STREET ENFORCEMENT APPLICATIONS FOR MOBILE ANPR SYSTEMS

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Synopsis

Developments in Automatic Number Plate Recognition (ANPR) systems have opened up opportunities for cost-effective enforcement applications.

Hitherto, ANPR applications have been based on high-powered PCs working on video feeds from full size cameras. Mobile ANPR has tended to be limited to specialised applications such as equipping police vehicles to assist their search for stolen vehicles. For mobile applications, miniaturised cameras are attached to ruggedised processors within the vehicle.

Additionally there has been considerable debate about the relative merits of infra-red sensitive and colour-sensitive cameras for particular applications.

For mobile applications, size matters, for both camera and processor.

Recent camera system developments, requirements for enforcement and pressure on the budgets to pay for enforcement have all combined to provide incentives for innovators like NCP and its suppliers to create new tools and processes for enforcement.

This paper discusses trials conducted by NCP using mobile ANPR systems to assist in its on-street enforcement activities.

Problem definition

On-street parking environments are uncontrolled. There are no barriers to prevent those that park and do not pay from driving away. Enforcement usually involves staff patrolling the streets on foot. For example, an enforcement officer must walk alongside the parked vehicles and note number plate and/or permit number to ensure that any violations to the parking rules can be responded to.

There are three physical parking patterns relating to on-street parking that are relevant to how efficient the enforcement can be (measured in vehicle checks per hour):

- Parking parallel to the road (most urban on-street parking;
- Parking end-on to the road (typical in wide streets such as in market towns, service roads such as in Milton Keynes or city squares);
- Chevron parking – end-on but at an angle to the traffic flow.

There are also different checks to be made in different circumstances:

- Are the vehicles parked in residents parking areas registered as residents?
- Are the vehicles parked in disabled bays registered as disabled persons' transport?
- Are any of the vehicles parked on-street in an area involved in any felonious activity, such as road tax evasion, or wanted by the police in connection with suspected criminal behaviour?
- Has a vehicle been identified as being linked to someone who persistently fails to pay parking or congestion charge penalties?
- Is the vehicle simply lost, for example in a car park? This could be a distinct possibility, particularly in large car parks such as, for example, the 6500-space Gatwick North long stay car park.

NCP has been developing technology tools to help with the challenge, "I am searching for one or more number plate registrations possibly hidden amongst a large number of other registrations".

NCP, in conjunction with PIPS Technology, has prototyped a system that can be used on-street specifically to search for a given set of registration numbers. The next section discusses this and the trial results to date. This paper then briefly discusses how mobile ANPR could be applied to the circumstances listed above – the practical applications.

Searching for persistent evaders

NCP has a number of contracts that require us to search urban parking for vehicles with particular number plates.

The technique hitherto used has been for mobile patrols, using hand-held computers, to walk the search areas entering vehicle number plate readings into the

computer. The number plate readings are compared with a reference database held on the mobile computers. When the entered number plate matches one of the database entries, an alarm sounds. Where appropriate, the patrol can call on a clamping and removal service to either clamp or remove the vehicle.

This approach has been successful even with contracts that require us to search for vehicles that make up only about 0.01% of the vehicles in an area. However, it is costly and time-consuming approach.

The prototype equipment comprised PIPS Technology's infrared cameras with integrated illuminators linked to a licence plate database. The PIPS Technology assembly include two monochrome cameras and an illuminator within the same enclosure. The equipment is sufficiently compact to easily fit onto a standard roof bar.

Using mobile automatic number plate recognition

Plate 1 below illustrates the prototype equipment.

The database was equipped with software that sought matches between database entries and licence plate readings. The match algorithm was able to offer wild card matching so that the match tolerance could be adjusted. This meant that partial matches, for example, where there was all but one character matched, would be signalled as a positive match.

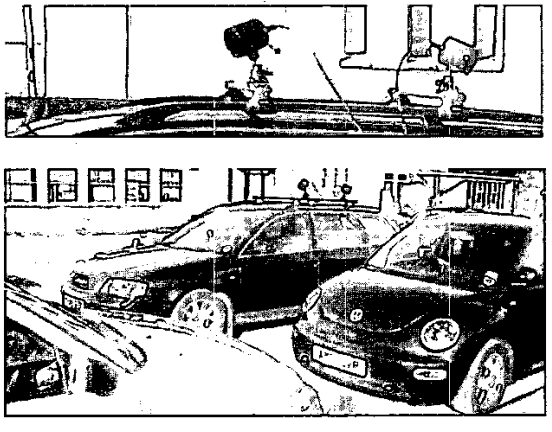

Plate 1 The prototype equipment with a detail showing the vehicle roof mounting illustrating the camera angles.

We drove the search vehicle at different speeds along streets with different characteristics to gauge how effectively the number plates could be read. The infrared cameras with their illuminators meant that the equipment was weather and lighting independent. We concentrated on parallel parked vehicles.

Results of the trials

The test scenarios were:

- Tested on roads including bends;
- Tested with genuinely parked vehicles;
- Speeds varied over the range 10mph to 20mph;
- ANPR Confidence set to 80% - below 80% counted as a mis-read.

This meant that the test scenarios represented real on-street conditions: The speeds at which these trials took place were appropriate for the estate roads where the tests took place but faster speeds would be desirable for some locations. Confidence levels are defined for the equipment by PIPS Technology and for our trial less than 80% meant that more than one of the characters would have been misinterpreted.

The results can be summarised as:

- Around 95% of the number plates of cars parked on-street were read
- Between 80% and 99% of the cars read had an 80% + confidence level.

This meant that only 5 in every 100 cars were parked in such as way that the equipment could not read the licence plate. This may be because:

- the licence plate was not visible – cars parked too close together; or
- the vehicle was parked at an acute angle which meant the licence plate characters appeared too italicised to be recognisable; or
- the licence plate was not retro-reflective – unusual occurrence except in cars aspiring to be 'classic';

Of the cars whose licence plates were readable, most of them were read with high confidence. The 80% to 99% confidence range reflects the combination of the variation in the way vehicles were parked and the speed that the detection vehicle was driving. The faster the vehicle's speed the less time to capture a licence plate fully within a frame, the lower the confidence level.

The presentation will also reveal the results from the next phase of the trial where we expect to improve on the results achieved so far. We are currently examining the frame rate and the user interface changes necessary to improve the operational of the system.

Operationally, the database matches a licence plate and alerts the operator. The operator then is able to park safely and on foot, identify the vehicle that triggered the positive match. The operator then is able to conduct the manual authentication necessary to confirm that the vehicle found is one on the reference database and appropriate action can be taken.

Although the test equipment was not using the global positioning system (GPS) to monitor location this is available within the PIPS prototype system, which was designed primarily for car park audit and which uses GPS to provide location data. This feature will be important in the on street application, providing positive evidence of location, where this is a factor in the offence.

Plate 2 illustrates the car park audit system including how the sideways-viewing cameras survey the parked cars.

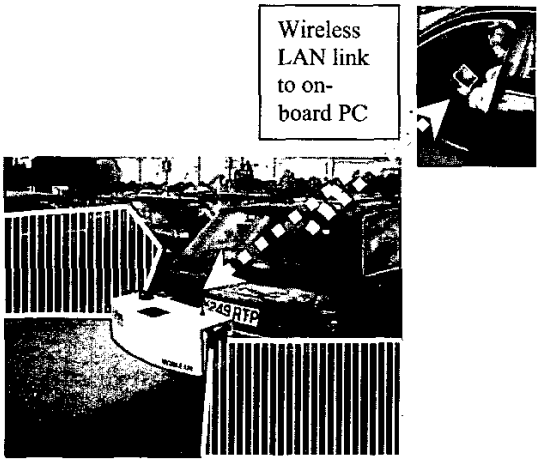

Plate 2. Car park audit system under test

Residents and disabled bay monitoring

Residents and disabled bay occupancy monitoring is one area where we see this equipment having considerable potential. One of our central London local authority clients surveys residents and disabled bay occupancy once a year. This local authority also zones residents parking. With knowledge of the vehicle number plates linked to residents and registered disabled vehicles in the zone, this equipment could be used to:

- monitor migration patterns within zones and between zones;
- monitor for possible permit swapping (the displayed permit would not match the number plate);
- potentially survey repeatedly during the day (or night) without drawing attention to the process, by simply driving along the street recording locations and number plates as the survey vehicle moves along.

Combining the roof mounting cameras and a GPS unit (possibly using differential correction to improve GPS accuracy), the equipment could differentiate between bay locations.

Searching for the needle (car) in a haystack (parked on-street)

There are several scenarios that fit within this broad heading. Anecdotally, we understand, for example, that the Metropolitan Police have procedures in place that enable them to search for particular vehicles anywhere in Greater London and to complete searching in a matter of hours. NCP adopt a similar process, albeit without the same urgency, for a contract finding vehicles related to non-payment of civil penalties.

Equally, although we have yet to test this application, there is potential for this equipment to be used, for example, in detecting vehicles known to be without road tax.

The trials today indicate that this equipment could substantially improve the efficiency by which these searches are undertaken.

Conclusions

We expect the benefits (and early assessments confirm this expectation), that the equipment will be beneficial in:

- enabling more rapid and less 'public' coverage within an area increasing the chances of a detection;
- enabling more patrols to be conducted in areas such as shopping streets, where vehicles park for shorter periods thereby concentrating the patrols' efficacy when searching for enforcement purposes;
- increasing the number of monitoring surveys possible for the same cost, thereby providing both better value and better data quality.

We deem these initial trials very successful; showing as they do, that using mobile ANPR to monitor for the presence of known number plates in the wider vehicle population parked on-street is a practical proposition likely to bring tangible benefits.