MICHIGAN STATE UNIVERSITY

Project Plan Presentation

ML/AI Pipeline for Condition-Based Maintenance

The Capstone Experience

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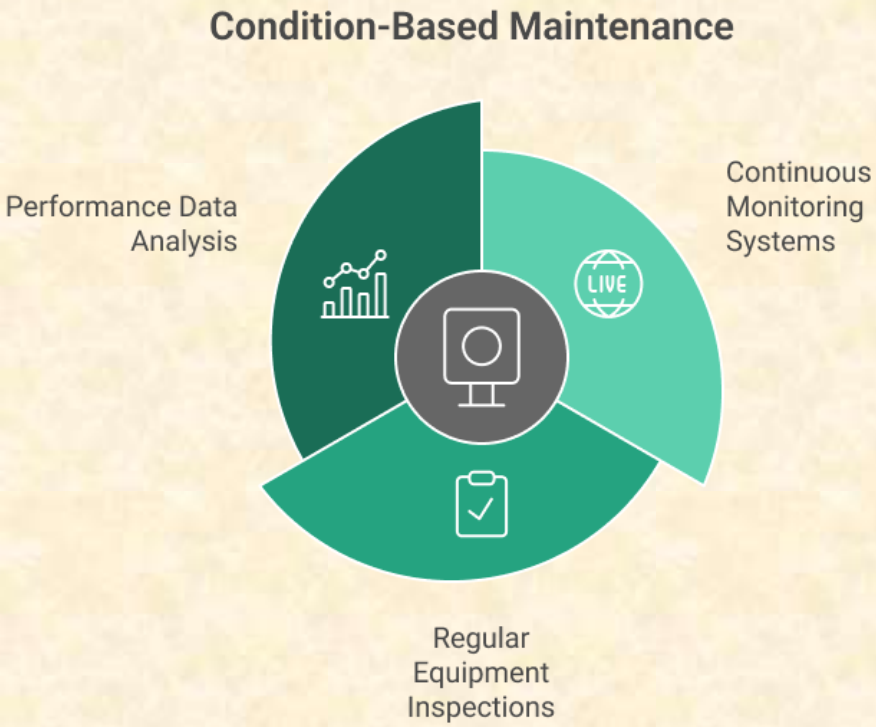
From Students…
…to Professionals

Project Sponsor Overview

- 164,000 Employees
- 2024 sales over 42 Billion USD
- Global leader in automotive industry

Project Functional Specifications

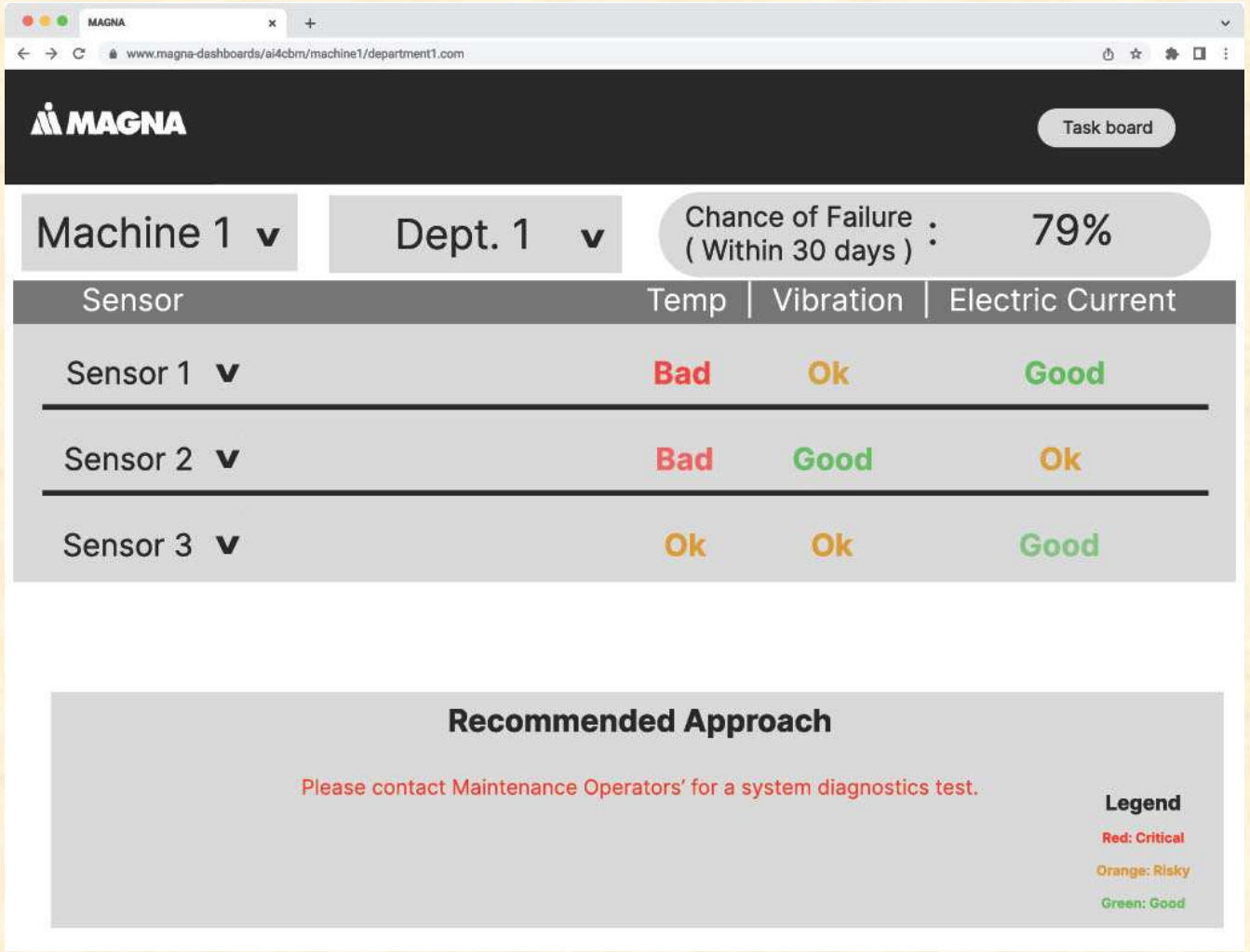
- Collect real time data
- Clean and organize data
- Use an AI model to find expected RUL
- Dashboard with live feeds and alerts



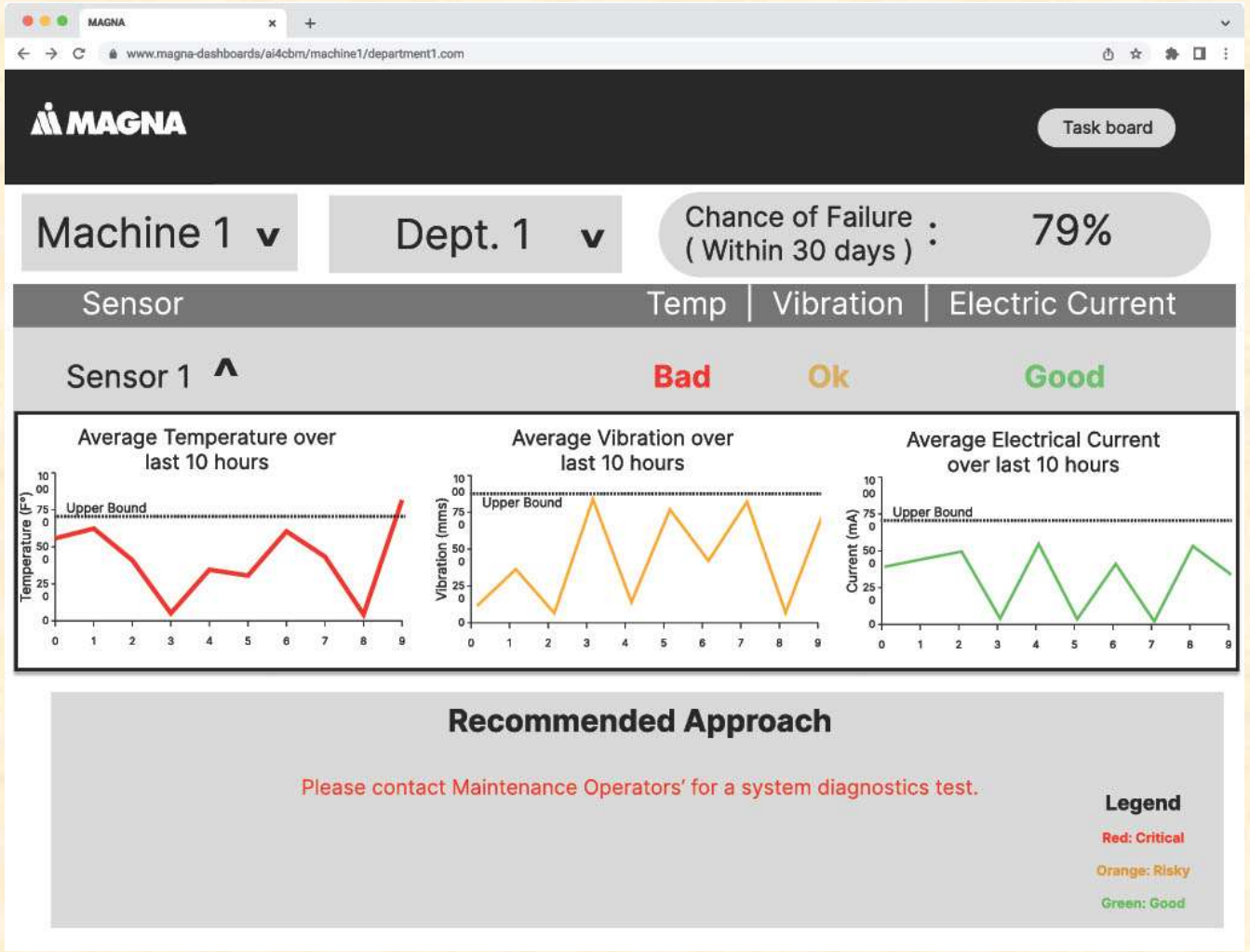
Project Design Specifications

- Data Collection
  - Use Magna sensors to capture live data
  - Use online datasets
- Data Processing and Flow
  - Sensors → Pipeline → AI → Pipeline → Dashboard
  - Pipeline handle data pre-processing, storage
- User Interface
  - Web-based dashboard displays live sensor readings, FFT plots, and fault predictions
  - Alerts abnormal conditions and failures
  - Choose brokers, multi-level selection

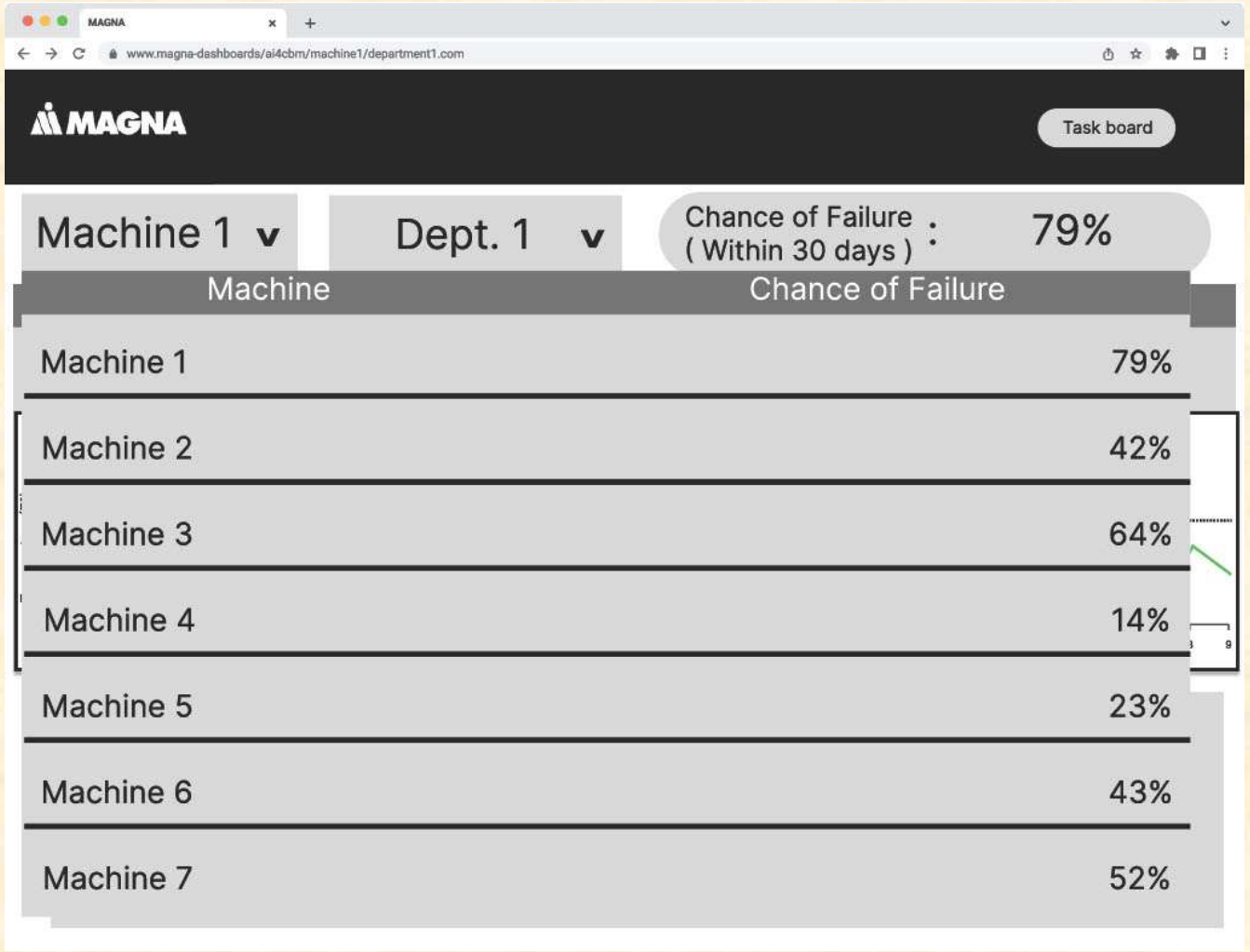
Screen Mockup: Machine Overview



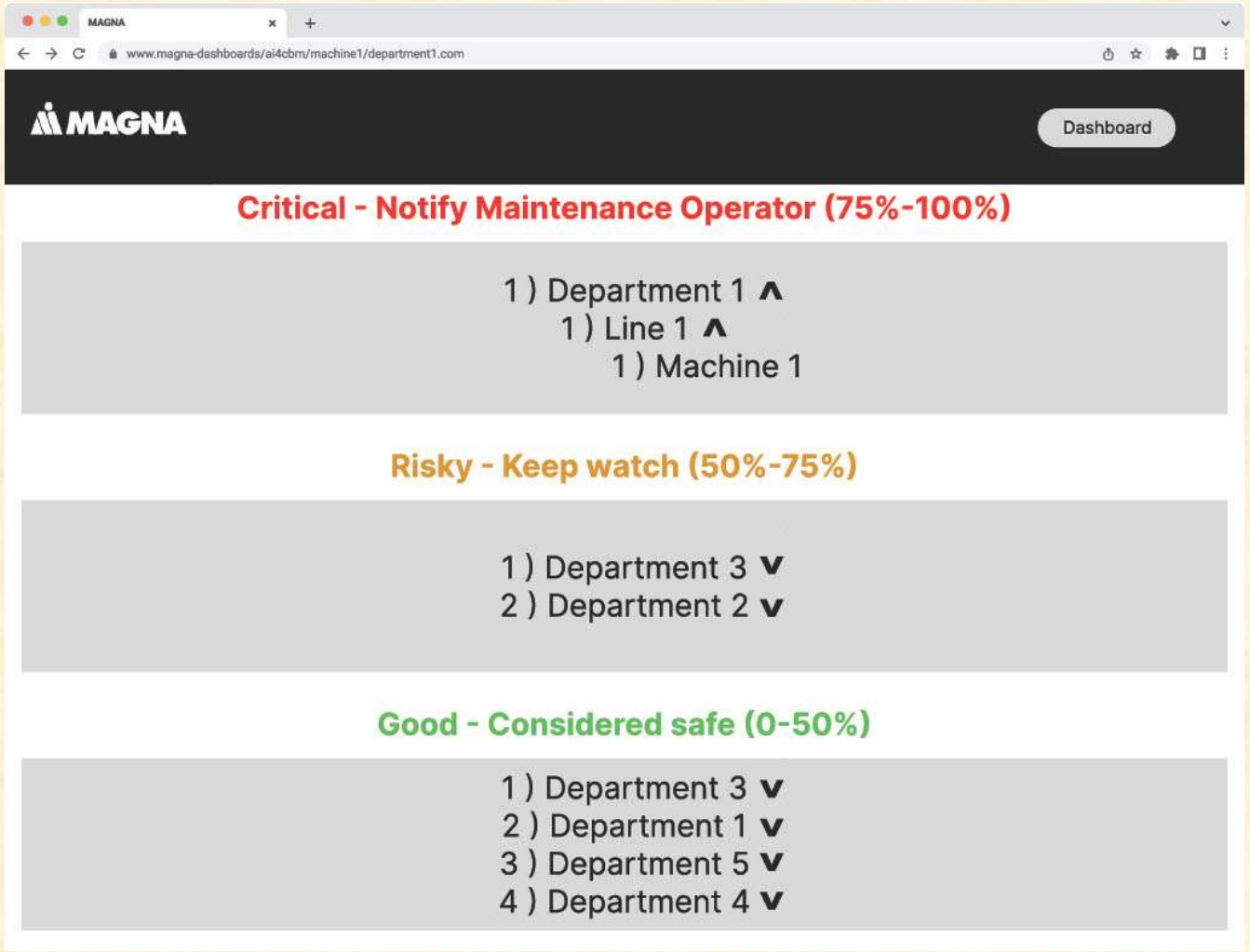
Screen Mockup: Sensor Trends



Screen Mockup: Machine Selection



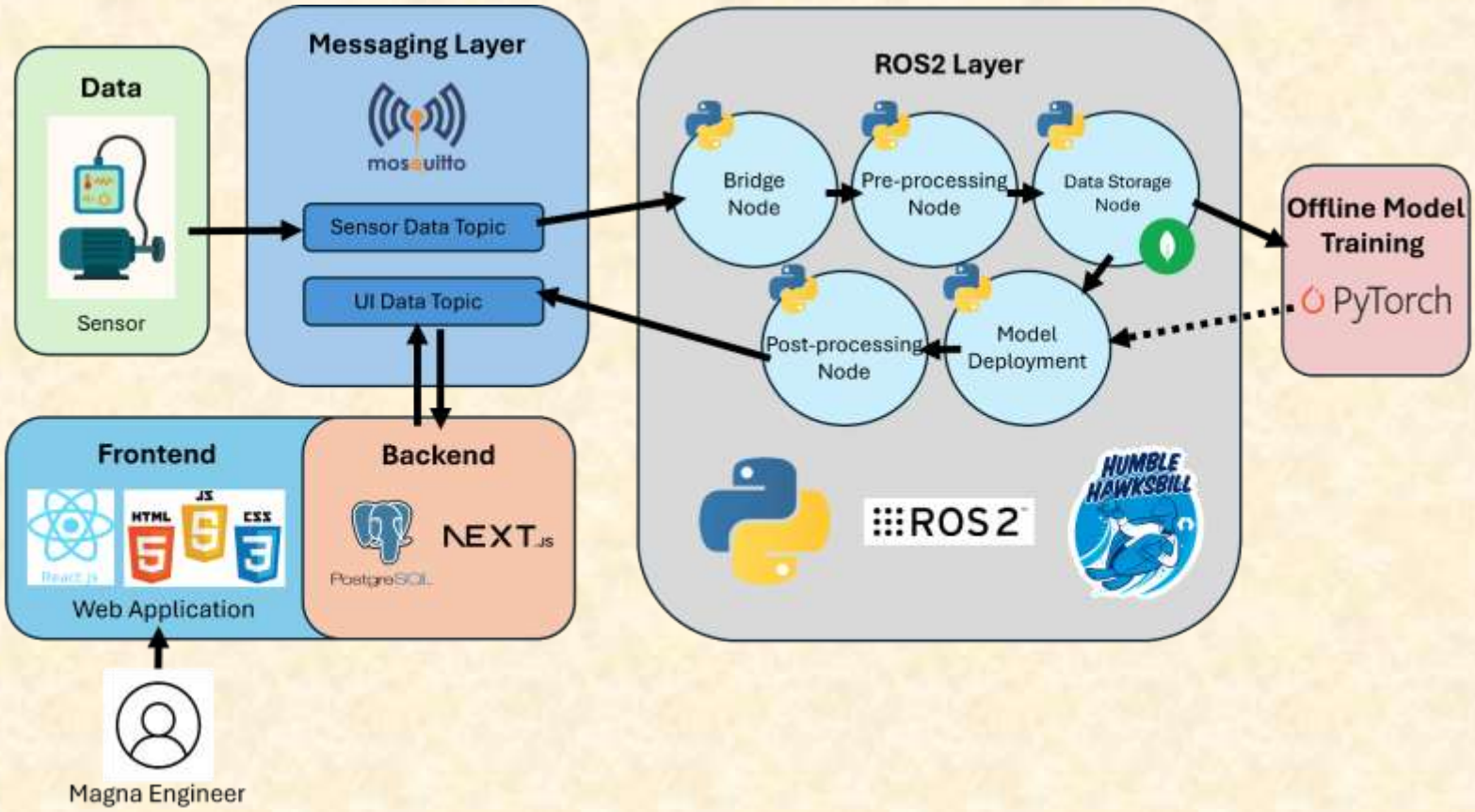
Screen Mockup: Task Board



Project Technical Specifications

- Sensor
- MQTT Broker
- ROS2 Layer
  - Bridge, pre-processing, data storage, model deployment, and post-processing nodes
- Offline Model Training
- Backend
- Frontend

Project System Architecture



Project System Components

- Hardware Platforms
  - Magna Specialized Sensor
- Software Platforms / Technologies
  - ROS2 - System
  - MQTT - Broker
  - Python (TensorFlow, Scikit-learn, PyTorch, Pandas)
  - Next.js - Dashboard
  - PostgreSQL - Data Storage

Project Risks

- Obtaining Training Data
  - Attaining access to machinery on campus where the sensor can be deployed
  - Reach out to campus labs to explore sensor deployment opportunities
- Pipeline Latency
  - Multiple machines with respective sensors each feeding data into system
  - Stress test MQTT and ROS2 with simulated machines and implement batching
- Model Generalization
  - Campus-based data or public data sets may not reflect client machinery
  - Work with client to understand their facilities and approval of data sets
- MQTT/ROS2 Message Security
  - Unsecured message traffic results in data leaks and tampering
  - Implement TLS encryption for MQTT, security for ROS2 nodes, and enforcing access control

Questions?