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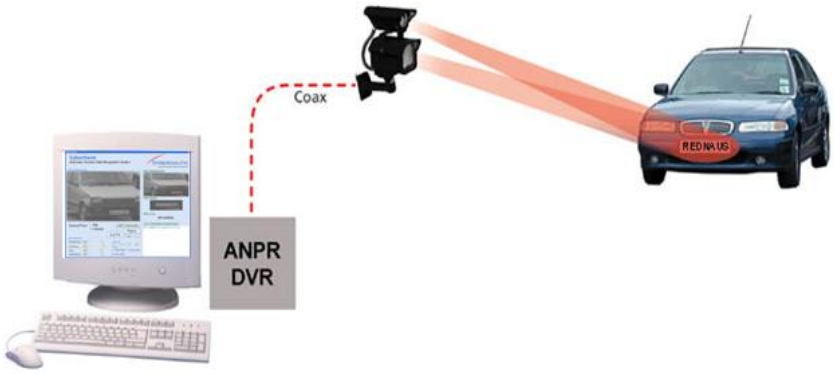
SyberHawk: Automatic Number Plate Recognition (ANPR) - A Case Study

Overview

Massive integration of information technologies into all aspects of modern life caused demand for processing vehicles as conceptual resources in the information systems. Because a standalone system without any data has no sense, there was also a need to transform information about vehicles between reality and information systems. This can be achieved by a human agent, or by special intelligent equipment which is able to recognize vehicles by their number plates in the real environment and reflect it into the conceptual resources. Because of this, various recognition techniques have been developed and the number plate recognition systems are today used in various traffic and security applications, such as parking, access and border control, or tracking of stolen cars.

Automatic number plate recognition is a system designed to recognize number plate automatically and store license plate number data on vehicles passing through a certain point. This is one of the mass surveillance systems that utilize optical character recognition programs and hardware capable of reading 1 plate/second of vehicles running at a maximum of 160 km/hr. Some systems make use of infrared cameras to increase the visibility during poor lighting conditions of the camera. This can be used to monitor traffic, enforce traffic rules and regulations, collect electronic tolls, etc.



ANPR systems can also store images from cameras while some can be configured to store drivers' photographs. However, since the design and font used in number plates differ from place to place or country to country, this systems tend to be region specific. These systems are deployed using two basic methods. One involves data processing near the camera location – data is processed locally and sent to a central station at a later time. Another method involves transferring the images to a central processing station where they are queued for processing and analyzed at a later time.

About SyberHawk:

SyberHawk is based on Optical Character Recognition technology and is built on Neural Network Architecture. It features accurate recognition of alpha numeric characters and is designed to offer superior performance in all weather conditions.

Features:

- Ability to process multi lanes.
- Accurate recognition results tested in Indian conditions.
- Ability to read characters from a license plate at a speed of 250 km/hour.
- Can form an integral part of any existing application.
- Available in Fixed and Mobile options.

Process:

The steps involved in SyberHawk system:

- It includes plate localization which involves the recognition of the license plate in a vehicle image captured by the cameras.
- The image is then tweaked to adjust for the skew angle and the size of the plate image in a step called plate orientation and sizing.
- After correcting the size and shape of the image, the contrast and brightness are then adjusted in a process called normalization.
- After that, the recognition engine identifies the license plate location and text written on the license plate through character segmentation and optical character recognition.
- The resulting data is then used to compare with the records in database so as to come up with specific information like the vehicle's owner, place of registration, address, time of identification etc.

ANPR Camera:

SyberHawkEye IBW-2000 camera was developed especially for ANPR system.

In this ANPR camera

- An **IR illuminator** is integrated which provides optimal conditions for taking an image.
- This illuminator works as a flash therefore the **consumption is very low**, about 10W while the light emission is about 2000W. The IR illuminator works at an undetectable rand for human eyes so there is **no disturbance for drivers**.
- The SyberHawkEye IBW-2000 is an all in one unit including a **camera**, a **2000 Watts IR flash**, **IR filter** and a **synchronizer** special designed and optimized for vehicle identification applications.
- The equipment effective range is **from 3 meters to 13 meters** depending on the environment conditions and on the quality of the number plates.
- The SyberHawkEye has primarily been **designed for Automatic Number Plate Recognition** applications, but the SyberHawkEye can be perfectly applied in other applications where outstanding image quality is needed.
- It has **automatic internal heating with thermostat** to heat up the glass before lens in heavy rain and fog conditions.

The distance between field of view area and the camera depends on the selected lens system. Professional cameras with C-Mount or even SLR allow finding an appropriate lens.

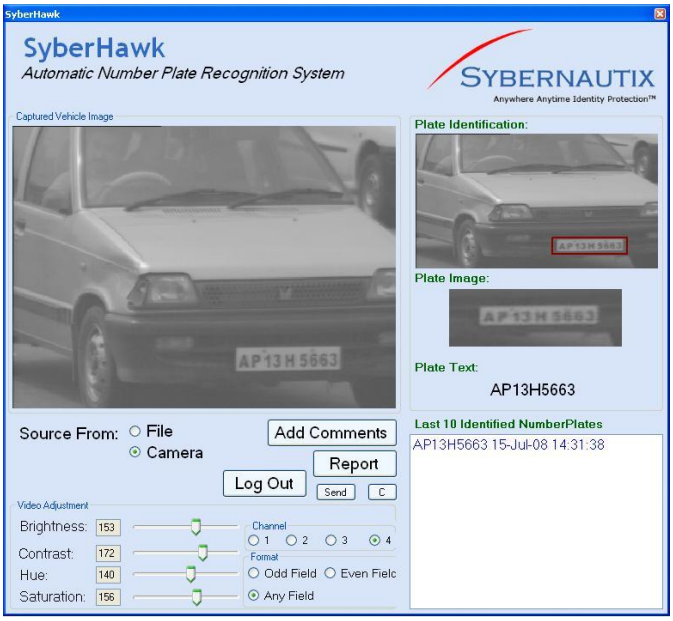
- Camera attributes: good white balance and low noise are helpful towards qualitative input.
- Frame rate: a good surveillance system should deliver 25 frames per second. Information might lose below this rate.
- High dynamic range cameras can better deal with the visible light power spectrum of up to 130 dB (sun light) than standard cameras. It is important that not only the sensor supports more than 8 bit of density information, but also the complete transmission line from sensor to the tracking software.

Client: Traffic Police Wing, Cyberabad Commissionerate, Home Department, Hyderabad

The test was performed at L.B.Nagar cross roads. The purpose of this test was to get the number plate recognition for different vehicles in both day and night mode and find the accuracy of the recognition engine in different scenarios.

Scenario 1: (Day mode for all vehicles)

The system and the ANPR camera were arranged at proper distances such that the number plate of the vehicle is visible to get the recognition. The recognition was done continuously for each frame. Once the number plate is recognized its location and the registration number are shown in the application, and the time of identification is saved in database. The recognition was done as shown in the below figure which was taken at field.



Once the vehicle was captured by the camera, the frame is automatically sent for the recognition. After recognition, red line appeared around the plate location and the registration number was displayed along with the time of identification (see above image).

Result of the Trail:

Vehicle	Total Captured	Correct Recognition	%
Motorbikes	56	40	71
Auto Rickshaws	135	87	64
Cars	453	394	87
Trucks/HGVs	371	267	72

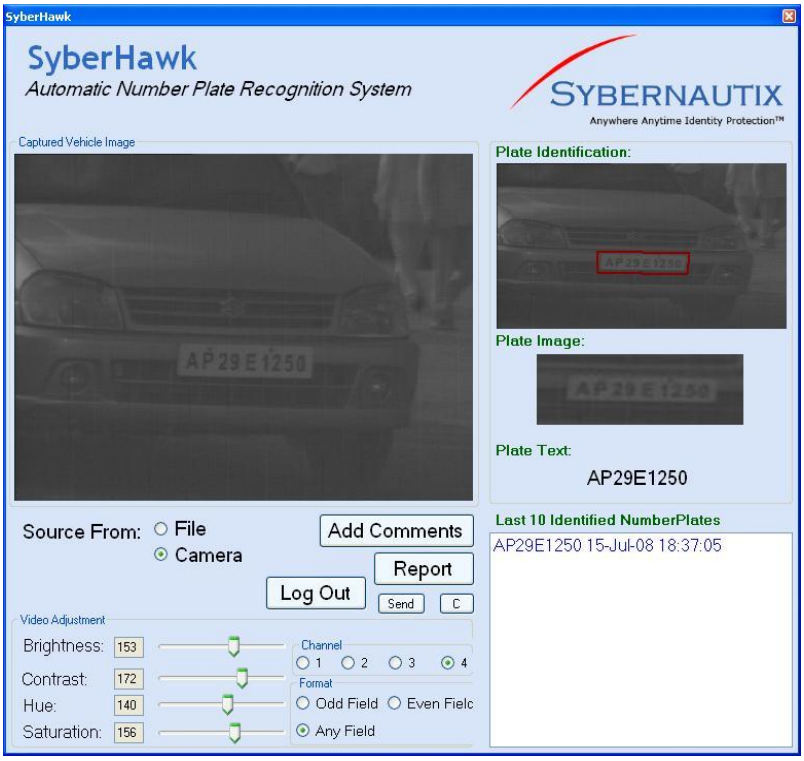
Technical Challenges:

ANPR is used in access control, as an aid to criminal investigations, speed enforcement and toll collection, is one of the most challenging imaging applications around. There are many variables to take into account for ANPR.

The following factors impose stringent demands on the imaging tool used for ANPR.

- Image quality and scene complexity (focus, background objects, multiple vehicles, vehicle occlusion, dirty plate, etc.), which introduces possible confusion.
- Weather (rain/sleet, snow, fog), which can introduce image "noise".
- Time of day (dawn, day, dusk and night), which affects lighting (uniformity and contrast).
- Camera or plate positioning, which may introduce perspective distortions.
- Vehicle speed and spacing, which dictates recognition speed.
- Plate styles (number of characters, single versus multi-row, dark-on-light versus light-on-dark, background graphics).
- Different character fonts including varying sizes.

Scenario 2: (Night mode for all the vehicles)



In this scenario, the same process was done as that of previous scenario, but here the IR lights of the camera automatically glow, and then the recognition continuous.

Perceived drawbacks of ANPR:

ANPR systems are perceived to have weakness that tends to undermine their effectiveness. Some of these common objectives include poor resolution of the captured images because of the quality of the cameras used or the distance of the vehicle being photographed; blurry images because of high speed motion; lighting or contrast problems because of shadows, overexposure and reflections; obstruction in the line of sight of the camera such as other vehicles, a tow bar or dirt in the plate itself; the use of a non standard font in the plate not recognized by the system; and intentional tactics used by drivers to avoid detection. With advances in the technology and equipment used like infrared cameras, however, most of these problems can be resolved. The objective of ANPR is to capture as much as possible and minimize error percentages to a greater extent which need experts to work on such high-end technologies.

Result of the Trail:

Vehicle	Total Captured	Correct Recognition	%
Motorbikes	29	18	62
Auto Rickshaws	25	15	60
Cars	150	122	81
Trucks/HGVs	154	95	62

Reasons for the less percentage of Recognition:

- Many number plates of trucks/HGVs were broken and contained lot of dust which causes the less percentage of recognition and some letters were not visible to read also.
- The number plate text written on the two-wheeler's and cars were with different font styles and no similarities in the whole text font size.
- Some number plates contained red letters on yellow surface because of this the engine failed to read the text.
- Mismatches in reading number plate for the letters
    - 0, O, D
    - P, R
    - 1, I
    - B, 8
    - Q, O, 0

Environmental Consideration and Recommendation:

A proper camera setup and environment is required to optimize the OCR performance.
There are minimal requirements to get accurate recognition

- The vehicle image should contain the number plate
    - With good spatial resolution
    - With good sharpness
    - With high contrast
    - Under good lighting conditions.
    - With standard font and should not be broken at text part on the number plate.
- Better illumination, line and sight of camera positioning.

Sybernautix

United Kingdom (H.Q.)
1000 Great West Road,
Brentford,
TW8 9HH
Tel: +44 20 8263 5680
Email: info@sybernautix.com

India
12-13-482/A,
St no 1, Tarnaka,
Secunderabad - 17.
Tel: +91 40 2700 2186
Email: india.info@sybernautix.com