Detecting, Mapping and Verifying Signage with Computer Vision and Machine Learning

The Problem

There exists no system available to ensure reliable inspection, documentation, purchasing and remediation of a train vehicle's signs.

The Proposed Solution — AutoSign

What?

Digitise the existing, manual approach, and introduce machine learning and computer vision techniques to provide automation.

How?

AutoSign: A proof-of-concept system made up of: a **mobile application** to capture footage of the train, a **processing server** to detect missing + damaged signs, and a **cloud server** to host the data.

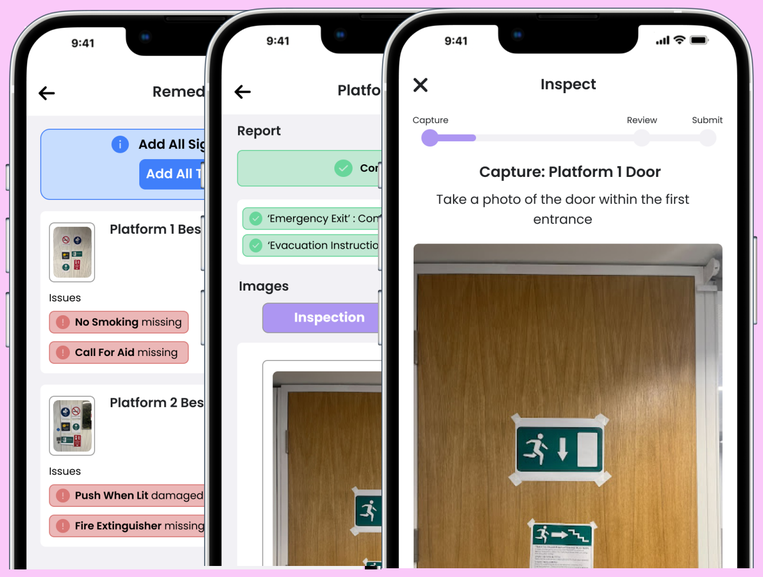
Project Goals

- Develop the system
- Demonstrate real world feasibility
- Evaluate performance
- Consider user perception

System Overview

Mobile Application

- Implemented using **Flutter**
- Supports:
  - **Inspection** of vehicle, and viewing results of inspection
  - **Purchasing** replacement signs
  - Logging **remediation** of signs



Train footage uploaded

Train footage downloaded

Cloud Server

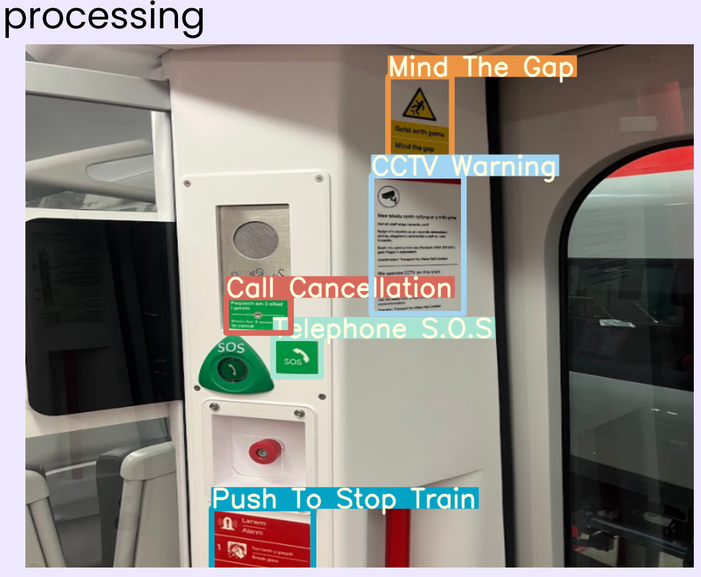
- Implemented using **Firebase**
- Stores:
  - System data via **Firestore**
  - System files via **Storage**

Report downloaded

Report uploaded

Processing Server

- Detects *presence of signs* using **YOLOv7 model** [1] trained on custom datasets
- Classifies *damage* using **BEiT classification model** [2] trained on custom dataset
- Implements custom algorithm for video processing



Results

- Custom ML models show high levels of accuracy
- Application provides all required functionality
- System components successfully integrated
- System able to detect missing and damaged signs in the real-world
- Potential users reacted positively

Conclusions

- Successfully developed system
- Demonstrated feasibility
- Laid foundations for future development

Future Work

- Deployment workflow
- Improve processor
- Improve application
- Additional data collection
- More field testing
- More user testing

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Stewart signs

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[1] Chien-Yao Wang, Alexey Bochkovskiy, and Hong-Yuan Mark Liao. "**YOLOv7: Trainable bag-of-freebies sets new state-of-the-art for real-time object detectors**". In: *arXiv preprint arXiv:2207.02696* (July 2022).

[2] Hangbo Bao, Li Dong, and Furu Wei. "**Beit: Bert pre-training of image transformers**". In: *arXiv preprint arXiv:2106.08254* (2021).