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ICVSS 2010
Registration and Video Analysis

NOVEL SHAPE AND TEXTURE DESCRIPTORS FOR FAST MULTICLASS TRAFFIC SIGN DETECTION

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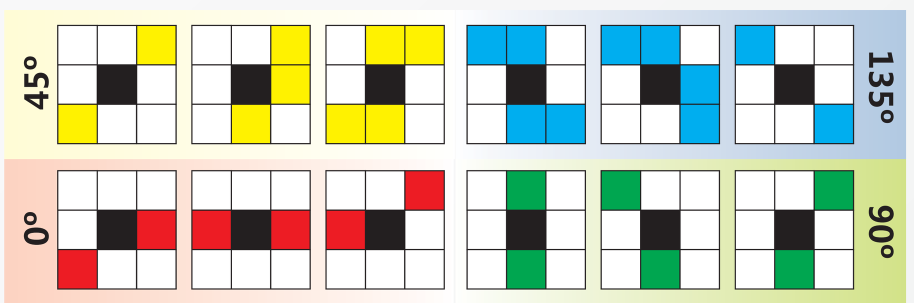
ABSTRACT

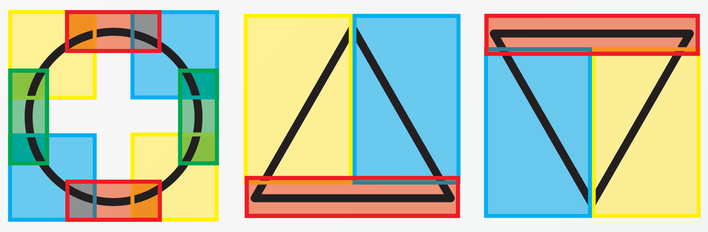
Detection of traffic signs is one of the most studied Advanced Driver Assistance Systems (ADAS), including solutions already used in vehicles. However these systems still have room for improvement, aimed at minimizing the chance of missing readable signs and saving processing time for other ADAS. In our work we propose a two-stage fast multiclass traffic sign detector for grayscale images, based on the use of novel shape (Local Contour Patterns) and texture (Quantum Features) descriptors.

SHAPE : LOCAL CONTOUR PATTERNS

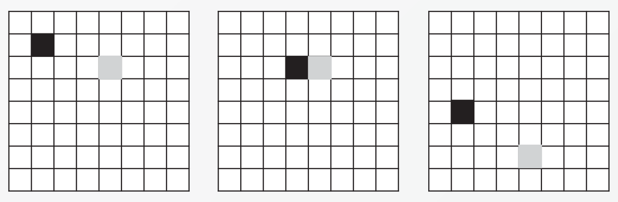


Every frame is converted to a contour image using the Canny operator [1]. Novel **Local Contour Patterns (LCP)** are defined from binary contour images to find local geometrical structures similarly to grayscale Local Binary Patterns [2]. Every active (contour) pixel encodes a N-bit LCP word (N=3 in our example) encoding neighborhood information. For Traffic Sign Detection only some code words representing linear structures with selected angles are meaningful, so they can be grouped in 4 sets of directions, which we call **Condensing Codes (CC)**.

In applications with clearly structured and simple contours (as Traffic Sign Detection), LCP processing can be accelerated by using Integral Images [3] of each CC. Accumulations can be topologically evaluated in different subregions of the scanning window, allowing for a fast rejection process whose result is a coarse set of ROIs for each studied traffic sign type: **speed limit**, **danger** and **yield**.

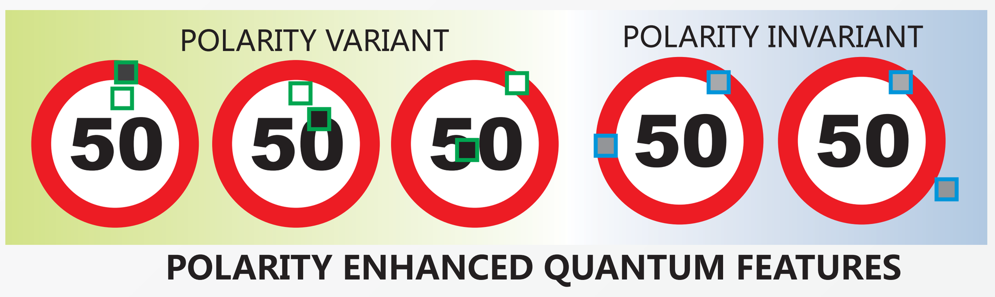


TEXTURE : QUANTUM FEATURES



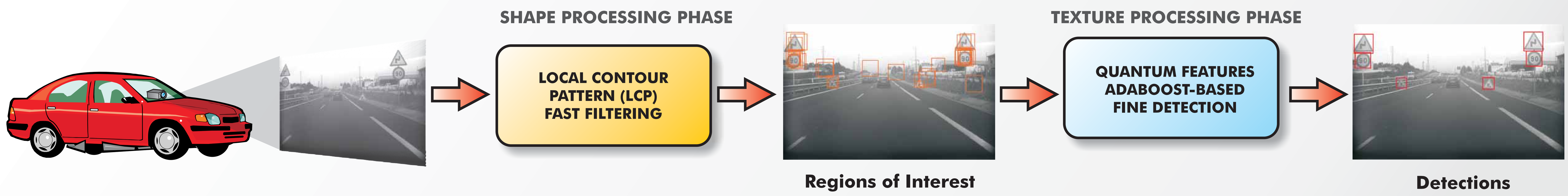
Based on Haar-like features [4], we propose a novel set of texture descriptors coined as **Quantum Features**. They are simple intensity level comparisons between pixels of the image at training resolutions. All possible pixel combinations are taken into account, and opposed to Haar features, involved zones do not have to be adjacent. Original Haar-Like features (or more complex Dissociated Dipoles [5, 6]) can be decomposed into a finite combination of Quantum features. Their versatility makes them extremely flexible for multipurpose detection tasks.

Using polarity enhancement concept [7], Quantum features can exploit all the contrast variability possibilities, carrying information about pixels being not only darker or lighter to another one, but also similar or different to it.



This representation allows more compact and efficient detectors, and can be effectively meaningful for Traffic Sign Detection.

SYSTEM ARCHITECTURE



EXPERIMENTAL RESULTS

	Type	#Signs	T.P.	F.P.	Recall	Precision
LCPQ	**Speed**	590	563	45	**95,42**	**92,60**
	Danger	921	802	32	**87,08**	**96,16**
	Yield	485	444	17	**91,55**	**96,31**
VJ	**Speed**	590	539	365	**91,36**	**59,62**
	Danger	921	789	313	**85,67**	**71,60**
	Yield	485	461	102	**95,05**	**81,88**

Comparison of Recall and Precision between our system (LCPQ) and standard Viola-Jones classifier (VJ) for Traffic Sign Detection in real scenarios.

	Sign	Time (ms)
LCPQ	Speed	56,42
	Danger	41,34
	Yield	34,62
	ALL	**70,21**
VJ	Speed	305,80
	Danger	310,79
	Yield	245,98
	ALL	**862,57**

Average Processing Time per frame (752x480). Our system achieves **more than 14 fps** on a 2.8 Ghz processor for the three types of signs simlutaneously.

Type	Scenes	Detected	Not Det.	Rate
Speed	71	70	1	**98,59**
Danger	68	64	4	**94,12**
Yield	42	42	0	**100**

Detection Performance of our system per scene (al least 3 consecutive correct true positives must be detected).

ACKNOWLEDGEMENTS

This work has been supported in part by the Galician Automotive Technology Center (CTAG) and the Galician Regional Government (2007/000023-0). I. Landesa-Vázquez is also funded through a pre-doctoral grant from the Galician Regional Government (IN808C)

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This work has been submitted to the 13th IEEE International Conference on Intelligent Transportation Systems (ITSC 2010): I. Landesa-Vázquez, F. Parada-Loira and J.L. Alba-Castro, "Fast Real-Time Multiclass Traffic Sign Detection based on Novel Shape and Texture Descriptors" 2010.