

**AGH**

**AGH UNIVERSITY OF SCIENCE  
AND TECHNOLOGY**



# **QART AGH CAR RECOGNITION TEST-PLAN**

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# PRESENTATION PLAN

- ◎ Car recognition test-plan
  - ◎ License plate
  - ◎ Color
  - ◎ Make
- ◎ Results
- ◎ Conclusions
- ◎ Further research plans



# CAR RECOGNITION TEST-PLAN

- License Plate
- Color
- Make



# LICENSE PLATE RECOGNITION TEST



Objectives:

Examine effectiveness of license plate recognition, performed by human, depending on video compression parameters.



Define video quality optimal for object recognition tasks.

# TEST PLAN



- ◎ Collection of reference video material (30 SRC)
- ◎ Preparation of degraded samples (900 PVSs)
- ◎ Conduction of test with human participation
  - ◎ Non expert viewers
  - ◎ Color and make identification
  - ◎ Web interface
  - ◎ Display settings adjusted by viewers
- ◎ Analysis and conclusions

# PHOTOS OF CAMERA



# SOURCE VIDEO SEQUENCES

Krakow, date: \_\_\_\_\_

**CONSENT**

I agree to the use of video containing shots of the vehicle operated by me with the following characteristics:

Make: \_\_\_\_\_

Registration Number:

Color:  black  blue  green  yellow  brown  red  grey  white

For scientific purposes (including publication) primarily related to the projects of the Intelligent Information System for Global Monitoring, Detection and Identification of Risk (INSIGMA) and "Intelligent Information System Supporting observation, searching for security of Citizens in urban environment" (INDECT ).

Visible and identifiable to the above-mentioned video, are the brand of vehicle colour and registration number. It was recorded at the entrance to the parking of building 5 AGH.

\_\_\_\_\_ Signature

\_\_\_\_\_ First Name and Surname

- ⊙ Each showing different car:
  - ⊙ Entering parking lot, or
  - ⊙ Leaving parking lot
- ⊙ Cars used in experiment owned by INDECT and AGH employees
- ⊙ **Ethical Issues:** signed permission received from all car owners
- ⊙ Permission allowing to:
  - ⊙ use sequence for research purpose
  - ⊙ share it with community (-> CDVL)
- ⊙ Example of permission sheet presented below

# VIDEO EXAMPLES (ALREADY COMPRESSED VERSIONS)

Entering



Leaving



# 1/3: RESIZE

QP: 43, 45, 47, 49, 51

1280x720



QP: 37, 39, 41, 43, 45

640x360



# 2/3: CROP + RESIZE

QP: 43, 45, 47, 49, 51  
704x576



QP: 37, 39, 41, 43, 45  
352x288



# 3/3: RESIZE (960:576) + CROP + RESIZE

QP: 43, 45, 47, 49, 51  
704x576

QP: 33, 35, 37, 39, 41  
352x288



# WEB INTERFACE



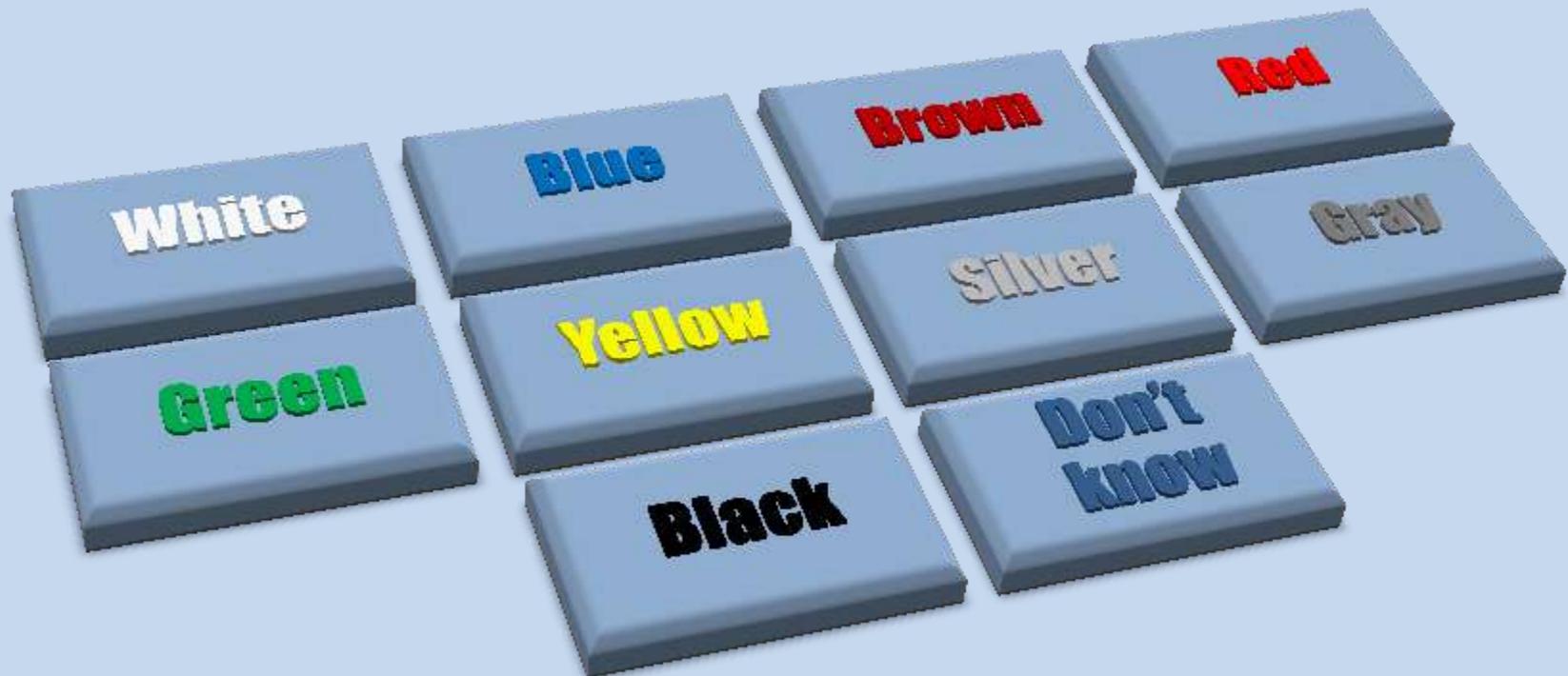
PLATE NUMBER:  I DONT KNOW  COLOR:

BRAND:

 Audi <input type="radio"/>	 BMW <input type="radio"/>	 Citroen <input type="radio"/>	 Daewoo <input type="radio"/>	 Fiat <input type="radio"/>
 Ford <input type="radio"/>	 Honda <input type="radio"/>	 Hyundai <input type="radio"/>	 Kia <input type="radio"/>	 Mazda <input type="radio"/>
 Mercedes <input type="radio"/>	 Nissan <input type="radio"/>	 Opel <input type="radio"/>	 Peugeot <input type="radio"/>	 Renault <input type="radio"/>
 Rover <input type="radio"/>	 Seat <input type="radio"/>	 Skoda <input type="radio"/>	 Subaru <input type="radio"/>	 Suzuki <input type="radio"/>
 Toyota <input type="radio"/>	 Volkswagen <input type="radio"/>	 Volvo <input type="radio"/>	<input type="radio"/>	 I don't know <input type="radio"/>

SEND

# COLOR SELECTION



# MAKE SELECTION



# RESULTS

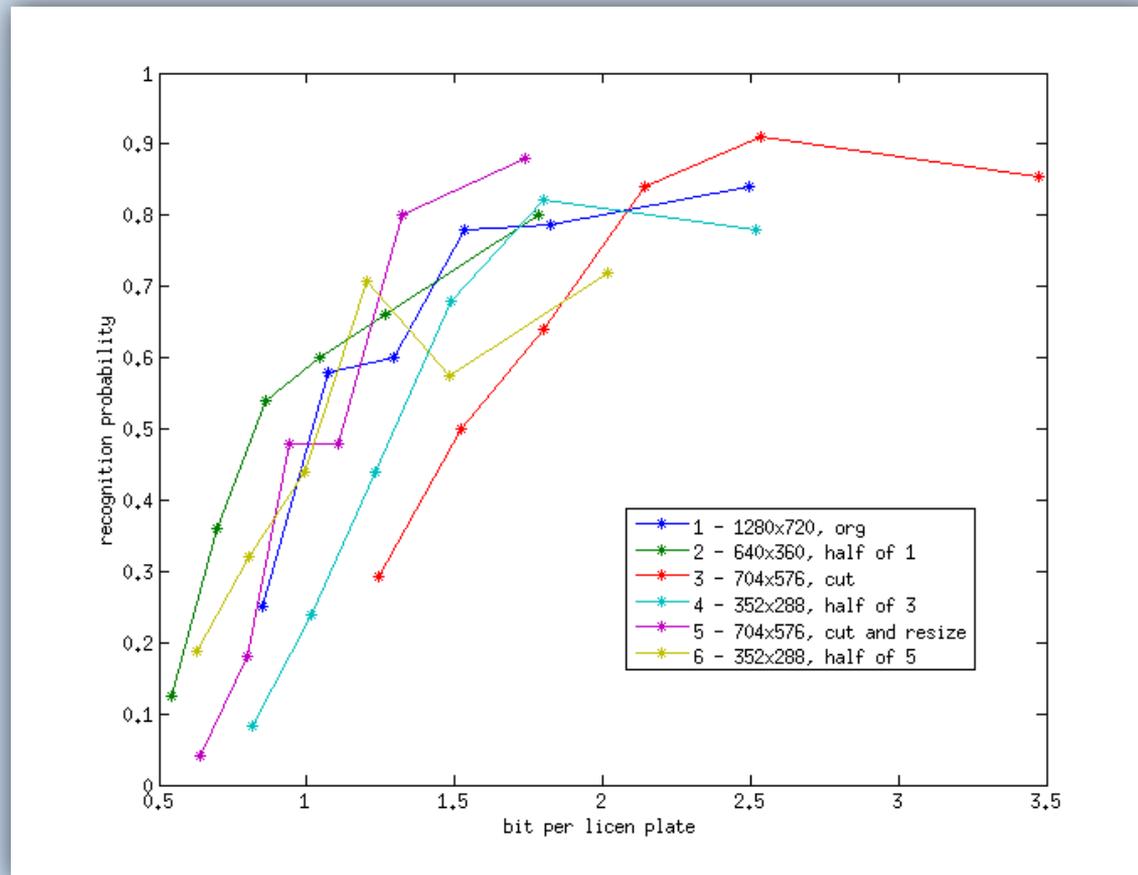


- ⊙ Plate recognition rate (**binary**) **54.8%** (**526/960**)
- ⊙ Recognized **72%** of all characters
- ⊙ Correctness of color recognition **82%**
- ⊙ **75%** of vehicle makes identified

# RESULTS FOR LICENSE PLATES



# BITS PER LICENSE PLATE VS. RECOGNITION PROBABILITY – DIVISION INTO HRC GROUPS



# CONCLUSIONS

1. SRC of great influence
2. Bitrate does NOT spreading evenly in space
3. Reducing resolution much better than stronger compression
4. Subjects sometimes put to sleep
5. Perhaps, you should not analyze binary
6. Errors when typing



# #1 SRC OF GREAT INFLUENCE

Example:

dirty plate

small contrast



# BEST VS. WORST RECOGNITION RESULTS

## ◎ Source Quality

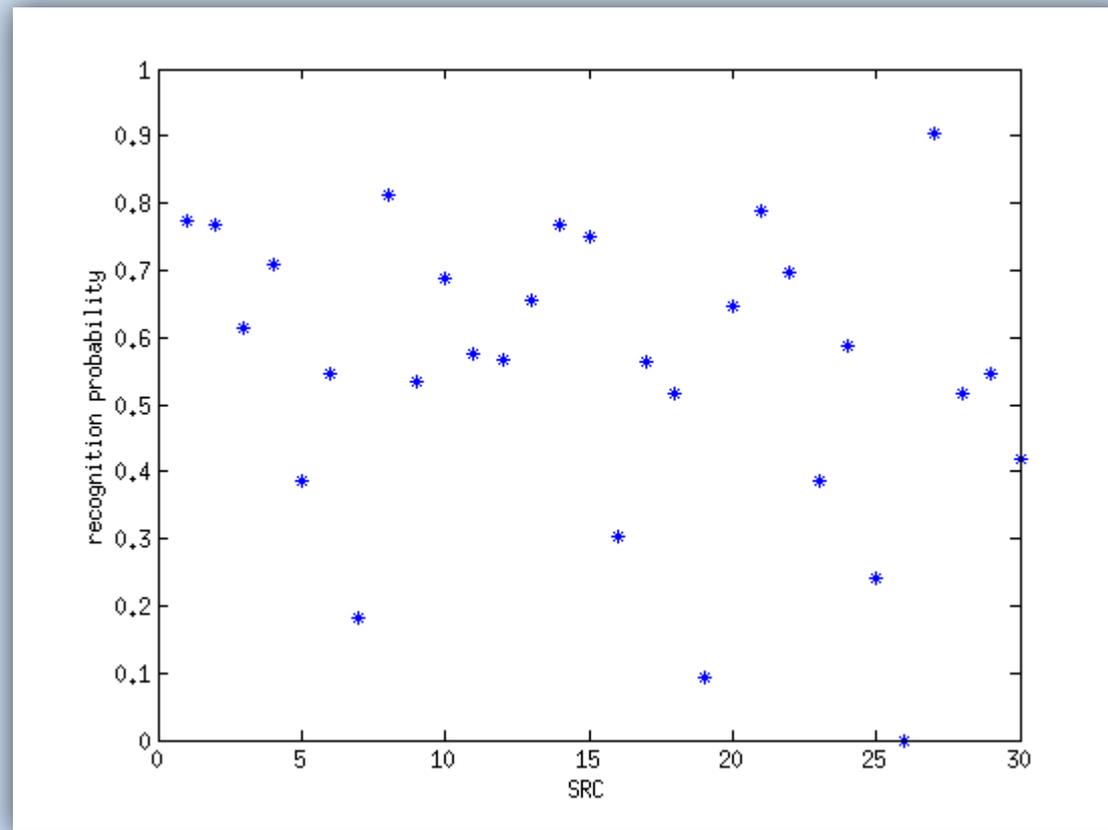


# THE SAME BITRATE

◎ 250 kbit/s



# SRC OF GREAT INFLUENCE ON RECOGNITION PROBABILITY



# #2 BITRATE DOES NOT SPREADING EVENLY IN SPACE

That is: cut and proportionate bitrate reduction does not work!

Weighting based on Temporal Activity needed?

# MOTION VECTORS DOES NOT SPREADING EVENLY IN SPACE

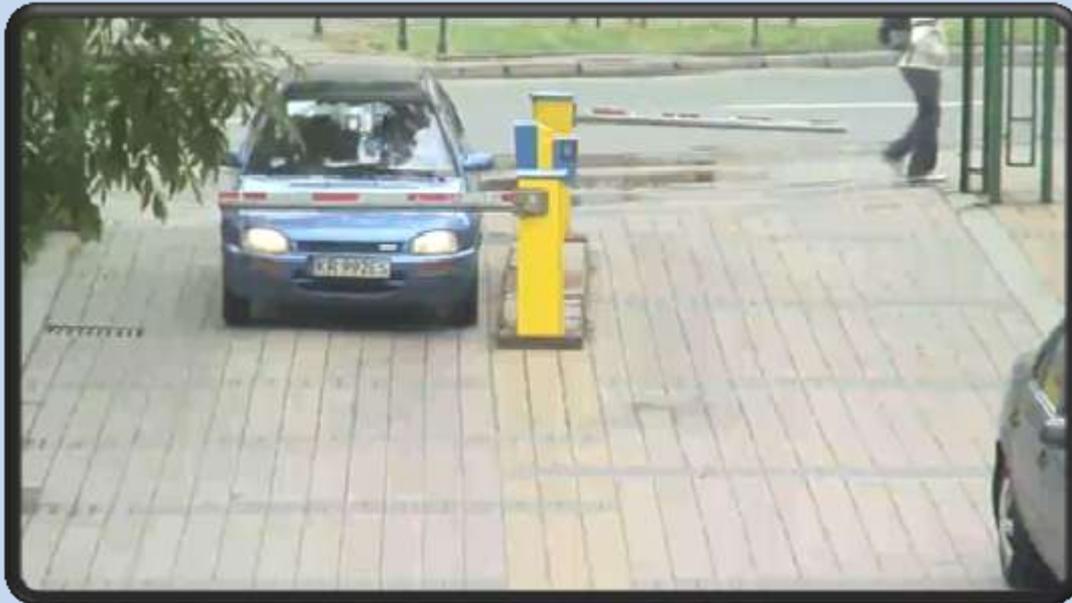
Entering



Leaving



# CROP



# SAME NUMBER OF BITS/PLATE

## Original



## Cropped



# #3 REDUCING RESOLUTION MUCH BETTER THAN STRONGER COMPRESSION

Contrary to Entertainment Video!



# #4 SUBJECT SOMETIMES PUT TO SLEEP

Methodology Needed to Remove Subjects!

(Another Presentation)



# #5 PERHAPS, YOU SHOULD NOT ANALYZE BINARY



# COMMON TYPOS: 'S' OR '5' ?



# HAMMING DISTANCE OR LEVENSHTEIN DISTANCE

- ◎ **Hamming distance** – number of positions in two **strings** of equal length at which corresponding symbols are different
  - ◎ KR 9764S
  - ◎ KR 97645
  - ◎ Distance: 1
  
- ◎ **Levenshtein distance** – **metric** for measuring amount of difference between two sequences (i.e. **edit distance**)
  - ◎ KR 9764W
  - ◎ KR 9764VV
  - ◎ Distance: 1



# CAVEATS (FOR SOME AREAS)

Local codes



“E” in most of cars in area



# #6 ERRORS WHEN TYPING

Mistakes Made by Shifting Numbers/Letters

# CORRECT RECOGNITION, THEN CLEARLY TYPO

KLI 50659

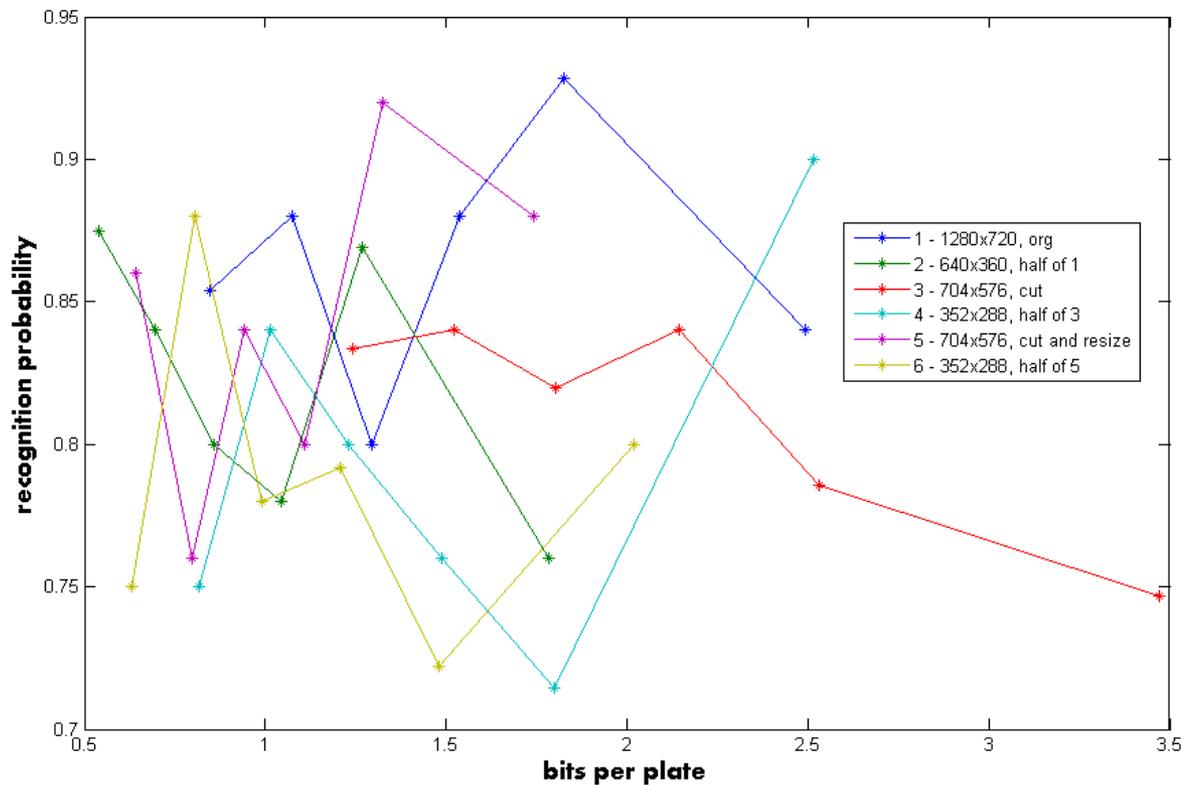
How to  
deal with  
such  
mistakes?



# PRELIMINARY RESULTS FOR COLORS AND MAKES



# BITS PER PLATE VS. COLOR RECOGNITION PROBABILITY – DIVISION INTO HRC GROUPS



# COLOR RECOGNITION: WORST CASE 1/3

- ⦿ white or silver?
- ⦿ Answers #:
  - ⦿ 1 – don't know
  - ⦿ 11 – white
  - ⦿ 1 – green
  - ⦿ 25 – silver
  - ⦿ 3 – gray



# COLOR RECOGNITION: WORST CASE 2/3

- ⊙ blue or black?
- ⊙ Answers #:
  - ⊙ 2 – don't know
  - ⊙ 18 – blue
  - ⊙ 3 – green
  - ⊙ 8 – gray
  - ⊙ 9 – black



# COLOR RECOGNITION: WORST CASE 3/3

- ⊙ silver or gray?
- ⊙ Answers #:
  - ⊙ 4 – don't know
  - ⊙ 5 – blue
  - ⊙ 1 – green
  - ⊙ 11 – silver
  - ⊙ 21 - gray



# COLOR RECOGNITION: BEST CASE (100% ACCURACY)

Red



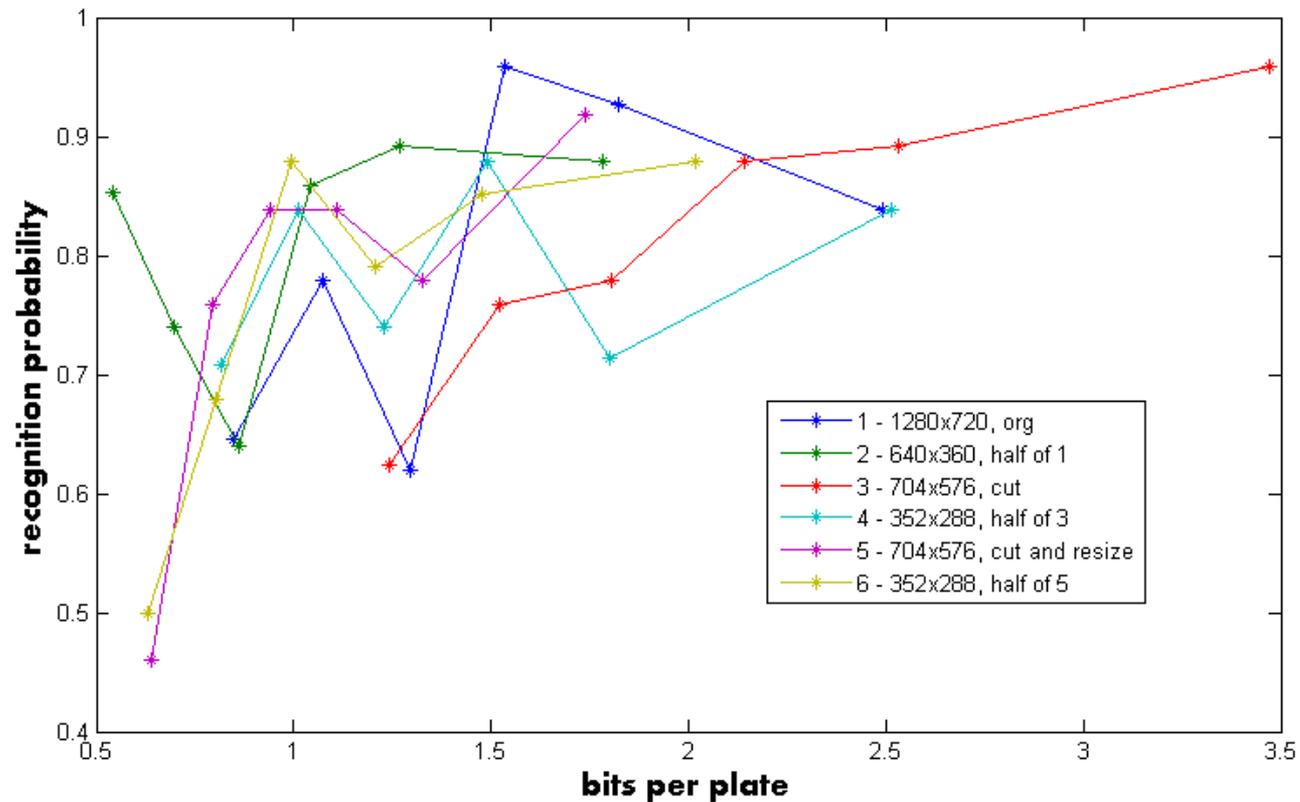
Black



Blue



# BITS PER PLATE VS. MAKE RECOGNITION PROBABILITY – DIVISION INTO HRC GROUPS



# MAKE RECOGNITION: WORST CASE

- 11 – Peugeot
- 14 – don't know
- 12 – others

- 13 – Mazda
- 13 – don't know
- 14 – others



# MAKE RECOGNITION: BEST CASE (100% ACCURACY)



Opel

Peugeot



# FURTHER RESEARCH PLANS

- ⊙ Possible extensions
  - ⊙ More HRCs
  - ⊙ More subjects
  - ⊙ New interface
- ⊙ Automatic Number Plate Recognition (ANPR) tests
- ⊙ Face recognition tests
- ⊙ Automatic classification into Generalized Use Classes



# NEW INTERFACE

PLATE NUMBER:



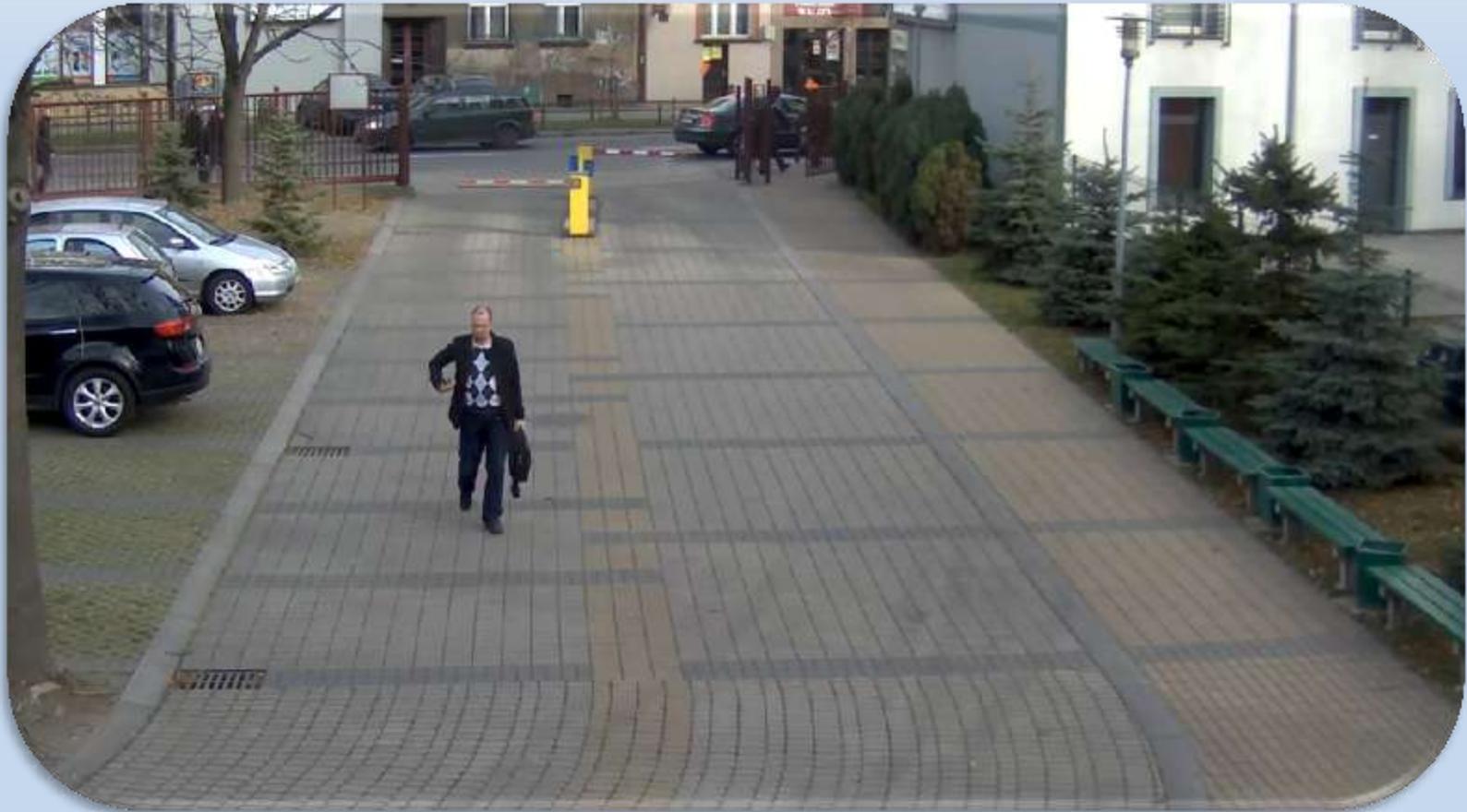
PLATE NUMBER:

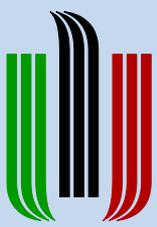
COLOR:

BRAND:

 Audi	 BMW	 Citroen	 Daewoo	 Fiat
 Ford	 Honda	 Hyundai	 Kia	 Mazda
 Mercedes	 Nissan	 Opel	 Peugeot	 Renault
 Rover	 Seat	 Skoda	 Subaru	 Suzuki
 Toyota	 Volkswagen	 Volvo		 I don't know

# FACE (PERSON) RECOGNITION TESTS





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# THANK YOU! ACKNOWLEDGMENT...



The research leading to these results has received funding from the European Community's Seventh Framework Program (FP7/2007-2013) under Grant Agreement n° 218086 (INDECT)

