Technical Report for Integrated sensing for span stability

This report provides comprehensive instructions for the Integrated sensing for span stability, designed to monitor bridge conditions and ensure safety. It details hardware, software, the dashboard interface, and how users can operate the system effectively.

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1. Introduction

The Safe Span Bridge Monitoring System integrates multiple sensors to measure deflection, vibration, load, and rain levels in real-time. The system provides live data visualization, ensuring engineers and authorities can monitor and act promptly to prevent potential structural failures.

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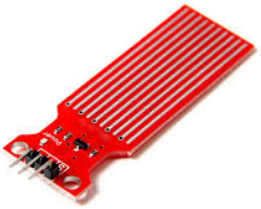
2. Hardware Setup

Components Overview

1. **Flex Sensor**: Measures deflection.
2. **Accelerometer**: Monitors vibration.
3. **Load Sensor**: Calculates the load on the bridge.
4. **Water Level Sensor**: Detects rain accumulation.
5. **Solar-Powered Battery**: Powers the system for up to six months.



6. **Esp32 Microcontroller**: Central unit for processing sensor data.

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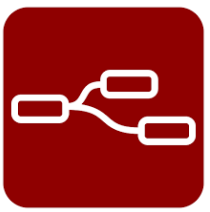
3. Software Installation and Configuration



Required Software

1. **Node-RED**: For data visualization.
2. **Arduino IDE** : Provided with the system for the microcontroller.

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4. Dashboard Usage

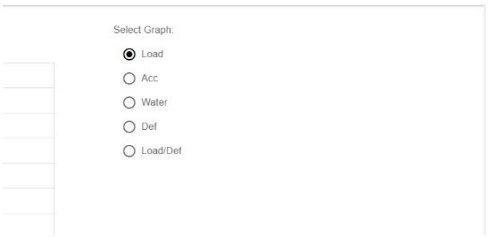
Interface Overview

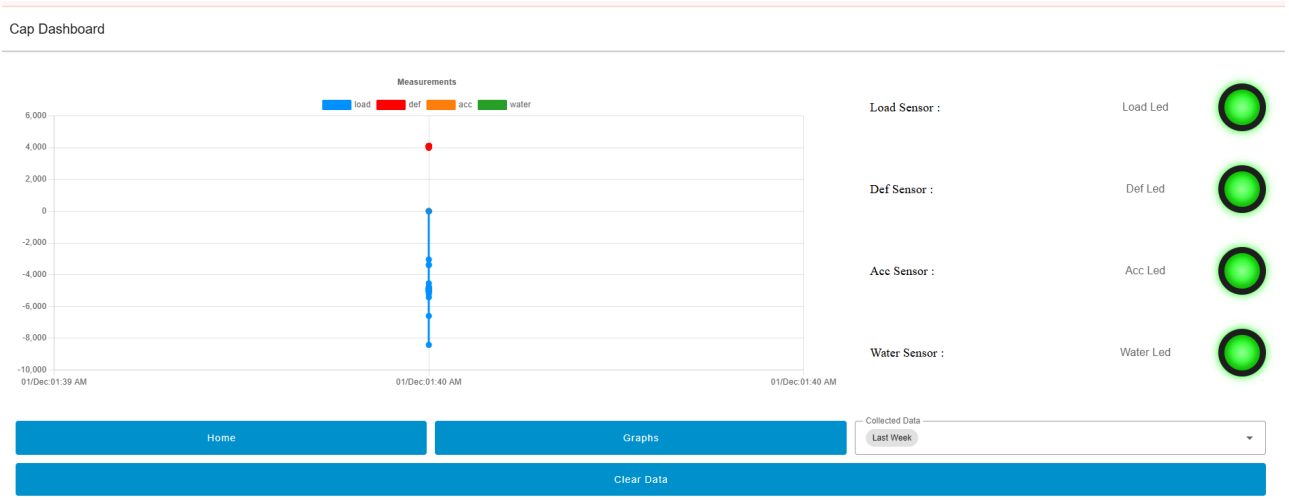
The dashboard is divided into sections:

- **Home screen** : contains a graph that collect all the sensor with different color for every factor

Buttons are part from the home screen and its green color reflected to the safe zone and the allowable range if it turn red that means it need an action

- **Graphs section**: contain list of all the graphs in real time and you can choose the graph you need
- **Collected data** : contain the historical data such as last hoy , last day , etc……..





- **Clear data** : clear both real time and the historical data

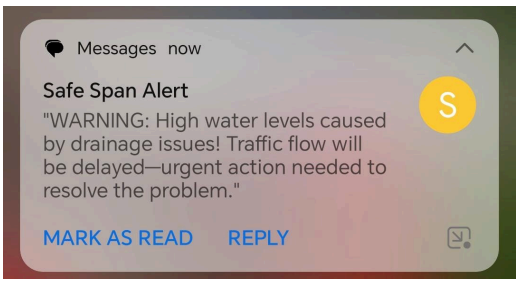
Using the Dashboard

Interface Overview

The dashboard provides a simple and intuitive interface accessible via any device with Node-RED installed. It includes:

- **Key Features**

1. **Real-Time Updates**:
    - The dashboard refreshes every 10 seconds with new data.
2. **Visual Alerts**:
    - Warnings are highlighted in red for immediate attention.
    - Notifications for critical conditions.



3. **Historical Data Access**:
    - View and analyze past trends for better decision-making.

Responding to Alerts

1. **Deflection Warning**:
    - Action: Temporarily limit traffic on the bridge.
    - Note: Check the system for sensor accuracy if readings persist.
2. **Vibration Alert**:
    - Action: Investigate for potential resonance issues or structural damage.
3. **Load Exceeded**:
    - Action: Restrict heavy vehicle access immediately.
4. **Flood Risk**:
    - Action: Initiate drainage protocols or clear debris around the bridge.

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4. Maintenance

Regular Tasks

1. **Weekly Checks**:
    - Inspect the dashboard for unusual readings.
    - Ensure sensors are securely mounted.
2. **Monthly Maintenance**:
    - Clean solar panels to maximize battery efficiency.
    - Check all sensor connections for wear or damage.

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5. Troubleshooting

Common Issues and Solutions

1. **No Data on Dashboard**:
    - Ensure the microcontroller is powered and connected to the device.
    - Restart the Node-RED application.
2. **Inaccurate Readings**:
    - Recalibrate the affected sensor using the calibration tool.
3. **Power Failure**:
    - Verify solar panel exposure to sunlight.
    - Check battery connections for any issues