



WHITE PAPER

# SMART INTERSECTION SOLUTION

Case Study: Tainan City Government



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## Overview

Intersections can be the most busy and dangerous locations in urban centers. Yet how can we streamline these typically chaotic locations into something safer and more intelligent? The Tainan City Government approached Gorilla to design a smart solution for one of its largest intersections.

## Traffic Convergence

Tainan City in southern Taiwan handles over 1 million vehicles on its streets every day.<sup>1</sup> Pedestrians navigating the city have to deal with unsafe intersections and frequent drivers flouting traffic laws. The Tainan City Government was looking for a way to manage its busiest intersection, ZhongShan–West HuaNan Roads, and make it safer for all users.



**Figure 1 – Tainan City in Taiwan has several converging and complex intersections**

<sup>1</sup> <https://traffic.tainan.gov.tw/FileDownload/FileUpload/20210111183827600516.pdf>

## The Intersection

Located next to the Tainan Railway Station, the Tainan Hospital as well as two popular department stores, ZhongShan–West HuaNan intersection is where five different streets converge. This means managing a lot of vehicle and foot traffic at all hours of the day.

The main problems that traffic officials needed help with managing were:

- **Red Light Infractions**
- **Illegal Turns**
- **Crosswalk Violations**



**Figure 2 – Common Infractions at ZhongShan–West HuaNan Intersection in Tainan**

# Tainan City Goals

Government officials had a tough challenge: there was not enough data to show how frequent these infractions were occurring, and the staffing for law enforcement and parking was not enough to monitor or enforce such violations.

The city turned to Gorilla to devise a smart intersection solution that would address its concerns. The main goals of the government were as follows:



## To Increase Safety

The convoluted intersection needed to work for both pedestrians and drivers and reduce any collisions.



## Obtain Violation Data

Illegal Turns and red light infractions needed to be recorded in detail to determine the extent of the problem.



## Reduce Traffic Violations

Government officials ultimately needed to curb any infractions in order to maintain public safety.

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# Issues & Solutions



## Red Light Infractions

Most of the infractions come from cars or motorcycles trying to cross the intersection despite the light turning red. This occurs in both directions of ZhongShan Road.



## Illegal U-Turns

Impatient motorcyclists who don't want to make a two-stage turn often just make a dangerous Uturn when the light changes.

**IVAs Required:** Vehicle Detection Direction.



## Crosswalk Violations

Crosswalks had multiple infractions occur by motorcyclists: illegally driving across the crosswalk itself, or failing to stop at the stop line and block the pedestrians' right-of-way.



## Unobservant Pedestrians

Some pedestrians would fail to obey the crosswalk signals, while others would not pay attention when crossing the busy intersection.

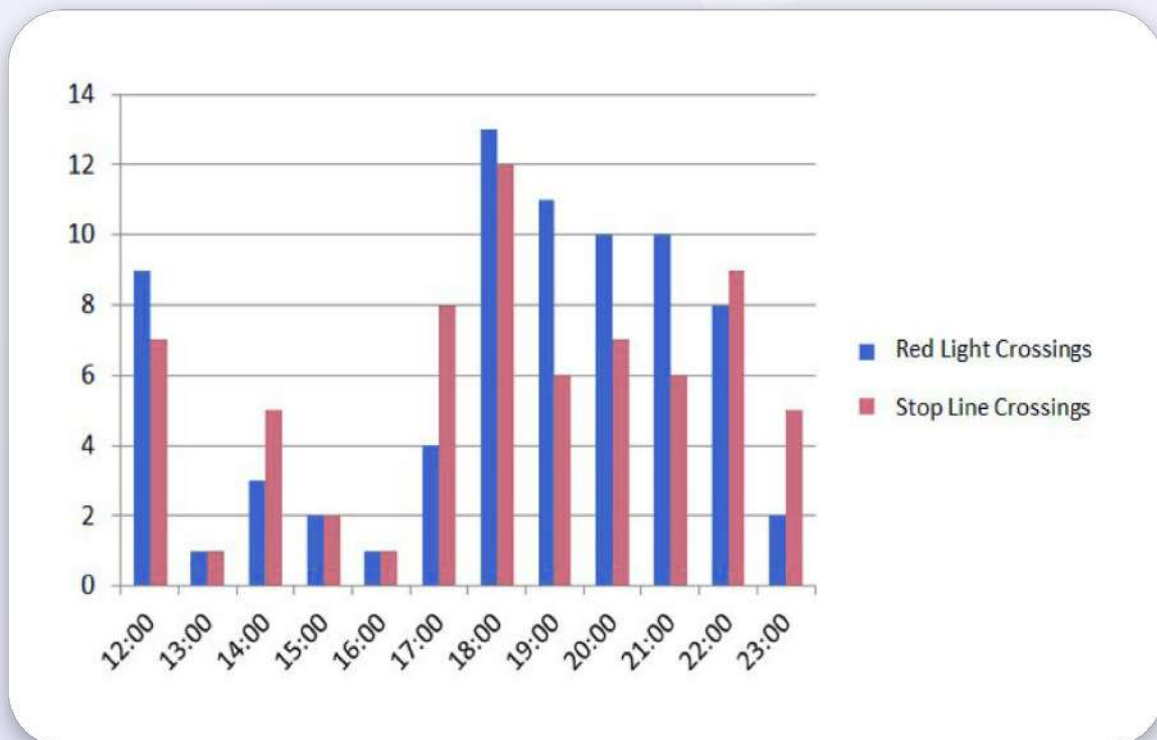
Tainan City Government noticed that there were 4 main areas that needed to be addressed. Gorilla set about designing a system using specific IVAs (Intelligent Video Analytics) for each problem.

## Technical Challenges

The pilot project brought about some technical issues. How to identify a motorbike from a pedestrian or another object? It's difficult to recognize a vehicle in motion. Moreover, the system needed to recognize different kinds of behaviors and types of traffic violations in order to successfully identify infractions. Traffic movements naturally have erratic patterns and this adds a lot of difficulty in accurate detection.

## Tracking Statistics

The initial systems were set up to measure the amount of traffic incidents at the different corners of the intersection. The data captured at the smart intersection showed just how frequently traffic violations were occurring with most infractions taking place in the evening:



**Figure 3 – Statistics indicate the number of infractions occurring at different times of the day**

This gave Gorilla technicians the data needed to figure out where best to deploy the smart intersection components.



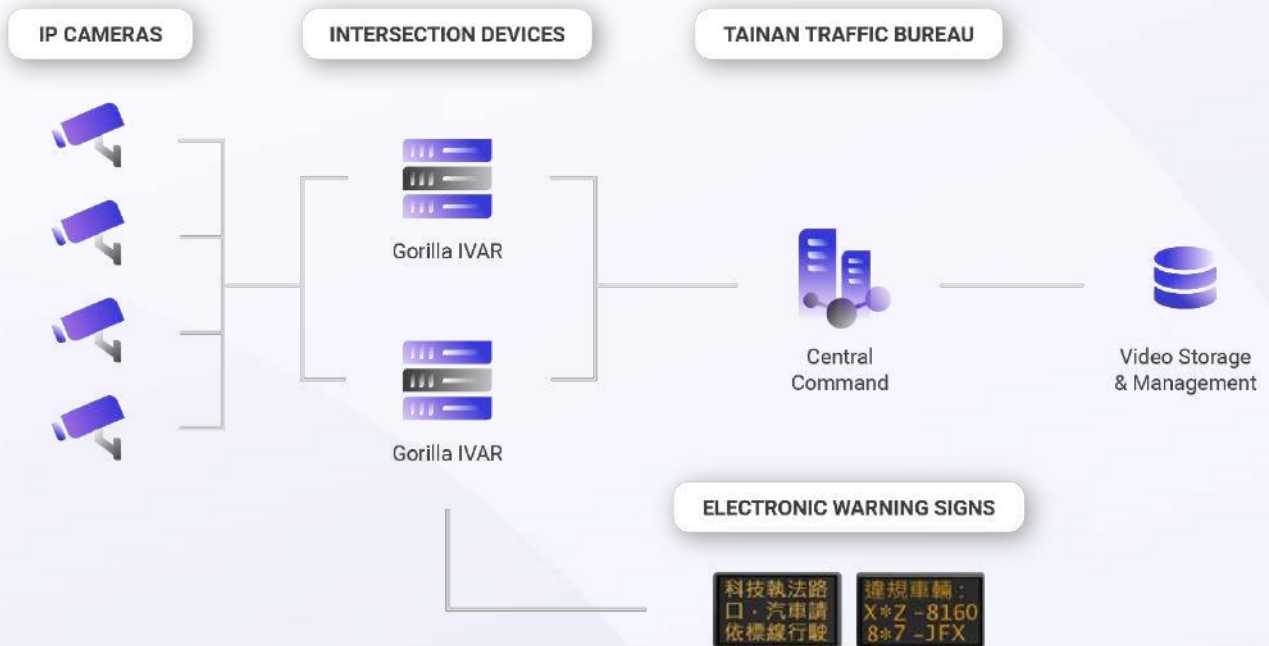
**Figure 4 – Placement of Smart Solution Equipment at ZhongShan–West HuaNan Intersection**

## System Overview

The technical setup of the smart intersection maximizes edge devices and big data and is comprised of the following:

- **IP cameras** to record infractions, follow illegal turns and identify vehicle types and license plates
- **IVAR devices** to perform video analytics on-site
- **CMS digital signs** to present warning messages to drivers and pedestrians
- **Central command Center** to monitor and manage infractions

## SMART INTERSECTION SYSTEM ARCHITECTURE



**Figure 5 – Smart Intersection System Architecture**

Two cameras were used at each red light—one to detect the vehicle type and its infraction, the other to recognize the license plate. The event data would be processed in Gorilla’s on-site IVAR machine and then sent back to central command for further analysis.



**Figure 6 – Placement of Smart Solution Equipment at ZhongShan–West HuaNan Intersection**

A CMS digital sign was used to record an infraction in real-time, meaning it was possible to communicate with the driver to point out their violation.

For example, if a motorcyclist is caught making an illegal turn, then the smart intersection system would detect the event and relay the motorist's license plate number to the CMS sign, so that the driver could see they've been recorded and hopefully curb their own behavior.



**Figure 7 – CMS Digital Signs produced real-time warnings to violating motorists**

In addition, a CMS sign was installed above the crosswalk lights timed to the intersection's stoplights. It would display safety messages to pedestrians indicating special warnings or safety messages directed by the Tainan City Government



**Figure 8 – CMS Warning Signs were also used to direct pedestrian traffic**

## Data Analysis

The smart intersection solution provided critical data that indicated the overall picture of incidents occurring at the ZhongShan–HuaNan intersection. The project also provided law enforcement with tangible evidence of violations, which is useful for prosecution as well as for city planners to design different traffic models.

	Red Light Crossing (North)	Stop Line Crossing (North)	Red Light Crossing (South)	Stop Line Crossing (South)	Illegal U-Turn (North)	Illegal U-Turn (South)	Illegal U-Turn (East)
<b>Average Incidents Pre-Installation</b>	43.2	44.4	80.8	107.8	23.3	82.1	23.3
<b>Average Incidents Post-Installation</b>	27.6	37.7	66.6	93.0	17.7	84.4	17.7

Figure 9 – Average infraction occurrence pre- and post-installation of smart intersection solution

## Result of the Project

The smart solution provided some promising data from its deployment, indicating a more widespread benefit for smart solutions at urban intersections.



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