Introduction

The proposed solution is a sophisticated vision-based License Plate Recognition (LPR) system that identifies and tracks number plates on vehicles travelling at low to high speeds. The system can integrate multiple lanes and multiple cameras per lane on a single standard PC system.

This project is a showcase in world-class transportation planning and the development of comprehensive solutions for modern evolving cities.

Enforcement – heavy, visible, with follow up of fines and identification of repeat offenders.

Education and communication - Emotive advertisements, showing consequences of unsafe behavior, and dealing with a single common offence at any one time, with a public relations campaign to ensure support of communities for the efforts being made.

Engineering – low cost engineering at hazardous locations to have the highest possible impact, a substantial amount of which must be aimed at protection of pedestrians.

Evaluation – research to ensure a data driven, scientifically based strategy.

Cooperation and Coordination between all role players, and involvement of business and industry and civil society
Intelligent transportation systems

Intelligent transportation systems (ITS) is a system of hardware, software and operators that allow better monitoring and control of traffic in order to optimize traffic flow. As the number of vehicle lane miles travelled per year continues to increase dramatically, and as the number of vehicle lane miles constructed per year has not been keeping pace, this has led to ever-increasing traffic congestion. As a cost-effective solution toward optimizing traffic, ITS presents a number of technologies to reduce congestion by monitoring traffic flows through the use of live cameras and in turn rerouting traffic as needed through the use of variable message boards (VMS), highway advisory radio (HAR), on board or off board navigation devices and other systems. Additionally, the roadway network has been increasingly fitted with additional communications and control infrastructure to allow traffic operations personnel to monitor in real time, as well as intelligent systems such as automated license plate recognition systems which help to automatically update VMS.

Benefits of video detection:

A high detection rate and a very low false alarm frequency makes the proposed system highly reliable and a great help for traffic operators

The industrial set-up in a 19'' rack, with Video Image Processing (VIP) detectors, is compatible with both centralized and decentralized detection systems

State-of-the-art video detection algorithms perform under all weather and lighting conditions

Open architecture makes it possible to integrate into existing traffic management systems without high costs

Easy maintenance and a low overall lifetime cost

Easy to install, easy to adjust to changing traffic situations, easy to extend and easy to update to additional traffic requirements

Incident detection and alarms can be fine-tuned to meet customized application requirements

Faster detection means a faster reaction and a better chance of preventing secondary incidents

Our road safety management systems have had far-reaching positive effects on driver behaviour, as the very presence of the technology serves to deter lawlessness on the roads. They have also increased the local authority's effectiveness in the collection of fines.

Once installed, the system typically records a massive number of violations, but these drop off markedly as the camera quickly affects drivers' behaviour. Reports indicate that in certain instances the number of reported accidents has dropped by as much as 30%, and in some areas the fall off in violations has reached 20% of the original offences
LPR

The Need for ANPR: As new technologies become available to law enforcement agencies around the world, the climate for offenders look set to become particularly uncomfortable, and Automated License Plate Recognition (ALPR) will become one of the first technologies they are likely to encounter as it increases law enforcement efficiency manyfold.

As the number of vehicles using the roads increases in a seemingly uncontrollable fashion, it becomes inevitable that any task requiring vehicles to be identified individually on the open road, can no longer be accomplished manually. The speed of vehicles and traffic density ensures that no human observer can read and note down number plates quickly enough to record all passing vehicles. Furthermore, the search for one particular vehicle from millions of vehicles of interest cannot be achieved manually. It automates a labour intensive task and is more accurate and reliable.

LPR is a non-intrusive, computerised method of capturing a licence plate and comparing it to a database of registration numbers. LPR systems consist of one or more cameras, in this case Internet Protocol units designed for high-speed LPR, connected to a PC running LPR software, proprietary to I-Cube, which controls the system, reads the images, analyses and identifies the plates.

This interfaces with a custom-developed average speed determination application and a database.

‘Huge advantage’

“The ability to interface into multiple data sources in real-time gives the LPR system a huge advantage over current techniques. The minimum requirement for LPR would be an image, the I-Cube software and a processing system to provide the results,”
Incident Management

In the unfortunate event of an accident occurring, it is essential that medical and rescue services are promptly notified and all activities are well co-ordinated and the required protocols are adhered to. This discipline consisting of well defined protocols is referred to as Incident Management System (IMS). The required IMS protocols along the route must be developed with all stakeholders. The proposed technology is key in supporting and assisting with the co-ordination of all services to ensure effective notification, response and co-ordination of medical and rescue activities between the Central Communication Centre, the Emergency Medical Services, Fire and Rescue, the Route Traffic Inspectorate, the Police Services, heavy vehicle operators, towing operators, chemical spill clean-up companies, and other service providers.

The IMS protocols not only includes Incident detection and notification to a regional Central Communication Centre but also manages the response by the emergency services to the scene of an incident, the on scene management, scene rehabilitation as well as incident debriefing with all roll-players.
Rush hour policies

Some cities adopt policies to reduce rush-hour traffic and pollution and encourage the use of public transportation. For example, in certain cities each vehicle has a specific day of the week in which it is forbidden from travelling the roads during rush hour. The day for each vehicle is taken from the license plate number, and this rule is enforced by strategically positioned traffic cameras backed by computerized image-recognition systems that issue tickets to offending drivers.

A special lane (called an "HOV Lane" - High Occupancy Vehicle Lane) that can only be used by cars carrying two (some locations-three) or more people, and several cities offer a public telephone service where citizens can arrange rides with others depending on where they live and work. The purpose of these policies is to reduce the number of vehicles on the roads and thus reduce rush-hour traffic intensity.
Speed limits

The higher the speed of a vehicle, the more difficult collision avoidance becomes and the greater the damage if a collision does occur. Therefore, many countries of the world limit the maximum speed allowed on their roads. Vehicles are not supposed to be driven at speeds which are higher than the posted maximum.

To enforce speed limits, computerized speed-measuring devices spread automatically detect speeding drivers and take a photograph of the license plate (or number plate), which is later used for applying and mailing the ticket.

Another interesting mechanism that is now possible with this technology is a green wave, which is an indicator that shows the optimal speed to travel for the synchronized green lights along that corridor. This encourages drivers to travel at the posted limit in order to minimize stopping.

A system of camera speed timing will be introduced at particular hazardous areas. There has been a pilot on the N3 in Kwa Zulu Natal, and speed offences dropped from 18% exceeding the speed limits, to around 2-3%.

Violators caught via the red-light cameras will receive a notification through the mail along with the two photographs for evidence. They can then review a video clip of the entire sequence online and pay the fine through the Web site or mail.
Turning

Vehicles will often want to cease to travel in a straight line and turn onto another road. The vehicle's directional signals (blinkers) are often used as a way to announce one's the intention to turn, thus alerting other drivers. The actual usage of blinkers varies greatly amongst countries.

The proposed technology allows the use of blinkers to be monitored and a fine issued if not used.
Red light violation technology

Red light violation technology has been dramatically effective in modifying driver behaviour. The installation of such systems initially resulted in a 30% drop off in violations. It has also produced significant revenues for councils - at zero capital expenditure for these councils - while effectively tracking the evidential trail for traffic authorities.

The technology operates using digital technology and therefore requires no film. Unmanned fixed equipment is installed at the roadside where traffic violations are automatically detected by the system using appropriate road sensors.

The system detects speed violations during the green and amber phases, and also detects red light violations. Multiple images are captured, the including a zoom shot showing the vehicle number plate, a wide angle image including make, model, colour of car and the offence data and wide angle images showing the time delay between frames. These images can be used as evidence to show that the vehicle was moving at the time of the recording.

Digital cameras record data relating to the offence and save the information along with the images that are taken. This data will vary according to the specific type of enforcement system installed. Information recorded with violation images include;

- Site Identification, Name and Location
- Date and Time
- Lane and Head Number
- Offence and Frame Number
- Time into Red
- Previous Amber Time
- Speed

This information is encrypted, protected with message authenticated codes, and then stored ready for subsequent transmissions to a central computer.

Changeable operational parameters include:

- Speed threshold
- Time into Red
- Selection of Specific Time Frames for Operation
- Statistics
Survey of Traffic usage

Systems alarm.

The state of traffic signals is continuously monitored and their on time recorded by the system. When the red aspect is detected, a timer is started. When this timer exceeds the programmed time into red all moving vehicles detected proceeds to violation capture.

This image shows a red light violation

The speed of vehicles passing through a monitored section of carriageway is measured. As soon as a timing reading is received from the timing processor, it is checked for accuracy, sequence number and validity and converted to a speed using the stored sensor spacing. If the measured speed exceeds the programmed speed threshold, images of the offending vehicle are sent for processing.

Encryption: By using key encryption codes for encryption an image is transformed into random data, ensuring the nature of the data is unrecognisable to an unauthorised observer. This makes it totally impossible to select or alter any part of an image or even to monitor it, which allows for maximum security.
Transmission: By using digital technology this allows the data to be collected and transmitted automatically with minimal delay, normally within seconds of the offence occurring, over a data network. Once the data is encrypted it can be transmitted to the back office via any communication protocol.

PSTN / ISDN

ADSL incorporating Satellite, Fibre and Microwave Radio Communication Technologies.

GPRS / 3G

The software is designed to run on a PC with Windows XP Professional operating system. It provides central control and management of the system, with its intuitive graphical user interface the user can be up and running in minutes.

The in station includes the following functions

Automatically retrieves violation image and data from the roadside and stores it in a local database

Allows remote communications with a site to modify operational parameters - for example, time into red

Allows viewing and printout of captured violations

Built-in image enhancement features such as brightness and contrast

Removable hard disc - for example, Iomega Jaz Disk or Optical disk (overseas version)

Automatic Number Plate Recognition

Provides database searches - for example, all red light violations above 10 seconds into red for the previous week from all sites

'Contact Sheet' display permits rapid visual overview of selected sections of database

Produces print-out of notice of Intention to Prosecute via 'hot-links' to standard word processing packages

Retrieves statistical information from the camera site including:

Total vehicle count

Number of violations

Speed Profiles (histogram of average vehicle over time period)

Violation profiles (histogram of violations over a given time period)
Pedestrian crossings

Pedestrians must often cross from one side of a road to the other, and in doing so may come into the way of vehicles travelling on the road. In many places pedestrians are entirely left to look after themselves, that is, they must observe the road and cross when they can see that no traffic will threaten them. Busier cities usually provide pedestrian crossings, which are strips of the road where pedestrians are expected to cross.

Some pedestrian crossings also accompany a traffic signals which will make vehicles stop at regular intervals so the pedestrians can cross. Some countries have "intelligent" pedestrian signals, where the pedestrian must push a button in order to assert his intention to cross. The traffic signal will use that information to schedule itself, that is, when no pedestrians are present the signal will never pointlessly cause vehicle traffic to stop.

Pedestrian crossings without are also common. In this case, the traffic laws usually states that the pedestrian has the right of way when crossing, and that vehicles must stop when a pedestrian uses the crossing. Countries and driving cultures vary greatly as to the extent to which this is respected.

Some jurisdictions forbid crossing or using the road anywhere other than at crossings. The supplied technology can be used for all the above.
Highway code

In many countries, the rules of the road are codified, setting out the legal requirements and punishments for breaking them, including some obligations, but also a lot of other advice on how to drive sensibly and safely. For this second set of advice, it states: *Although failure to comply with the other rules of the Code will not, in itself, cause a person to be prosecuted, The Highway Code may be used in evidence in any court proceedings under Traffic Acts to establish liability.*

The ability to use the cameras in court allow areas outside the rules to be taken to court.

Seatbelts

The proposed solution will allow seat belt enforcement of drivers and passangers.
Live Traffic Cameras

The solution proposed is a revolutionary application for on-line processing of speed and red-light violations that were captured using IP cameras. The application automates the tedious manual process of scanning violation films, extracting the plate registration number, reading the speed and red-light information, verifying the data and issuing the violation fine notice.

This automation allows the municipality to increase the rate of fines issued to drivers while reducing the processing time and expenses.

- Uses LPR for automatic plate recognition
- Includes Site information dialog that defines the details of the camera location
- Includes camera information dialog that defines the current camera connections
- Employs special techniques to improve the image quality
- Sends messages to client applications for automated fine processing
- Writes a log file with all the violation details
- Runs in either automatic-mode or manual-mode (with on-line manual verification)

An example of an actual violation record seen on the web is shown in the following image:
The system started its operation in Spring 2000 in Pretoria - and has since been installed in many other locations. Its first effect was to improve the fine processing cycle time and lowering its overhead by several orders of magnitude. The following chart shows the improvement of fine processing volume over the manual operation (the leftmost bar) by an average factor of X5.

This operation also has a dramatic reduction of traffic violations. An example of reduction in volume of traffic violations (in the corner Potgieter str and Klawer str, Pretoria) is 73% reduction in 11 months - as shown in the following graph. The introduction of the system has reduced the traffic speeds and red-light violations and thus contributed to saving lives on the road.

Due to their success in automation, these systems were installed in many other municipalities.
Traffic Slow

Each camera site can be linked to any other camera site, allowing vehicle average speed to be determined. When this speed is below a set limit, an alarm can be generated allowing possible corrective action.

The average speed can be determined and sent for real time display on the VMS
Traffic Queue

The digital software allows the traffic queue to be measured. Where multiple lanes exist, each traffic lane queue can be measured.
Vehicle Count

Each vehicle is captured and counted.

No license plate

Each vehicle is captured and counted, regardless of the presence of a plate.

The image can be used to alarm and pull the vehicle over.

UNSAFE OVERTAKING

Identify unsafe overtaking and other moving offences. Unsafe overtaking/barrier line offences lead to 17% of the deaths on our roads.
SYSTEM DESIGN

Each intersection would have a number of cameras (9 to 16), connected to a 19I rack via TCP/IP (Cat 5/6). The cameras would consist of:

- At least 2 dome camera which would cover all 4 roads;
- At least 2 high resolution (5 MB) IP cameras per road covering 4 lanes

The PC would run Windows 2000 or XP or Vista, with the I-Cube LPR software.

Each PC would require 8 GB of RAM, as much hard drive space as would be required for the number of days recording (suggested as 1 TB).

Each Intersection would be connected to a central monitoring station via a 2 Mbps fibre optic link.

**Software**

1. NVR 16 Channel LPR Package
   LPR software for up to 16 Cameras

1. NVR Software
   Versatile surveillance software for remote viewing, Instant playback
   Base pack includes 4 camera channel, full support of IP cameras
   Easiest to use, and fastest surveillance software for NETWORK VIDEO RECORDERS (NVR)
   Megapixel Optimization- Megapixel cameras are the latest in cutting edge technology.
   Surveillance software for up to 16 Cameras

**OPTIONS**

1. Database remote update

1. Prosecution Software

1. Vehicle Counting

1. Average Speed Determination

1. Queue Determination

1. Stopped Traffic Option

**CAMERAS**

8. Arecont Vision Day/Night Network Camera
   5 Megapixel 1/2" Progressive Scan Colour CCD, 1.3 Megapixel Monochrome Progressive Scan CCD, Real Time
   Arecont Manual Iris Mega Pixel. 2/3" 12-100mm F1.4-16C
   VideoWise Camera Housing (L375xH117x138W). Use with GL-208 Bracket
Medium Outdoor Aluminum Side Opening Housing, Concealed Cable Entry, Sun Shield, IP65, VideoWise Housing Bracket
Indoor / Outdoor Beige, Wall Mount, Cable Managed, 10kg (Use with GL618, GL-619 Housing)

4 Samsung Colour Speed Dome
22x Optical Zoom, High Speed, Ceiling Mount, 480Tvl, 0.01Lux, 3.6-79.2mm, 10 x Digital zoom, 240deg/sec pan, 150deg/sec tilt, VMD, Alarm I/O 4/3, 128 Pre-Sets, PIP, S/N 52dB.
Samsung Indoor/Outdoor Wall Mount Bracket for 120/220 Housings
Samsung Pole Mount Adaptor for SADT-100WM Bracket

Samsung Dome Housing
Outdoor Cylindrical Wall or Pendant Mount, IP66, Integrated Fan and Heater
VideoWise Speed Dome Camera Power Supply
24Vac, 2Amp for Internal Speed Domes

AXIS 241S Video Server
Four Port, full frame-rate video server, based on Motion JPEG/MPEG4 video. Security package with IP filtering, HTTPS support, multi-level password protection, built-in video motion detection and Watch-dog functionality. Event management

HARDWARE

2 4 U PC Rack, XP, 1 TB HD, 8 GB Mem, Qad core
19I, Raid 5, Redundant PS, Hot Swop HD, DVD

1 0261-021 Axis 243Q Blade Video Server
High quality video at up to 25fps per channel, 4CIF per channel, Simultaneous MPEG4/MJPEG, VMD, Alarm Management, PTZ Control, Hot Swap Blade. (Use with Axis 291 Server Rack, Max 3 Blades per Rack)
0267-002 Axis Rack Mount
Axis 291 1U, 19” Rack mount unit for 3 x Axis 243Q Blade units, Includes Alarm I/O, TCP/IP Connection, PSU

INSTALL

1 Install of HW
1 Install of SW
1 Configuration of HW
1 Configuration of SW
1 Training
Range of equipment and services

Equipment

Permanent monitoring cameras
Permanent Red Light and Speed Cameras
Permanent Cameras that can cover 4 lanes
Automatic Number Plate recognition
Link to alarm lights and sirens for immediate driver feedback
Mountings especially designed for digital cameras
Safety Camera Systems
LED warning systems

Back Room Service

Traffic Management System
Audit process on all violations
Image analysis and processing software
Data capturing software
Viewing Station
Validation Station
Internet viewing
Report structures
Print and post
Collection
Summons served
Call Center
Automatic NPR
Cell alert
Mobile ANPR
National servers

Other Services

Expert evidence
Repair and Maintenance
Installation team for cameras and roadworks
IT department
R & D Department
Calibration
Consulting
Traffic flow surveys
Overload control
Vehicle counting
Training
Project Management
Contract implementation
Contract forensic auditing
Courier Services local and international
Video Production (link)
Photography (link)
Web Hosting
Software

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OPTIONS

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<td>Indoor / Outdoor Beige, Wall Mount, Cable Managed, 10kg (Use with GL618, GL-619 Housing)</td>
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<td>4 Samsung Colour Speed Dome</td>
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<td>1 0261-021 Axis 243D Blade Video Server</td>
<td>$2,774.35</td>
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<td>High quality video at up to 25fps per channel, 4CIF per channel, Simultaneous MPEG4/MJPEG, VMD, Alarm Management, PTZ Control, Hot Swap Blade, (Use with Axis 291 Server Rack, Max 3 Blades per Rack)</td>
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<td>0267-002 Axis Rack Mount</td>
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INSTALL

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LPR@I-Cube.co.za +27 31 764 3077 I-Cube