Bicycle Theft Detection

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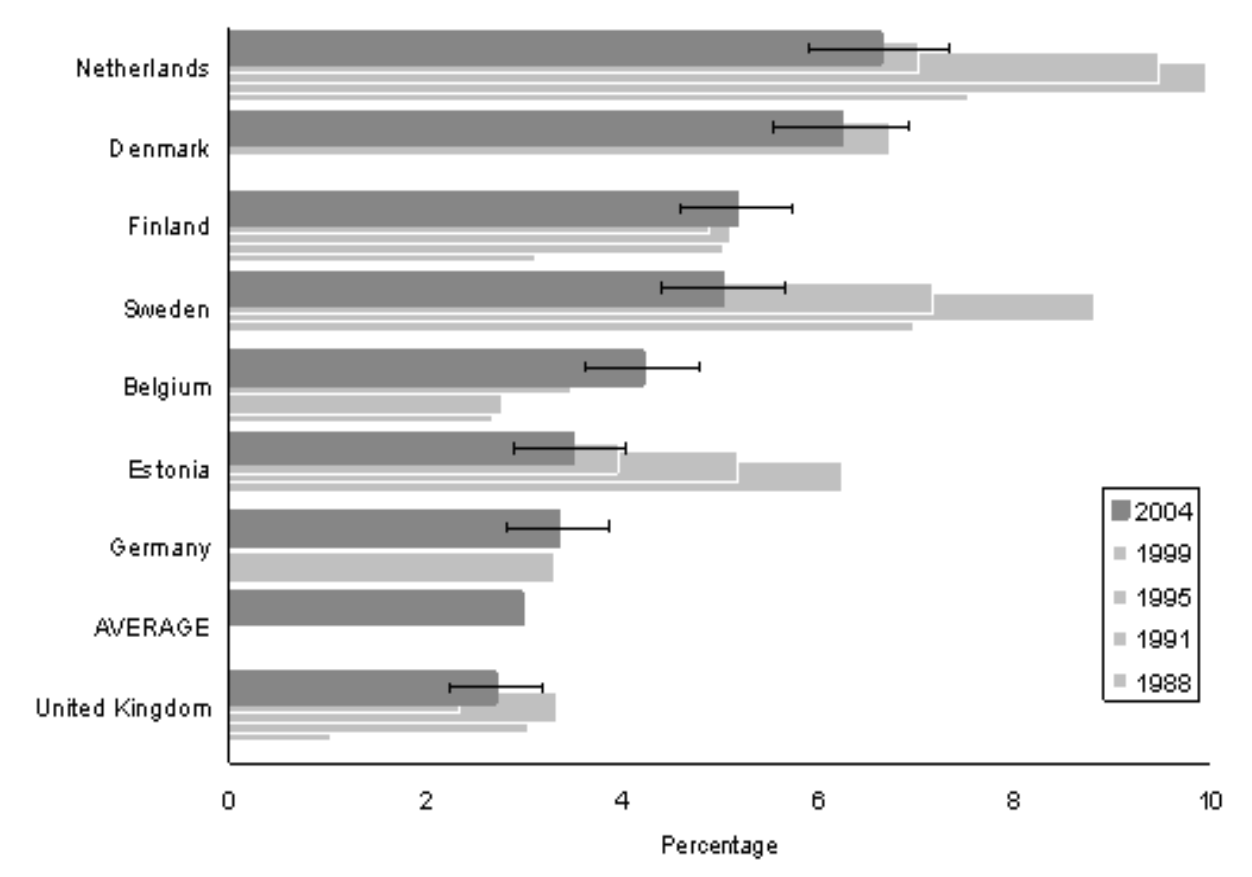
UNIVERSITY OF LEEDS

Facts

- 500,000 Bicycles stolen annually in the UK
- 21,236 bicycles stolen in London (2006/7).
- 5% of the stolen bicycles returned to their owners. (2005)
- Highest rate of bicycle thefts in: the Netherlands, Sweden, Japan, Canada, New Zealand, England, Finland and South Africa

Facts



Source: EUICS report, The Burden of Crime in the EU, A Comparative Analysis of the European Survey of Crime and Safety (EU ICS) 2005

From the news…

- 22/5/2007: Cheltenham - £100,000 worth of bicycles have been stolen over the past 9 months.
- 7/6/2007: York (290 bicycle thefts during May 2007) city sets up CCTV cameras over bicycle racks.
- 22/6/2007: Oxford (1800 bicycle thefts during the last year) city sets up CCTV cameras over bicycle racks.

From the news…

- 23/5/2007 – Catching Daniel Westrop…
  "*have been stealing commuters' cycles, often two a day, for the past three years*"!!

The Task

Relevant work

1. Metro Stations

Rota, M. and M. Thonnat. “Video sequence interpretation for visual surveillance” 3rd IEEE Int. Workshop on Visual Surveillance. (2000).

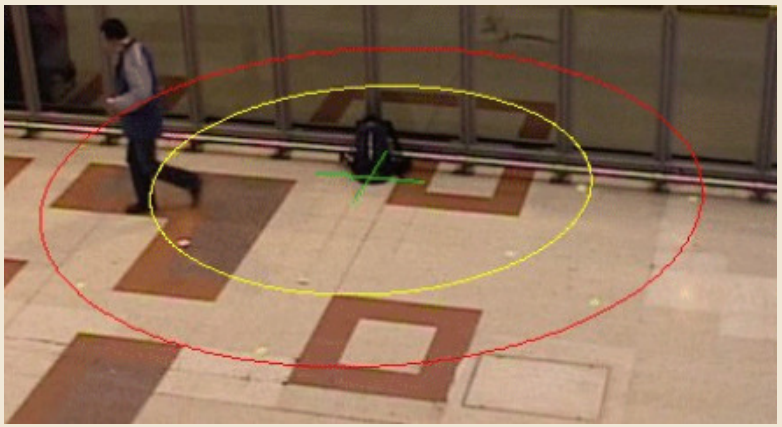
Relevant work

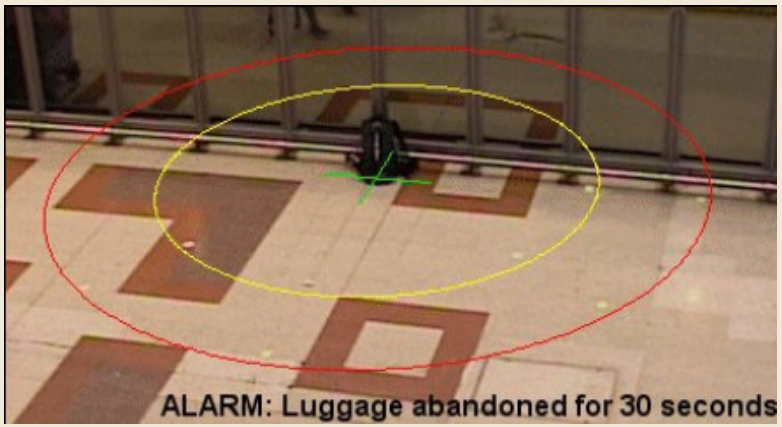
2. Airport Gates

Wang, Y., et. al. “A video analysis framework for soft biometry security surveillance”. Int. Workshop on Video Surveillance and Sensor Networks. (2005).

Relevant work

3. Abandoned Baggage





Ferryman, J., Ed. *Ninth IEEE International Workshop on Performance Evaluation of Tracking and Surveillance (PETS 2006)*, New York, IEEE, (2006)

Bicycle Theft Detection

1. **Tracking People**
2. Detecting Bicycles
3. Deciding on drop-off and pick-up actions.
4. Comparing colour information
5. Raising warnings

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Damen, D. and Hogg D. (Sept 2007) Associating People Dropping off and Picking up Objects. British Machine Vision Conference (BMVC07), Warwick, UK.

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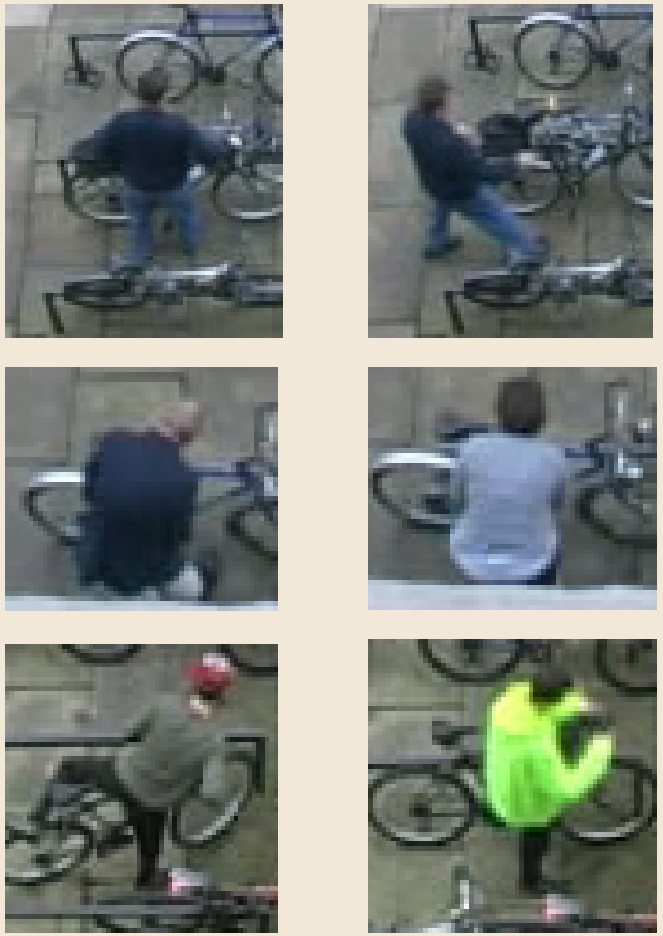

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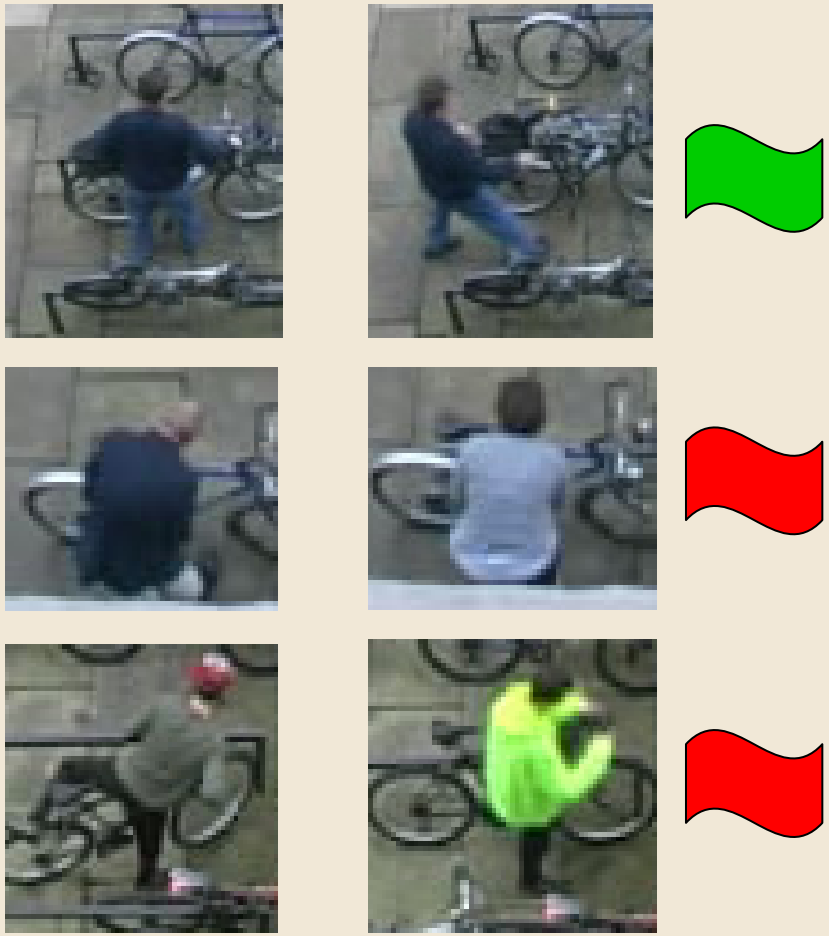


Experiments and Results

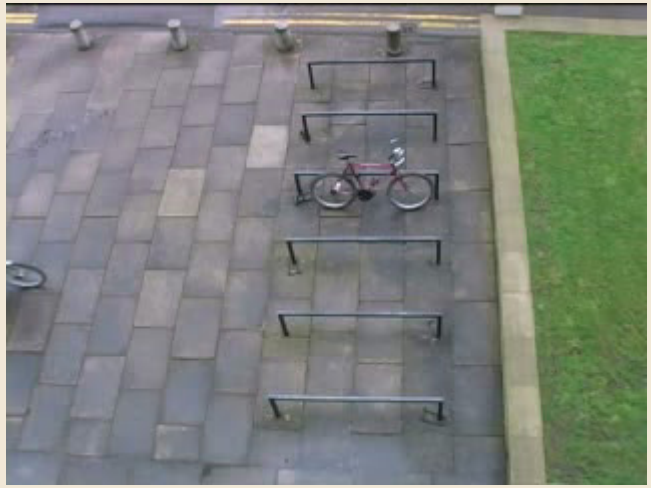
1. 1 hour recording
   - 45 events – 22 pairs
2. 50 min recording
   - 22 events – 9 pairs
3. 9.5 hrs recording
   - 40 events – 18 pairs

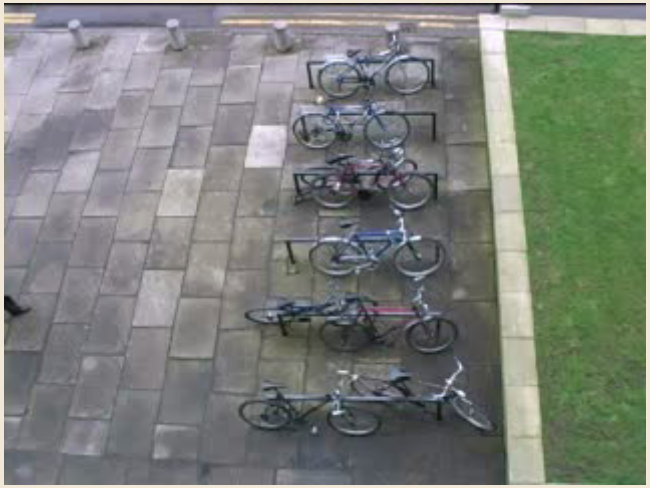
	Predicted	
Actual	Thief	Non-Thief
Thief	5	2
Non-Thief	6	45

	Predicted	
Actual	Thief	Non-Thief
Thief	0	1
Non-Thief	4	23

	Predicted	
Actual	Thief	Non-Thief
Thief	4	2
Non-Thief	6	116

Correct Example





Theft Warning Example

Strengths & Weaknesses

Strengths:

- Decrease in required monitoring time.

Recorded time: 11 hours and 30 minutes
Warning time: 13 minutes

Strengths & Weaknesses

Strengths:

- Decrease in required monitoring time.
- Raises warning, no action taken.

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Weaknesses

- Person changing clothing.

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Weaknesses

- Person changing clothing.
- Does not detect suspicious behaviour
- System's failure cases…

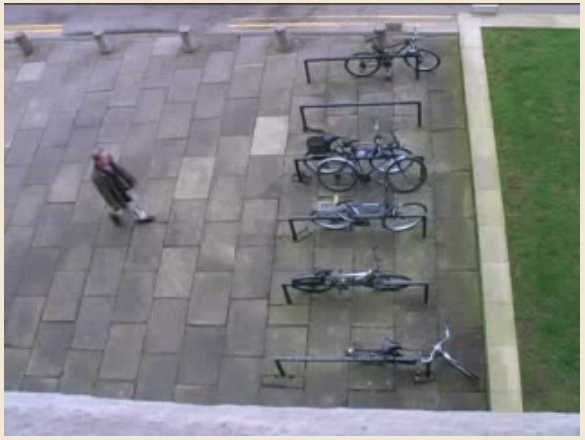
System's Failure Cases

1. The thief wears the same clothing as the owner.

System's Failure Cases

2. The thief drops another bicycle and picks a better one at the same time.
3. The tracker loses track of people as they pause
4. Theft cases of parts of the bicycle

False Warning Example



Conclusion

- 77% theft detection rate.
- 8.5% false negative rate.
- 1.9% of required monitoring time.

Thank you..

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