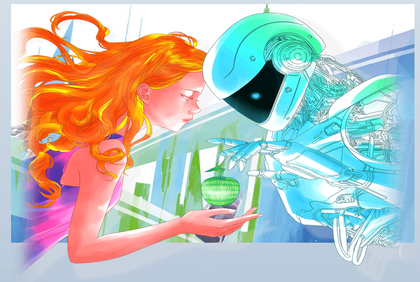


Smart Gas Station

FORUM8

13th CPWC

SafeFlow Innovators

Overview

This project develops an intelligent digital twin system for gas stations. It utilizes YOLOv11 and Qwen2.5-VL for real-time vehicle tracking and anomaly detection, creating a synchronized 3D virtual replica via UC-win/Road. The system provides managers with a visual monitoring and early-warning platform, while a mobile app offers users services like real-time status checking, reservation, and contactless payment. It aims to enhance safety, optimize operational efficiency, and enable a smarter refueling experience.

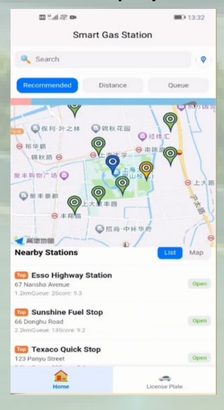
System Architecture

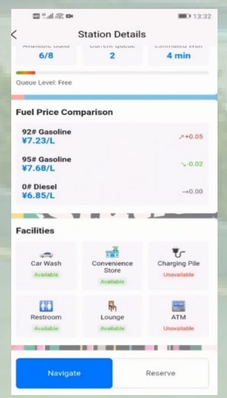
The digital twin integrates real-time traffic flow data and enables multi-terminal data linkage. And combine multiple type of data to improve the efficiency and safety of gas stations.

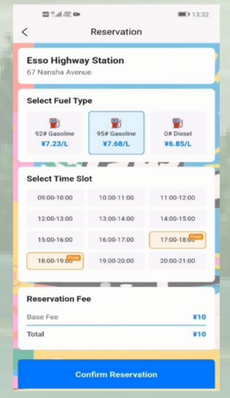
UC-win/Road Simulation scenario	Algorithm-Driven	Application	Database	Digital Twin Dashboard

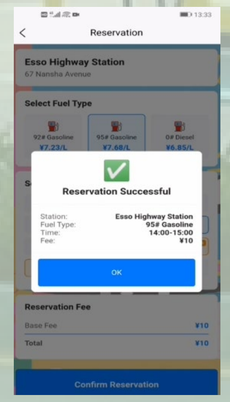
Mobile App

First, we developed a mobile app that works om conjunction with the database.
We use the LSTM algorithm to implement the optimal gas station recommendation feature, considering fuel price, distance, and queue length as inputs to the algorithm.
The LSTM algorithm is utilized to provide optimal gas station recommendations. The mobile app synchronizes with gas station data in real-time, allowing you to check fuel prices, inventory levels, and queue congestion at various stations anytime.
Moreover, we have also integrated navigation functionality. Users can make reservations and pay for gas stations through the app.
We use the Hyperlpr3 algorithm framework to recognize license plates, that takes an input image and outputs license plate information. And link their license plate number to enable frictionless payment.









System Overview

- **Automatic Payment**

HyperLPR3 performs license plate recognition to enable frictionless payment.

- **Digital Twin: Coordinate transformation**

We capture real-world footage of gas stations and employ the YOLO v11 algorithm for vehicle tracking.
Use coordinate transformation to project real-world Coordinate into UC-win/Road. Digital twin integration from Tracked coordinates into UC-win/Road.

- **Abnormal behavior detection algorithm**

We utilize the Qwen2.5VL large model to analyze videos, Generate textual prompts for detection abnormal behaviors.
Its key advantage lies in the automatic addition of new prompts v behaviors are encountered.

- **Dashboard**

Through the dashboard, we can monitor the safety conditions of gas stations in real time.

Future

- **Deeper integration of smart technology**

Utilizing 5G and sensors to monitor equipment in real-time, allowing for early problem detection, increased efficiency, and reduced failures.

- **Expanded energy options**

Beyond just fuel, offering charging, hydrogen refueling, and even solar power, promoting environmental sustainability.

- **More personalized service**

Connected to the vehicle network, enabling fuel reservations and facial recognition payments, with service recommendations based on your needs.

- **Enhanced functionality**

Not limited to refueling, but also offering shopping and transportation services, transforming into a comprehensive service hub.