Developments in red light safety camera technology: reducing costs, increasing safety.

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Abstract

The safety benefits of automated enforcement has been well documented with jurisdictions across Australasia using red light and speed safety camera to improve the safety of their roads. Redflex Traffic Systems has been at the forefront of the development of automated photo enforcement systems, improving the safety of communities worldwide through the adaptation of digital technology. The Australian based Research and Development team at Redflex have now developed world leading radar technology that eliminates traditional reflectivity issues, therefore enabling it to be deployed in built up areas. This radar has been incorporated into a new non-intrusive red light/ speed system that produces prosecutable images that are comparable to evidence produced by in road sensors. Along with the safety benefits derived through automated enforcement, by using non-intrusive technology, jurisdictions can reduce costs significantly. With non-intrusive systems there is no longer the need for costly civil works cutting into the road to lay sensors during implementation. With no in-ground sensor the maintenance costs are also reduced. This presentation provides a high level overview of the new technology used in non-intrusive red light/ speed safety cameras, allowing those non-technical delegates to have a basic understanding of how the systems work and the benefits that they can bring through cost reduction and road safety.

1. Introduction

Redflex Traffic Systems has been at the forefront of the development of automated photo enforcement systems, improving the safety of communities worldwide through the adaptation of digital technology.

The Australian based R&D team at Redflex have now developed world leading radar technology that eliminates traditional reflectivity issues, therefore enabling it to be deployed in areas that were previously problematic. This radar has been incorporated into a new non intrusive red light / speed system that produces prosecutable images that are comparable to evidence produced by in road sensors.

Along with the safety benefits derived through automated enforcement, by using this non intrusive radar technology, Jurisdictions can reduce costs significantly. This paper aims to provide a high level overview of this new technology used in non intrusive red light / speed safety cameras, allowing readers to have an understanding of how the systems works and the benefits that they bring though cost reduction and road safety.

2. Red light running

2.1 Why red light safety cameras are needed.

Traffic lights are installed at intersections to allow for the safe passage of vehicles through the cross road. Vehicles with a green light are free to travel through the intersection and do so

with the expectation that traffic will not come through from the other direction. Vehicles with a red light are required to come to a complete stop. The majority of drivers follow these road rules, but there are those that consciously make the decision to not stop, or through poor driving miss the signal to stop, creating the problem of red light running.

When a driver ignores a red light and proceeds through the intersection, the safety consequences of this action are considerable. With traffic free flowing in the other direction, the probability of a front into side collision (T-bone) is high. The injuries caused by a side impact collision are severe and with high speeds usually involved in the collisions, fatalities are common. The side door area of a vehicle lacks the substance needed to absorb the energy of a high speed crash. Even in a car with side airbags, it's difficult to completely safeguard passengers from a side impact crash. The limited material between the side of the vehicle and the vehicles occupants means that the front end of one car can actually enter into the passenger compartment of another.

2.2 Red light running enforcement

Human behaviour traits dictate that the higher the likelihood of apprehension for red light running, the higher the compliance levels of drivers to stop on a red light. To see a long term change in driver behaviour the likelihood of apprehension needs to be constant. The enforcement of red light intersections falls typically to local police and government transport departments, but police are just not resourced enough to be able to man every dangerous intersection at all time of the day and night.

Automated red light enforcement systems function efficiently 24 hours a day, 365 days a year, capturing those dangerous drivers that break the law by running a red light. These automated systems allow for the enforcement of both red light and speeding violations, changing driver behaviour with the number of violations reduced over time. Those drivers that do break the law initially are far less likely to reoffend after they have been issued with an infringement.

3. <u>The results of enforcement</u>

There are a number of globally published studies conducted by respected research institutions that support the use of red light safety cameras to reduce incidences of red light running. In the United States of America, a study into the effectiveness of the use of red light cameras across major US cities (Institute for Highway Safety,February 2011) found that red light cameras saved 159 lives in 2004 – 2008 in 14 of the biggest US cities. Alarmingly it was also found that had these cameras been operating in all large US cities, a total of 815 deaths would have been prevented.

Closer to home red light running crash risks in the Auckland CBD were a serious concern for the Auckland council. The council along with a number of other road safety stakeholders conducted a trial of red light enforcement using safety cameras, commencing in 2006 to assess if the technology was an effective means of reducing red light running crash risk (Auckland Transport, July 2011).

The results of this trial listed in the executive summary were very encouraging and support the use of red light safety cameras. These findings included:

- An average 43% reduction in red light running behaviour at the red light camera sites
- An average 69% decrease in red light running crashes at the red light camera sites
- An estimated 32% reduction in rear-end crashes at red light camera locations
- An estimated 93% reduction in the social costs of crashes at red light camera sites

These are just two of the many examples of research available that supports the use of red light safety cameras, and quantify the benefits of this automated enforcement.

4. Technology Overview

4.1 Traditional red light enforcement systems

Traditionally, in ground sensors have been looked upon as the most accurate and reliable form of detection for use in not just red light, but all types of enforcement systems. Piezo sensors are placed into the road, with inductive loops used in conjunction as a secondary verification method to accurately detect any vehicles passing over the sensors and detailing things such as the classification and speed of the vehicle.

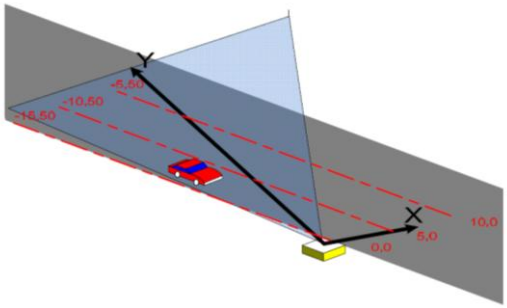
For red light enforcement these in road sensors interface with digital piezo and loop cards and phase information from traffic lights to detect vehicles that enter the intersection after the light has turned red. This then triggers the high resolution camera to capture an image of the incident for prosecution. A flash unit enables the system to capture images of offenders in all lighting conditions, and ensure that number plates are clearly visible for prosecution. Along with the standard plate shots images of the offending, additional images of the vehicle entering the intersection and continuing through are captured to ensure that there is no doubt that the vehicle has run the red light/violated. Video footage can also be recorded as secondary evidence. All of this information is collated into an incident file and encrypted for secure transferred and processing.

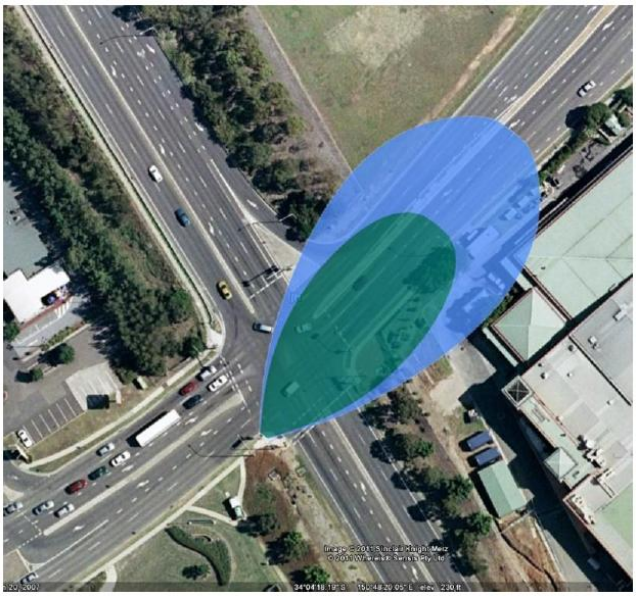
4.2 Non intrusive radar detection

For non intrusive enforcement, Redflex uses the REDFLEX– MR mapping radar and Redflex SMARTcam. The combination of this technology eliminates the need for inroad sensors as the two work together to accurately detects vehicles and incidents.

4.2.1 Radar

The REDFLEX– MR radar tracks the speed and X,Y,Z position of each vehicle travelling along the road. This primary radar is mounted forward facing towards the traffic, ideally at a height range between 3 and 6 metres and between 25 to 50 metres from the intersection. With vehicle tracking over a wide area by the REDFLEX– MR radar, it enables enforcement across large intersections with multiple lanes and identifies target vehicles in specific lanes.





An additional rear facing secondary radar is added to the system if there are requirements for vehicle length determination, vehicle classification and as a recorded speed enforcement crosscheck. The secondary radar is rear facing and installed within the camera enclosure. All radar data for the detected vehicle is saved within the incident and can be analysed by authorised persons at a later time.

In the past there have been reservations in using radar for non intrusive detection as older radar technology was subject to problems with reflectivity in built up and populated areas. Radio waves bouncing back off the target vehicle could sometimes bounce off other objects, distorting results.

The complex filtering algorithms used by the new generation Redflex radars detect and remove reflections enabling the system to be used in built up areas such as inner city intersections, tunnels and gantries. Unlike laser enforcement, this radar system also has all weather capabilities, it is unaffected by rain and poor weather conditions.

4.2.2 Detection

Redflex's SMARTcam software enables a virtual detection line or series of lines to be 'drawn' on the road. When a vehicle being tracked by the REDFLEX-MR radar crosses the virtual line SMARTcam triggers the camera to take a photo of the vehicle. An 11 mega pixel camera is used to capture the incident, producing high resolution prosecutable images that easily indentify the offending vehicle. Like the previous systems all of the data is transferred as a single incident file for the next stage of processing and verification.

This innovative technology also allows for more substantial enforcement opportunities other than just red light running being detected from this system. This includes the detection of violations such as:

- Speeding
- Pedestrian Crossing
- Gridlock Enforcement
- Cars straddling lanes
- Improved detection of motorcycles
- Improved detection for right turn on red

The non intrusive red light enforcement system is made up of:

1. 11MP Camera
2. REDFLEX-MR Radar
3. Computer (in roadside cabinet or camera housing)
4. Flash
5. Video (optional)
6. Light Weight Camera Housing

5. Results

5.1 Performance results

Data gained from systems installed in the USA have shown the increased performance of the new Redflex non intrusive radar detection over the traditional loop / sensor detection. Internal Redflex research has found that:

Red light running enforcement: average of 25% more detections than loop systems
Right turn on red enforcement: 150% more detections than loop systems
Speed / point to point freeway enforcement: 98.9% detection rate

5.2 Cost Savings - Installation

Installing a red light enforcement safety camera system that uses in ground sensors requires the closure of roads / lanes to allow workers access to the road surface. Civil contractors are required to cut into the road surface to lay the sensors, and with this work occurring outside of peak traffic times the cost for manpower and services can be expensive, especially in multi lane intersections.

In addition to the installation, if the road surface is cracked or in poor condition prior to the install, the road will need to be resurfaced; otherwise the road / loops will break. If there are any problems with the sensors, or the positioning of them, again the roads / lanes will need to be closed with contractors required to recut the road surface. All of these things incurring additional costs.

In comparison the installation of non intrusive radar systems is a much simpler task with a significantly lower cost. All works are conducted on the road side, and in some cases can be attached to existing infrastructure where suitable.

5.3 Reduction in crashes

The reduction of vehicle crashes has an obvious and dramatic human effect with lives saved and quality of life improved due to a decrease in the severity of injuries, but there are also well documented cost savings. Any vehicle crash has associated financial costs, and these costs increase in proportion to the severity of the crash. The estimated economic cost of road traffic crashes in the year 2000 was approximately $518 billion (USD) (World Health Organisation, 2011). In reality, vehicle crashes and road trauma are a preventable health issue with costs impacting government services such as hospitals, ambulance, police and other emergency services.

With the increased performance of the non inductive radar systems, the reduction in frequency and severity of red light running crashes has a flow on affect with costs savings to not just the government/jurisdiction but also individual households. These cost benefits also impacts on things such as:

- Lost labour / Workplace disruption
- Long term care and medical costs
- Travel delays
- Insurance administration
- Legal services
- Vehicle repair

6. References

Auckland Transport, July 2011, "Auckland Red Light Camera Project"

Insurance Institute for Highway Safety, February 2011, "Effects of Red Light Camera Enforcement on Fatal Crashes in Large US Cities"

World Health Organisation, September 2011, http://www.who.int/mediacentre/factsheets/fs358/en/index.html.