Cutting Edge Video Detection

An Examination of Traficon's Detection Systems deployed in ITACA in Mumbai, SCOOT in Liverpool and with MOVA at Junction 34 of the M1 Motorway

The Mumbai Experience

The feasibility study to determine the benefits that a fully adaptive traffic control system had commenced in 1995 concluding with a comprehensive technical specification being developed in 1996 providing a dedicated fibre network, general surveillance cameras and replacement of existing traffic signal control equipment at 253 sites. In early 2008 after many years of trying we finally had a contractor in place to deliver a fully adaptive area traffic control system to Mumbai India with a much reduced requirement in terms of transmission and CCTV.

Delivery of the scheme was specified to take place in two phases Milestone I 53 junctions and Milestone II 200 junctions. Milestone 1 was delivered over a 2 year period which included 8 months of the monsoon when restrictions dictate that no civil engineering work shall take place. The Island City effectively a peninsular was originally 7 distinct islands before the British arrived and as such has a high water table. During this time it was noted that inductive loops performed well where there were concrete roads but failed rapidly where the road surface material was asphalt. For this reason it was determined to evaluate an emerging video detection technology as far as adaptive traffic systems was concerned in the form of Traficon's video detector. A visit to Belgium was undertaken where we were particularly interested in both the TrafiCam and TrafiCam x-stream some of these cameras features are as follows:-

- Traficam – a video detector which provides around the clock detection of stationary and moving vehicles.
  - Stop bar and advanced detection (8 detection zones and 16 outputs
  - Field proven traffic algorithms
  - Detection during daytime on vehicles and detection at night on vehicle headlights/tail lights
  - Advanced filtering – shadows headlight reflections unstable camera
  - Fail safe status
- TrafiCam, x-stream – is an integrated camera and detector offering vehicle presence detection (24 detection zones and 16 outputs) and Mpeg4 image compression. This intelligent system provides detection and monitoring of moving and stationary vehicles at signalized intersections via detection outputs vehicle presence information is transmitted to the traffic controller so that signal timing can be adjusted dynamically resulting in reduced waiting time improved traffic flow and less pollution.
- TrafiCam x-stream is an IP addressable video detection Colour streaming video at full frame rate is available via Ethernet or system and traffic monitoring. Users can configure view and control the system both on site – remotely.

It's worth mentioning that the visit to Traficon and the placing of any order was subject to what was found and the level of independent verification which was provided. A series of presentation were made which clearly illustrated:-

- their background;
- a structured engineering approach to product development and delivery;
- their philosophy in the way that they manage and control the quality of their products both currently and how they perceive the product will develop in the future. The company has a unique and genuine philosophy that reflects quality management throughout its various activities.
- All components used are evaluated prior to selection for use with any of the company's products. This includes an evaluation of all cameras currently available in the market place where an assessment takes place and where cameras are rated on a scale of 1 to 5. Any camera achieving a score of less than 3 is not considered for use;
- Camera lenses are assessed on a similar basis where specific criteria are assessed in terms of the usage to which the camera is ultimately to be put to;
- In terms of semiconductors and processors the company ensures that they hold a minimum of 12 months stock to ensure that they have sufficient time to resource new devices should manufacturers cease production of existing components or should new technology emerge which would require changes to firmware;
- In a similar way each products firmware is continually reviewed and updated;
- The company works with universities to ensure that they are always aware of emerging technologies and video detection algorithms;
- The software is configured such that the company is always able to easily integrate changes in terms of functionality with respect to the type of equipment and its performance. Individual software teams develop the software for each application;
- The modular construction of the equipment reflects the ability to be able to accommodate changes easily.

The question of the IP rating of the TrafiCam camera was raised. Traficon had no hesitation in undertaking a demonstration to confirm their confidence in the products IP67 rating. Traficon did this by selecting a unit at random from a batch the camera was placed in a cylindrical transparent container filled with water to a depth of over one metre. The container was then placed in a corridor where people passing could be counted on a monitor in real time. The detector remained where it was for over 24 hours without issue and was still functioning the following day.

Orders were placed for two hundred TrafiCams and five hundred TrafiCam x-streame cameras. Currently, there are >35,000 TrafiCam sensors which are fully operational in over 62 countries.

The ITACA system

The Spanish fully adaptive system ITACA is very much a SCOOT look alike system which was developed by Sianco Traffico with the assistance of an ex Plessey engineer. ITACA has many of the characteristics of SCOOT but has been developed as one might expect in a slightly different manner. Validation is referred to as calibration, STOC values reflect discharge values, vehicles left at the end of green, max queue, journey time and a percentage weighting until correlation exercise reflecting the number of vehicles left at the end of green between street and the model output is achieved.

The placement of inductive loops or video detectors in ITACA follows the same general rules as SCOOT i.e. typically 110 meters from the stop line and at the mouth of the junction for the identification of turning vehicles. Link diagrams and Sub Areas and Regions are also defined.

Mumbai and India generally are a traffic engineers dream in terms of saturation flow discharge. This is because drivers make use of every bit of road space and will not join a long queue they will join the shortest queue so maximum stop line discharge is always achieved. However, someone once wrote a paper reflecting the benefits of flaring stop line widths but whoever read the paper in Mumbai failed to take note of the need to continue this flare for a significant distance on the downstream discharge side. As a consequence in many areas this just produces a bottle neck.

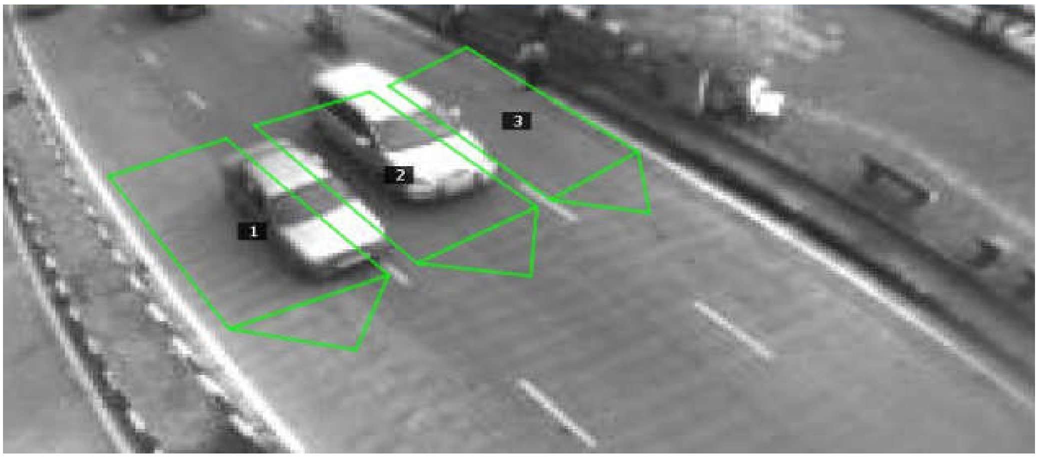
There is a fully equipment control centre located within the Traffic Police Headquarters at Worli on the western side of the Island City. It is worth mentioning that the Traffic Police have a responsibility as defined by the 1897 Traffic Act to ensure the highways is clear for the passage of people of goods and to this end they look after the movement of traffic. The Municipal Corporation have their own control room with similar facilities where they are responsible for the maintenance of the system and overall management of the systems.

The decision to procure and deploy video detectors has proved beneficial in that throughout the 1st Monsoon periods covering June through to September 2010 and this years monsoon to date has not resulted in any failures of equipment.

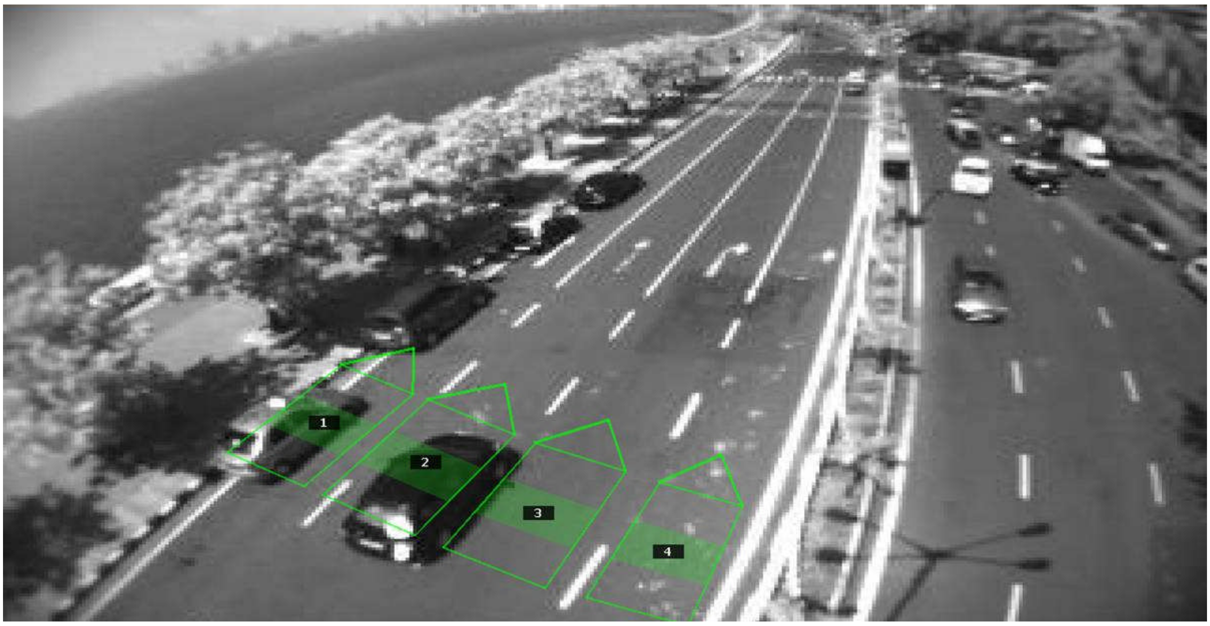
Defining the zones of detection for links was key to ensuring the accuracy of count information for the adaptive system. One of the many problems in Mumbai is that pedestrians cross even where there are no formal facilities so ensuring that locating video detectors where there were no pedestrian desire lines was a key consideration. But by no means achievable.

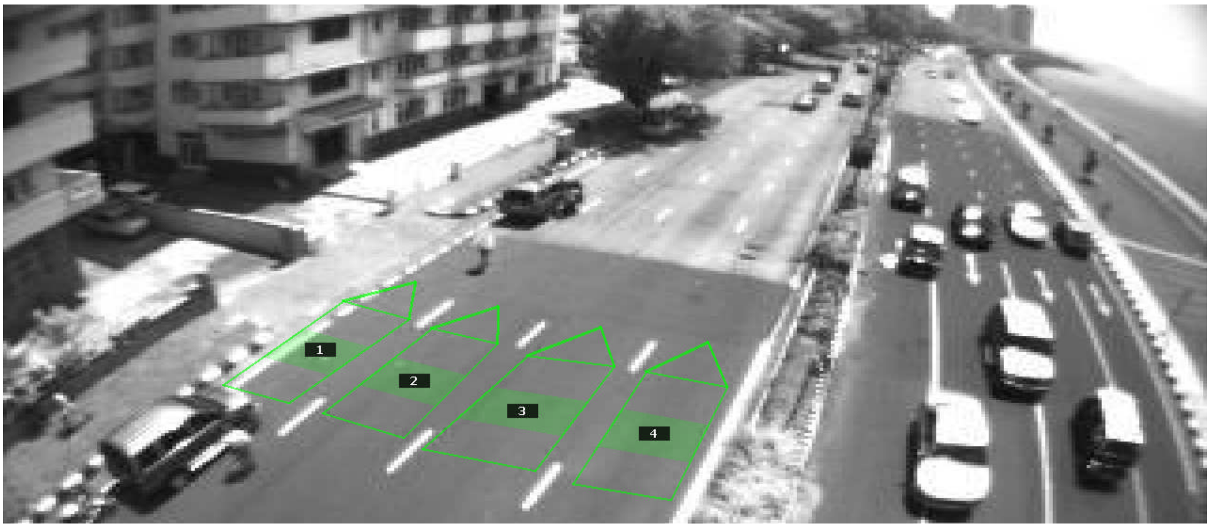

As this is a problem that is nearly impossible to resolve particularly on side roads bisecting residential areas and one not normally encountered particularly in the UK however, in Mumbai it is common place to find pedestrians walking in the road. I perceive that for the Asian Market Traficon may have to develop a further algorithm to identify pedestrians and not count them.

Alternatively on faster roads pedestrians do not normally reflect this problem as traffic is moving much faster as along Marine Drive pictured below where there are three lanes in each direction and vehicles speeds are in the range of 50mph.

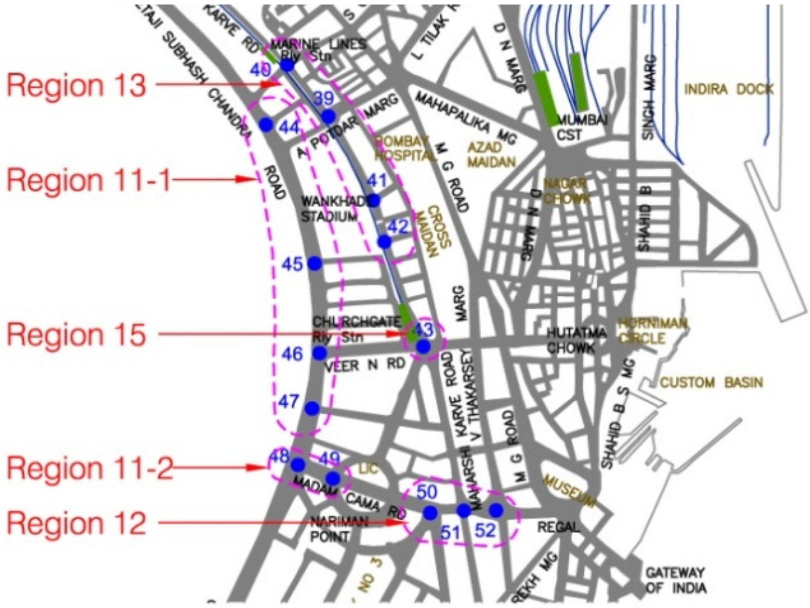


Outlined above is an illustration of this Marine Drive location of a typical video detector position and the associated configured zones of detection.





An Example of Network Performance

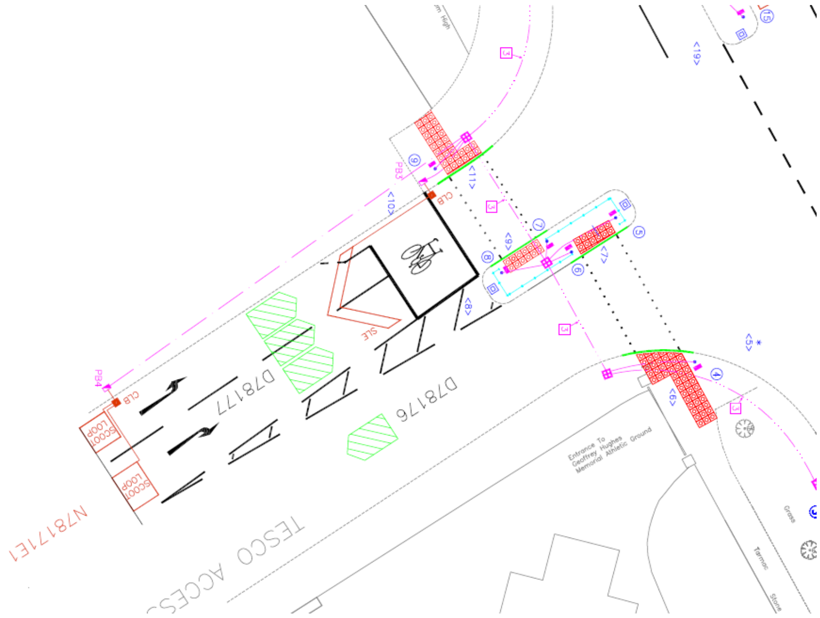


	Region 11-1		Region 11-2		Region 12	
	Jn- 44,45,46,47		Jn-48,49		Jn-50,51,52	
	Before	After	Before	After	Before	After
8 to 9 AM	120	85	120	85	120	85
9 to Midday	150	130	150	100	150	85
Midday to 5PM	150	130	150	130	150	90
5 to 8.30PM	140	120	140	115	135	85
8.30 to 9.30PM	110	100	100	95	100	85
9.30 To 11 PM	110	90	100	85	100	85

Here is an illustration in the variation in cycle time that has been found in the central business district of the Island City. One of the major problems in Mumbai is that there are no parking restrictions other than within the immediate proximity of the mouth of a junction. The other major irritation from a traffic engineering perspective is the number of "U" turning vehicles that one finds at every junction.

Resolving an Issue with SCOOT

There are probably many examples of where this approach of the use of video detection could be used to overcome specific problems and to get SCOOT performing more effectively. This specific example reflects a typical small supermarket where the car park exits are short typically reflecting two lane exit and one lane entry. Where also the SCOOT point of detection is often less than 60 to 80m from the stop line due to multiple feeds to and from the main car park or where a petrol station is close to the exit: this presents a problem for efficient SCOOT control.



When a link is over 50% full, SCOOT begins to believe that the link is congested and the loading percentage starts to build up over successive cycles. The positioning of the loop in these situations is critical particularly if the loop is just a single loop, not unidirectional then dependent upon the location incoming vehicles can be counted as outgoing. In such situations where there may be say 6 vehicles present in successive cycles SCOOT can believe that it is congested adjusting the green splits to the disbenefit of the main road where the time is really needed. Typically those 6 or so vehicles would normally clear within the minimum green period so any additional green time given by SCOOT to that stage can be effectively lost time. The issue is therefore to ensure that a more accurate picture is presented to the SCOOT model so that this situation is avoided.

At peak shopping times Thursdays, Fridays and weekends the car park exist handles an increased volume of traffic and, if not identified early as a problem can lead to long delays for vehicles exiting and entering the car park and other vehicles on the main road as a result. Complaints of “ice cream melting in the boot” are often heard on warm days.

A solution developed by applying a little thought and by utilising a TrafiCam as a virtual count detector sited on the offside duplicate primary signal pole of the car park exit in a position which faces into the car park it was possible to monitor the entry and two exit lanes effectively. Adopting this approach permitted the count information to be fed back into the UTC system and monitor effectively the car parks occupancy at any time.

From experience, we note that shoppers generally spend between 1 and 1.5 hours doing their normal supermarket shop and that once the car park fills to over 250 vehicles, its time to do something to avoid adversely impacting the junctions overall performance. At this point, a COMET strategy implements a higher importance factor beyond its normal value of 1; CGIF values range form 0 – least important, to 7 – maximum importance.

At this point a Comet strategy implements a higher congestion importance factor to the link controlling the car park exit road of 5. Should the occupancy reach over 320 as measured by the video detector then the Comet strategy manager automatically raises the congestion importance factor to 6. When then the occupancy reduces the strategy manager automatically reduces the CGIF accordingly or, if the level failed to reach 320, it will be returned to its normal value of 1 once the occupancy falls below 250 for at least 5 minutes.
The logical conditions therefore are:-

- Occupancy below 250 – no action
- Occupancy between 250 and 320 – CGIF set to 5
- Occupancy above 320 CGIF set to 6 and if
- Occupancy level of 320 not reached CGIF returns to 1 after occupancy drops under 250.

This may seem strange but it isn't. For example in the am peak traffic from the supermarket is light but can easily be 6 or more vehicles on recurring cycles. This can equate to the exit link being more than half full with the result that SCOOT starts to demand more green time which is at the expense of the main road so adopting this approach prevents SCOOT seeing this problem. If we were to restrict SCOOT by say imposing a low max stage time in the event that the store got busier with a resultant high level of vehicle throughput SCOOT would not be able to respond at all.

As the store gets busier with a resultant higher level of vehicle movements SCOOT does need to respond and increase the time to deal with this change. The question therefore is how we manage the change between SCOOT being able to determine the correct way to respond to the change in traffic flow. The operator could make a judgement and utilise a timetable event however we are moving away from timetables in favour of real time dynamic response based on logical statements in the strategy manager of COMET which is simple to program and implement. The strategy looks at the current occupancy levels and we know from experience the trigger level of vehicles in the car park that leads to increased outflow. The TrafiCam accuracy in counting vehicles entering and leaving is key to the success of this implemented solution.

By adopting this strategy we manage SCOOT effectively ensuring that when the car park is less than half full additional time is not unnecessarily taken from the main road and the cycle time and green splits are managed efficiently through the strategy manager.

M1 Junction 34

Change from Fixed Time control to that of MOVA

In the last few months telent in association with the North East TechMAC have implemented changed the existing controller infrastructure at M1 Junction 34 north from Fixed Time control controlled from Sheffield to that of MOVA. The overall site was upgraded and in preference to inductive loops video detectors were installed as is illustrated in the photograph below.

Trafficam's have been installed as can be seen above on the centre span of Tinsley Viaduct linking both exist arms of Junction 34 of the M1. The site has only been operational for a short period but has shown more dynamic responses to variations in traffic patterns that did the former Fixed Time control strategy. However the Sheffield UTC section have observed That the video detection on the middle deck has performed very well. Cycle times at the site are on occasion much lower and queues are shorter.

It has been observed that there has been the odd unexplained formation of congestion and Sheffield UTC reserve judgement on the MOVA set up until after the summer sales, lead in to Christmas and the January sales before stating that the implementation of MOVA has been a success.

However as can be seen from the illustration below there are clear indications of the sensitivity of the video detection zones as is shown by the slide on the right hand side where the vehicle is almost straddling the centre line and has not activated the offside lane detection zones.