

***Technical Description***

***For***

**License Plate Reader System**

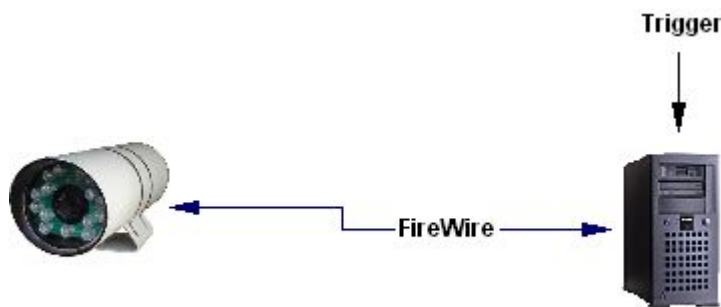
June 2007

***TRANSPORT DATA SYSTEMS***



## 1.0 OVERVIEW

The TDS lane license plate reader system is designed to operate on a PC running either Linux or Windows XP as the operating system. The basic LPR system is shown below. It includes a single FireWire camera equipped with a strobed LED illuminator built into the sealed camera enclosure. The system can be delivered with a TDS provided lane image processor or it can be incorporated into the lane controller by the system integrator. TDS can provide a standard PC or a weatherproof PC for this purpose. In the event the TDS AVC system is also being implemented, the processor that was proposed for the AVC will also be able to accommodate the LPR image capture system.



## 2.0 LANE IMAGE CAPTURE SYSTEM

The Transport Data Systems license plate capture system uses a high resolution digital area scan color FireWire camera capable of operating in the full visible spectrum or in the near IR band.

This camera will provide high resolution lane coverage over a capture area of approximately 10 feet wide by 6 feet high. The size of this coverage coupled with accurate triggering insures that a single image will include the vehicle license plate. While the system is capable of capturing multiple images, TDS experience indicates that this is not required to meet LPR system goals. The resolution of the camera coupled with the low noise performance provides an excellent image for optical character recognition. TDS has developed a companion OCR package for use with this camera.

TDC can also supply the capture system with a monochrome camera equipment with the necessary filters and LED illumination to allow operation in the near IR band. This method of operation provides enhanced plate detection and optical character recognition. The use of IR illumination eliminates the bright lights associated with full spectrum operation. This is especially important when front plates are being captured as it removes the safety hazard associated with blinding the driver of the vehicle. The privacy issue is also addressed as the image does not produce a recognizable picture of the driver. However, during nighttime operation, the image also does not include the vehicle. Only the license plate itself is visible.

The digital video image is transmitted from the camera to a FireWire interface board located in a PCI slot in the processor. This link provides a means for initialization and control of the camera by the processor.

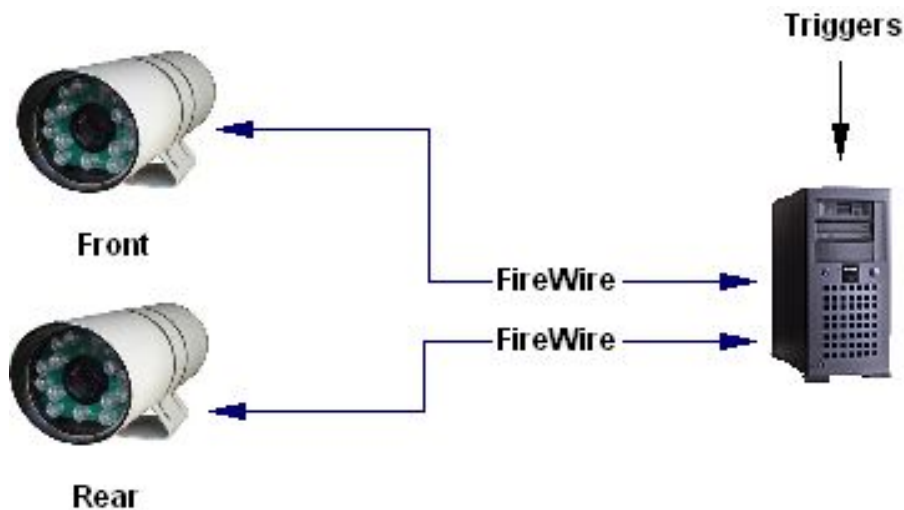
The image capture software provides for the capture of the image and the transmission of the image to the next higher level. The image capture software relies on a trigger input for control of the image process. Further it expects a signal indicating that the most recent image needs to be stored and transmitted to the next higher level for further processing.

Transport Data Systems provides the image capture and camera control software for installation on an Intel© PC based processor. The key to good capture performance in the fare collection environment lies in the ability of the camera control module to adjust the camera operating parameters and the lens opening to cope with various lighting conditions in the lane. The TDS camera control module uses a set of adaptive algorithms that examine image data over a series of time periods to eliminate the need for extensive setup and tuning. When the system is turned on, the automatic tuning process begins. The correct camera and lens settings are determined within a few images after startup. The algorithm then learns the correct camera settings over time with the initial training process being completed within 24 hours. The system is capable of providing better than 90% usable images over an extended period of operations with no further tuning required. The camera control application software is presently in operation on over 600 lanes at various locations throughout the US and the world.

### 3.0 MULTIPLE CAMERAS

TDS can supply the image capture system with one camera for front or rear capture or with two cameras for capture of both the front and rear images. The use of two cameras (front and back) in a single lane will provide a significant improvement in the OCR process and thus reduce the amount of manpower required to process the violations. TDS recommends that the rear camera operate in the visible band and the front camera operates in the near IR band. However in certain areas the color combination of the license plates may render the near IR operation unusable. In this case both cameras would be color.

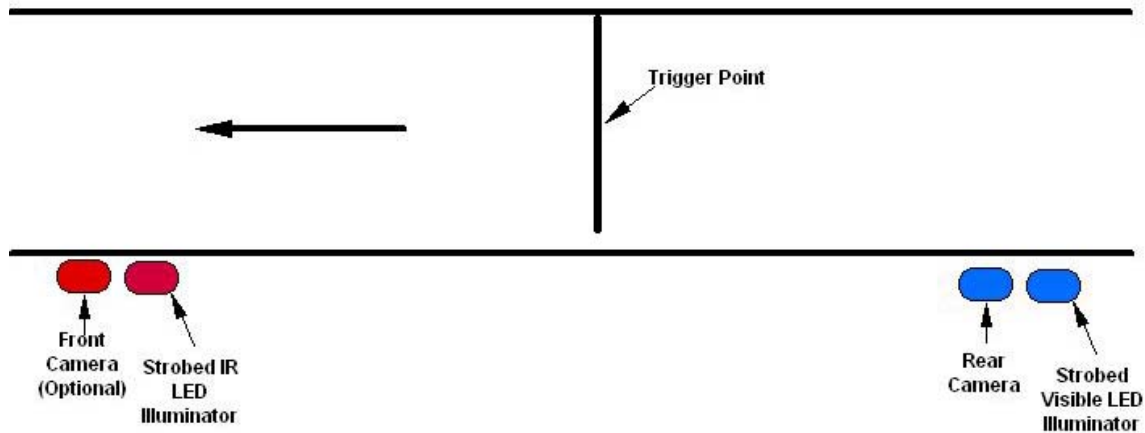
This system is shown in the figure below:



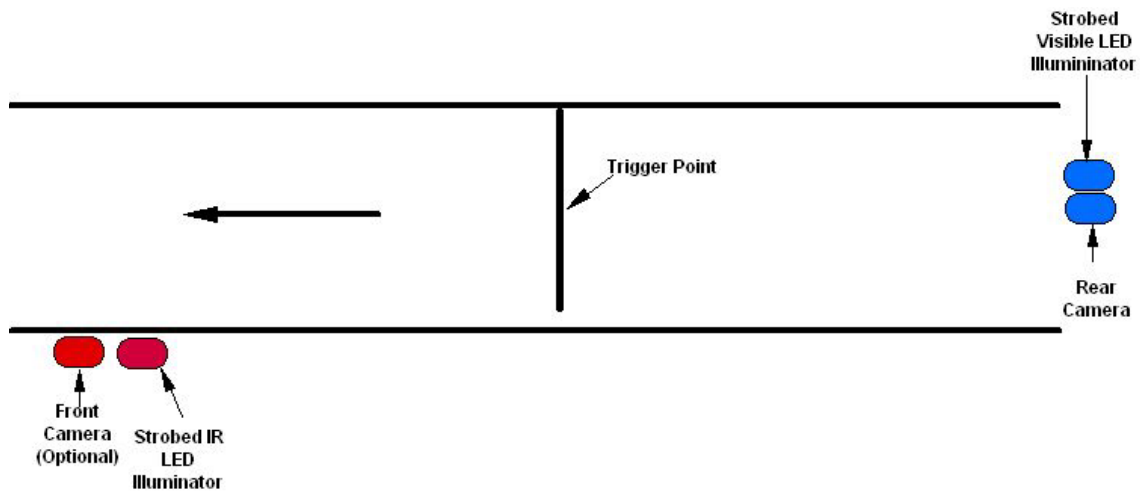
## 4.0 LANE GEOMETRY

The simplest stand-alone implementations are shown in **Exhibit 1; LPR Stand Alone Side Mounted Lane Implementation** and **Exhibit 2; LPR Stand Alone Overhead Mounted Lane Implementation**. Either one or two cameras can be implemented, either overhead or along the side of the lane.

**Exhibit 1; LPR Stand Alone Side Mounted Lane Implementation**



**Exhibit 2; LPR Stand Alone Overhead Mounted Lane Implementation**



## 5.0 HARDWARE DESCRIPTIONS

### 5.1 Camera



TDS designs for license plate capture systems using area scan digital cameras produced by Point Grey. These include the Scorpion and the Grasshopper. The Scorpion is a 1600 x 1200 pixel digital area scan camera with integrated remote camera control, digital I/O, RS-232 interface and FireWire interface (IEEE 1394A). The Grasshopper is a 2448 x 2048 pixel digital area scan camera with integrated remote camera control, digital I/O, RS-232 interface and FireWire interface (IEEE 1394B). Each of these cameras can be set up to operate in the visible or near IR bands. For more information on the cameras, please visit the Point Grey website



### 5.2 Image Capture Board

Each camera is interfaced into an industry standard FireWire interface board.

Two cameras can be installed in every lane and an associated FireWire interface board can be installed in the processor assigned to that lane. A single FireWire interface board can accommodate multiple cameras.

TDS delivers the cameras with a Pelco case and one of a variety of Pelco mounts. TDS also manufactures ring shaped pulsed LED visible and near IR illuminator boards for inclusion inside the Pelco case. These illuminators have sufficient strength to provide the needed coverage at ranges up to 45 feet.

### 5.3 Enclosure



A Pelco enclosure is provided for mounting the camera and power supply. It is a Pelco EH4718-1 Housing. It includes an environmental control unit. Where required, the Pelco SS4718 Sun Shroud is also provided.

### 5.4 Illumination

Illumination is provided by a strobed LED illuminator. The strobed illumination module is available either as a full visible band illuminator or as a near IR band illuminator. The use of the strobe technique is extremely energy efficient and provides long life. The illumination is sufficient to support operation at up to a distance of 45 feet.



Figure 2.3 – Camera Enclosure with IR Illumination

### 5.5 Mount



TDS uses a variety of PELCO mounts to meet different mount requirements. Under normal conditions the Pelco MM22 and Pelco PM2000 mount extension are provided.



mount and

MM22

PM2000

## 5.6 Image Capture Triggering

Each of the cameras is independently triggered. The LPR image capture software receives a trigger from the triggering application. The trigger is developed from the lane sensor information (loop or vehicle separator).

In the case of a front camera, the trigger is generated when a vehicle enters the capture zone defined by the lane sensor. In the case of a rear camera, the trigger is generated when the vehicle has exited the capture zone as defined by the lane sensor. This integrated mechanism provides an extremely accurate trigger for both cameras.

## 5.7 Image Capture Software

The image capture software application receives the trigger and triggers the camera to capture an image. The camera captures the image and then downloads the data to the processor memory via the high-speed digital fiber interface. The image is then stored on the hard drive in an uncompressed raw format. The application then either uploads the image to the next level user or performs the OCR process locally. The lane image processor generates a transaction for upload to the next level.

At a minimum, the transaction will include the following information:

- Lane Number
- Plaza Number
- Lane Location
- Time
- Date

## 5.8 Optical Character Recognition Software

Transport Data Systems has developed and tested a plate locator and associated optical character recognition package specifically designed to extract ASCII representations from license plates that have been photographed using a high resolution digital camera. This OCR can be implemented in the lane processor. The OCR process works best with uncompressed images. This system will perform the OCR process on the uncompressed images and then compress the images for storage and transmission to the next higher level. The extraction of the license number at the plaza will also enhance the ability of the plaza to select and examine specific transactions and to provide this selection capability externally through the plaza web interface. Furthermore should the end user ever decide to outsource the violation processing, the VPC vendor would not have to deal with the OCR process for the specific image capture process as implemented by the end user.

As each violation transaction is received, it will be processed and entered into the database. The associated images will be processed by the OCR software and then

compressed. The compressed images will be stored in the database along with the license plate number and the quality data developed during the OCR process. The OCR process will statistically combine the results of the two plates and create a single ASCII representation of the license plate number. This will result in a license plate capture percentage that is significantly higher than that of a single plate system.

The addition of the new Grasshopper camera from Point Grey gives the system enough resolution for determination of the state of origin of the license plate.