cameras and other sensors.
- We implement cloud-based data management for real-time analytics and remote management.

3.ARCHITECTURE DIAGRAM: -
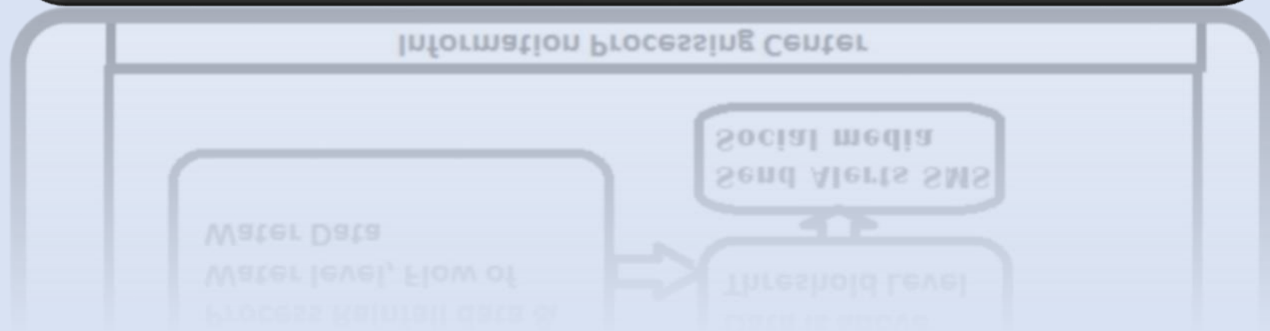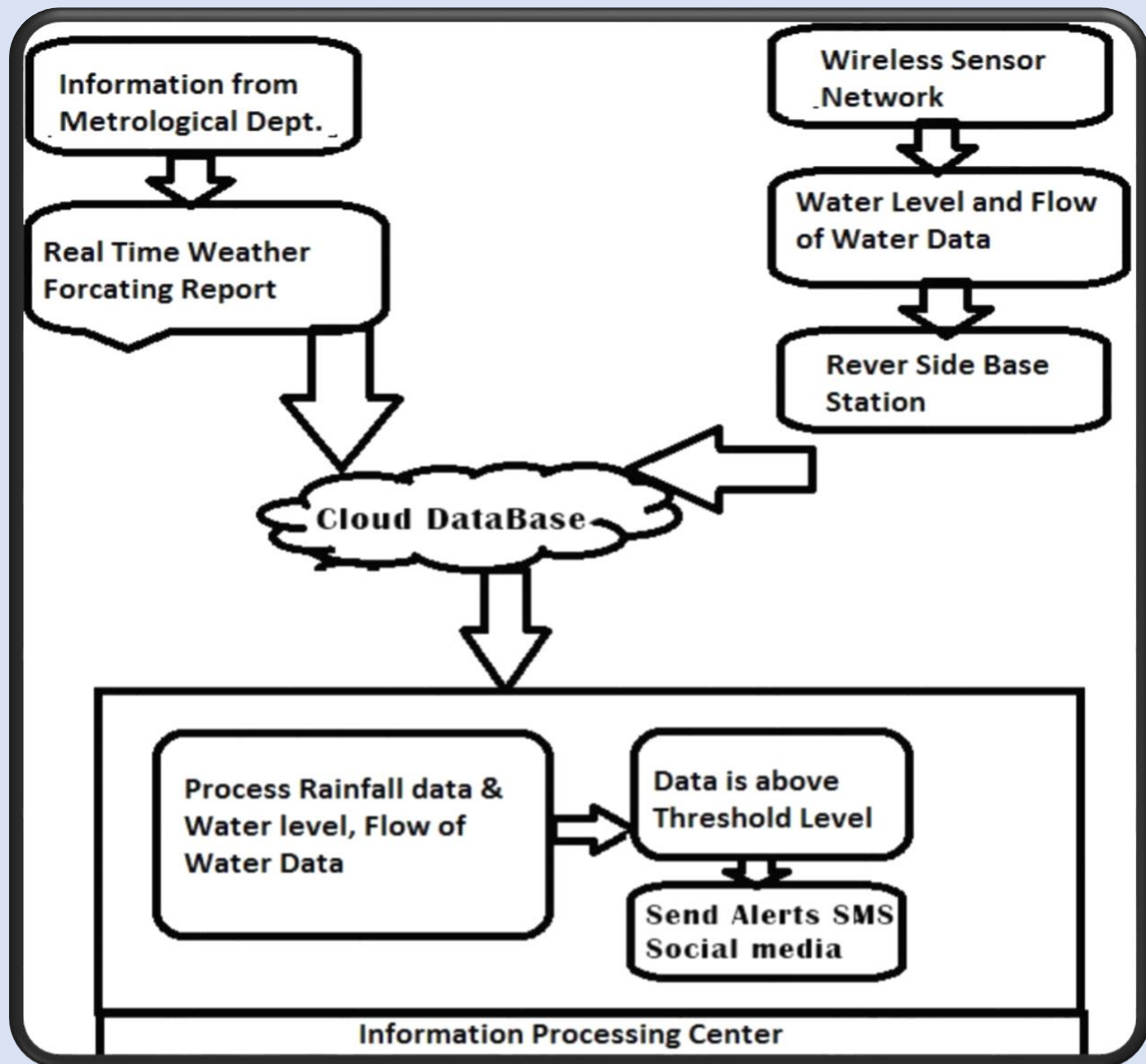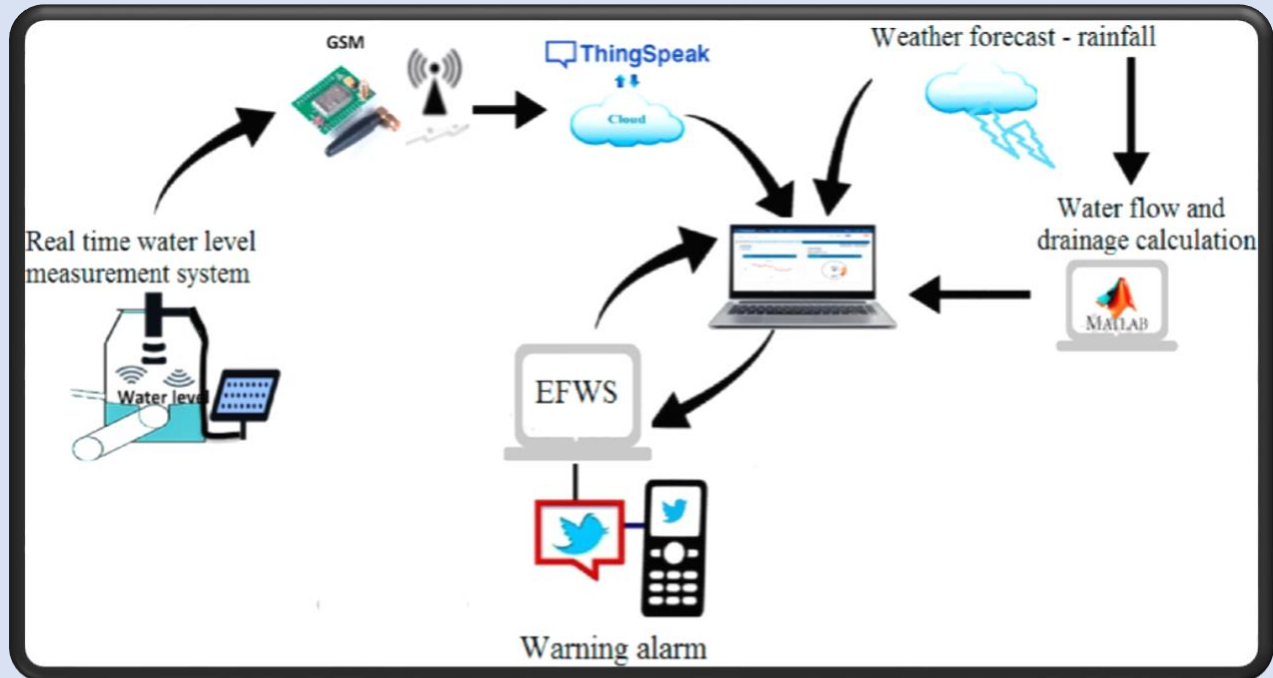
DESCRIPTION OF THE PROJECT:

Here initially the data from the sensors are Collected by the micro controller then it transmits the data to the Cloud through the LoRa Gateway which help to transmit the data to long range. Later the data are collected by the Cloud and Pre-Processed. it gets the real time update from the sensors and then it sends the efficient information to the user through the SMS and social media the user can see the flood area from the map. If the water level is above the threshold, then it sends the alert messages to the users.

4.BLOCK DIAGRAM:
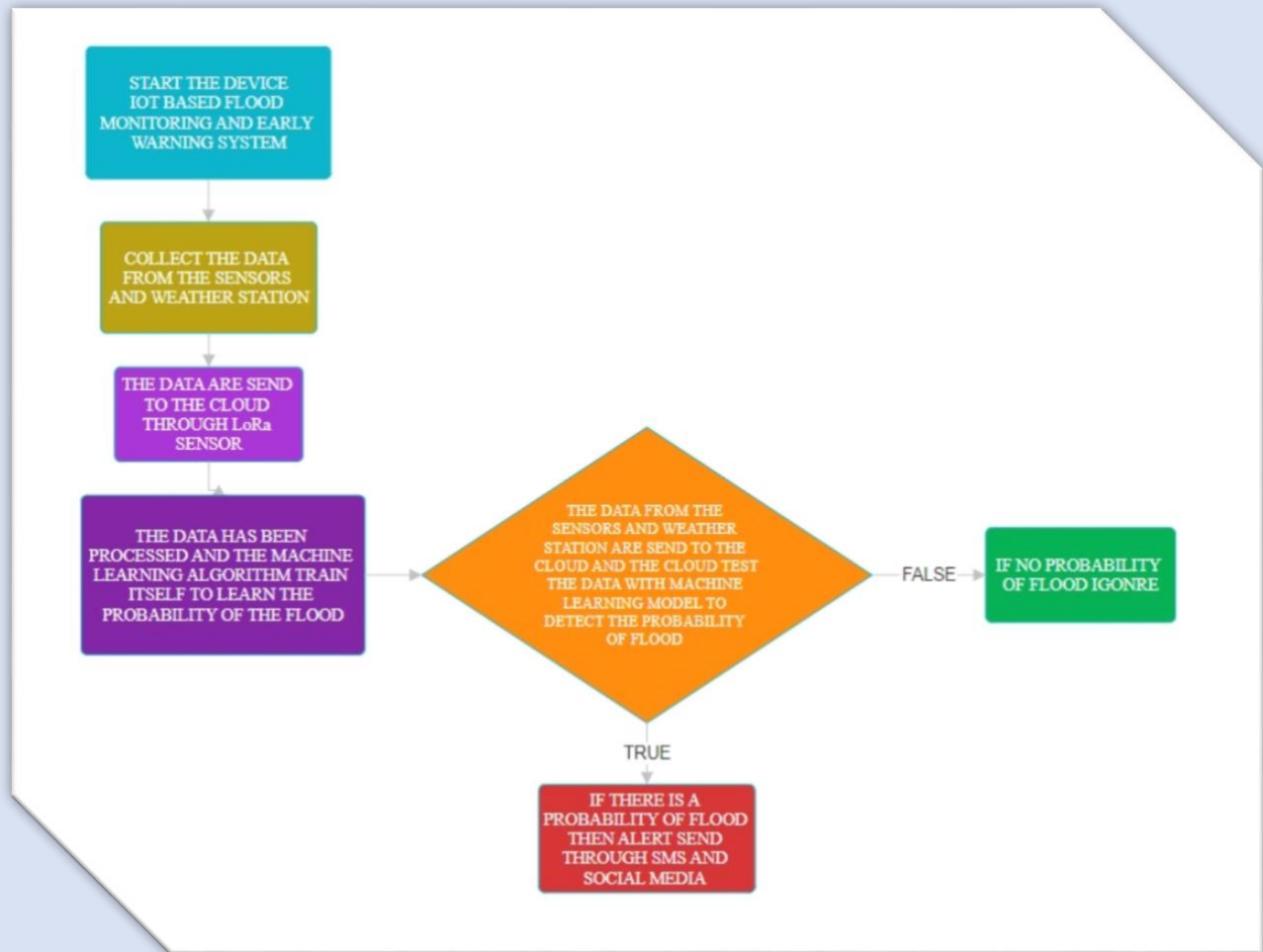
5. MOBILE APPLICATION DESCRIPTION: -

In this project we have plan to make the flood monitoring and early warning problem to be solved. Flood Watch is a comprehensive mobile application designed to keep users informed about flood risks, provide early warnings, and facilitate better preparedness and response during flood events. Whether you live in a flood-prone area or are traveling through one, Flood Watch is your reliable companion for staying safe and informed.

6. HARDWARE DESCRIPTION: -

In this project the flood monitoring and early warning information is an input and output. Through the sensors the data are collected and the micro-controller which plays the vital role in this project which controls the sensors and assign role for individual sensors. The data collected by the sensors are transmitted to the cloud by the communication through Lora which help to transmit the data long range. The Cloud process the data and transmitted to the sensors. The real time update of the water level can be provided every 5 seconds.

7.USES OF SENSORS:

7.1 ULTRASONIC SENSORS: -

- **Use**: Ultrasonic sensor are used to measure the distance of the water level.
- **How they work**: they utilize high-frequency (ultrasonic) soundwaves to calculate the distance to a remote object without physically touching it, they can be used to create systems that reliably determine wave height and water levels at much lower installation and maintenance costs.
- **Why we use them:** Ultrasonic sensors can measure water level without physically touching the water. They use sound waves to calculate the distance form the sensor to the water surface.

7.2 FLOAT SENSORS: -

- **Use:** Float sensor are used to determine the water level and analyzes the collected data and determine the type of danger present.
- **How they work:** When the water level is below the threshold, the float sensor maintains the electrical circuit in an open state. However, when the water level raises to the present threshold the float sensor causes the electrical circuit to close, completing the connection.
- **Why we use them:** Float sensors can trigger real-time alerts when water levels reach predefined thresholds. The timely information is essential for issuing flood warnings, initiating emergency response measures, and safeguarding lives and property.

7.3 CAMERA AND IMAGE SENSORS: -

- **Use:** Camera Sensor (CS) for water level monitoring at varying operating and image capturing distances from the water bodies. Changes in water levels were captured at five (5) minutes time intervals at varying tilting angles both at indoor and outdoor conditions.
- **How they work:** Cameras and image sensors capture visual data in the form of images or video footage. These devices are strategically positioned in flood-prone areas at critical infrastructure points like dams.
- **Why we use them:** The visual data from cameras and image sensors can be integrated with other data sources such as radar, weather stations, river gauges, and GIS (Geographic Information Systems). This integration provides a comprehensive view of flood conditions.

7.4 LORA SENSORS: -

- **Use**: LoRa sensors are used for efficient and long-range data transmission from sensors to a central hub.
- **How They Work**: LoRa (Long Range) technology enables low-power, long range wireless communication.
- **Why we use them:** LORA sensors are well-suited for flood monitoring due to long range communication. they are relatively easy to deploy, as they do not require extensive wiring or infrastructure setup. This networks typically have lower operating costs to compared to cellular or satellite communication option. so, we use the LORA sensor to communicate the data.

7.5 WATER TEMPERATURE SENSOR: -

- **Use:** Water temperature sensors are used in flood monitoring to gather data.
- **How they work:** water temperature sensors are typically deployed in bodies of water in dams. That are prone to flooding. These sensors continuously measure the temperature of the water at specific location.
- **Why we use them:** It helps to monitor the hydrological changes, detect rainfall and snowmelt events, provide early flood warning, assess environmental impacts and support data integration and analysis.

7.6 RAIN GUAGES: -

- **Use:** Rain gauges are specifically designed to measure the amount of rainfall at a given location.
- **How they work:** Precipitation is a key factor that can contribute to the dams which can lead to flooding when it exceeds the capacity of the drainage system.
- **Why we use them:** Many flood monitoring systems are equipped with rainfall thresholds. When rainfall exceeds a certain threshold, it can trigger alarms or alerts to warn of potential flooding. Rain gauges provide the data necessary to determine when these thresholds are reached.

7.7 WEATHER STATIONS: -

- **Use:** Weather stations play a vital role in flood monitoring by continuously collecting meteorological data that helps predict and assess flooding events.
- **How they work**: weather sensors help municipalities and response agencies identify when dangerous   flood conditions are occurring and can save lives by enabling a quicker, more automated response.
- **Why we use them:** These sensors provide real-time data on current weather conditions at the weather station's location. This data is collected and recorded at regular intervals, typically every few minutes.

7.8 FLOW METERS: -

- **Use:** Flow meters are essential devices in flood monitoring systems for measuring the flow or discharge of water in dams.

How they work: Flow meters continuously collect data on water depth, velocity, or other relevant parameters, depending on their design. This data is typically recorded at regular intervals, such as every few minutes.

Why we use them: Flow meters are used to collected the flow data and used as inputs for hydrological models. These models help forecast future flow rates based on current and predicted weather conditions, which is critical for flood prediction and early warning.

7.9 GPS SENSORS: -

Use: GPS (Global Positioning System) sensors can play a crucial role in flood monitoring by providing location information that enhances the accuracy and effectiveness of flood prediction, monitoring, and response efforts**.**

How they work: GPS sensors continuously collect real-time location data, including latitude and longitude coordinates, as well as altitude information. The sensors update this data at regular intervals, typically multiple times per second.

Why we use them: GPS are used to create detailed maps and visualizations of flood-affected areas.

7.10 CELLUAR MODEMS: -

Use: Cellular modems play a vital role in flood monitoring systems by enabling remote data transmission, real-time communication, and data access in areas where wired internet connectivity may be limited or unavailable.

How they work: The cellular modem sends the collected data to a central monitoring station, data repository, or cloud-based platform in real-time.

Why we use them: Cellular modems are cost-effective solutions for flood monitoring, as they eliminate the need for extensive infrastructure development and maintenance, such as laying cables or building dedicated communication towers.

7.11 DOPPLER RADAR SENSOR: -

Use: Doppler radar sensors are instrumental in flood monitoring by providing crucial meteorological data that helps predict and monitor rainfall patterns and intensities.

How they work: The work of the Doppler radar sensors is to emit electromagnetic radio waves, typically in the microwave frequency range.

Why we use them: The doppler radar sensor are used to transmitted the radar signals travel through the atmosphere, they encounter precipitation, such as raindrops or snowflakes, within their range. When radar signals come into contact with precipitation, they scatter in various directions.

7.12 BORAMETERIC PRESSURE SENSOR: -

Use: Barometric sensors, also known as barometers, are used in flood monitoring primarily to measure atmospheric pressure.

- **How they work:** Barometric sensors continuously monitor changes in atmospheric pressure over time. These sensors can detect fluctuations in pressure that may indicate the arrival of weather systems that are associated with heavy rainfall.

- **Why we use them:** Barometric sensors are used to maintain the historical records of pressure measurements. This historical data can be analyzed to identify pressure patterns associated with past flood events, aiding in flood risk assessment and prediction.

7.13 LIGHT DETECTION AND RANGING: -

- **Use:** The light detection and ranging is used to provide valuable data that contributes to flood risk assessment, flood modeling, and floodplain management.

- **How they work:** LiDAR-generated DEMs are crucial for delineating floodplains and understanding how water will flow across a landscape during a flood event.

- **Why we use them:** LiDAR can be used to assess the condition of critical infrastructure such as dams. Detailed topographic information helps identify vulnerabilities in these structures and informs maintenance and repair efforts.

7.14 MOTION SENSOR: -

- **Use:** Motion sensors are commonly used to detect unauthorized intrusions into flood-prone areas, such as dams, levees, or flood control infrastructure.

- **How they work:** Motion sensors can be used to detect and deter unauthorized access to infrastructure components vulnerable to tampering or sabotage during a flood event.

- **Why we use them**: Motion sensors are primarily used for security, they can be integrated into broader flood monitoring and early warning systems. Combining security data with data from water level sensors, weather stations, and other flood-related sensors can provide a comprehensive view of flood conditions.

CONCLUSION: -

In conclusion flood monitoring and early warning systems are critical components of disaster risk reduction and management. They play a pivotal role in safeguarding lives, property and the environment in flood prone regions. Early warning systems can significantly reduce the loss of life during flood events.