Flood Monitoring and Early Warning System

Flood Early Warning System (FLEWS) is a system by which flood induced hazards can be minimized and prevented. Currently different organizations are working on flood forecasting and early warning at national, continental and global scale.

ABSTRACTS:

A flood warning system typically integrates information on telemetric precipitation and water level/flow, calculated at different places in the local area. Based on these observations, it is difficult to provide information about river conditions, flood types, etc.Floods and excessive rainfall are unavoidable phenomena that can cause massive loss of people's lives and destruction of infrastructure. Flash floods rise rapidly in flood-prone areas, resulting in property damage, but the impact on human lives is relatively preventable by the presence of monitoring systems.

Although there are many systems widely in practice by disaster management agencies in monitoring flood levels, most of these systems are limited range and sophisticated to be used and maintained.

Furthermore, in most developing countries, the conventional flood gates in water canals are manually operated and suffer from the lack of real-time monitoring of water levels, leading to an overflow in the channels and flash floods.

On top of that, the lacking accurate data analysis in the system that can be accessed is one of the limitations of the conventional flood monitoring and warning systems (FMWS).

Therefore, in this paper, we have explored and reviewed the existing methods of flood monitoring and emphasizing their structure and sensing techniques. We have also classified and compared their advantages and limitations and accordingly suggested new solutions and improvements by utilizing new technologies based on the Internet of Things.

This paper introduces a detailed mini-review of sensing methods in the existing flood systems as reported in previous studies to serve as a quick guide to researchers who are engaging in this field. Based on the review, conclusions have been drawn.

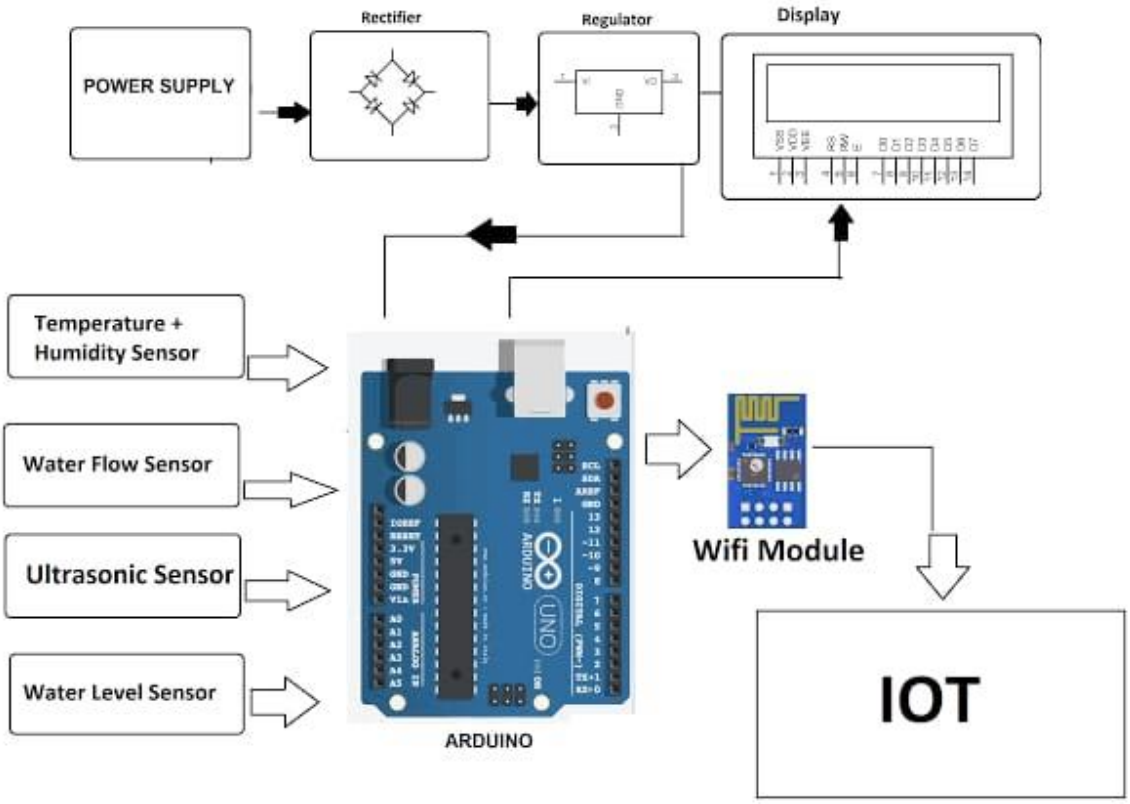
Problem Statement:

A flood warning system is a way of detecting and forecasting flood events so that the public can be alerted in advance and can undertake appropriate responses to minimize the impact. A basic flood warning system consists of sensor circuits, communication system, controller and power system.

Loss of lives and property: Immediate impacts of flooding include loss of human life, damage to property, destruction of crops, loss of livestock, non-functioning of infrastructure facilities and deterioration of health condition owing to waterborne diseases.

India is highly vulnerable to floods. Out of the total geographical area of 329 million hectares (mha), more than 40 mha is flood prone. Floods are a recurrent phenomenon, which cause huge loss of lives and damage to livelihood systems, property, infrastructure and public utilities.

Block diagram



MEASUREMENT:

Architectural Framework The two monitoring devices are composed of Ultrasonic sensor to measure the distance of the water level, Arduino micro-controller that process the signal from the sensor, GSM module to send the data or information from the micro-controller to the computer server and a power source using Solar .

PROBLEM SOLVING:

A flood warning system is an early flood monitoring solution that deploys accurate and well-maintained sensing instruments, like rain gauges, water level sensors, and flow rate sensors.

The early warning system is a web-based system that users can access which includes web flood information. The ultrasonic sensors used temperature and humidity sensors to achieve better sound waves which are further combined with flash flood sensors installed on bridges for convenient access to the river.

FUTURE SCOPE :

This study is conducted to solve the problems brought about by floods. The device shall contain with the

following features:

It has ultrasonic sensor to sense the distance of water level of flood on the road. The system provided a camera that will display the real-time image of the flood that can view via livestream.

It includes Serial Communication to send warning text message with the content of date, time, water level and road accessibility. The system has three (3) modules which are Users, Logs, and Contact Numbers. It can be modify by the admin. The unit containing the sensor is suggested to be place in front of Our system.

The position of the sensor must be placed perpendicular to the flood water; otherwise, there will be an imperfect reflection of ultrasonic waves and cause measurement errors. The sensor is suggested to be placed on a pole with a height of about 3 to 3.5 meters.

The flood sensors and microcontrollers will be powered by a Solar Power Bank with 80, 000 Ampere Ampere-Hour (mAh) for the benefit of continuous operation of water flood height detection and network data transmission.

Building Of Flood Monitoring and Early Warming:

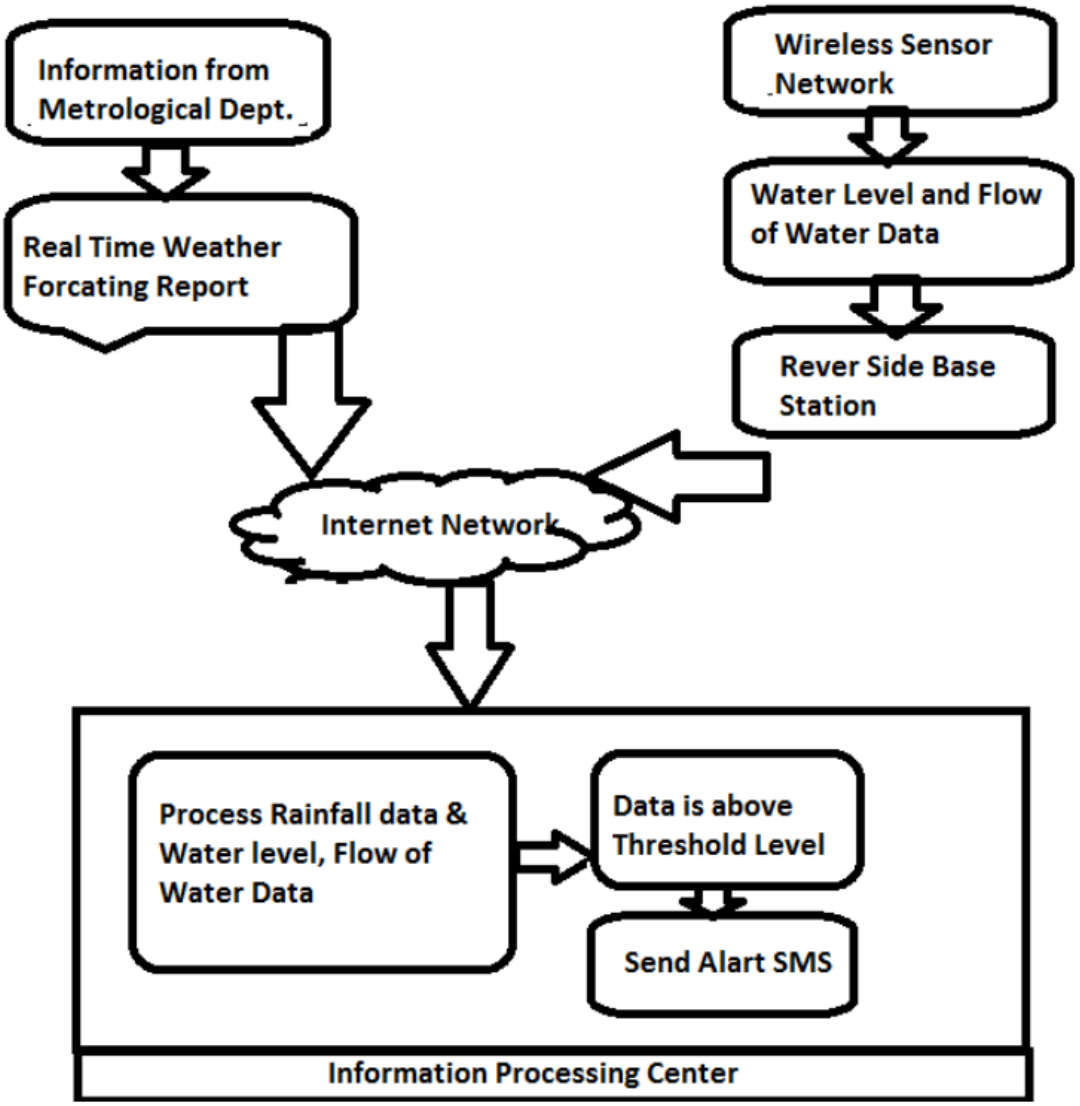
The early warning system is a web-based system that users can access which includes web flood information. The ultrasonic sensors used temperature and humidity sensors to achieve better sound waves which are further combined with flash flood sensors installed on bridges for convenient access to the river.

Flood Early Warning System (FLEWS) is a system by which flood induced hazards can be minimized and prevented. Currently different organizations are working on flood forecasting and early warning at national, continental and global scale.

The flood monitoring and warning system developed by ENVIRA IoT receives accurate and reliable information about real risks, so measures to protect the most vulnerable areas can be established and Public Administrations can collect real data to generate statistics for the design of optimal protection strategies.

Dams provide flood control and also serve many other purposes: water storage, recreation, navigation, electrical generation, and irrigation. Flood control dams keep floodwaters impounded and either release floodwaters in controlled amounts downstream to the river below or store or divert water for other uses.

Avoid building in flood prone areas unless you elevate and reinforce your home. Elevate the furnace, water heater, and electric panel if susceptible to flooding. Install "Check Valves" in sewer traps to prevent floodwater from backing up into the drains of your home.



Deploy IoT sensors (Water level sensors) in flood-prone areas and configure them to measure water levels:

An Internet of Things (IoT) water level control and monitoring system is a smart, automated solution to manage and maintain water levels in various applications such as tanks, reservoirs, and swimming pools.

Ultrasonic sensors play a vital role in the systems used for these purposes, which makes them important to flood preparedness.

It is a advanced sensor module with consists of resistive humidity and temperature detection components. The water level is always under observation by a float sensor, which work by opening and closing circuits (dry contacts) as water levels rise and fall.

Continue building the project by developing the early warning platform. Use web development technologies (e.g., HTML, CSS, JavaScript) to create a platform that displays real-time water level data and flood warnings. Design the platform to receive and display water level data from IoT sensors and issue flood warnings when necessary.

HTML Code (index.html)

```
<!DOCTYPE html>
<html>
<head>
<title>Real-Time Flood Warning System</title>
<link rel="stylesheet" type="text/css" href="styles.css">
</head>
<body>
<nav class="nav-2">
<a href="#data-display" class="nav-1">Water Level Data</a> 
<a href="#warning-section"class="nav-1">Flood Warnings</a>
<a href="#settings" class="nav-1">Settings</a>
</nav>
<header>
<h1>Real-Time Water Level Data and Flood Warnings</h1>
</header>
<section id="data-display">
<h2>Water Level Data</h2>
<table>
<thead>
<tr>
<th>Location</th>
<th>Water Level (meters)</th>
<th>Timestamp</th>
</tr>
</thead>
<tbody id="data-table">
<!-- Real-time data will be displayed here -->
```

```
</tbody>
</table>
</section>
<section id="warning-section">
<h2>Flood Warnings</h2>
<ul id="warnings-list">
<!-- Real-time flood warnings will be displayed here -->
</ul>
</section>
<section id="settings">
<h2>System Settings</h2>
<form id="settings-form">
<label for="server-url">Server URL:</label>
<input type="text" id="server-url" name="server-url"
placeholder="Enter the server URL" required> <label for="sensorthreshold">Sensor
Threshold (meters):</label>
<input type="number" id="sensor-threshold" name="sensor-threshold"
step="0.01" placeholder="Enter the sensor threshold" required>
<label for="notification-interval">Notification Interval
(seconds):</label>
<input type="number" id="notification-interval" name="notificationinterval"
placeholder="Enter the notification interval" required>
<button type="submit">Save Settings</button>
</form>
</section>
<div id="water-level-chart">
<!-- JavaScript will populate and render the chart here -->
</div>
<section id="notifications">
<h2>Notifications</h2>
<ul>
<li>System is operational.</li>
```

```
<!-- Display real-time flood warnings here -->
</ul>
</section>
<footer>
<div style="align-content: center;">
<p>&copy; 2023 YourCompany. All rights reserved.</p>
<p><a href="privacy-policy.html">Privacy Policy</a> | <a href="terms-ofservice.html">Terms
of Service</a></p></div>
</footer>
<script>
// Simulate fetching and updating real-time data
function fetchData() {
// Simulate data from IoT sensors (you should replace this with real
data)
const locations = ["Location A", "Location B", "Location C"];
const waterLevels = [Math.random() * 10, Math.random() * 10,
Math.random() * 10];
// Get the data table element
const dataTable = document.getElementById("data-table");
// Clear previous data
dataTable.innerHTML = '';
// Loop through the data and populate the table
for (let i = 0; i < locations.length; i++) {
const row = document.createElement("tr");
row.innerHTML = `
<td>${locations[i]}</td>
<td>${waterLevels[i].toFixed(2)}</td>
<td>${new Date().toLocaleString()}</td>
`;
dataTable.appendChild(row);
// Check for flood warnings (you can set your own thresholds)
if (waterLevels[i] > 7.0) {
```

```
const warningsList = document.getElementById("warningslist");
const warning = document.createElement("li");
warning.textContent = `Flood Warning: High water level
detected at ${locations[i]}.`;
warningsList.appendChild(warning);
}
}
}
document.getElementById("settings-form").addEventListener("submit",
function (event) {
event.preventDefault(); // Prevent the default form submission
// Get values from the input fields
const serverUrl = document.getElementById("server-url").value;
const sensorThreshold = parseFloat(document.getElementById("sensorthreshold").value);
const notificationInterval = parseInt(document.getElementById("notificationinterval").value);
// Use the values to update system settings (you can send them to the server
or store them locally)
// For example, display the updated settings in the console
console.log("Server URL:", serverUrl);
console.log("Sensor Threshold:", sensorThreshold);
console.log("Notification Interval:", notificationInterval);
// You can also send these settings to your server for further processing
// Optionally, provide feedback to the user that settings were saved
alert("Settings saved successfully!");
}); // Update data every 5 seconds (adjust the interval as needed)
setInterval(fetchData, 5000);
</script>
</body>
</html>
```

This is an HTML document that represents a web page for a "Real-Time Flood Warning System." Let me explain the structure and functionality of this HTML code:

1. Document Type Declaration (<!DOCTYPE html>):

This declaration specifies that the document is an HTML5 document.

2. <html> Element: The root element of the HTML document.

3. <head> Section:

• <title> Element: Sets the title of the web page to "Real-Time Flood Warning System."

• <link> Element: Links an external CSS file named "styles.css" for styling the page.

4. <body> Element: The main content of the web page is contained within the <body> element.

5. Navigation Bar (<nav>):

• This section defines a navigation bar with links to different sections of the page.

• The links point to various sections of the page, including "Water Level Data," "Flood Warnings," and "Settings."

6. <header> Element:

• Contains the main heading, which is the title of the web page: "RealTime Water Level Data and Flood Warnings."

7. Sections:

• Three main sections are defined within the <body>:

• "Water Level Data" (<section id="data-display">): This section displays water level data in a table.

• "Flood Warnings" (<section id="warning-section">): This section displays flood warnings as a list.

• "System Settings" (<section id="settings">): This section contains a form for configuring system settings.

8. Data Display:

• The "Water Level Data" section includes a table with columns for "Location," "Water Level (meters)," and "Timestamp."

• Real-time data will be populated in this table via JavaScript.

9. Flood Warnings:

• The "Flood Warnings" section includes an unordered list (<ul>) with

the id "warnings-list." Real-time flood warnings will be displayed in this list.

10.System Settings:

• The "System Settings" section includes a form (<form>) with various input fields for setting system parameters, including server URL, sensor threshold, and notification interval.

• A "Save Settings" button allows users to submit their settings. The JavaScript code handles the form submission and provides feedback when settings are saved.

11.Water Level Chart ( ):

This empty div is a placeholder for a chart that will be populated and rendered using JavaScript.

12.Notifications:

• The "Notifications" section is an unordered list that currently contains a single list item indicating that the system is operational. Real-time flood warnings can be added to this list.

13.<footer> Element: The footer of the web page, containing copyright information and links to the Privacy Policy and Terms of Service pages.

14.JavaScript:

• The JavaScript code in the <script> element at the end of the document simulates fetching and updating real-time data. It fetches data from imaginary IoT sensors, populates the data table, and adds flood warnings based on a threshold.

• It also handles the form submission for system settings, logging the values to the console and providing an alert when settings are saved.

• Data is updated every 5 seconds using setInterval.

CSS Code : (style.css)

```
/* CSS styles for your Real-Time Flood Warning System */
/* Reset some default browser styles */
body, h1, h2, ul, li, p {
margin: 0;
padding: 0;
```

```
}
/* Define general styles for your page */
body {
font-family: Arial, sans-serif;
background-color: #f2f2f2;
}
header {
background-color: white;
color: black;
padding: 20px;
text-align: center;
}
h1 {
margin: 0;
}
section {
background-color: #fff;
padding: 20px;
margin: 10px;
}
table {
width: 100%;
border-collapse: collapse;
}
table, th, td {
border: 1px solid #ddd;
}
th, td {
padding: 10px;
text-align: center;
}
ul {
```

```
list-style-type: none;
padding: 0;
}
li {
margin: 5px 0;
}
#data-display {
background-color: #f9f9f9;
}
#warning-section {
background-color: #FF4136;
color: #fff;
}
#data-table th {
background-color: #333;
color: #fff;
}
.nav-2 {
background-color: #716666;
display: flex;
justify-content: left;
padding: 10px;
}
.nav-1 {
text-decoration: none;
color: #fff;
padding: 10px 20px;
transition: background-color 0.3s;
}
/* Change link color on hover */
.nav-1:hover {
background-color: #555; /* Background color on hover */
```

```
}
/* Style the system settings section */
#settings {
background-color: #f7f7f7;
padding: 20px;
margin: 20px;
box-shadow: 0 0 5px rgba(0, 0, 0, 0.2);
}
/* Style form elements */
#settings-form {
max-width: 400px;
margin: 0 auto;
}
label {
display: block;
margin-bottom: 10px;
font-weight: bold;
}
input[type="text"],
input[type="number"] {
width: 100%;
padding: 10px;
margin-bottom: 20px;
border: 1px solid #ccc;
border-radius: 4px;
font-size: 16px;
}
input[type="submit"] {
background-color: #0074D9;
color: #fff;
border: none;
padding: 10px 20px;
```

```
cursor: pointer;
}
input[type="submit"]:hover {
background-color: #0056b3;
}
body {font-family: Arial, Helvetica, sans-serif;}
form {border: 3px solid #f1f1f1;}
input[type=text], input[type=password] {
width: 100%;
padding: 12px 20px;
margin: 8px 0;
display: inline-block;
border: 1px solid #ccc;
box-sizing: border-box;
}
button {
background-color: #04AA6D;
color: white;
padding: 14px 20px;
margin: 8px 0;
border: none;
cursor: pointer;
width: 100%;
}
button:hover {
opacity: 0.8;
}
.cancelbtn {
width: auto;
padding: 10px 18px;
background-color: #f44336;
}
```

```
.imgcontainer {
text-align: center;
margin: 24px 0 12px 0;
}
img.avatar {
width: 40%;
border-radius: 50%;
}
.container {
padding: 16px;
}
span.psw {
float: right;
padding-top: 16px;
}
/* Change styles for span and cancel button on extra small screens */
@media screen and (max-width: 300px) {
span.psw {
display: block;
float: none;
}
.cancelbtn {
width: 100%;
}
}
footer {
text-align: center;
padding: 3px;
background-color: DarkSalmon;
color: white;
}
```

The provided CSS code contains styles for various elements and sections of a

"Real-Time Flood Warning System" web page. Here's an explanation of the CSS styles:

1. Reset Styles:

• The initial styles reset default browser margins and paddings for body, h1, h2, ul, li, and p elements to make the layout consistent.

2. General Page Styles:

• body is styled with a background color of light gray (#f2f2f2) and a fallback font of Arial or sans-serif.

• The header section has a white background, black text, padding, and is centered.

• h1 within the header has its margin set to zero.

3. Section Styles:

• Sections (<section>) have a white background, padding, and margin to separate them.

• The table within sections has a 100% width and a collapsed border.

• Table cells (th and td) have padding, a thin border, and text centered.

4. List Styles:

• Unordered lists (ul) have no list-style and no padding.

• List items (li) have margin space on top and bottom.

5. Specific Section Styles:

• The "Water Level Data" section (#data-display) has a light gray background (#f9f9f9).

• The "Flood Warnings" section (#warning-section) has a background color of red (#FF4136) with white text.

6. Navigation Bar Styles:

• The navigation bar (nav-2) has a dark gray background, is displayed as a flex container, and has left-justified content with padding.

• Navigation links (nav-1) have no text decoration, white color, padding, and a background color transition on hover.

7. System Settings Styles:

• The "System Settings" section (#settings) has a light gray background, padding, margin, and a box shadow.

• Form elements are styled, including labels, text input fields, number input fields, and the submit button.

• The submit button has a blue background color that changes on hover.

8. Form Styles:

• Form elements like text and password inputs are styled with width, padding, margin, and border properties.

• The submit button is styled with background color and padding.

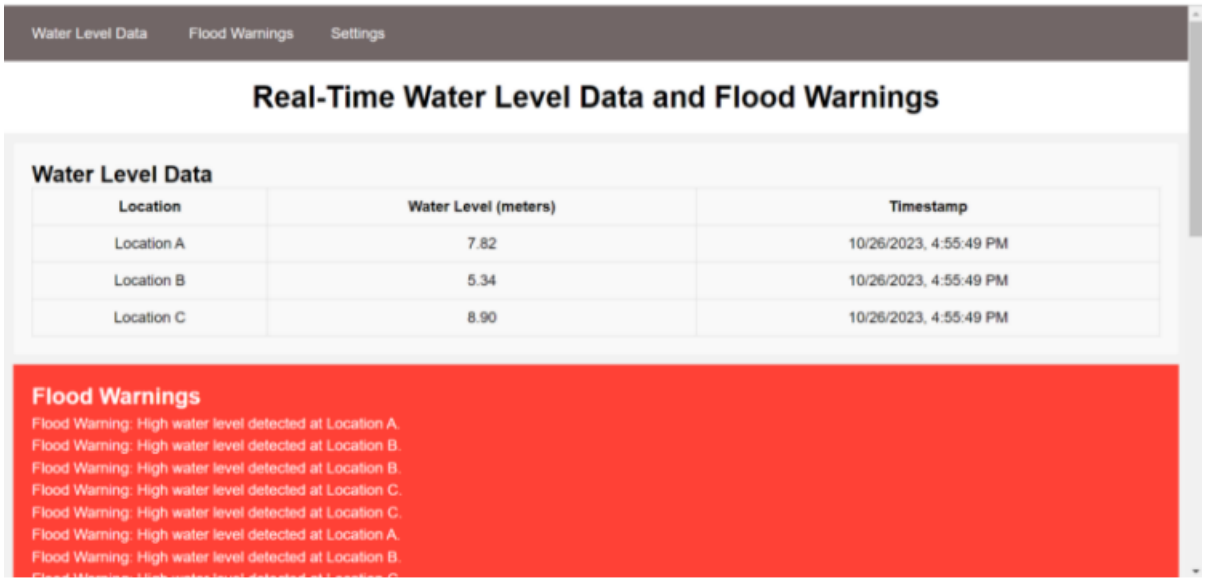
9. Extra Small Screens:

• There is a media query that changes styles for extra small screens (max-width: 300px). It modifies the span.psw and .cancelbtn styles.

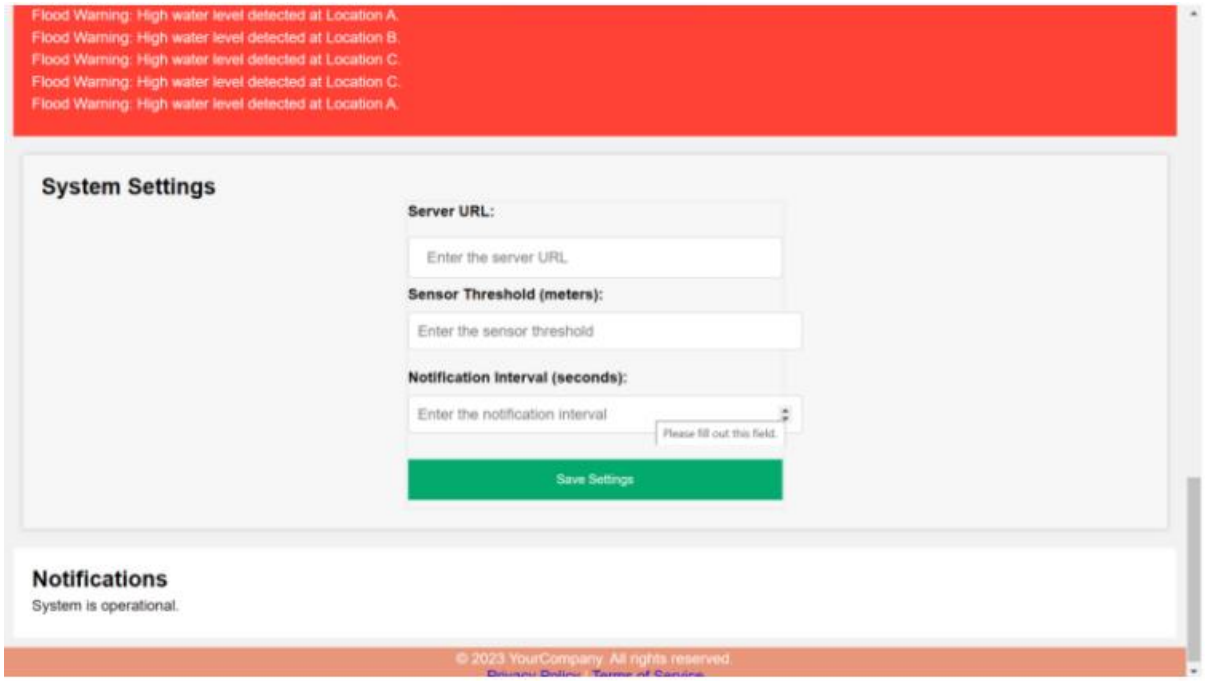
10.Footer Styles:

• The footer (footer) is styled with white text on a Dark Salmon background, with centered text and a little padding.

These CSS styles provide a clear and consistent design for the web page, making it user-friendly and visually appealing. Additionally, it offers responsiveness for extra small screens. However, please note that the styles related to the form elements and buttons seem to be repeated in the provided code; you can choose which styles to keep based on your design preferences.




Flood Warning: High water level detected at Location B.
Flood Warning: High water level detected at Location C.
Flood Warning: High water level detected at Location C.
Flood Warning: High water level detected at Location A.
Flood Warning: High water level detected at Location B.
Flood Warning: High water level detected at Location C.
Flood Warning: High water level detected at Location A.
Flood Warning: High water level detected at Location C.
Flood Warning: High water level detected at Location B.
Flood Warning: High water level detected at Location C.
Flood Warning: High water level detected at Location A.
Flood Warning: High water level detected at Location B.
Flood Warning: High water level detected at Location C.
Flood Warning: High water level detected at Location A.
Flood Warning: High water level detected at Location B.
Flood Warning: High water level detected at Location C.
Flood Warning: High water level detected at Location B.
Flood Warning: High water level detected at Location A.
Flood Warning: High water level detected at Location C.
Flood Warning: High water level detected at Location B.
Flood Warning: High water level detected at Location A.
Flood Warning: High water level detected at Location B.
Flood Warning: High water level detected at Location B.
Flood Warning: High water level detected at Location C.
Flood Warning: High water level detected at Location B.
Flood Warning: High water level detected at Location C.
Flood Warning: High water level detected at Location B.
Flood Warning: High water level detected at Location C.
Flood Warning: High water level detected at Location A.
Flood Warning: High water level detected at Location B.


Flood Warning: High water level detected at Location A.
Flood Warning: High water level detected at Location B.
Flood Warning: High water level detected at Location C.
Flood Warning: High water level detected at Location C.
Flood Warning: High water level detected at Location A.
System Settings
Server URL:
Enter the server URL
Sensor Threshold (meters):
Enter the sensor threshold
Notification Interval (seconds):
Enter the notification interval
Please fill out this field.
Save Settings
Notifications
System is operational.
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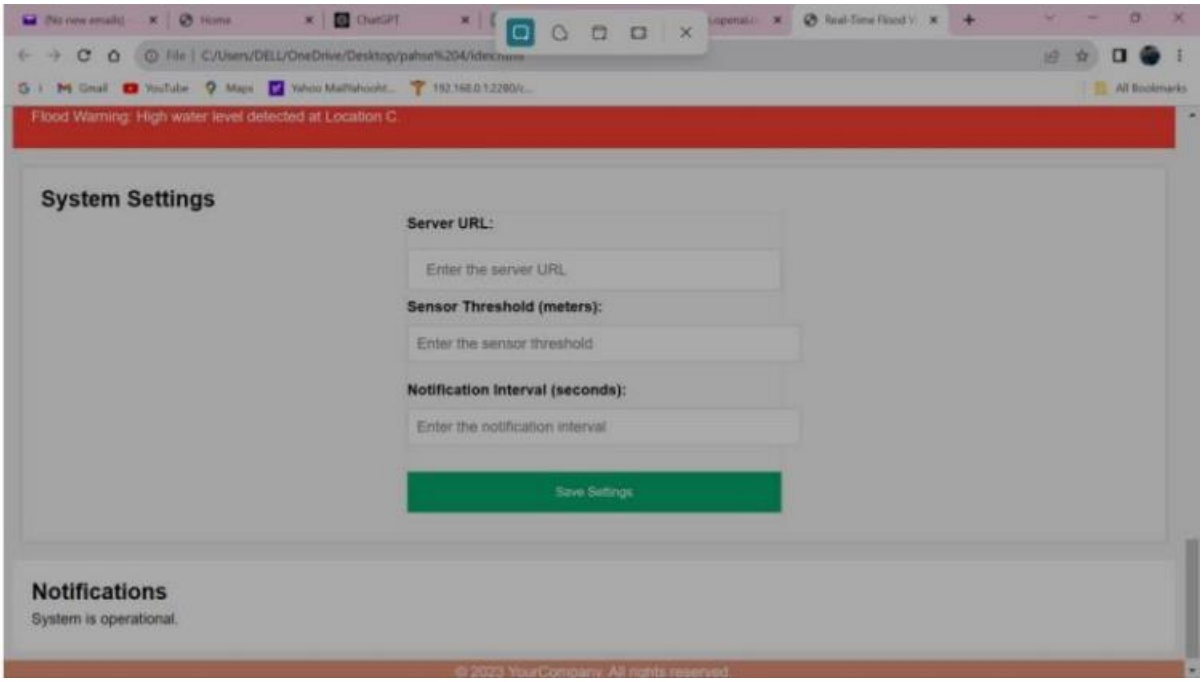

Conclusion :

The developed flood monitoring and early warning system that utilizes ultrasonic sensor to detect water level, functions perfectly according to the specification provided. It successfully passed several tests based on the different parameters.