Scope of the Solution

The scope of this IoT Flood Monitoring System includes the design and deployment of a low-cost, real-time water level monitoring and alerting platform using Raspberry Pi Pico. The solution focuses on accurate measurement, rapid alerts, and easy integration with cloud services. The following functionalities are included:

1. Real-Time Water Level Measurement

- Use an **ultrasonic sensor (HC-SR04)** to continuously measure the distance between the sensor and the water surface.
- Convert the measured distance into water level percentage or height.
- Ensure stable and noise-free readings using averaging/ filtering.

2. Local Safety Indications

- Implement **three safety states** based on water level:
  - **Safe Level** → Green LED ON
  - **Warning Level** → Rapid Buzzer alarm
  - **Critical Level** → Red LED continuously ON + buzzer alarm
- Provide immediate alerts through visual and audio signals for quick local response.

3. On-Device Display

- Use an **OLED display (SSD1306)** to show:
  - Current water level (cm / %)
  - Sensor status
  - System state (Safe / Warning / Critical)
  - Connectivity status (ThingSpeak / MQTT)

4. Cloud-Based Monitoring

- Send real-time water level data to **ThingSpeak** for:

- Data logging
- Trend analysis
- Graphical visualization
- Remote monitoring

5. IoT Alerts Through MQTT

- Implement MQTT communication to publish:
  - Water level updates
  - Warning and critical alerts
- Receive MQTT messages on a **mobile app (MyMQTT)** for instant notifications.

6. Timely Alerts for Flood-Prone Areas

- System provides multi-level early warning based on sensor-defined thresholds.
- Ensures timely response to rising water levels before reaching a dangerous point.

7. Low-Cost and Easy Deployment

- All components are inexpensive and widely available.
- System can be powered using USB/power bank, making it suitable for rural flood-prone zones.
- Simple circuit layout and lightweight firmware allow quick installation and maintenance.

8. Scalability and Extendibility

- Supports future enhancements like:
  - More precise sensors
  - Additional alerts (SMS, WhatsApp, email)
  - Battery-based operation
  - Multiple sensor nodes using MQTT