

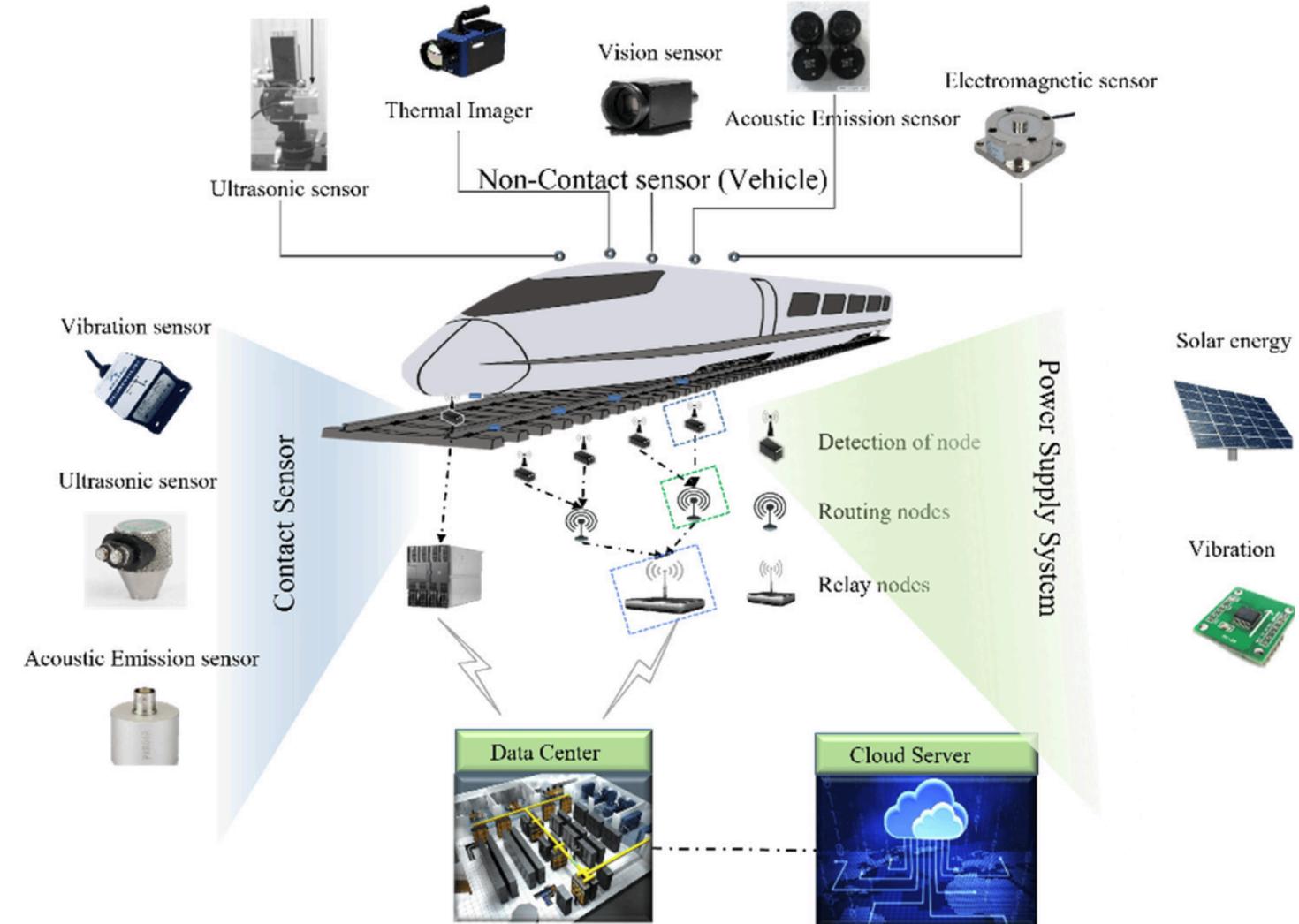
TITLE PAGE

- **Problem Statement ID** - 1584
- **Problem Statement Title**- AI-based acoustic wave monitoring of rail defects like cracks, and fractures, and prediction for rail wear, quality along with other parameters.
- **Theme**- Transportation & Logistics
- **PS Category** - Hardware
- **Team ID** -
- **Team Name** : Entropy



Proposed Solution

- AI-powered rail defect detection using sensors for real-time monitoring and predictive maintenance.
- This idea offers a real-time, scalable solution for detecting rail defects and predicting wear, improving safety and maintenance efficiency.



Uniqueness

Our solution offers predictive maintenance, Remaining Useful Life (RUL) forecasting, and rail damage assessment, ensuring proactive maintenance and timely interventions.

TECH STACK

IMPLEMENTATION

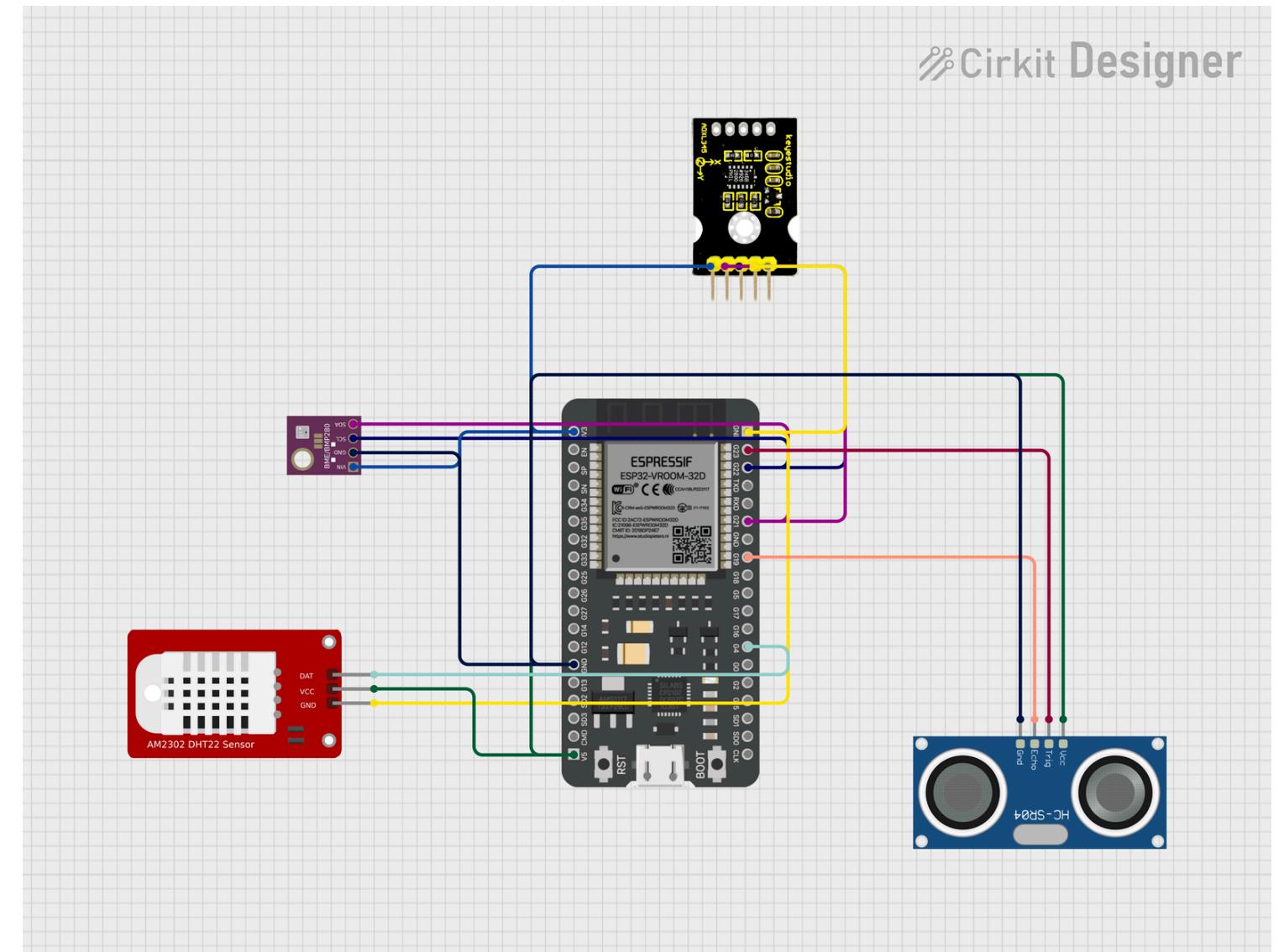
ESP32 BOARD (WIFI AND BLUETOOTH)

ARDUINO IDE

ACOUSTIC SENSORS

MACHINE LEARNING (CNN)

CIRCUIT DIAGRAM



FEASIBILITY AND VIABILITY

Technical Feasibility:

- AI Integration: AI can effectively analyze acoustic data to identify cracks, wear, and fractures.

Operational Feasibility:

- Implementation Challenges: Requires robust sensor installation and real-time monitoring capabilities.
- Scalability: System must be scalable across large rail networks with environmental resilience.

Financial Feasibility:

- High Initial Cost: Significant upfront investment for R&D, sensors, and AI development, but potential long-term savings in maintenance and safety.

Challenges and risks

- **Signal Interference:** Environmental noise and conditions may affect accuracy.
- **Complex Data Analysis:** Requires advanced algorithms and high computational power.
- **Installation Complexity:** Difficult to install and maintain sensors across large networks.
- **High Costs:** Significant upfront and ongoing maintenance expenses.

Strategies to overcome

- **Minimize Interference:** Use noise filters and environmental sensors.
- **Improve Data Analysis:** Train AI models and use edge computing.
- **Simplify Installation:** Pilot tests and modular sensor designs.
- **Manage Costs:** Seek partnerships and emphasize long-term savings.

IMPACT AND BENEFITS



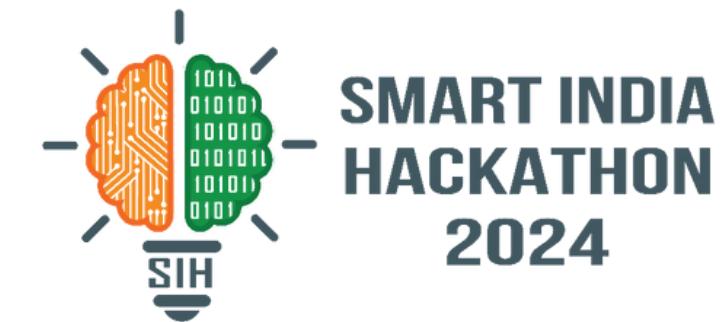
IMPACT :

- This device is predominantly useful in preventing rail accidents caused by crack or fatigue in the tracks.
- Reduces the need for emergency repairs and the associated environmental impact.

BENEFITS:

- Ensures a safe journey for the passengers travelling onboard a train.
- Allows to improve the mechanical properties of tracks in order to support high speed passenger cum freight trains at higher loads in the future.
- Provides information about the maintenance required to carry on tracks at regular intervals.
- Improves employability as a technician is required to calibrate and monitor the device regularly.

RESEARCH AND REFERENCES



A Novel Approach to Railway Track Faults Detection Using Acoustic Analysis

<https://www.mdpi.com/1424-8220/21/18/6221>

Collaborative Damage Detection Framework for Rail Structures Based on a Multi-Agent System Embedded with Soft Multi-Functional Sensors

<https://www.mdpi.com/1424-8220/22/20/7795>

A Review on Rail Defect Detection Systems Based on Wireless Sensors

<https://www.mdpi.com/1424-8220/22/17/6409>