ABILITY

Agile & Adaptive Transportation Management

Accurate Traffic Flow Analysis & Optimization

AI-Vue **VS12110 2MP ANPR Bullet Camera**

NDAA Compliant | SUPER HDR PRO | IP67 | IK10 | -20°C ~ 60°C | SMART IR 40 METERS | 60 FPS | 4G LTE

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Introduction

In the real world, traffic flow and the number of vehicles change all the time though rolling patterns can be observed. By taking advantage of Edge computing in cameras to determine the fluctuation in number, direction and the length of vehicle queue in each intersection, a holistic and real-time information can be obtained to continuously train AI models to provide best suggestions to transportation management and optimize the traffic flows. Through coordination of the traffic signal controls, on-the-spot optimization can immensely benefit city transportation immediately and adapt to the changing pattern to improve AI models over time. This provides seamless and significant improvements to the commute experience by saving drivers' time. The accurate analysis and optimization of traffic flow can provide larger scale benefits than simply using navigation applications that predict commute time on a smartphone.

Challenges

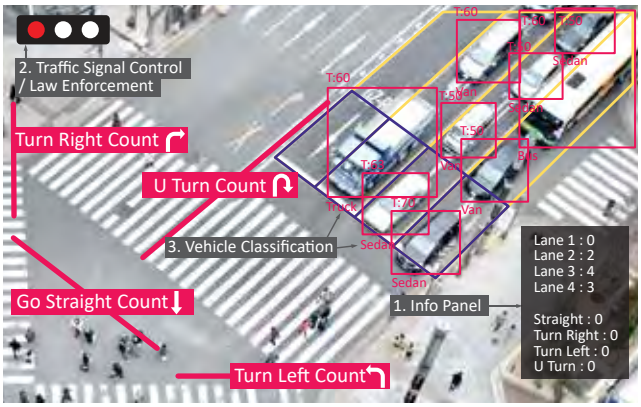
Urban planning is usually the ultimate solution to the chaos of traffic management but is the least feasible. Since the behavior of drivers is hard to predict, a real-time and instant optimization is more practical. However, a real-time optimization needs information of the fluctuation in traffic flow over time – that is, a real-time statistic in the region. That' s difficult for a management system based on cloud architecture due to network latencies and overall responsiveness. Instead, a well-developed Edge AI camera system can be the solution to this problem.

Solution

Little effort is required is integrate the Edge AI system above with the traffic signal system. A signal control box connected to the internet is installed in each intersection. This allows real-time traffic flow management in the entire traffic system to happen immediately.

The key to resolving the challenge is to make a rigid traffic signal control system flexible so that the change of signs can be adaptive to the fluctuation of traffic flow based on changes in the number and the direction of vehicles and respond to each situation accurately, automatically and immediately.

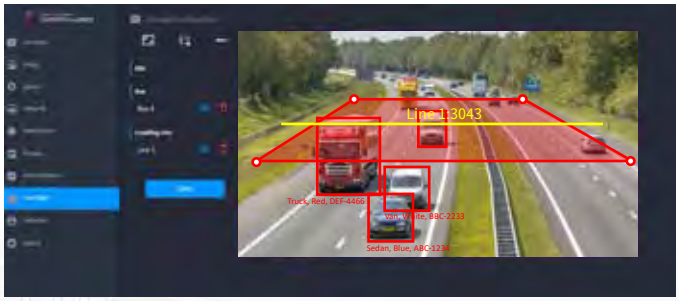
The solution can be simplified into three phases.



<u>The first phase</u> starts with traffic data statistic collection with smart cameras and dashboard visualization for a model build-up. The experimental field test is conducted within three main consecutive traffic intersections.

The Edge AI cameras run Automatic License Plate Recognition (ANPR), vehicle detection / counting, and classification models asynchronously by drawing bounding box and line to get real-time data. The captured / recognized data then will be sent to cloud for big data analysis. In the cloud, the number and size of each identified vehicle will be calculated and converted into the length of the queue. The accuracy of acquired data is critical for model building to know the dynamics of the flow after consolidating with idle and and non-idle time of vehicles.Thanks to the tracking feature on Edge AI camera powered by Intel® Movidius™ Myriad™ X MA2485, it is now feasible to track the vehicle' s driving trajectory and turn.

With additional inference logic executed in the cloud, further insights can be extracted. Based on the analysis and results, the control of traffic signal will be also synchronized and adjusted for traffic flow optimization in accordance to different time periods. Once the statistical Modeling of traffic flow across time is ready, the development will can continue to the next phase to optimize traffic KPI.



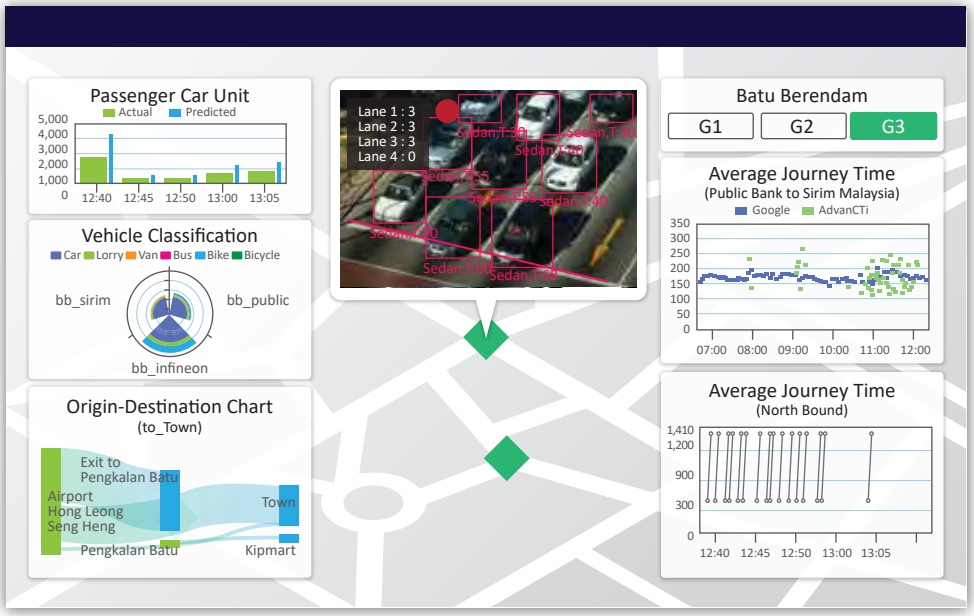
The second phase is to develop a more accurate model which is based on traffic flow theory integrating factors such as number of lanes, saturation flow, traveling speed from intersection to intersection, combination of vehicles, as well as driver behavior. Then we employ the use of artificial intelligence (Genetic Algorithm, deep reinforcement learning, and etc.) to learn the best offset and timing which can adapt to real-time traffic flow. The practical optimization will be implemented in two levels by AI model. The first level is to run weekly data batches from suggested intersections for AI optimizing simulation. The optimization maneuvers are optional to implement manually or automatically. The second level is to run on a real-time basis in recommended intersections for automated and agile optimization.

The third phase is then to integrate the well-trained model with traffic controller and Ability cameras in intersections for actual verification and optimization.

Once the optimization plan suggested by the AI model is adopted, traffic information is displayed into an operational dashboards with metrics all updating in real-time. Strategic dashboards can track performance in relation to key performance indicators for each intersection.

From the operational dashboard, administrators can know the instantaneous idle time in each intersection and compare to thhose in simulations.. The idle time is an output of two key real-time figures - vehicle number and queue length from edge AI cameras. By monitoring the comparison, administrator can adjust their operation from time to time and make traffic flow optimization possible.

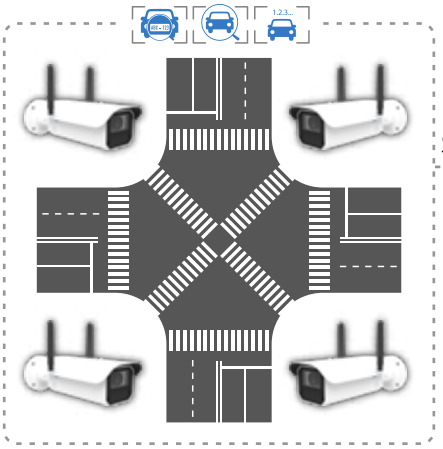
The strategic dashboard reports the statistical information of traffic flows over time period in the area covering passenger car units, classification, destination and average journey time. This information can help administrators know the long term traffic trends and patterns. The strategic dashboard makes better long-term planning decisions and determines traffic issues such as traffic congestion and other negative impacts. A real-time video stream can be seen by navigating the deployment map.



The dashboard features provide incredible benefit to administrators. First, the data transparency can provide a detailed overview of traffic management immediately in one quick glance. Better yet, it reduces the amount of time it takes to compile information coming from each edge AI cameras and saves a lot of time.

Secondly, the comparison of real and simulations provide an unbiased view not only of the model performance overall, but modification for real world KPIs. The reconciliation results in better decision making as well. Finally, the dashboards can show exactly where the troubled areas are and equip the administrators with the information needed to improve. By tracking the improvement with the visible numbers on the dashboards, administrators can trace the improvements throughout the organization with accountability.

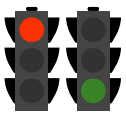
System Architecture



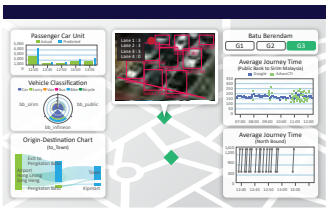
Edge A.I. Traffic Cabinet
Intersection 1

Stream

Intersection N



Integrate with Traffic Controller



Real-time Traffic

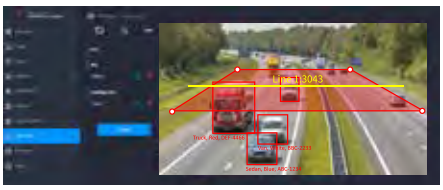
Centralized city traffic engineering storage and UI

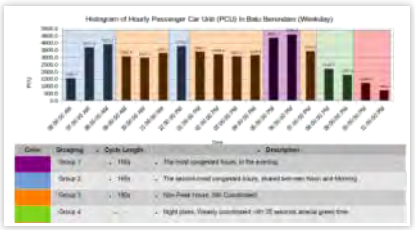
Local server or cloud based

1 Catch vehicle information based on ANPR, vehicle Identification, and counting for quantity, models, direction, dwelling time and etc.

2 Let AI Model to run for the best offset and timing which can adapt to real time

3 Dashboard & Monitoring KPI

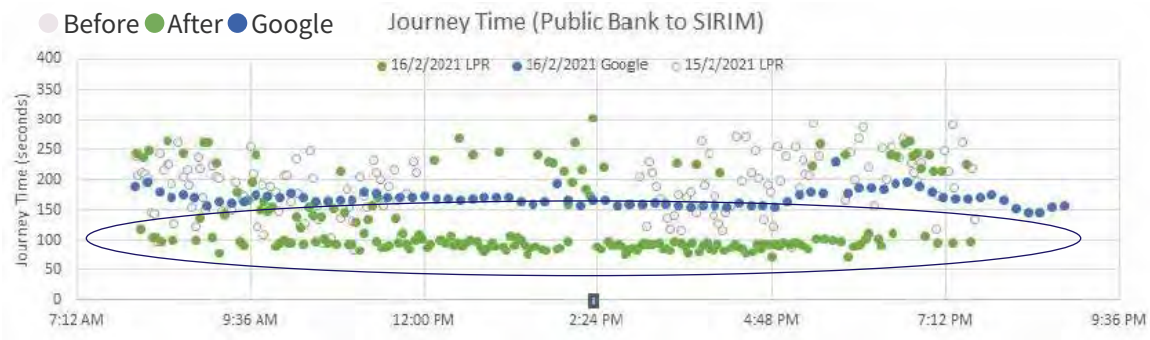




Real-time Flow Analysis | Synchronization | MGMT Center

Result

From a real-world validation project deployed in Southeast Asia, it was proven that an average of 33.5% reduction on travel time of vehicles was achieved. This result is better than the commute time predicted by a search engine giant using an app on the smart phone. Also, the improved traffic experience especially in downtown areas provided invaluable relief to drivers by avoiding time wasted in chaotic traffic.



The Leading Manufacturer of AI Camera
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