Kapsch Smart Intersection

Safer and better optimized Intersections to improve traffic flow

Background

The goal of this solution is to collect useful information for traffic management and urban planning, while minimizing disruption to people's daily lives. Road safety is a major concern across the world. About $15 billion Australian Dollars are lost annually due to congestion. In comparison, estimates suggest it could cost $200 to $300 million Australian Dollars to digitize the transport system in the whole of Melbourne.

All the parts of a transport system can be connected and "talk" to each other – from vulnerable road users like pedestrians, cyclists and drivers using Bluetooth, to sensors placed on buses, trams and trains, to environmental sensors recording pollution and noise. Traffic congestion is approaching a level where we cannot afford it anymore. Intelligent Transport Solutions (ITS) can help our cities with congestion and its impact.
The most promising way to tackle congestion is to use these technologies which are comparatively low-cost.

Creating safer and better optimize intersections

The Kapsch Smart Intersection (KSI), which is currently operational on the corner of Victoria Parade and Brunswick Street, Carlton, Melbourne, is equipped with Kapsch's latest ANPR sensor configured as a 'Yellow Box' detector to provide traffic detection of vehicles blocking busy 'yellow box' intersections to prevent incursions into a yellow box and blocking oncoming traffic. This technology enables the City of Melbourne to test our new mobility strategies in a real-world environment – with a special focus on improving safety standards and the latest congestion-reducing technologies to reduce time spent in stopped traffic. We also integrate any 3rd party CCTV camera with our Deep Learning Versatile Platform (DLVP), that annotates video streams in providing 'traffic insights' to operators on a variety of very valuable datasets to provide an accurate picture of what's going on in real-time at busy intersections.

Use Case Overview

The diagram below illustrates the use cases which are further described in the following sections.

Yellow Box Detection & Enforcement

1. **Yellow Box Detection & Enforcement**
2. **Protected Turn**
3. **Erratic Driving Detection**
4. **Pedestrian Jaywalking Detection**
5. **Speed Analytics**
6. **Bus Lane Enforcement**

Automated Detection & Enforcement

Various road rules exist in regards to vehicles using the existing road area, but are rarely enforced, especially in peak hour scenarios. Through both effective passive enforcement (through fines and demerits, awareness to the public of an enforcement solution and active monitoring to influence road users in contravention to the road rule (e.g. digital signs automatically trigger when a vehicle is sensed breaking the road rule), both active and passive enforcement can be utilized to maximize the efficiency of the intersection or corridor that has a large effect on traffic throughput.

Victoria has approximately 120 bus lanes with an estimated total length of approximately 52km.
The vast majority (approximately 76%) of the bus lanes in Victoria have operational and/or safety concerns associated with allowing smaller car-like vehicles to use them.

(Source: VicRoads)

Challenges

- **Yellow box scenarios:**
A car enters a yellow box intersection without a clear exit ahead and stops, blocking the intersection. This creates congestion in the alternate direction across multiple lanes and impedes the flow of traffic under a green light scenario. This also creates a safety hazard with cars trying to pass the stopped vehicle and moving between lanes.

- **Truck curfew:** Defined curfew limits dependent on the time of day to reduce vehicle noise in residential environments are put in place across various urban areas.

- **Clearway enforcement:** Set times of when no parking is allowed on roads (2+ lanes).

- **Bus Lane enforcement:** Vehicles other than buses using defined bus lanes, especially in peak hour situations, impeding buses using the lanes and encouraging other users to use these lanes too. This discourages the use of public transport to users, creating negative user experiences wherein the flow of buses is hindered.

Our Solution

Currently, the majority of the above challenges can arise due to a lack of enforcement, particularly via an automated solution. The Kapsch Deep Learning Versatile Platform (DLVP) is a comprehensive ecosystem enabling complex traffic monitoring and traffic management applications driven by artificial intelligence. The system has been built in a highly flexible way; its deep learning component can be trained quickly and efficiently to customer specific needs. The platform translates visual input into digital data – this data is analyzed and processed in real time to trigger manifold actions and generate dynamic reports.

Road & Pedestrian Safety – 'Safety Insights'

Safety to both road users in moving traffic as well as pedestrians are a key focus to the Dept. of Transport (DoT), in order to reduce any road related injuries or fatalities.

Challenges

- Protected Turn:
  A car turning left comes within close contact or makes contacts of a crossing pedestrian. A near miss or incident is detected.

- Erratic Driving Detection:
  Crossing a solid white line or changing lane prior to entering the intersection. This creates a safety hazard for the violating vehicle moving lanes to a nearby vehicle and cyclist using the dedicated cycle lane.

- Pedestrian Jaywalking Detection:
  Pedestrians are detected not using a crossing and a near-miss or incident is detected.

- Interaction at lane level between cycle lanes / vehicle lanes, etc.

- Mobility-impaired pedestrians using crossings:
  Requirement of using eWalk integrated with the SPaT signal data through SCATS to a user's smartphone or smartwatch

Our Solution

The Kapsch DLVP system detects as a calculated near miss and provides as analytic data to the operator to review change strategies to improve intersection safety.

Traffic Analytics and Data Collection – 'Traffic Insights'

Collection of rich and accurate traffic data for statistical purposes, with emphasis on active traffic & demand management and load balancing of supply of public services (e.g. trams, buses) and managing Signal Phasing and Timing (SPaT) data of traffic lights to influence congestion.

Challenges

- Existing loops in the road only detect the start/end of queue length with basic vehicle counting only.

- Vehicle counting for statistical purposes and demand management at designated areas through software in a video feed.

- Classification of vehicles for statistical purposes and road user type

- Pedestrian counting at bus or tram stops for demand management purposes.

- Congestion/Load management of a corridor, with an incident causing partial or complete blockage.

- Multimodal coordination of road users, including public transit, following congestion.

Our Solution

The Kapsch DLVP system provides a nonintrusive rich stream of various data labels such as number of vehicles, classification of type of vehicle, with current speed estimation and direction of travel for traffic analytics. This provides transport agencies real-time insights for situational awareness of traffic conditions at each intersection location for demand management strategies. No roadside infrastructure is required other than a camera. This data can be captured and streamed to other stakeholders within a multimodal environment.

Added Value

Technical
- Optical capture of license plates through ANPR cameras.
- VDX for testing and validation.
- Classification of vehicle types.

Financial
- Through the enforcement solution creates a new revenue stream for our customer
- Focus on business digitalization through revenue generated

Operational
- Improved operational efficiency
- Reduction in product time to market
- Enhanced quality of product / service

Safety
- Through the safety solution and near miss generator, a value for injuries and deaths quantified

Client Reference
AIMES – University of Melbourne, DoT

Kapsch Australia have established a local testbed environment in association with the University of Melbourne and DoT, within the Australian Integrated Mobility EcoSystem (AIMES), a 6km² area located near Melbourne CBD in and around the University of Melbourne city campus. This ecosystem is funded by the University and DoT, Victoria.

The purpose of this testbed is to develop, prove and test new solutions relative to the Australian market (and to an extent towards the Asian market (where applicable)). $30 million AUD were spent over the past 4 to 5 years on the AIMES project. The AIMES VDX site is located at the corner of Nicholson Street and Victoria Parade.

Objectives

- Focus on development of technology around safety, analytics, system integration, closer data integration and capture, improvements to state and federal policy & privacy standards and existing framework.

- Test, measure and derive new decision making with a multimodality focus.

- Test and trial new devices, ideas and technology in a real urban environment.

- Focus to system integration – test and integrate the verticals

- Generate new use cases in coordination with global domain experts and decrease the time to market of new technology

System Placement
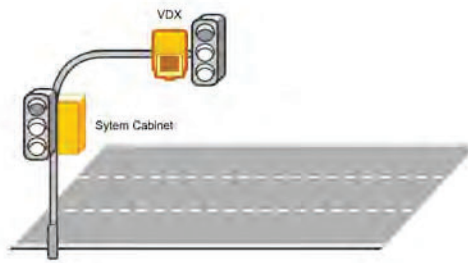
System Architecture
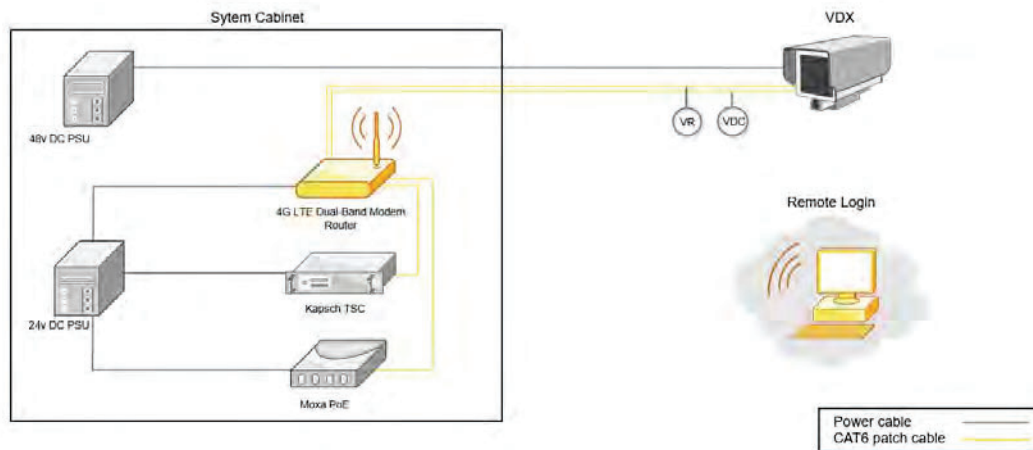
Outcomes

Impact

- The focus of the Kapsch Smart Intersection has key themes around road user safety, congestion and enforcement to change road user behaviours within a busy intersection of Victoria Parade and Nicholson Street.

Longevity

- The installation is a permanent fixture within AIMES and provides not just future use cases to Kapsch to develop but the opportunity to be used by other 3rd party vendors to fuse their unique offerings to this platform.

- Scaling out the solution for future use by government agencies to change road user behavior by increasing the awareness to road users that a detection and enforcement device is active and present in the intersection, and provide additional signage to influence their behavior are the next steps.

Transferrable

- The system, although situated in Melbourne, has been built with ease of deployment in mind and to be scaled out across other locations with minimal limitations or development changes. For example, a software change to observe the change of direction of travel and also ability to be adapted to suit a variety of vehicles, including motorcycles and scooters, more present in the Asia region.

Innovative

- Being situated within the AIMES environment brings a variety of vehicle types, Kapsch have been able to optimize the system and improve both the readability of license plates and also detection through their deep learning platform to detect erratic driving behavior to provide increased and a rich data set to improve the situational awareness on our roads.

- With this diverse data set of driving behavior, the future intent is to add classification of cars including vehicle make, model, colour, that will provide various DoT agencies with data to make better more informed decisions on to improve the congestion and safety on our roads and to be able to measure these changes in the network at critical intersections.

Timeframe

- At present, the intention is to provide this data into the wider ecosystem within AIMES to have a better connected view of how the network can function along connected intersections and corridors and to use these insights to further enhance other locations in future.

Kapsch TrafficCom is a globally renowned provider
of transportation solutions for sustainable mobility.
Innovative solutions in the application fields of tolling,
tolling services, traffic management and demand management
contribute to a healthy world without congestion.
Kapsch has brought projects to fruition in more than
50 countries around the globe. With one-stop solutions,
the company covers the entire value chain of customers,
from components to design and implementation to the operation
of systems.
As part of the Kapsch Group and headquartered in Vienna,
Kapsch TrafficCom has subsidiaries and branches in more
than 25 countries. It has been listed in the Prime Market segment
of the Vienna Stock Exchange since 2007 (ticker symbol: KTCG).
In its 2020/21 financial year, around 4,660 employees generated
revenues of EUR 500 million.

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