



Τάσεις σε Μετρήσεις Οπτικής Τεχνολογίας σε Κυκλοφοριακή Καταγραφή σε Σταυροδρόμια

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Περίληψη: Οι οπτικοί αισθητήρες είναι ιδιαίτερα σημαντικοί σε συγκοινωνιακές εφαρμογές κυρίως λόγω της ταχύτητας τους, της ευκολίας εγκατάστασης, μη παρεμβαίνουσας λειτουργίας και συντήρησης και την ικανότητα τους να επιβλέπουν μεγάλες περιοχές. Στην εργασία μας διερευνούμε την καταγραφή παρά τον έλεγχο κυκλοφορίας ή την αυτόματη οδήγηση αυτοκινήτου. Η εφαρμογή ολοκληρώνεται με αυτόματη εύρεση, παρακολούθηση, διατήρηση λεωφορειολωρίδας σε στατικό περιβάλλον και την ανίχνευση εμποδίων στατικών ή κινουμένων σε συγκεκριμένο χώρο ανίχνευσης. Τα συγκοινωνιακά δεδομένα εισόδου κατηγοριοποιούνται σε: βασισμένα σε χαρακτηριστικά εικόνας, σε περιοχή, ή σε μοντέλο και το πεδίο επεξεργασίας είναι χωρικό σε πλαίσιο video ή χρονικό σε ακολουθία πλαισίων video. Θεωρούμε ότι παρουσιάζεται αδήριτη ανάγκη, το σύνολο των οδικών σημάτων να εκσυγχρονισθεί και αναβαθμιστεί με οπτική τεχνολογία μετρήσεων και σηματοδότησης, ιδιαίτερα στα οδικά σταυροδρόμια. Διακρίνουμε στατικές και κινητές cameras. Η σύγχρονη τεχνολογία χρησιμοποιεί laser, radars, video cameras, GPS για να εκτελέσει αυτόματη οδήγηση αυτοκινήτων καθώς και για ασφάλεια και παρακολούθηση, σε συνδυασμό με μεθόδους Τεχνητής Νοημοσύνης για αποφάσεις και έλεγχο σε κινδύνους.

Λέξεις Κλειδιά: Καταγραφή κυκλοφοριακού, οπτική τεχνολογία, όχημα, εύρεση λεωφορειολωρίδας, ανίχνευση οχήματος, δυναμική ανάλυση σκηνής.



Trends of Optical Measuring Technology in Traffic Monitoring at Cross-Roads

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Abstract: Video image sensors become particularly important in traffic applications mainly due to their fast response, easy installation, non destructive operation and maintenance and their ability to monitor wide areas. In this paper we work on traffic monitoring rather than on traffic control or on automatic vehicle guidance. We integrate, the analysis of their static environment (e.g. automatic lane finding) and the detection of static or moving obstacles (object detection) within a space of interest. Input data are categorized as feature-driven, area-driven, or model-based and the domain of processing as spatial/frame or temporal/video. We suggest that there is an enormous need for adapting to optical measuring technology in traffic monitoring and especially at cross-roads. We discriminate between static and mobile camera. Modern technology uses laser, radars, video cameras, GPS to perform monitoring of driverless cars, automata, safe cars, etc that use AI to decide and control emergencies.

Keywords: Traffic monitoring, optical technology, vehicle, lane finding, object detection, dynamic scene analysis.



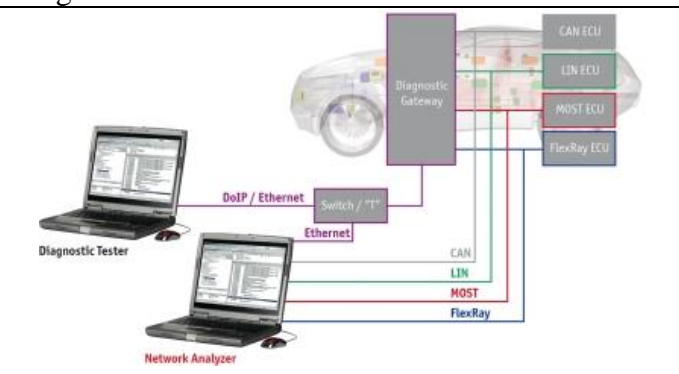
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The needs of traffic management are:	
<ul style="list-style-type: none"> • Incidents and events • congestion • Car parks and parking zones • Variable message signs • Equipment status • Reporting and analysis • Incident and event management • Effective delay network management • Consistent traffic management • Accurate journey time monitoring • Car park guidance / wasted journeys • Reduced congestion 	<ul style="list-style-type: none"> • Reliable traffic / travel information • Positioning of cars • Cross roads, national roads entrances • Emergency side lane stops • Vehicles classification and routing • Velocity reduction • stops at tolls, crossroads, etc • Car / driver crossing a street reflection jacket recognition, • alarm lights operations • rain / fog, restricted visibility • special lights operation
<p>In modern traffic monitoring in general and more specifically in crossroads, we face problems such as classifying traffic problems and parameters, optimizing traffic cameras set-up, project rescheduling, traffic condition adaptation, node statistics, static or moving observer camera.</p>	
	
<p>We want to recognize reliably colors, traffic signs, navigation markers, directions, obstacles</p>	
<p>We start with simple static image processing problems, such as parking, crossroad car placement before crossing, red light car violation monitoring and difficult static image processing problems such as parked car licence plate recognition, car accident prediction at crossroad, etc. Simple and difficult dynamic image processing problems are examined, such as dangerous car to car by passing, dangerous driving car manipulation, traffic accident analysis, moving car licence plate recognition, image cross-correlation, optical methods for car velocity measurement, integration of static and dynamic traffic problems, adaptation to traffic changes, embedding traffic monitoring, intelligent image processing system and camera design, mmi, information fusion. We are based on theory and technology of data bases in local municipalities and Traffic Police Experience. The purpose is to invest on a local spin-off company for traffic technology commerce and safety.</p>	

	
<p>Traffic signs recognition, car size, weight, power and cost are the next generation optics challenges.</p>	
	 <p>Car counting and marking at a node</p> <p>Wireless paid card transmitter</p>
	 <p>A complicated traffic node</p> <p>Transparent displays allow modern GUI</p>
	

Any loss of road lanes or horizon can be interpreted with some percentage of success as ongoing dangerous manoeuvres and situations ahead.



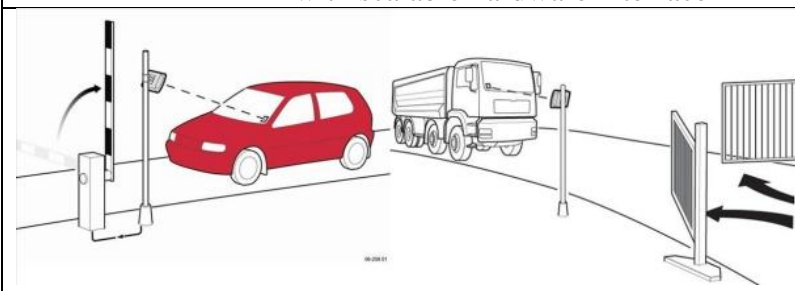
Big vehicles and long vehicles cover optically, i.e. act as obstacles for constant backgrounds



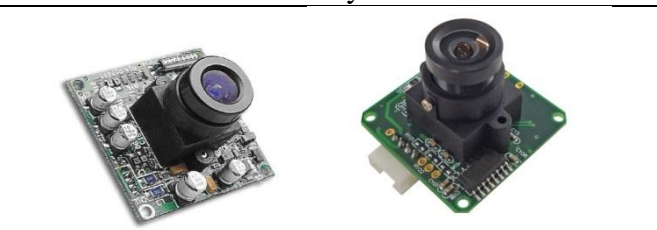
IP supports the development, simulation and testing of embedded systems that communicate over IP or Ethernet. It assists diagnosis, local data transmission, accessories, etc



IP with scalable hardware interface



Web publishing and the internet is a powerful resource in providing live, accurate and timely information to the travelling public. Monitoring systems create live traffic and travel web-pages which can be embedded in personalised web page designs, without having to go through the long process of web development and design. These provide real-time and predicted journey-critical information to travellers in a 'simple to read' and 'easy to understand' geographical format using Google or other similar, web-based mapping displays for regular updates about public transport issues across the whole city.

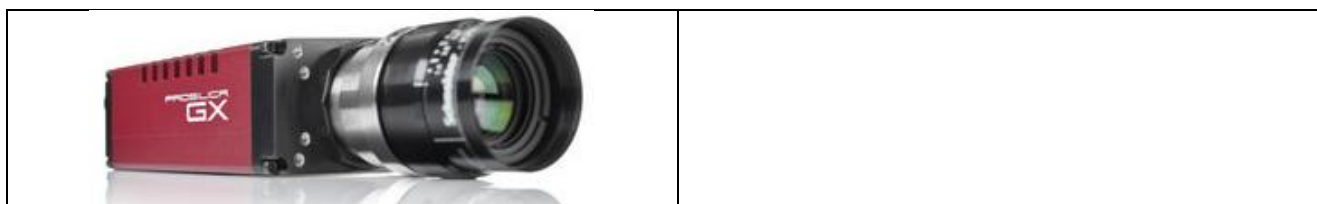


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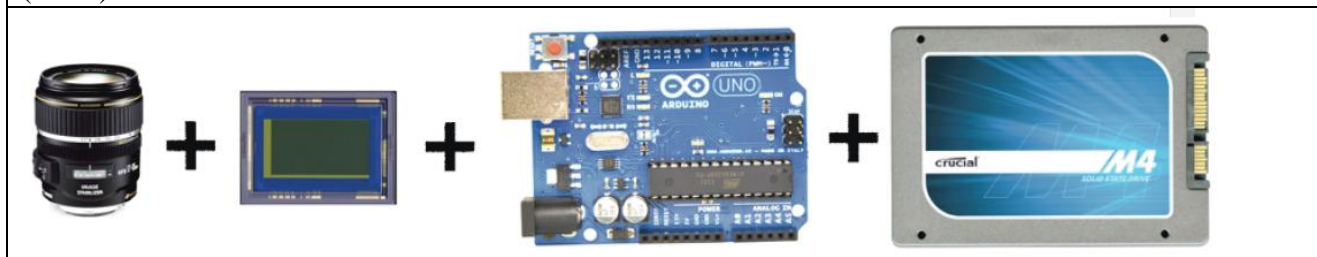


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In the camera application, there are requirements related to time synchronization and Quality of Service (QoS). They are addressed by protocol extensions of the Audio Video Bridging standard (AVB).



Embedded Vision, creates machines that see. New super camera designs use parallel optical processor.

Types of smart cameras, typical characteristics, and sample applications

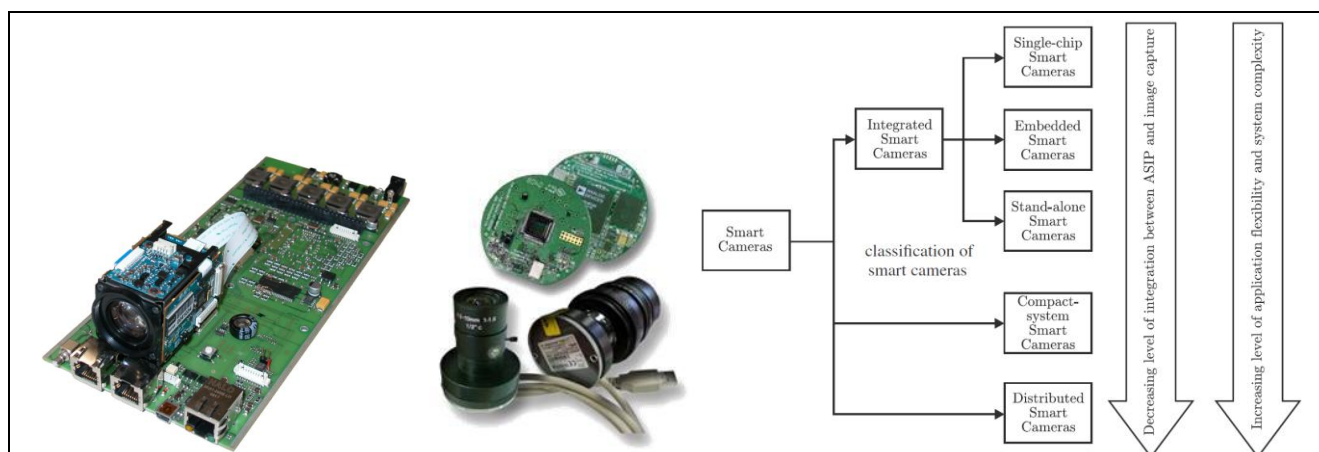
Type	Characteristics	Applications
Single-chip smart cameras	ASIP on the same chip as the image sensor, extremely low power, small size	Toys, pervasive information sensors
Embedded smart cameras	Camera is embedded in another device such as a mobile phone	Optical mice, fingerprint readers, smart camera phones
Stand-alone smart cameras	“Normal” smart cameras, all in one camera casing	Industrial machine vision, human-computer interfaces
Compact-system smart cameras	ASIP in a separate embedded system nearby	Security, traffic surveillance, machine vision
Distributed smart cameras	Part of the system ASIP rendered by the network topology	Intelligent and pervasive video surveillance, industrial machine vision, pervasive information gathering systems

The cameras support a wide variety of different communications methods including GPRS, DSL and Ethernet. They use a multi-scale optics design with micro optical field processors to seamlessly stitch very large panoramic scenes. High density of pixels allows for many levels of zooming.



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Research developed novel detectors that are used in a very broadband camera, i.e. an IR camera through MWIR for many applications. By appropriate filters, we use a single camera to image in visible, near IR, short-wave infrared (SWIR) and MWIR. This camera could be used in a dual color mode, to discriminate targets better than a colour camera. Multi-band imaging has a broad set of applications.



Detection of a pedestrian / stopped vehicle inside the tunnel

Weather monitoring




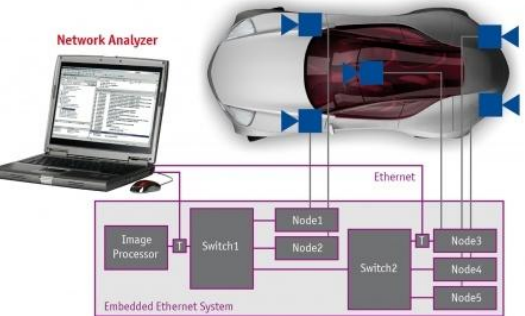

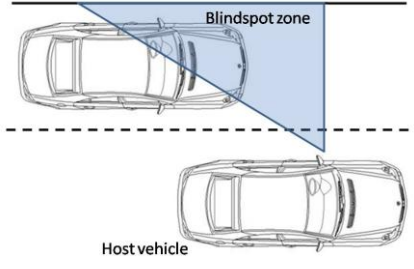


Car park guidance and management provides motorists with accurate, up to date information, informing about a choice to be made for the best parking options and traffic conditions.

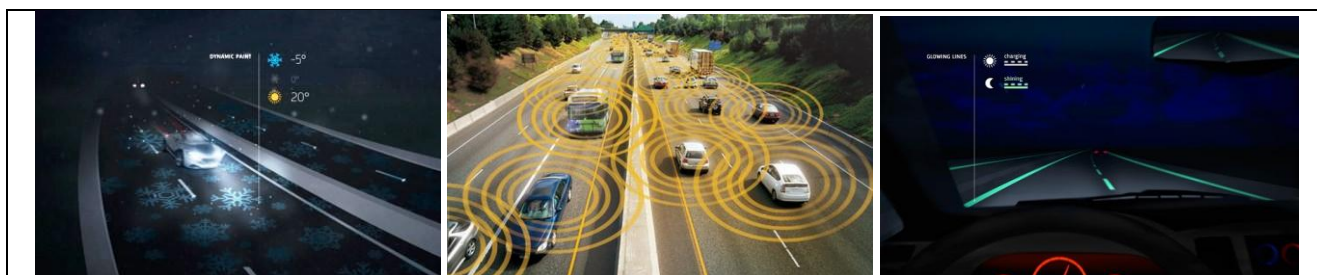


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<p>Blind spots are overcome by car installed cameras</p>	
<p>Reliable analysis of camera-based driver assistance systems requires monitoring the data traffic at multiple points of the Ethernet network, ideally via “tee-couplers” with as little time offset as possible and with a common time base.</p>	<p>IP protocols of automotive applications mapped to the OSI reference model include administrative functions. Both new protocols and those known from office communications are used.</p>
<p>Night vision is a technology to enhance a vehicle driver's perception and sight distance under low beam conditions. However, the technology has not been applied to every vehicle on the road because it is not fully ready for automotive applications and is very expensive to provide high quality images.</p>	
	
<p>Night vision and signs. There is a need for greater traffic information capability in the area of optical signs and night vision technologies, including far -infrared (FIR) image sensor based night vision and on road products under fiscal constraints. Effort is focused on scaling the pixel size to the Nyquist limit.</p>	
<p>High IQ highways charge electric vehicles by wind power, and use interactive lighting switches triggered on/off by the cars passing by (that saves energy), and communicate weather forecasting and interactive dynamic signs. A powder that emits light for over 10 hours in darkness substitutes radiating paints thanks to sun day light absorption and senses environmental temperature, especially when it snows or there is ice on road; signs of weather or traffic incidents can be communicated by electronic dynamic changing signs. Smart Highways infrastructure developed traffic systems for smart road lighting to increase traffic visibility and decrease power consumption.</p>	

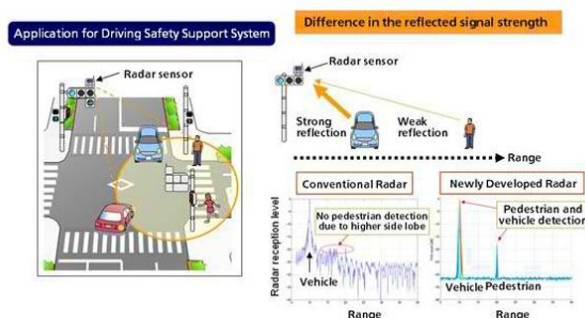


Night signs assistance and monitoring of high IQ roads

The National Highway Traffic Safety Administration of USA included communication and optical safety systems in a great number of buses and trucks; this ensures safety for drivers, car makers and insurance companies. V2V technology allows vehicles inter-communication through wi-fi by 10 frames/sec and vehicles to antenna distance of 300 m. V2V allows wireless information exchange to avoid collision, about cross-road traffic conditions, v2v distance and velocity, blind spots, vehicle size, etc. It tracks the pattern of the rest of the cars for safe distance brake, off the road/lane deflection control, capable to avoid the 80 % of the collisions.

Night vision is a technology to enhance a vehicle driver's perception and sight distance under low beam conditions. However, the technology has not been applied to every vehicle on the road because it is not fully ready for automotive applications and is very expensive to provide high quality images.

Weather forecasting and weather monitoring for drivers assists driving in roads with snow, safe distance preservation, cars identification, driver fatigue recognition, car lights operation, etc.



Incar Ethernet standardization organization Most Cooperation (Mostco) with Media Oriented Systems Transport (Most) - infotainment transport of audio and video within the car, is equivalent to an IEEE802.x network, extremely flexible, allowing star, daisy-chain, tree, and other topologies implemented on different physical layers such as POF (plastic optical fiber) and electrical physical layers: coax and shielded or unshielded twisted pair (STP/UTP) copper wires. Regarding content protection, HDCP (High-Bandwidth Digital Content Protection) has been added in addition to DTCP (Digital Transport Content Protection). Bandwidth for Ethernet transport exceeds 100 Mbit/s by the Internet Protocol (IP), the Transmission Control Protocol (TCP), or the Hypertext Transfer Protocol (HTTP) which are required to support Internet access in a distributed infotainment system for synchronous and isochronous channels for easy and efficient audio and video streaming, with a net bandwidth of over 107 Mbit/s can be achieved, showing that the maximum bandwidth of 142.8 Mbit/s can be used with efficiency of over 75%.

Cloud communication protocols (Skype, etc) are not secure; AES (advanced encryption standard) used on the Internet communication employs a 256-bit key, ie 2^{200} operations to break it.



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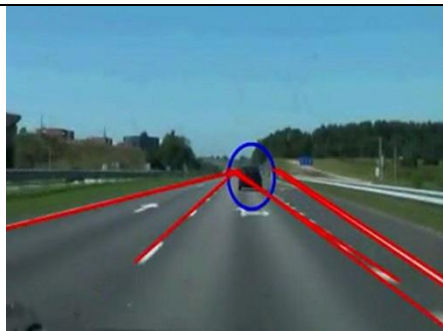
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To achieve intelligent transportation, from automatic navigation to automatic drive, and then to unmanned drive, there is a long way to go. The Internet of Things in intelligent transportation systems, (intelligent vehicles, vehicle active safety, driving simulation systems, discrete event systems, error diagnosis and detection, etc) uses electronics, control, sensors, actuators, communications and computational technologies.

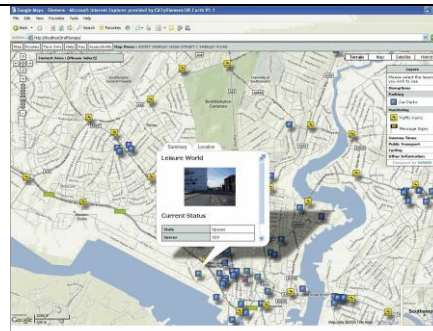
IP and Ethernet in vehicles, such as CAN, LIN, MOST and FlexRay bus systems became established in the motor industry, for simple and cost-effective data exchange of noncritical signals in the convenience area. In the automotive field, Ethernet proved itself for diagnostic access and in camera-based driver assistance systems; a physical layer offers full-duplex transmission at 100 Mbit/s on a CAN-like, two-wire cable (unshielded twisted pair).

Optical illusions, 3D barriers, painted onto city streets slow traffic used as virtual speed humps to. Fake speed limits are installed in a campaign against aggressive driving. Virtual humps are adopted as an alternative to traditional "sleeping policeman" which is criticised for damaging cars.

Motorists using information systems spend 20% of driving time not focusing on the road, since get distracted by clouds, scenery, advertisements, etc. Eye-tracking technology follows drivers' eye movements, that spend 3 % of their journey time on checking mirrors and just 2% looking at oncoming vehicles, 3% observing pedestrians, not involved with and 10% they completely concentrate on screen.

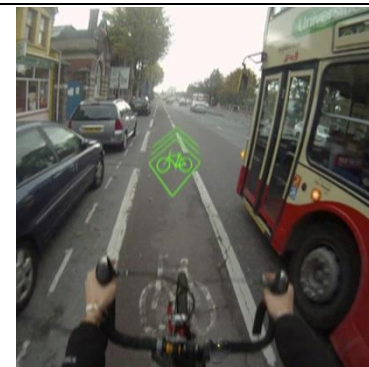


Lane detection enhanced environment



City guidance by

Traffic intelligence platform monitor congestion since drivers waste 66 hours a year in London traffic. Park-and-ride and public transport is the best way to the quickest journeys. On-demand access to real-time travel conditions takes into consideration traffic police activity, historical traffic patterns modes of transport available at all times, etc.



TMS manage the incident rather than the systems. It reduces the operator workload by creating and maintaining historic profiles of congestion, flow, journey time, car park occupancy and other parameters.



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School holidays, public holidays are monitored. Short-term future prediction offer information in 30 and 60 minutes, informing travellers about their journey. Automatic Number Plate Recognition technology support monitoring journey times for overall road network performance.

A warning system prevents bicycle-related collisions in dense bike lanes. Bicyclists frequently attempt to navigate streets and intersections by cutting across moving traffic and pedestrians. A laser projects ahead bright signs, set on flashing mode that alert bus drivers of the presence of an approaching bicycle to prevent bicycle-related collisions during vehicle maneuvers in the driver's blind spot.

CONCLUSIONS Video image processing is used in traffic applications, status recognition and traffic monitoring. We integrate, static traffic environment (e.g. lane recognition) with static or moving obstacles (object detection) within a space of interest and other dynamic problems through feature-driven, area-driven, or model-based data in the spatial/frame or temporal/video domain. We propose that there is a need for adapting to optical measuring technology in traffic monitoring and especially at cross-roads. We discriminate between static and mobile camera.

REFERENCES

2. W. Enkelmann, G. Struck, J. Geisler, ROMA—a system for model based analysis of road markings, *Proceedings of IEEE Intelligent Vehicles 95, Detroit (1995)* 356–360.
3. K. Kluge, G. Johnson, Statistical characterization of the visual characteristics of painted lane markings, *Proceedings of IEEE Intelligent Vehicles 95, Detroit (1995)* 488–493.
4. A. Broggi, Parallel and local feature extraction: a real-time approach to road boundary detection, *IEEE Transaction on Image Processing* 4 (2) (1995) 217–223.
5. S. Beucher, M. Bilodeau, Road segmentation and obstacle detection by a fast watershed transform, *Proceedings of IEEE Intelligent Vehicles 94, Paris, France October (1994)* 296–301.
6. F. Chavand, E. Colle, Y. Chekhan, E.C. N'zi, 3D measurements using a video and a range finder, *IEEE Transactions on Instrumentation and Measurement* 46 (6) (1997) 1229–1235.
7. 99P.J. Burt, Smart sensing within a pyramid vision machine, *Proceedings of IEEE* 76 (1988) 1006–1115.
8. Bogenberger, R., BMW AG: IP & Ethernet as potential mainstream automotive technologies. *Product Day Hanser Automotive. Fellbach, 2011.*
9. Neff, A., Mattheus, K, et al.: Ethernet & IP as application vehicle bus in use scenario of camera-based driver assistance systems, *VDI Reports 2132, Electronics in the motor vehicle. Baden-Baden, 2011.* pp. 491-495.
10. Streichert, T., Daimler AG: Short and Longterm Perspective of Ethernet for Vehicle-internal Communications. *1st Ethernet & IP @ Automotive Technology Day, BMW, Munich, 2011.*
11. Powell, S. R., Broadcom Corporation: Ethernet Physical Layer Alternatives for Automotive Applications. *1st Ethernet & IP @ Automotive Technology Day, BMW, Munich, 2011.*
12. NXP Develops Automotive Ethernet Transceivers for In-Vehicle Networks, November 09, 2011.

Links:

- <http://www.nxp.com/news/press-releases/2011/11/nxp-develops-automotive-ethernet-transceivers-for-in-vehicle-networks.html>
- www.vector.com/viipethernetsolutionsen.html
- www.vector.com/vicanoehhttp://eetimes.com/ContentEETimes/Images/ip_en.html
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- <http://www.roadtraffic-technology.com/news/newsmotorists-spend-18-journey-time-not-focusing-road>

- www.getaheadofthegames.com
- www.mostcooperation.com
- controleng.com/networks

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