Automatic Number Plate Recognition

Approximately 11,000 cameras active in UK

Estimated 10 billion 'reads' per year

Lancs Constabulary collect half a billion reads per year across 150 cameras

The biggest of 'big police data'

ANPR data and use

Rolling deletion of unused data after one year, but special internal permissions required to access data over 90 days old. Data stored on and retrieved via Police servers – local and national. ANPR data is 'personal data'

When a vehicle with an outstanding warrant or tagged vehicle of interest passes an ANPR camera, it issues a 'ping' in a command suite. Lancs Constabulary received 14m pings in a year (1 per 2sec)

Can be used to reconstruct vehicle journeys or to track vehicles of interest in real time

ANPR distribution

Locations of fixed cameras are protected and secrecy of locations deemed to be in the public interest (*Mathieson vs IC & Devon & Cornwall Constab*.)

Maximum average of 1 camera per 27 miles, but it is likely to be lower and cameras are clustered towards higher volume roads

Case required for each new camera based on balance of public protection against public right to privacy. Rationales reviewed every year

Modern slavery

Exploitation of an individual as a commodity

Categories

Slavery

Servitude and forced or compulsory labour

Human trafficking

In March, there were 1,500 live MS investigations

Defining modern slavery

NCA
Forms of Modern Slavery and associated exploitation seen in the UK include: Sexual; Labour; Child Trafficking; Forced marriage; Forced criminality; Domestic Servitude

Modern Slavery Act 2015
S1 Slavery = Holding someone as a slave or servant or for compulsory or forced labour
S2 Human Trafficking – Offence of Arranging and facilitating the travel of a person with a view to them being exploited -
S3 The Meaning of Exploitation – consolidates all the different definitions from the existing legislation by putting exploitation under one meaning and at the centre of slavery offences. – sexual, labour, forced criminality, organ harvesting

NHS England: " … the recruitment, movement, harbouring or receiving of children, women or men through the use of force, coercion, abuse of vulnerability, deception or other means for the purpose of exploitation."

Home Office: 17 typologies of Modern Slavery

Modern slavery and movement

Economic slaves, such as farm labourers, prostitutes, nail salon workers, are collected at the same place each day and drive to the same place

People trafficking slaves by air collect from the same plane each week

Human traffickers often drop slaves at the same motorway services or follow special/unusual routes to avoid customs/police

Like everyone, drivers are habitual and may have preferred routes and pick-up patterns that are common across similar offenders or may have unusual stop-start routines that can indicate an offending pattern – are these different from non-perpetrator patterns?

Mapping and identifying modern slavery vehicular activity using ANPR: Proof of concept

Question 1: Are there common patterns in movement between perpetrators of modern slavery?

Rationale:

Modern slavery frequently involves the movement of people in ways that are efficient, consistent and inconspicuous

Machine learning may be able to detect subtle similarities in patterns of movement that human observation could not

Method: Map the movement patterns of target and non-target vehicles; define variables on which to model movement patterns; classification algorithm and assessment

Mapping and identifying modern slavery vehicular activity using ANPR: Proof of concept

Question 2: If patterns exist, are they predictable?

Rationale:

If patterns exist, they might be predictable, but they might also be an artefact of the data set

Method: Split ANPR data and target vehicle data in two by cut-off date; before cut-off are 'training' data and after cut-off are 'test' data; develop algorithm on 'training' data; use model to test classification performance

Mapping and identifying modern slavery vehicular activity using ANPR: Proof of concept

Question 3: Is all this a good idea, practically?

Rationale: Police receive a huge number of 'pings' per day; how accurate would a detection tool need to be to make this useful?

Method: Estimate probability of true positive based on a 'ping' using Bayes' Theorem

$$p(target|ping) = \frac{p(ping|target)p(target)}{p(ping)}$$

If 1 in 100 vehicles is a perp and the test has only 5% false positives and no false negs, 5 out of 6 pings will be wrong.

Low base rate of target vehicles would require exceptionally selective test

Mapping and identifying modern slavery vehicular activity using ANPR: Proof of concept

Question 4: Is all this a good idea, ethically?

Ethical issues: Modern slavery is a harmful crime and police should get all the help they can – if science can help in some way, shouldn't it?

How much harm is done by predictive algorithms? Is it better than human judgement?

What sort of precedent is set by basing suspicion on driving behavior?

Is ANPR ethical and is working with it condoning a surveillance culture? Where might the biases be? They are in fixed locations – are these locations unfairly close to particular communities?

Obstacles

VRMs are personal data, so can't be passed to a University – data encryption training, vetting and loads of security questions

Approx. 1 billion records across Forces, but almost impossible to retrieve from servers – importance sampling

Can't know where cameras are, so can't know distance between them – use distribution of speeds between cameras to estimate distance, but lose contextual information

Conclusion

Not sure we'll have a useful algorithm at the end

Possible that the one-year rolling deletion restrictions on ANPR retention are too short for good developmental work

Exceptionally low base rate of modern slavery vehicles (at least in police records) may mean the target offence is wrong

Thanks!
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