Computer Vision - CAR BRAND RECOGNITION

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Problem Description

Computer Vision = understanding of the scene in an image by computer

Vehicle recognition and identification system – very often solved tasks in Computer Vision with wide range of application.

Several approached exist for vehicle recognition and identification:

- Vehicle identification (Is there a car? [yes|no])
- Vehicle type recognition (what type is that car? [track|bus|van|sedan etc.])
- Car manufacturer recognition (Who is the producer? [Skoda|Audi|Kia etc.])
- Car type recognition (What is that car? [KIA Ceed|BMW E46|BMW E46 facelift|])

Solved task = the car type recognition

Car type recognition

Try yourself – which car do you see at the figure 1?

Figure 1 image on the left - BMW E46, image on the right BMW E46 facelift

Presented modeis looking for answer of given question.

Proposed Solution

Designed vision system should provide

- High positive classification rate with respect to false negatives – reliable classification.
- Proposed design applicable under various conditions (noise, lightening changes, scale variance, etc.) and for different data.
- Stable system for different application – simple deployment, in time consistent execution.

Used Methods

- We suppose edges are the most informative – we used Histogram of Oriented Gradients (HoG) for feature extraction [1,2] (figure 2).
- From current state of art, progressive classification result in many applications were achieved using *Support Vector Machine (SVM)* as classifier [3,4] (figure 3).

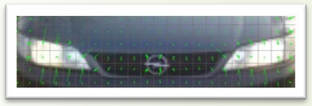

Figure 2 HoG features

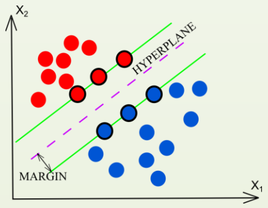

Figure 3 SVM classifier

Searching for the best solution

To propose robust, effective and deployable classifier a bunch of consideration must be verified at different levels of execution.

- Methods selection is the first step
- More challenging step is looking for sub-optimal solution for the problem car brand recognition. Therefore different approaches were designed as is showed in table 1 and in text below.

Table 1 This table shows all alternatives for evaluation classifier

	Single parametric classifier	Multi parametric classifier
Classifier one-vs-one	Yes	Yes
Classifier one-vs-all	Yes	Yes

- SVM kernel function
- Feature extraction – contrast sensitive HoG / contrast insensitive | Falzenszwalb HoG
- Scale of inputs
- Dimensionality reduction

Implementation

- C++, Dlib – SVM [5], OpenCV
- Modular system
- Multiclassifier support
- Parallel API – real time execution

Methods Verification

Used datasets for evaluation

- Db1 – 38 different classes, 15, images in each class, uncontrolled conditions
  a) Frontal view (see figure 4)
  b) Back view (see figure 5)
- Db2 – 17 classes, 1360 cars in training set, 1140 in testing set, controlled conditions (see figure 6)

Figure 4 Frontal view

Figure 5 Back View

Figure 6 db2 - sample car

Achieved results

The Table 2 shows positive recognition rate achieved using proposed approach.

Table 2 Results obtained using our approach compared to other methods

Used Database	Our results	Other Works
Db1 frontal	**57.6 %**	48 % (LESH + ID)
Db1 back	**80.8 %**	62 % (LESH + ID)
Db2	**87.7 %**	91.7 % (SURF + SVM)

SURF – Speeded-Up Robust Features, LESH – Local Energy based Shape Histogram, SVM – Support Vector Machine, ID – Integral Difference

Conclusion

- Proposed design achieved result comparative with existing works.
- Positive results were measured for different databases.
- Several approaches were proposed, some of them were behind awaiting (e.g. our approach " multi parametric classifier" was not able to overcome single parametric classifiers.

References

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