SMART FLOOD DETECTION

Group no. 21

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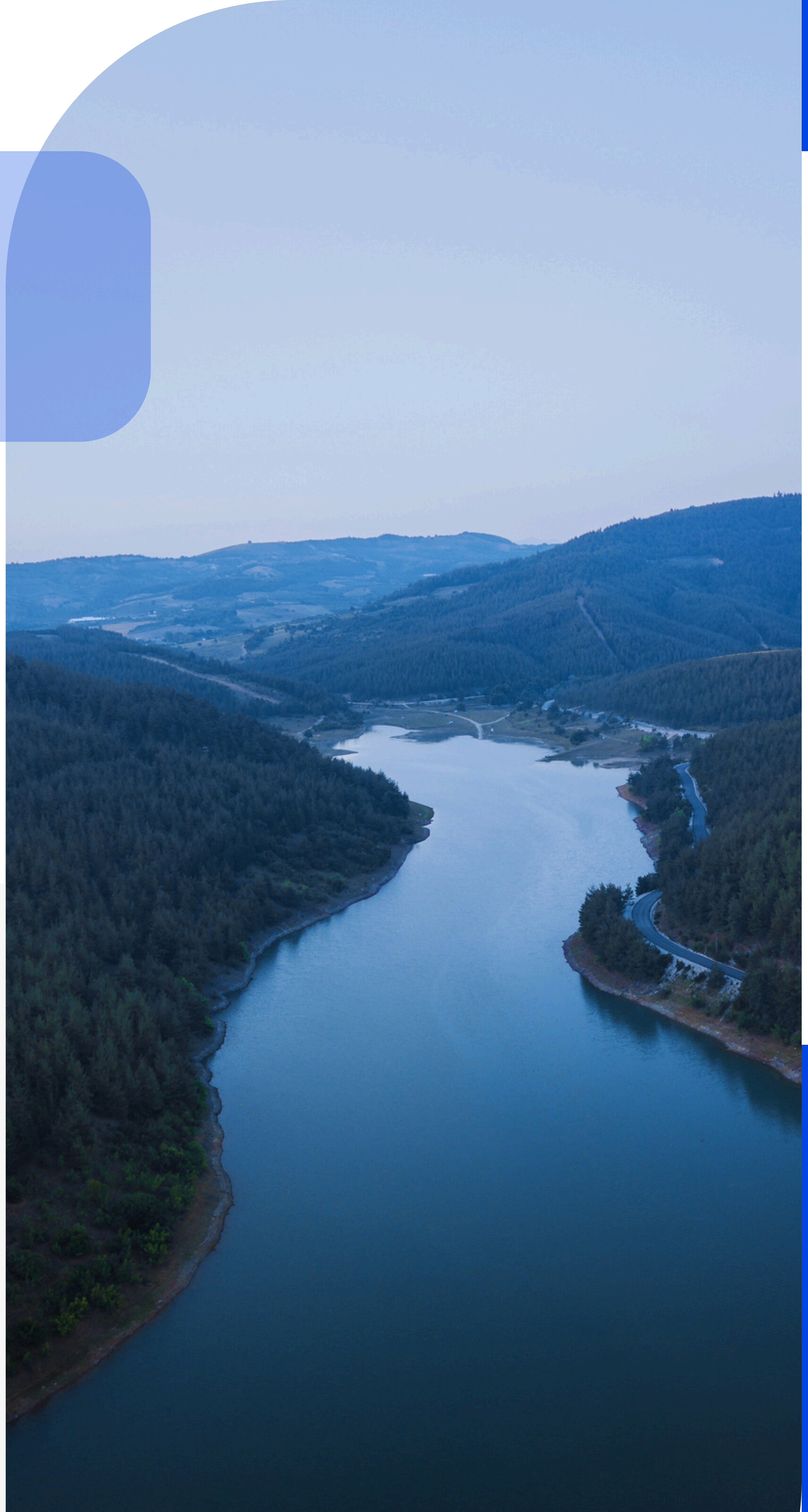
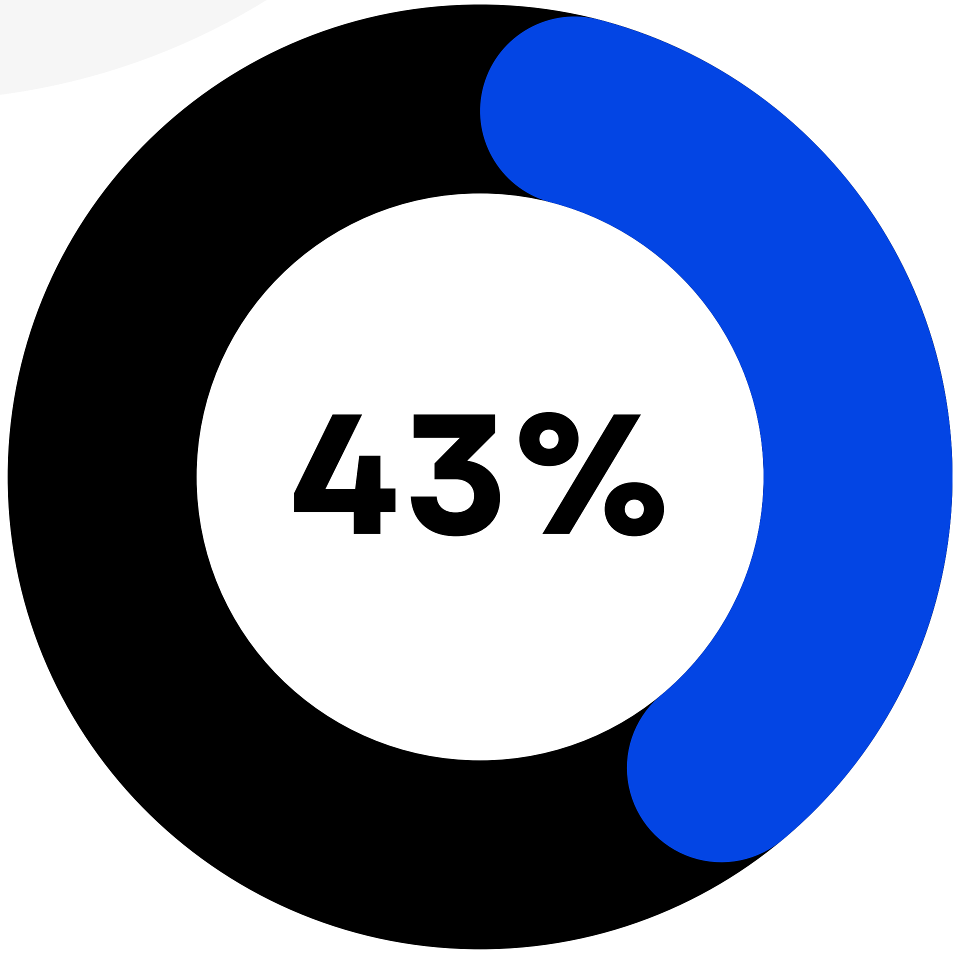


EMPATHISE

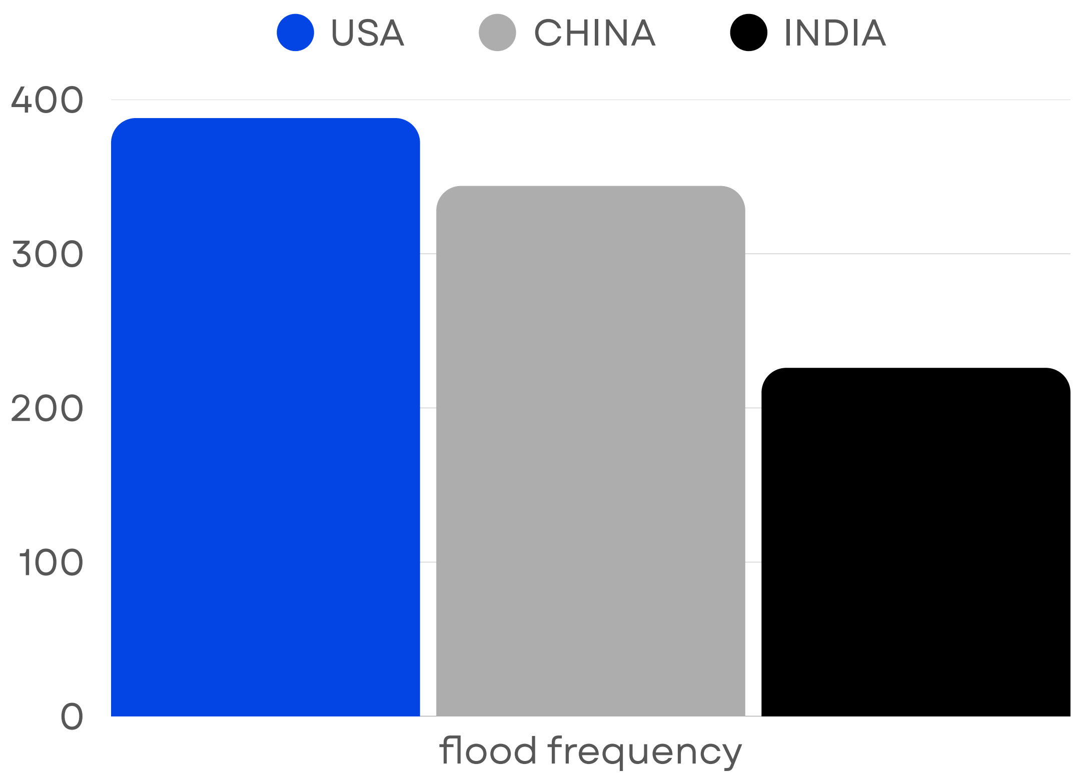
METHODOLOGY

- Analyzed news interviews.
- Distilled shared pain points.
- Collected government flood data.
- Identified alert-system gaps.

Floods are 43% of the natural disasters



India ranks **3rd** in terms of floods frequency



Annual damage in India:
₹13,000+ crore from riverine floods
₹5,000+ crore from urban floods

EMPATHISE

01 Lack of Timely Warnings
People were caught off guard; early alerts could've prevented losses.

02 Severe Property Damage
Homes, vehicles, and shops suffered costly damage.

03 Disrupted Daily Life
Work, school, and travel were brought to a standstill.

04 Power and Water Outages
Services were cut off for days, forcing relocations.

05 Emergency Services Inaccessible
Flooded roads delayed rescue and medical help.

06 Inadequate Drainage Infrastructure
Most complaints pointed to poor or clogged drains and encroachments on stormwater paths.

DEFINE

01 CONTEXT

While flood prediction systems exist, they do not effectively reach or alert citizens in time, especially in a clear, local, and actionable manner.

02 CORE PROBLEM

- Lack of localized monitoring of water bodies, drains, and vulnerable areas—so early signs of flooding go unnoticed.
- Weak last-mile communication, meaning even when flood risk is known, timely, area-specific alerts often fail to reach the people who need them.

OUR GOAL

To create a smart system that monitors local water levels in real time and delivers timely flood alerts directly to affected communities, helping them act before damage happens.

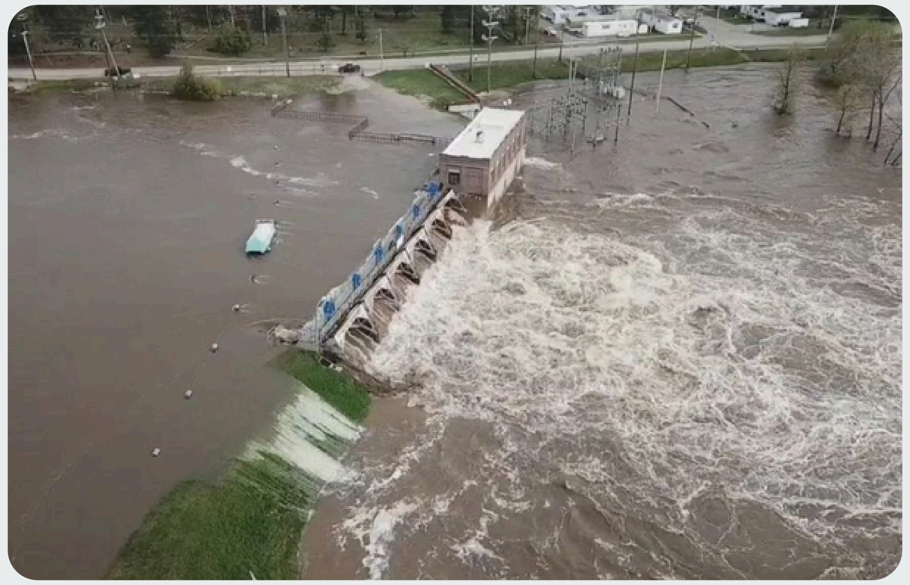
IDEATE

We have broadly categorized the floods into three types and the major causes for each of these:

Urban Floods

- Poor drainage systems
- Concretization of catchment area
- Encroachment

Riverine Floods



- High Rainfall
- Overflowing Dams
- Silting of waterbeds
- Encroachment

Flash Floods

- Cloudbursts
- Cyclones
- Sudden weather change

BRAINSTORMING

Sensing

- **Urban areas** : Using **pressure sensors** on roads to alert water clogging on roads.
- **Rivers and drains** : Weather factors combined with increasing water levels detected by **ultrasonic sensors** indicate alert for flood.

Power & Communication

- Powered by **solar panels** for sustainability.
- **Good connectivity**: Use of **SMS API** to send SMS flood alerts.
- **Poor connectivity:** Trigger local **physical alarms** (sirens, LED flashes).

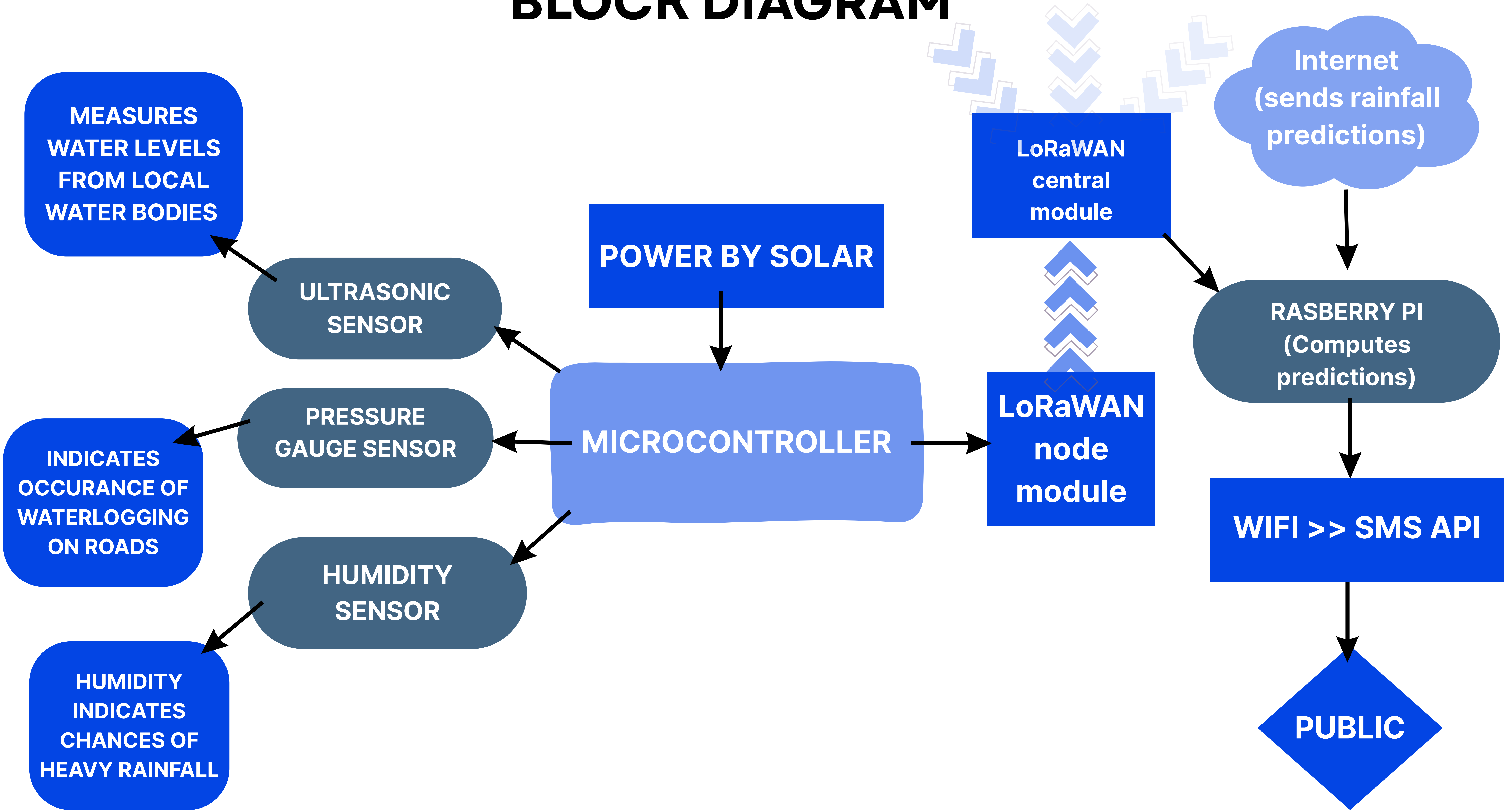
Cost Optimization

- Microcontroller used for the device must have **low power** requirements and **be cost effective**.
- Computing is **not to be done locally** to avoid cost for high processing microcontrollers.

Challenges

- In case of **silting**, data is collected regarding silting but actions are not taken to consider this factor to predict floods.
- **Drain health** can be monitored periodically alongside water levels.

BLOCK DIAGRAM



FINAL CONCEPT

System Architecture and Data Flow of Our Flood Detection Device:

DETECTION → TRANSMISSION → DATA RECEPTION → ML COMPUTATION → ALERTING

LORA MODULES

SX-1278

Sensor nodes (Arduino + LoRa) transmit data to the gateway

MACHINE LEARNING

RANDOM FOREST CLASSIFIER

Develop and execute campaigns to foster customer engagement.

SENSORS+ARDUINO

SHTC3, JSN-SR04T, MS 5805

- Measure water level, temperatue and humidity.
- Arduino reads the sensors and formats data and is programmed to enable sleep mode

MICROPROCESSOR

RASPBERRY PI 4

- Raspberry Pi acts as the central LoRa gateway
- Parses, validates, and stores incoming sensor data

CHOICE OF ELECTRONIC COMPONENTS

Humidity/ Temperature sensor : SHTC3

- Very low power consumption
- Hydrophobic venting used instead of inbuilt waterproofing
- Cost optimal solution
- Uses I2C protocol so easy to integrate

Ultrasonic sensor : JSN SR04T

- Range upto 6m
- Waterproof
- Chosen over cheaper sensors that were’nt made to withstand harsh weather.
- Low power consumption

Pressure Sensor : MS 5805

- Manufactured to have optimal performance in submerged conditions
- Measurement range 10cm - 20m
- Cost effective and low power consumption

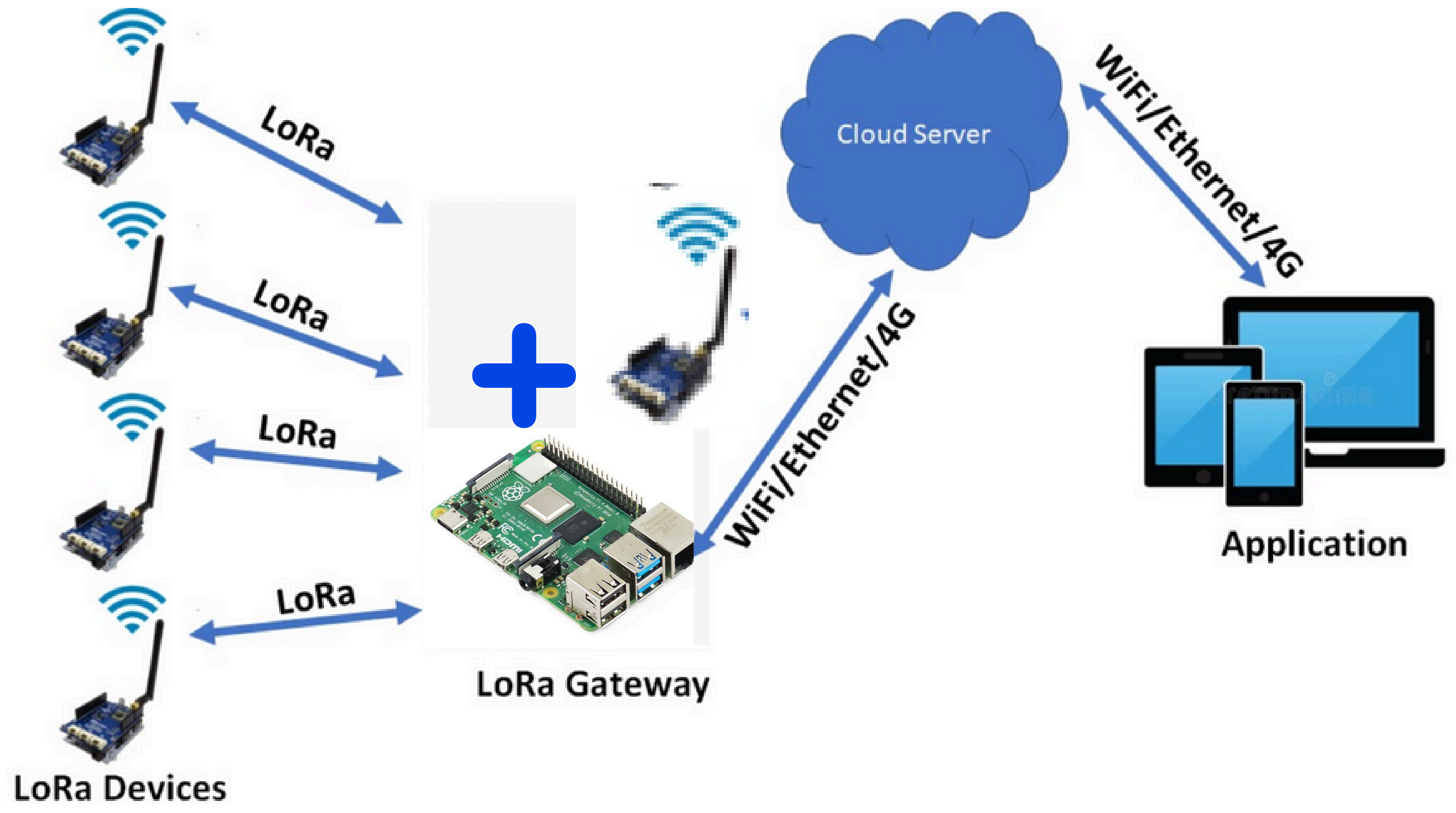
Microcontroller : Arduino UNO

- Cost effective choice
- Open source softaware available
- Compatible with I2C and UART protocol used in sensors and LoRa module

TRANSMISSION NETWORK (LoRa IOT Technology)

Why LoRa - Long Range

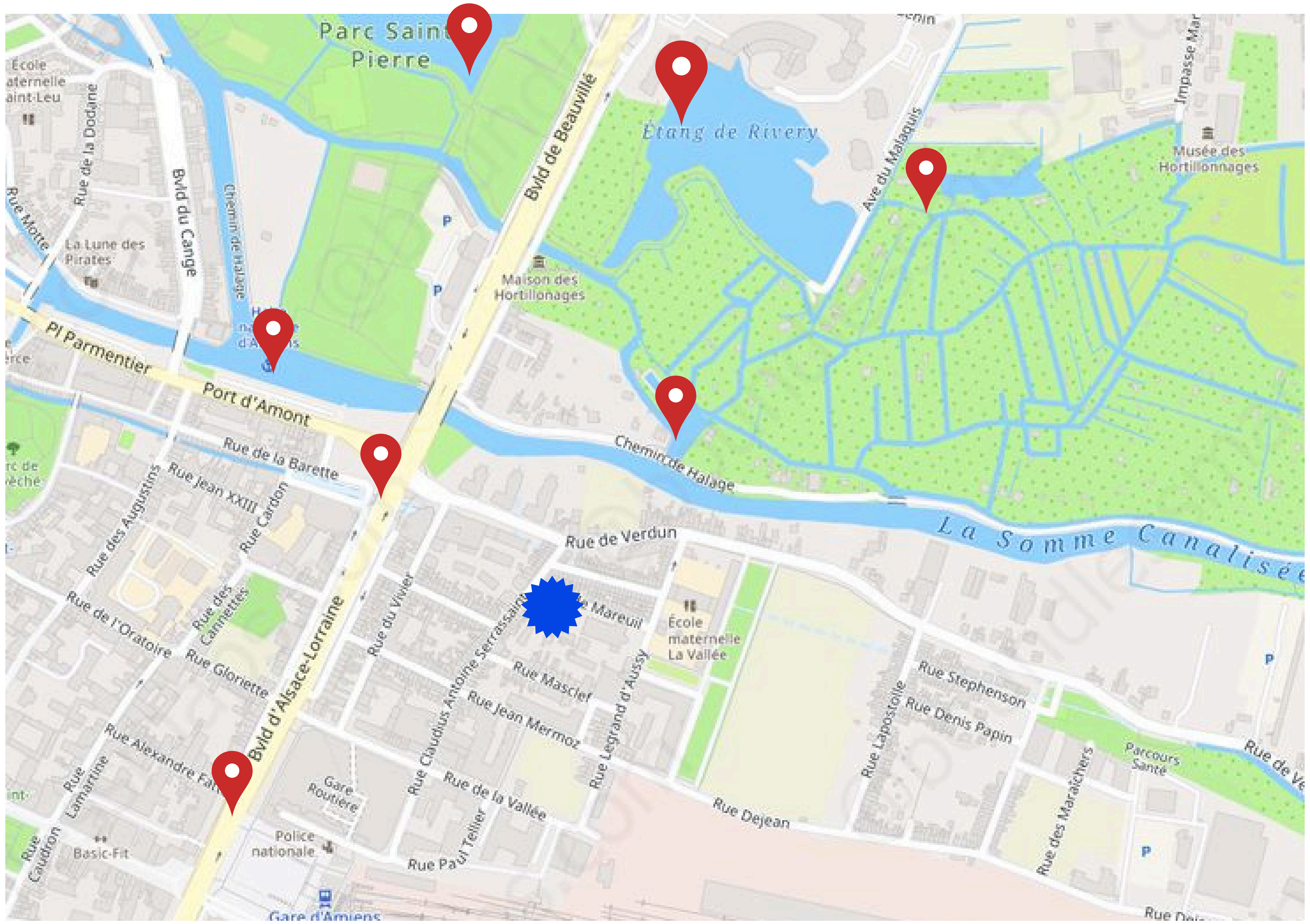
- Long range even in non-line-of-sight.
- Very low energy use → battery-powered nodes for years.
- Inexpensive hardware → affordable large-scale deployment.
- Doesn’t rely on telecom operators.
- Can penetrate buildings and underground drains.



REAL LIFE WORKING

LoRaWAN nodes

LoRaWAN central node (acting gateway)



- Nodes are placed at water bodies, SWDs, and flood-prone spots across the locality.
- They transmit data to a gateway, which forwards it to a microcontroller for analysis.
- The microcontroller processes real-time sensor data, rainfall forecasts, and past flood records to compute flood probability.
- This probability, along with sensor data, is shared with the public via SMS.
- Authorities also receive this info to act quickly. SWD water level trends can help identify and prevent encroachments.

DATA COMPUTATION

01 **Receives data from multiple nodes via LoRa**

02 **Fetch Cloud Data**

03 **Fuse Local + Cloud Data**

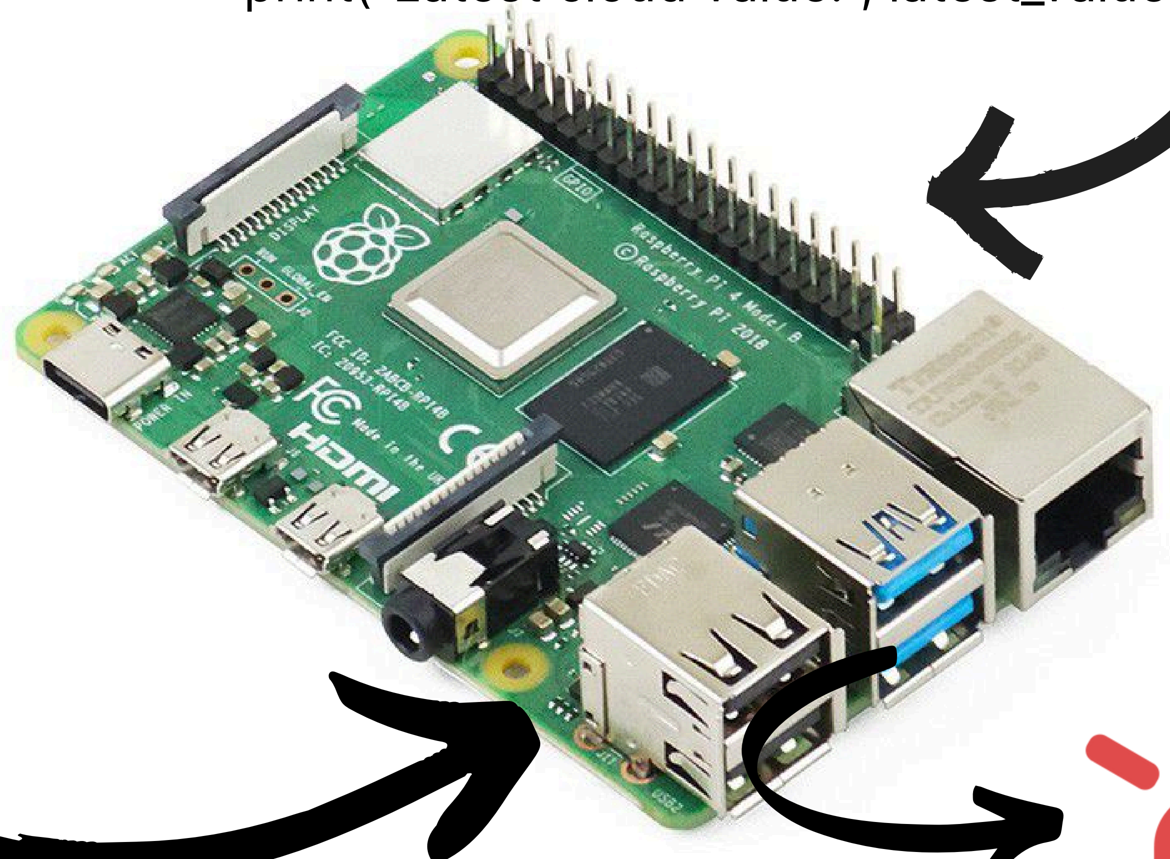
04 **Does the computation using the ML model.**

05 **Send Messages or Trigger alarm**

“The biggest problem in predicting floods is not the inability to make perfect predictions, but in convincing people to take them seriously”

CLOUD

```
import requests

response = requests.get("https://api.thingspeak.com
data = response.json()
latest_value = data['feeds'][0]['field1']

print("Latest cloud value:", latest_value)
```

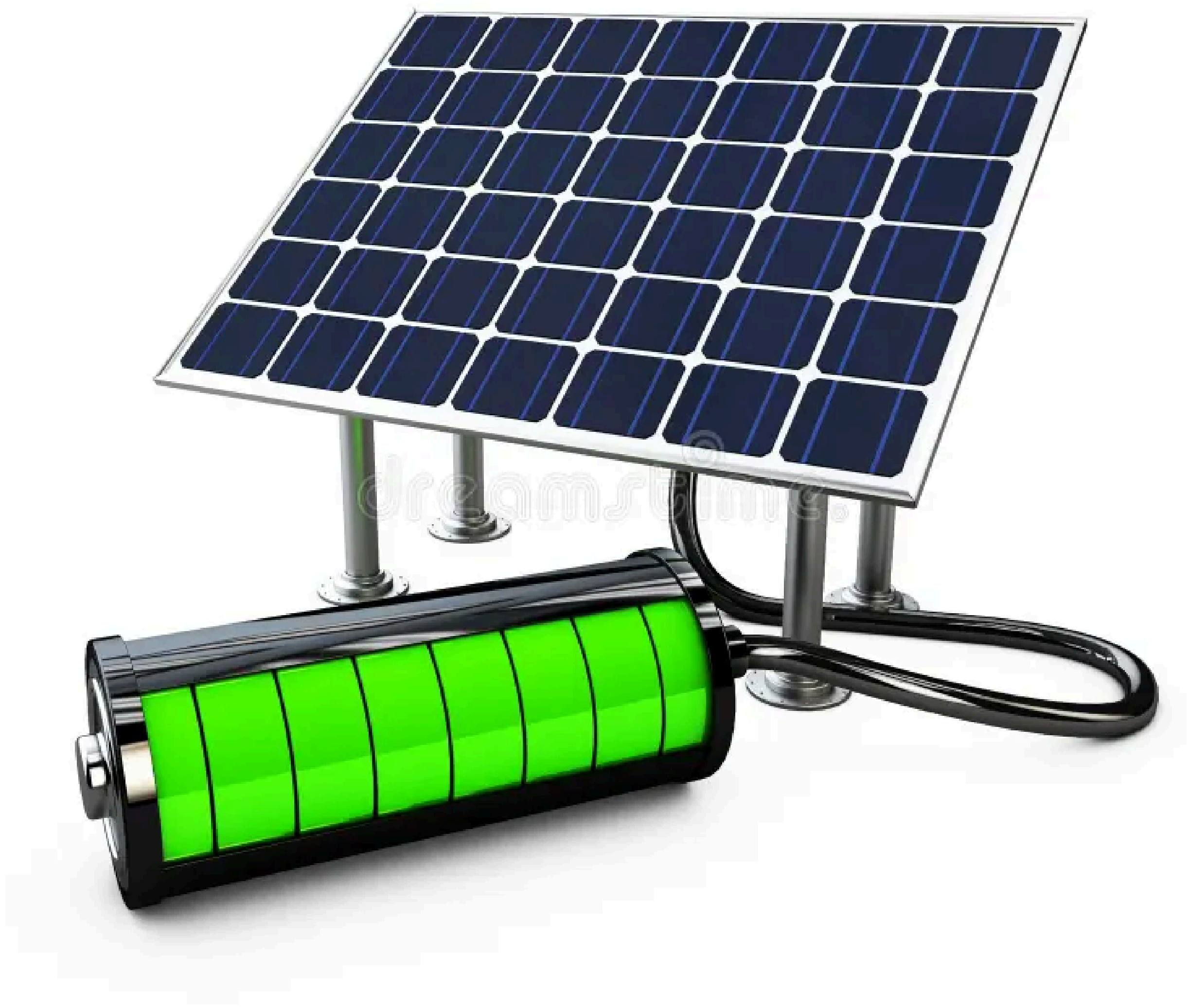


```
from SX127x.LoRa import *
from SX127x.board_config import BOARD

BOARD.setup()

class MyLoRa(LoRa):
    def on_rx_done(self):
        self.clear_irq_flags(RxDone=1)
        payload = self.read_payload(nocheck=True)
        print("Received:", bytes(payload).decode())
```

POWER ESTIMATION

🔋Power Consumption:
Sensors: 10 mA (2 hrs/day → 20 mAh)
Arduino:
- Active (2 hrs): 40 mA → 80 mAh
- Idle (22 hrs): 25 mA → 550 mAh

Total Daily Consumption: 650 mAh



🔆 Solar Charging (5V, 5W, 70% efficiency):
- Output: 700 mA
- 3hrs of direct sunlight to recharge to full capacity.

🔋Battery Life (2000 mAh):
- Lasts approx. 3 days per full charge

COST ESTIMATION

Component	Name	Cost Estimate
microcontroller (Ardiuno UNO)	Arduino UNO	240
Ultrasonic Sensor	JSN-SR04T	790
Temperature and Humidity Sensor	SHT-C3	280
Pressure Gauge Sensor	MS 5805	940
LoRa Module	AS32	1000
Solar Power + Batteries		800
Total		4050

Component	Name	Cost estimate
Rasberry Pi	Rasberry Pi 4	4600
LoRa Module	AS32	1000
Total		5600

FUTURE DEVELOPMENTS

- **Using a commercial LoRa gateway.**
- **Use an enhanced ML model to compute predictions.**
- **Including silting information to push flood prevention along with detection**
- **Use of more robust/industrial sensors that withstand harsh conditions.**
- **Create a web dashboard to view live sensor status.**
- **Making Bidirectional LoRaWAN.**
- **Community feedback to retrain the model for accuracy.**

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THANK YOU