

Flood monitoring and early warning systems are critical for the following objectives:

Public Safety:

To protect lives and property by providing advance notice of potential flooding events.

Risk Reduction:

To minimize the impact of floods by allowing people and communities to prepare and take preventive actions.

Infrastructure Protection:

To safeguard critical infrastructure such as roads, bridges, and utilities from flood damage.

Environmental Conservation:

To protect ecosystems and natural habitats from the destructive effects of floods.

Economic Stability:

To reduce economic losses caused by flooding, including damage to agriculture and businesses.

Disaster Response Planning:

To enable authorities to plan and allocate resources for disaster response in a more efficient manner.

Community Resilience:

To build resilient communities that can better cope with and recover from flood events. Flood monitoring and early warning systems typically involve the use of technology, sensors, data analysis, and communication networks to achieve these objectives.

Introduction:-

The Internet of Things (IoT)

Data analytics and insights based on the Internet of Things (IoT) involve collecting, processing, and analyzing data generated by IoT devices to gain valuable insights and make informed decisions. IoT refers to a network of interconnected devices, sensors, and systems that collect and exchange data over the internet. Here's a breakdown of how data analytics and insights are derived from IoT data.

1. Data Collection:

IoT devices are deployed to collect data from various sources such as sensors, cameras, GPS, and more. These

devices can be found in a wide range of applications, from smart cities and industrial automation to healthcare and agriculture. Data collected may include temperature, humidity, location, motion, and much more.

2. Data Transmission:

☐ Collected data is transmitted securely to a central location or a cloud-based platform using communication protocols such as MQTT, HTTP, or CoAP. The data may be transmitted in real-time or batched, depending on the application and requirements.

3. Data Storage:

☐ IoT data is typically stored in databases or data lakes. The choice of storage solution depends on factors like data volume, velocity, and the need for historical analysis. Popular options include SQL databases, NoSQL databases, and distributed storage systems like Hadoop HDFS.

4. Data Preprocessing:

☐ Raw IoT data often needs preprocessing to clean and structure it for analysis. This may involve data cleaning, normalization, filtering, and data enrichment through techniques like geolocation tagging or time-series alignment.

5. Data Analysis:

❓ Various data analysis techniques can be applied to gain insights from IoT data, depending on the specific use case. Common approaches include descriptive statistics, predictive analytics, anomaly detection, machine learning, and deep learning. The goal is to identify patterns, trends, and anomalies in the data.

6. Visualization:

❓ Visualization tools and techniques are used to represent the analyzed data in a comprehensible and actionable format. Dashboards, charts, graphs, and maps can help stakeholders understand the insights quickly.

7. Real-time Monitoring:

❓ In some IoT applications, real-time monitoring and alerting are crucial. This involves continuously analyzing incoming data streams and triggering alerts or actions when predefined thresholds or patterns are detected.

8. Predictive Maintenance:

❓ IoT data can be used for predictive maintenance in industrial settings. By analyzing sensor data from machinery and equipment, organizations can predict when maintenance is needed, reducing downtime and costs.

9.Optimization:

❓ IoT data can help optimize processes, resource allocation, and energy consumption. For example, smart grids can use IoT data to balance energy supply and demand efficiently.

10.Security and Privacy:

❓ Protecting IoT data is essential. Data encryption, access control, and cybersecurity measures are crucial to prevent unauthorized access and data breaches.

A smart water system refers to a technologically advanced approach to managing and optimizing water resources. Here are some key points about smart water systems.

A smart water system based on the Internet of Things (IoT) is designed to monitor, manage, and optimize water usage in various applications, such as homes, industrial facilities, agriculture, and cities. IoT technology enables the collection of real-time data from sensors and devices, which can then be analyzed to improve water conservation, efficiency, and

sustainability. Here are the key components and features of a smart water system based on IoT.

Flood monitoring and early warning systems

Flood monitoring and early warning systems are crucial components of disaster management and public safety. These systems are designed to detect and predict flooding events, allowing authorities to issue

timely warnings to residents and take necessary actions to mitigate the impacts of flooding. Here are some key aspects of flood monitoring and early warning.

1. *Data Collection*:

Flood monitoring begins with data collection. Various sensors and monitoring devices are deployed in flood-prone areas to measure factors such as rainfall intensity, water levels in rivers and streams, soil moisture, and weather conditions. Remote sensing technologies like satellites are also used to gather data on a larger scale.

2. *Weather Forecasting*:

Weather forecasts are an integral part of flood monitoring. Meteorologists weather patterns and issue warnings for heavy rainfall, storms, or other weather events that could lead to flooding.

3. *Hydrological Modeling*:

Hydrologists use data from monitoring stations to build mathematical models that simulate how rainfall and other factors will affect river and stream flow. These models can predict quickly water levels will rise and where flooding is likely to occur.

4. *Warning Systems*:

When flood risk is detected, warning systems are activated. These systems can include sirens, emergency alerts viacell phones, radio broadcasts, and social media updates. The goal is to alert the public as quickly as possible so they can take protective measures.

5. *Community Preparedness*

Public education and community preparedness programs play a crucial role. Communities in flood-prone areas should be informed about the risks, know what to do in case of a flood, and have access to emergency resources.

Innovation:

Despite massive investments and continuous flood-control efforts in India, the socio-economic damages and death toll continue to remain high. Undoubtedly, the process of flood management in India is very complex due to the influence of several socio-hydroclimatological factors, such as climate change, sea level rise, and socio-economic dynamics. While these factors influence the intensity and frequency of flood events, factors explicitly related to the process of flood management, such as the improper execution of traditional structural measures, the lack of the proper implementation of schemes, lackadaisical execution of traditional structural measures and end-to-end management of the flood management programs/practices, ensure only partial protection. This review article identifies the region-specific flood problems in India and discusses the initiatives undertaken by major Indian flood management agencies, with an emphasis on the current ongoing flood management practices. The effectiveness of these practices in the long term is discussed, and specific gaps are identified By the use of IOT.

Getting Started with the ESP32 With WOWKI Platform

The ESP32 is a series of low-cost and low-power System on a Chip (SoC) microcontrollers developed by Espressif that include Wi-Fi and Bluetooth wireless capabilities and dual-core processor. If you're familiar with the ESP8266, the ESP32 is its successor, loaded with lots of new features.

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Introducing the ESP32:

First, to get started, what is an ESP32? The ESP32 is a series of chip microcontrollers developed by Espressif.

Why are they so popular? Mainly because of the following features:

Low-cost:

you can get an ESP32 starting at \$6, which makes it easily accessible to the general public;

Low-power:

the ESP32 consumes very little power compared with other microcontrollers, and it supports low-power mode states like deep sleep to save power;

Wi-Fi capabilities:

the ESP32 can easily connect to a Wi-Fi network to connect to the internet (station mode), or create its own Wi-Fi wireless network (access point mode) so other devices can connect to it—this is essential for IoT and Home Automation projects—you can have multiple devices communicating with each other using their Wi-Fi capabilities;

Bluetooth:

the ESP32 supports Bluetooth classic and Bluetooth Low Energy (BLE)—which is useful for a wide variety of IoT applications;

Dual-core:

most ESP32 are dual-core— they come with 2 Xtensa 32-bit LX6 microprocessors: core 0 and core Rich peripheral input/output interface—the ESP32 supports a wide variety of input (read data from the outside world) and output (to send commands/signals to the outside world) peripherals like capacitive touch.

Compatible with Micro Python:

you can program the ESP32 with Micro Python firmware, which is a re-implementation of Python 3 targeted for microcontrollers and embedded systems.

****Flood monitoring and early warning**

Flood monitoring and early warning Systems Are crucial components of disaster Management and public safety. These Systems are designed to detect and predict Flooding events, allowing authorities to Timely warnings to residents and take Necessary actions to mitigate the impacts of Flooding.

***Data Collection*:**

Flood monitoring begins with data Collection. Various sensors and Monitoring devices are deployed in Flood-prone areas to measure Such as rainfall intensity, water levels In rivers and streams, soil moisture, weather conditions. Remote Sensing technologies like satellites are Also used to gather data on a larger Scale.

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When flood risk is detected, warning Systems are activated. These systems Can include sirens, emergency alerts via Cell phones, radio broadcasts, and Social media updates. The goal is to Alert the public as quickly as possible So they can take protective measures.

Community Preparedness

Public education and community Preparedness programs play a crucial Role. Communities in flood-prone areasShould be informed about the risks, Know what to do in case of a flood, andHave access to emergency resources.

Flood monitoring and early warning
Systems enhanced by the Internet of

Things (IoT) technology have become increasingly effective in recent years.

Sensors and devices can provide real-time data and remote monitoring capabilities, improving the accuracy and timeliness of flood warnings. Here's how IoT can be integrated into flood monitoring and early warning systems

***Sensor Deployment*:**

IoT-enabled sensors can be strategically deployed in flood-prone areas to collect data. These sensors can include water level sensors, rain gauges, weather stations, and soil moisture sensors. These devices continuously collect data and transmit it wirelessly to a central data repository.

***Data Transmission*:**

IoT devices transmit data over wireless networks (e.g., cellular, Wi-Fi,)

- **Flood monitoring and early warning systems typically include the following features:**

1. **Real-time Data Collection:**

These systems use various sensors to collect real-time data on rainfall, river water levels, and weather conditions. Remote sensing technologies like satellites and radar may also be used.

2. **Data Analysis and Modeling:**

Collected data is analyzed to model potential flood scenarios. This helps in predicting flood events.

3. **Warning Algorithms:**

Advanced algorithms are used to assess the data and issue warnings when conditions indicate a potential flood. These warnings are often tiered to convey the level of risk.

4. **Communication Systems:**

Warnings are communicated to the public through various means, including sirens, text messages, social media, and emergency broadcasts.

5. **GIS and Mapping:**

Information Systems (GIS) are used to map flood-prone areas and provide visual representations of flood forecasts.

6. **Evacuation Plans:**

Early warning systems may integrate with evacuation plans, helping authorities and individuals know when and where to evacuate.

7. **Public Education:**

Informing the public about flood risks, how to interpret warnings, and what actions to take is a critical feature.

8. **Integration with Local Authorities:**

Coordination with local emergency services and government agencies ensures a timely response to flood warnings.

- These features are crucial in helping communities prepare for and

respond to flooding, reducing the potential for loss of life and property

damage.

- Certainly, I can provide you with a simplified pseudocode example for a

basic flood monitoring and early warning system. This pseudocode

doesn't cover all the complexities of a real-world system but should give

you an idea of the logic involved:

- ```plaintext
- Initialize flood_monitoring_system:
- Define critical_river_level
- Define rainfall_threshold
- Define warning_level

while True:

- # Collect real-time data
- current_river_level = get_current_river_level()
- current_rainfall = get_current_rainfall()
-
- # Check for potential flood conditions
- if current_river_level > critical_river_level:
- # The river is above the critical level, a flood might occur
- if current_rainfall > rainfall_threshold:
- # High rainfall, increase the warning level
- else:
- warning_level = "Moderate"
- else:
- # The river is below the critical level
- if current_rainfall > rainfall_threshold:

- warning_level = "Low"
- else:
- warning_level = "No Warning"
-
- # Issue warnings and take actions
- if warning_level == "High":
- send_warning("Flood Warning: Severe flooding possible. Evacuate immediately!")
- initiate_evacuation()
- elif warning_level == "Moderate":
- send_warning("Flood Warning: Flooding possible. Be prepared to evacuate.")
- elif warning_level == "Low":
- send_warning("Flood Warning: Low risk of flooding. Stay vigilant.")
- else:
- clear_warnings()
- # Wait for a specified interval before checking data again

Please note that this pseudocode is highly simplified for illustration

purposes. In a real-world implementation, you would need to consider a

more sophisticated algorithm that takes into account historical data,

predictive modeling, multiple data sources, and collaboration with local

authorities. Additionally, actual code implementation would depend on

the specific programming language and technologies you're using.

- Certainly, evaluating the performance of a flood monitoring and early

warning system is crucial to ensure its accuracy and effectiveness. Here

are some key aspects to consider when evaluating such a system:

1. ****Accuracy and Reliability:****

- - Measure the system's ability to correctly predict and warn about

floods. Calculate metrics like accuracy, precision, recall, and F1-score to

assess its reliability.

2. ****False Alarms:****

- - Evaluate the rate of false alarms, which can lead to unnecessary evacuations or panic.

3. ****Lead Time:****

- - Measure the lead time between the issuance of a warning and the occurrence of a flood. A longer lead time allows for better preparation and response.

4. ****Response Time:****

- - Assess the response time of authorities and the public to issued warnings. A quick response can save lives and reduce damage

5. ****Data Accuracy:****

- - Check the accuracy and reliability of the data sources. Inaccurate data can lead to incorrect predictions.

6. ****Model Performance:****

- Continually monitor the performance of the prediction model and adjust it as necessary.

7. **Feedback Mechanism:**

- Evaluate the feedback from the community and relevant agencies to improve the system's performance.

8. **Communication Channels:**

- Review the effectiveness of the communication channels used to relay warnings to the public and authorities.

9. **GIS Mapping:**

- - Verify the accuracy of GIS mapping and its ability to provide clear information on flood-prone areas.

10. **Response Effectiveness:**

- - Assess the effectiveness of evacuation plans and other responses initiated based on warnings.

11. **Historical Analysis:**

- - Analyze historical flood events to see if the system accurately predicted past occurrences.

12. **Weather Forecast Integration:**

- - Evaluate the integration of weather forecasts into the system and its impact on prediction accuracy.

13. ****Continuous Improvement:****

- - Ensure that the system is updated and improved regularly based on

the evaluation results and changing conditions.

14. ****Cost-Benefit Analysis:****

- - Consider the costs associated with the system and weigh them against the benefits in terms of lives saved and property damage prevented.
- It's important to note that the evaluation of a flood monitoring and early warning system is an ongoing process. The system should be continuously refined and adapted to improve its accuracy and effectiveness, especially in the face of changing environmental

mart Home Automation

Use Case Title: Energy-efficient Smart Home Automation

Scenario:

John and Jane are a couple who want to make their home more energy-efficient and convenient. They have a busy lifestyle and often forget to turn off lights, adjust the thermostat, or lock

doors when leaving home. They decide to implement a smart home automation system to address these issues.

Smart Home Automation Components:

Smart Thermostat:

They install a smart thermostat that can be controlled remotely through a mobile app. The thermostat learns their preferences and adjusts the temperature based on their schedule, optimizing energy consumption.

Smart Lighting:

They replace traditional bulbs with smart bulbs that can be controlled individually or as a group. Motion sensors in different rooms automatically turn off lights when no one is present and turn them on when someone enters.

Smart Lock:

They install a smart door lock with keyless entry. The lock can be controlled remotely and sends notifications when the door is locked or unlocked. It can also be set to lock automatically when they leave the house.

Security Cameras:

Smart security cameras are placed around the house. These cameras can be accessed through their smartphones, allowing them to check on their home's security while they're away.

Voice Assistant Integration:

They connect their smart home system to a voice assistant like Amazon Alexa or Google Assistant for voice control of various devices. For instance, they can say, "Alexa, turn off all lights," or "Google, set the thermostat to 70 degrees."

When John and Jane leave for work in the morning, the smart lock automatically locks the door behind them. The smart thermostat adjusts the temperature to an energy-saving setting.

During the day, motion sensors and occupancy detectors in each room control the smart lighting, turning lights off when no one is in the room.

If they forget to lock the door or turn off lights, they can use their smartphones to control these devices remotely.

When they return home, the smart thermostat has already adjusted the temperature to their comfort level.

In case of any unusual activity, their security cameras send alerts to their phones for immediate action.

Benefits:

Energy savings through automated temperature control and lighting.

Enhanced security with remote door locking and surveillance.

Convenience with voice control and remote access to devices.

Reduced environmental impact through efficient energy use.

This smart home automation use case not only makes their lives more convenient but also contributes to a more energy-efficient and secure living environment.

Computer vision is a field of artificial intelligence that focuses on enabling computers to interpret and understand visual information from the world, much like the human visual system.

Python is a popular programming language for developing computer vision applications, thanks to its rich ecosystem of libraries and tools. Here's a brief introduction to computer vision in Python:

Install Required Libraries: Start by installing key Python libraries for computer vision, including OpenCV (Open Source Computer Vision Library) and NumPy. You can use pip for installation:

```
python
```

Copy code

```
pip install opencv-python numpy
```

Image and Video Processing: You can use OpenCV to load, display, and manipulate images and video streams. For example, you can read an image from a file:

```
python
```

Copy code

```
import cv2
```

```
image = cv2.imread('image.jpg')
```

```
cv2.imshow('Image', image)
```

```
cv2.waitKey(0)
```

```
cv2.destroyAllWindows()
```

Basic Operations: You can perform operations like image resizing, cropping, and applying filters using OpenCV functions.

Object Detection:

OpenCV includes pre-trained models for object detection, like Haar cascades or deep learning-based models. These can be used to detect faces, objects, and more.

Image Processing:

You can apply various image processing techniques, such as filtering, thresholding, edge detection, and contour analysis to extract meaningful information from images.

Machine Learning Integration:

You can combine computer vision with machine learning for tasks like image classification, object recognition, and image segmentation.

Real-time Video Processing:

OpenCV allows you to process video streams from cameras, making it suitable for applications like video surveillance or gesture recognition.

Deep Learning:

Python libraries like TensorFlow and PyTorch are often used for deep learning-based computer vision tasks, including

image classification, object detection, and semantic segmentation.

Community and Resources:

Python has a large and active computer vision community, so you can find extensive documentation, tutorials, and code examples online.

To get started with computer vision in Python, consider following tutorials and documentation for OpenCV and exploring various computer vision projects to apply these concepts in practical applications.

Coding

Certainly! Here's a simple pseudocode outline for flood monitoring and early warning system:

```
```plaintext
Initialize variables
water_level_threshold = 5.0 # Set a
threshold for water level
sensor_data = [] # Store sensor data
warning_triggered = False # Flag to track
if a warning has been triggered
```

```
Continuously monitor water level
while True:
 # Read sensor data
 current_water_level =
read_water_level_sensor()

sensor_data.append(current_water_level)

 # Check if water level exceeds the
threshold
 if current_water_level >
water_level_threshold:
 if not warning_triggered:
 # Trigger a warning
 send_flood_warning()
 warning_triggered = True
 else:
 # Reset the warning flag if water
level is below the threshold
 warning_triggered = False

 # Remove old sensor data to manage
memory
 if len(sensor_data) > 1000:
 sensor_data.pop(0)
```

```
Wait for a specified time interval
before the next reading
 sleep(300) # e.g., 5 minutes
...
```

Please note that this pseudocode is a simplified representation and may require actual hardware integration, data processing, and more robust algorithms for a real-world flood monitoring and early warning system. The

"read\_water\_level\_sensor,"  
"send\_flood\_warning," and "sleep"  
functions need to be implemented in your specific environment or programming language of choice. Additionally, you might want to incorporate more advanced features like data analysis, historical data storage, and communication with a central monitoring system for a comprehensive solution.

***IoT (Internet of Things) sensors and mobile apps are often used together to create smart and connected solutions. IoT sensors are devices that can collect data from the physical world, such as temperature, humidity, motion, or even environmental conditions. These sensors are connected to the internet, allowing them to transmit data to a central system.***

Mobile apps are used to interact with and control IoT devices, as well as to display the data collected by the sensors. Here are some key points about IoT sensors and mobile apps:

### 1. **\*\*Types of IoT Sensors\*\*:**

There are various types of IoT sensors, including environmental sensors, proximity sensors, motion sensors, and more. These sensors can be integrated into different devices and systems.

### 2. **\*\*Data Collection\*\*:**

IoT sensors collect data in real-time or at specified intervals. This data is sent to a cloud server or a central database for storage and analysis.

### 3. **\*\*Mobile App Control\*\*:**

Mobile apps provide a user interface for individuals to control IoT devices remotely. For example, you can use a mobile app to adjust the temperature in your smart thermostat or turn on lights in a smart home.

#### **4. *\*\*Data Visualization\*\**:**

*Mobile apps can display the data collected by IoT sensors in a user-friendly manner. This allows users to monitor and analyze information conveniently.*

#### **5. *\*\*Mobile app\*\**:**

*Mobile apps can be programmed to send alerts or notifications based on sensor data. For instance, you can receive an alert if the temperature in your home drops below a certain level.*

#### **6. *\*\*Integration\*\**:**

*IoT sensors and mobile apps can be integrated with other technologies, such as voice assistants like Alexa or Google Assistant, to provide voice control and automation.*

#### **7. *\*\*Security\*\**:**

*Security is a critical concern when using IoT sensors and mobile apps. Ensuring data privacy and device security*

is essential to protect against potential threats.

#### **8. *\*\*Customization\*\**:**

Mobile apps often allow users to customize settings and preferences for their IoT devices, giving them greater control and personalization.

#### **9. *\*\*Energy Efficiency\*\**:**

IoT sensors are designed to be energy-efficient, and mobile apps can help users manage and optimize the power consumption of connected devices.

#### **10. *\*\*Scalability\*\**:**

IoT solutions can scale from small, home-based applications to large-scale industrial and smart city deployments.

Overall, the combination of IoT sensors and mobile apps offers a wide range of possibilities for creating smart and connected environments, improving efficiency, and enhancing user experiences.



Real-time smart water management is an approach that leverages advanced technologies to monitor, control, and optimize water distribution and usage in real-time. It aims to improve the efficiency, sustainability, and reliability of water supply systems. Here's an explanation of how it works and its benefits:

### 1. **\*\*Sensor Technology\*\***:

Smart water management systems incorporate a network of sensors placed throughout the water distribution infrastructure. These sensors can monitor various parameters such as water flow, pressure, quality, and temperature.

### 2. **\*\*Data Collection and Analysis\*\***:

The data collected from these sensors is transmitted in real-time to a central control system. Advanced analytics and algorithms process this data to detect leaks, assess water quality, and predict demand patterns.

### 3. **\*\*Remote Control\*\***:

Operators can remotely control valves, pumps, and other components of the water supply system based on real-time data and insights. For example, if a leak is detected, the system can isolate that section to minimize water loss.

#### **4. \*\*Consumer Engagement\*\*:**

Smart water management often includes tools for consumers to monitor their water usage. Homeowners can receive insights into their consumption patterns and take steps to reduce water wastage.

#### **5. \*\*Improved Leak Detection\*\*:**

Real-time monitoring can quickly identify leaks or abnormal usage patterns. This leads to early intervention, reducing water loss and minimizing damage to infrastructure.

#### **6. \*\*Demand Forecasting\*\*:**

By analyzing historical and real-time data, water utilities can better predict demand, which helps in optimizing water production and distribution, reducing energy consumption and costs.

## **7. *\*\*Water Quality Management\*\**:**

Continuous monitoring of water quality ensures that consumers receive safe and clean water. Any deviations from acceptable quality standards trigger alarms and immediate corrective actions.

## **8. *\*\*Energy Efficiency\*\**:**

Optimizing the operation of pumps and valves based on real-time data can significantly reduce energy consumption, making water distribution more sustainable.

## **9. *\*\*Reduction in Non-Revenue Water\*\**:**

Non-revenue water refers to water that is lost before it reaches the consumer, often due to leaks or theft. Real-time management helps reduce non-revenue water, saving resources and revenue.

## **10. *\*\*Environmental Benefits\*\**:**

By conserving water resources, reducing energy consumption, and preventing pollution, real-time smart water management contributes to environmental sustainability.

### **11. *\*\*Cost Savings\*\**:**

Water utilities can save money by reducing maintenance costs, minimizing energy expenditure, and extending the lifespan of infrastructure through proactive maintenance.

### **12. *\*\*Resilience\*\**:**

These systems enhance the resilience of water supply systems by allowing quick responses to unexpected events such as natural disasters, ensuring a stable water supply for communities.

In summary, real-time smart water management systems combine data-driven monitoring, automation, and consumer engagement to optimize water distribution, conserve resources, and enhance the overall efficiency and reliability of water supply systems. This approach is

*crucial in addressing water scarcity and ensuring sustainable water management in the face of growing urbanization and environmental challenges.*