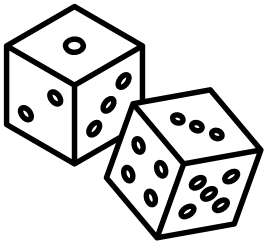


# PROJECT WORKFLOW SIH 2024 draft

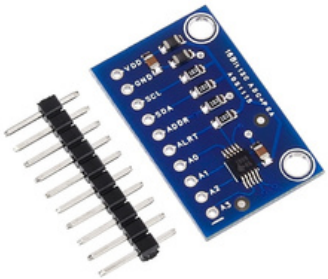
## OBJECTIVE

Monitor rail defects (cracks, fractures) and predict rail wear and quality using AI.

## WORKFLOW FOR  HARDWARE


Acoustic Sensors are placed at key points along the railway tracks.

Sensors continuously capture acoustic wave data (e.g., vibrations, noise).
Examples: Physical Acoustics R15α, Vallen VS150-M.



ADS1115

The acoustic sensor outputs an analog signal, which is fed into the ADC module. The ADC converts the signal to a digital format, which is then sent to the microcontroller or edge device.

Arduino, Raspberry Pi, or NVIDIA Jetson (depending on processing needs)

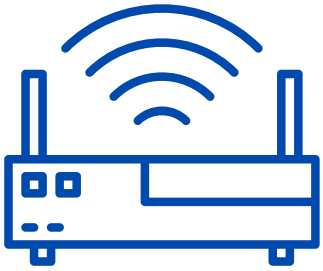
The digital signal from the ADC is fed into the GPIO pins of the microcontroller or edge device.

Preprocessing tasks such as signal filtering and basic computation are handled here.

ESP8266

Wireless Communication Module (Optional for Arduino) module is connected to the microcontroller (such as Arduino) via UART or SPI interfaces.

It sends processed data wirelessly to a central hub or cloud server.



Cloud Connectivity Wi-Fi/Ethernet Module(for Raspberry Pi or Jetson) directly connects to the router for transmitting data to the cloud.

Power all components appropriately. For instance, a 5V battery or power bank can power Arduino or Raspberry Pi via a USB connection. Larger edge devices may need dedicated power.

Power source (e.g., batteries, solar power, or direct DC supply)

## WORKFLOW FOR  SOFTWARE

NumPy

Basic preprocessing of acoustic data to clean it and extract important features (e.g., filtering noise, resampling data).

The processed data is sent securely to the cloud through the wireless communication module using IoT protocols

MQTT, HTTP, WebSocket protocols, or LoRaWAN for wireless transmission

The cloud stores large volumes of preprocessed data in a structured format for analysis, using databases or object storage systems.

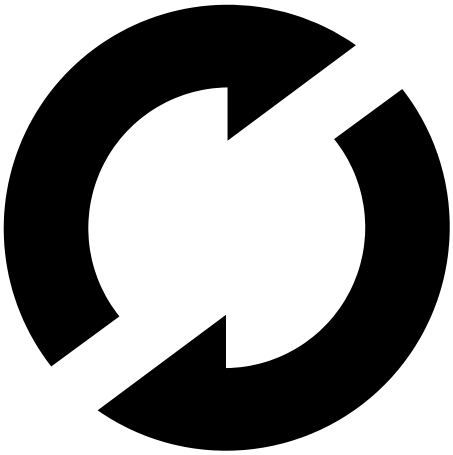
AWS S3, Google Cloud Storage, or a custom database

The AI/ML algorithm (typically a deep learning model) continuously monitors the incoming data and compares it against trained models to detect anomalies such as cracks, wear, or fractures.

Python (PyTorch, TensorFlow)

If an anomaly is detected, the system sends alerts in real-time through mobile notifications, emails, or dashboard updates.

Web-based dashboards (e.g., Grafana, React.js, D3.js)



The AI model is retrained periodically as new data comes in, improving detection accuracy.

AutoML tools, version control for models (e.g., MLflow, DVC)