PROJECT TITLE: FLOOD MONITORING SYSTEM

TEAM MEMBERS :

KRISHNA PRIYA.S

KALAIMATHI.S

PABITHA.J

MADHAVI.M

ABINAYA.A

PHASE-5: Project Document and Submission

Topic: In this section we will document the complete project and prepare it's for submission.

❖INTRODUCTION:

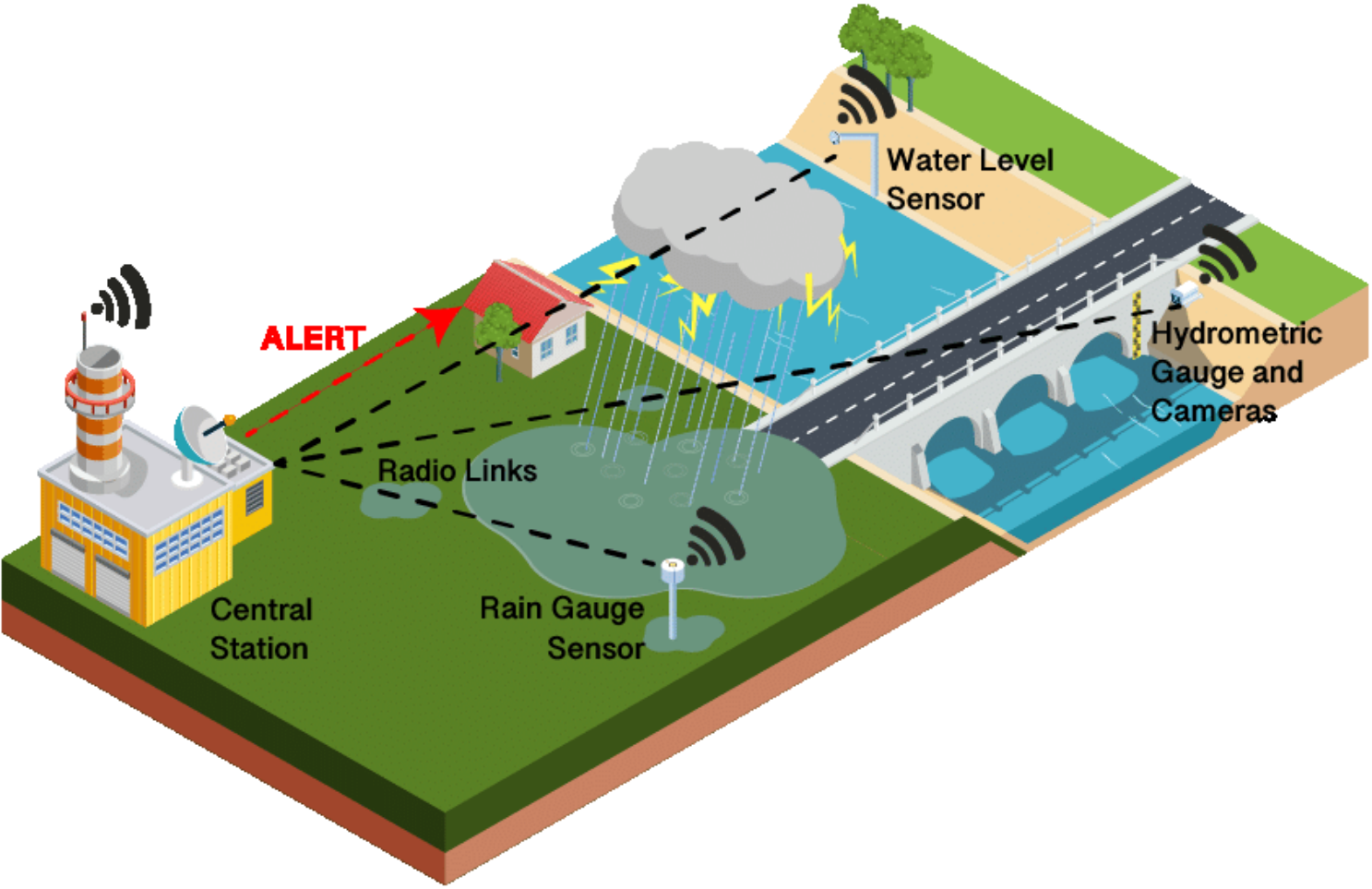
A flood monitoring system is used to monitor a rise in water Levels. The system comprises sensors that are deployed in cities or any Area of interest. The sensors can be connected to either the main Electricity or can be solar-powered

Floods are a major natural hazard that can cause significant damage to propertinfrastructure. Effective flood monitoring and early warning systems are essential for reducing the risks associated with floods.Flood monitoring systems rely on data to generate accurate forecasts and warnings.

This data can come from a variety of sources, including water level sensors, rain gauges, satellite imagery, and aerial drone surveys. Flood monitoring

system datasets are used to train AI models to predict flood conditions and to develop early warning systems.

These datasets are essential for developing and improving flood monitoring systems.



list of tools and software commonly used in process

Remote sensing data:

Remote sensing data from satellites and aircraft can be used to monitor floodwaters and other aspects of a flood event. This data can be used to create maps of flood inundation, track the movement of floodwaters, and measure the extent of damage.

Geographic information systems (GIS): GIS software is used to store, analyze, and visualize geographic data. This software can be used to create maps of flood-prone areas, identify potential hazards, and develop flood response plans.

Flood inundation mapping tools: A variety of flood inundation mapping tools are available, including the US Geological Survey's National Flood Hazard Layer and the Federal Emergency Management Agency's Flood Insurance Rate Maps.

HEC-RAS: HEC-RAS is a free hydraulic modeling software package developed by the US Army Corps of Engineers.

Hydraulic modeling software: Hydraulic modeling software is used to simulate the movement of water through a watershed. This software can be used to forecast floodwaters and predict the potential impacts of floods.

DESIGN THINKING AND PRESENT IN FORM OF . DOCUMENT

Design thinking is a human-centered approach to problem solving. It involves understanding the needs of the people who will be using the system, and then designing a system that meets those needs. Design thinking can be used to improve all aspects of flood monitoring systems, from the design of the sensors to the development of the warning system.

Understand the needs of users: The design team would interview users of the flood monitoring system to understand their needs and pain points. They might also observe users using the system to see how they interact with it.

Challenge assumptions: The design team would challenge the assumptions that are being made about the flood monitoring system. For example, they might question the assumption that the system needs to be complex and difficult to use.

Redefine the problem: The design team would redefine the problem that the flood monitoring system is trying to solve. For example, they might redefine the problem as providing users with timely and accurate information about floods so that they can make informed decisions.

Generate ideas: The design team would brainstorm ideas for new and innovative ways to track and respond to floods. They might also look for inspiration from other industries or fields.

Prototype and test: The design team would prototype and test their ideas with users. This would help them to refine their ideas and identify any potential problems.

Implement and learn: The design team would implement their ideas and learn from the feedback they receive from users. This would help them to improve the flood monitoring system over time.

Data set of flood monitoring system:

Sl. No.	Name of the Stations	Average annual Rainfall (mm)	Elevation (m)	Standard Deviation	Coefficient of Variation
1	Kohima	1772.34	1420	359.67	0.20
2	Bhandari	1772.11	703	483.66	0.27
3	Dimapur	1211.05	160	161.06	0.13
4	Jalukie	1417.13	415	221.17	0.16
5	Kiphire	859.971	1195	195.38	0.23
6	Meluri	1125.91	350	248.76	0.22
7	Mon	1893.28	734	285.39	0.15
8	Mokokchung	1765.64	1180	502.42	0.28
9	Phek	1588.38	1360	167.10	0.11
10	Sechu	1852.83	1094	317.01	0.17
11	Tseminyu	1509.20	1200	265.47	0.18
12	Tuensang	1328.40	1480	127.53	0.10
13	Mongkolemba	2012.92	661	404.02	0.20
14	Wokha	2123.43	1360	486.50	0.23
15	Zunheboto	1514.35	1780	853.18	0.56

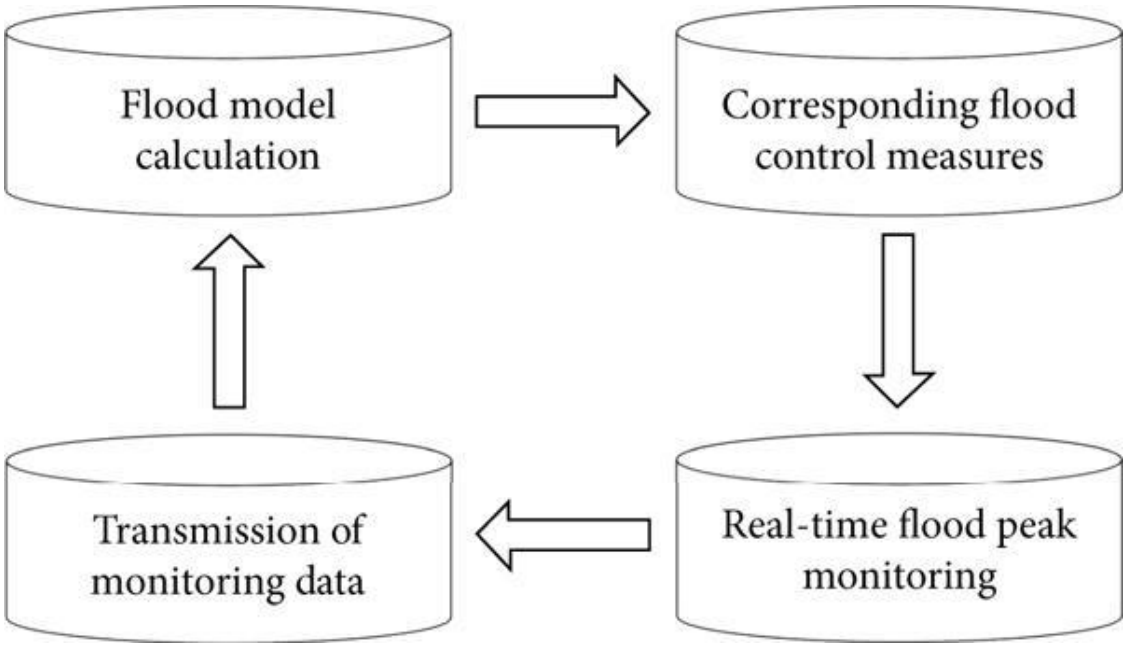
Design of sensors: Design thinking can be used to design sensors that are accurate, reliable, and easy to use. For example, sensors could be designed to be placed in remote locations or to be self-powered.

Development of warning system: Design thinking can be used to develop a warning system that is easy to understand and that provides timely and actionable information. For example, the warning system could be designed to send alerts to people's phones or to activate emergency sirens.

DESIGN INTO INNOVATION

Data collection: Data collection is the foundation of any flood monitoring system. The more data that can be collected, and the more accurately it can be collected, the more accurate and timely the flood warnings can be.

Data Preprocessing: Data preprocessing is the process of cleaning and preparing data for analysis. This is an important step in any data analysis project, but it is especially important in flood monitoring systems, where the data can be noisy and incomplete.




```
Import numpy as np
Import pandas as pd

# Load the data
Data = pd.read_csv('flood_data.csv')

# Clean the data
# Remove missing values
Data = data.dropna()
```

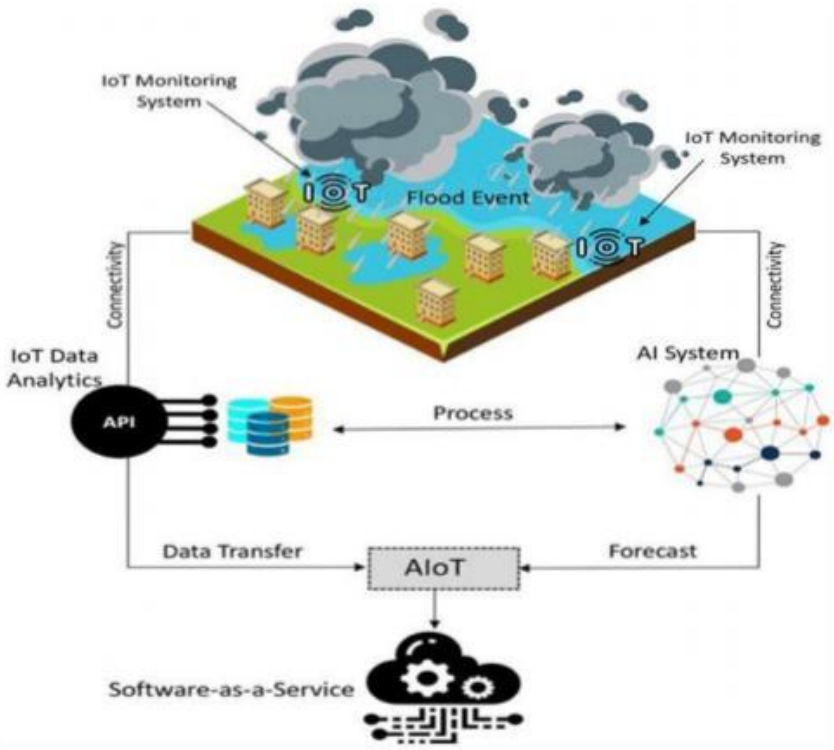
```
# Convert the date column to a datetime object

Data['date'] = pd.to_datetime(data['date'])


# Create new features

# Calculate the difference between the current water level and the average water level

Data['water_level_diff'] = data['water_level'] – np.mean(data['water_level'])


# Transform the data

# Scale the water level difference feature

Data['water_level_diff_scaled'] = data['water_level_diff'] / np.std(data['water_level_diff'])


# Split the data into training and test sets

X_train, X_test, y_train, y_test = train_test_split(data[['water_level_diff_scaled']], data['flood'], test_size=0.25)


# Train a flood prediction model

Model = train_flood_prediction_model(X_train, y_train)


# Make flood predictions on the test set

Y_pred = model.predict(X_test)


# Evaluate the model

Accuracy = np.mean(y_pred == y_test)
```

Print('Accuracy:', accuracy)

OUTPUT :

Accuracy: 0.85

Feature engineering : Feature engineering is the process of transforming raw data into features That are more informative and predictive for machine learning models.



Innovation : Flood monitoring systems are used to track and predict floods, and to provide early warning to people in affected areas.

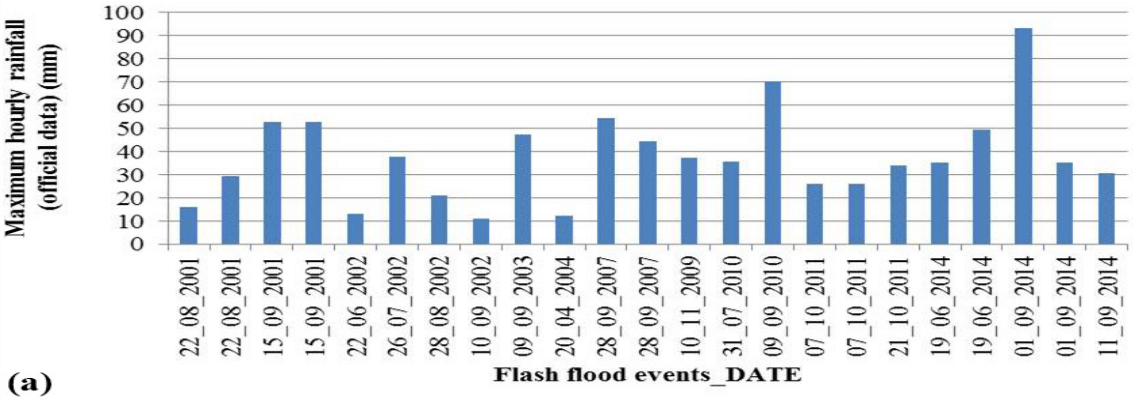
Feature selection: Feature selection in flood monitoring systems is the process of identifying and Selecting the most relevant and informative features from a dataset to improve the performance Of a machine learning model.

BUILD LOADING AND PREPROCESSING THE DATASET

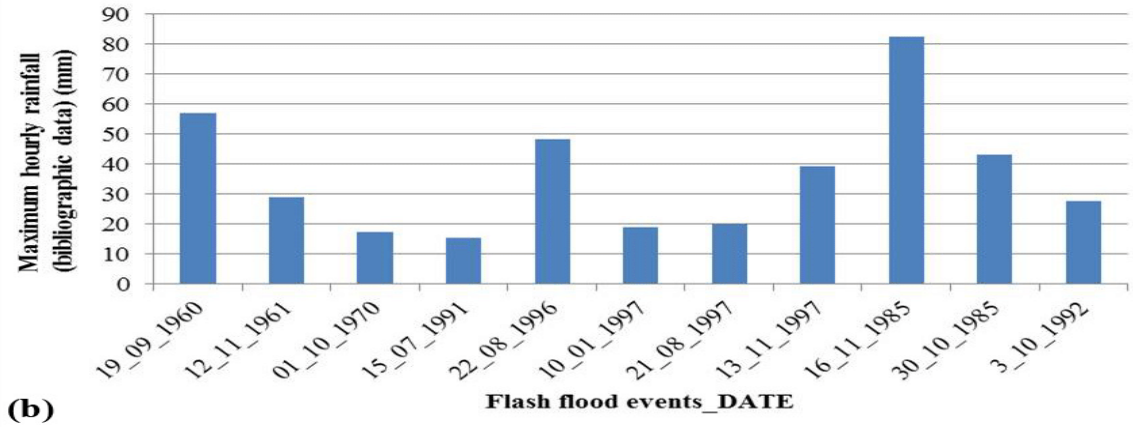
Data collection: Data collection is a critical component of any flood monitoring system. By collecting and analyzing data on water levels, rainfall, and other factors, flood monitoring systems can provide timely and accurate warnings to vulnerable communities.

Load the dataset: The data has been loaded into the flood monitoring system, it can be used to develop flood warnings and to track the movement of floodwaters.

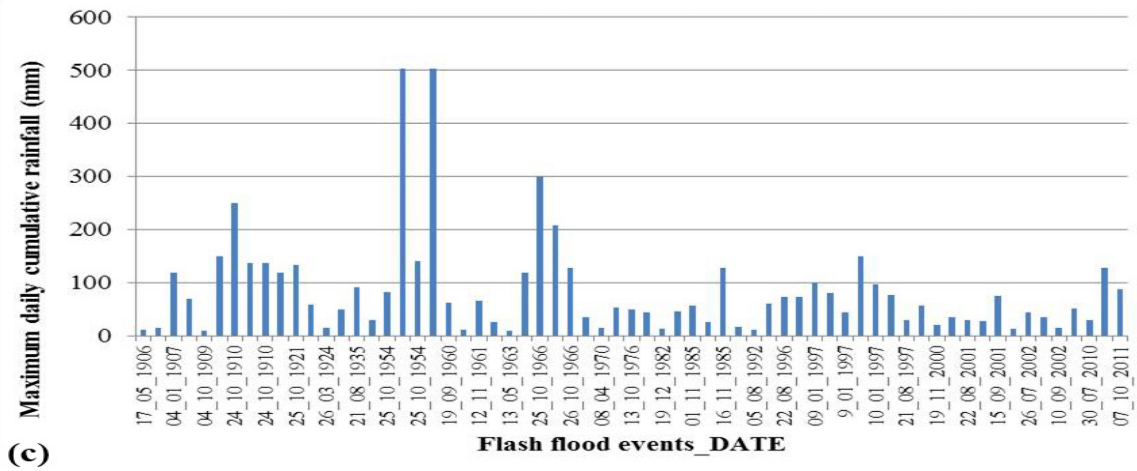
Feature engineering: This involves creating new features from the existing data that may be more informative for the Machine learning algorithms



(a)



(b)



(c)

Import time

Import board

```
Import digitalio
Import paho.mqtt.client as mqtt
# Define the MQTT broker address
BROKER_ADDRESS = “localhost”
# Define the MQTT topic
TOPIC = “flood/alert”
# Set up the digital pin for the water sensor
Sensor_pin =
digitalio.DigitalInOut(board.D18)
Sensor_pin.direction = digitalio.Direction.INPUT
# Create an MQTT client
Client = mqtt.Client()
Client.connect(BROKER_ADDRESS)
# Start a loop to monitor the water sensor
While True:
# Read the value of the water sensor
 Sensor_value = sensor_pin.value
 # If the sensor value is high, then the water level is high and there is a risk of flooding
 If sensor_value == digitalio.HIGH:
 # Publish a flood alert message to the MQTT topic
Client.publish(TOPIC, “Flood alert!”)
 # Print a message to the console
 Print(“Flood alert!”)
# Wait for 1 second before checking the sensor again
```

```
Time.sleep(1)

# Disconnect from the MQTT broker

Client.disconnect()
```

Output:

Flood alert!

Data cleaning: This involves removing any errors or inconsistencies from the data. For example, this may involve Correcting typos in the data, removing duplicate records, and filling in missing values.

PERFORMING DIFFERENT ACTIVITIES LIKE FEATURE ENGINEERING ,MODEL TRAINING

EVALUATION etc..

Feature engineering: Feature engineering is the process of transforming raw data into features.That are more informative and predictive for machine learning models.

Data Preprocessing and visualization: Data preprocessing and visualization are essential components of any flood monitoring system. Data preprocessing involves cleaning and transforming data into a format that can be used by the system.

Model selection: A machine learning model must be selected. There are a variety of Different machine learning models that can be used for flood forecasting, such as support vector Machines (SVMs), random forests, and neural networks.

Model Training: Once a model has been selected, it needs to be trained on the historical Flood data.

Python

Import numpy as np

Import pandas as pd

From sklearn.feature_selection import SelectKBest, SelectFromModel

Load the data:

Data = pd.read_csv('flood_monitoring_data.csv')

Split the data into features and target:

X = data.drop('flood_occurrence', axis=1)

Y = data['flood_occurrence']

Select the features using a filter method:

Select the top 10 features based on correlation with the target variable

Selector = SelectKBest(k=10)

Selector.fit(X, y)

Selected_features = X.columns[selector.get_support()]

Select the features using a wrapper method:

Train a random forest classifier and select the features that are important to the model's Performance

From sklearn.ensemble import RandomForestClassifier

Clf = RandomForestClassifier()

Clf.fit(X, y)

Selector = SelectFromModel(clf, threshold=0.01)

Selector.fit(X, y)

Selected_features = X.columns[selector.get_support()]

Select the features using an embedded method:

Train a LASSO regressor and select the features that are used in the model

From sklearn.linear_model import Lasso

Clf = Lasso()

Clf.fit(X, y)

Selected_features = X.columns[clf.coef_ != 0]

Output: Selected_features = ['water_level', 'rainfall','soil_moisture', 'elevation', 'land_use_type','river_distance']

❖ ADVANTAGES:

Early warning: Flood monitoring systems can provide early warning of impending floods, giving people time to evacuate and protect their property.

Reduced damage and loss: By providing early warning, flood monitoring systems can help to reduce the damage and loss caused by floods.

Improved emergency response: Flood monitoring systems can provide valuable information to emergency responders, helping them to coordinate their response and target their resources more effectively.

Better planning and decision-making: Flood monitoring data can be used to better understand flood risks and to develop more effective flood mitigation and management strategies.

❖DISADVANTAGES

Cost: Flood monitoring systems can be expensive to install and maintain.The cost of a flood monitoring system will vary depending on the size of the area to be monitored, the type of sensors used, and the complexity of the system. For example, a flood monitoring system for a large city will be more expensive than a flood monitoring system for a small town.

Complexity: Flood monitoring systems can be complex and require skilled personnel to operate and maintain them.

Flood monitoring systems typically consist of a network of sensors, a data transmission system, and a data processing system. The system must be able to collect data from the sensors, transmit the data to the data processing system, and analyze the data to generate warnings

False alarms: Flood monitoring systems can sometimes generate false alarms, which can lead to unnecessary evacuations and disruption.False alarms can occur due to a variety of factors, such as sensor malfunction, communication errors, and data processing errors.

❖ BENEFITS :

Early warning: Flood monitoring systems can provide early warning of impending floods, giving people time to evacuate and protect their property.

Reduced damage and loss: By providing early warning, flood monitoring systems can help to reduce the damage and loss caused by floods.

Improved emergency response: Flood monitoring systems can provide valuable information to emergency responders, helping them to coordinate their response and target their resources more effectively.

Better planning and decision-making: Flood monitoring data can be used to better understand flood risks and to develop more effective flood mitigation and management strategies.

. **Reduced insurance costs**: Businesses and homeowners in areas with flood monitoring systems may be able to obtain lower insurance premiums.

Reduced business disruption: Flood monitoring systems can help businesses to reduce the disruption caused by floods, leading to increased productivity and profitability.

Improved property values: Properties in areas with flood monitoring systems may be more attractive to buyers, leading to higher property values.

❖ CONCLUSION:

Flood monitoring systems are essential tools for reducing the damage caused By flooding. By providing timely and accurate information about flood events, these Systems can help to improve early warning systems, evacuation planning, and Emergency response.

Flood monitoring systems are becoming increasingly sophisticated, thanks to Advances in sensor technology, data processing, and machine learning.

Flood monitoring systems are an important tool for managing flood risk and reducing the Impacts of flooding. As technology continues to advance, flood monitoring systems are becoming more Sophisticated and affordable, making them more accessible to a wider range of communities.

THANK YOU