Universidad
de Alcalá

Comunidad
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Dirección General de Investigación
e Innovación Tecnológica
CONSEJERÍA DE CIENCIA,
UNIVERSIDADES E INNOVACIÓN

CATALOGUE

Industry and transportation

Scientific and Technological Offer

Industry and Transportation

FACE TRACKING AND POSE ESTIMATION WITH AUTOMATIC 3D MODEL CONSTRUCTION

TECHNOLOGY OFFER

Code

TRANSP_UAH_01

Application areas

- Information and Communication Technologies.
- Industrial Manufacture, Material and Transport technologies

Type of collaboration

- Interested in companies or institutions to conform a consortium for a project proposal to make it the system real.
- Commercial agreement with technical assistance

Main researches
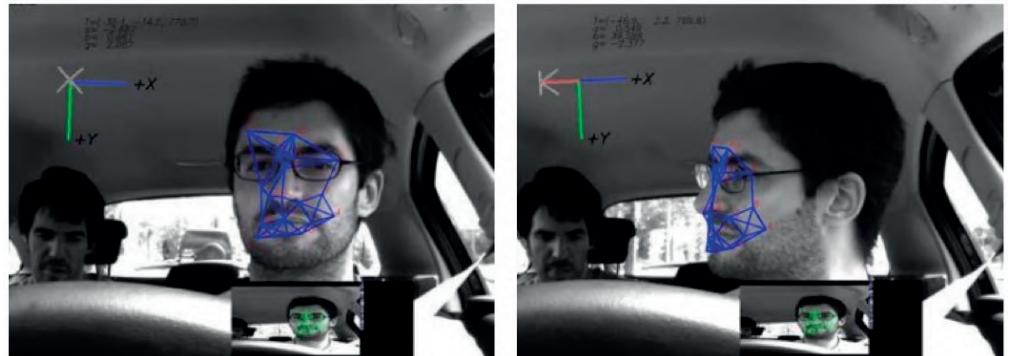
Prof. Luis Miguel Bergasa Pascual

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ABSTRACT

The model is formed by a set of 3D tri-dimensional points of the face. These points are automatically selected in the first image obtained from the cameras.

The face is located using Viola&Jones method, and points in the face that present adequate characteristics for tracking are found with Harris detector. Up to 30 points are used. The image patches around the 2D projections of these points on each camera are tracked on each frame, using the Simultaneous Modelling and Tracking (SMAT) algorithm. This algorithm builds a model of the changes of the appearance or texture around each point. The 3D pose is obtained from the 2D points using POSIT, redundantly for both cameras to improve robustness.

Tracking may fail for some points on each frame. RANSAC is used to discard erroneous points from the estimation of the pose. After a set of correctly tracked points (inliers) is obtained, the position of the outlier points is reset accordingly to the estimated pose. Points become occluded as the head turns and cannot be tracked. The system is able to robustly estimate the pose of the face in presence of turns of up to ±90o.

It uses a novel technique that completes the model as the face rotates and employs the method of bundle Adjustment to adjust the model. The system is able to track a driver's face robustly in real conditions. Experimental results and an analysis of the performance are ready to be presented.

ADVANTAGES AND INNOVATIONS

For the first time, this system of computer vision is able of recognizing the orientation of the human face, with no need of previous identification of the person or offline training. This system is innovative in the way of joining the three algorithms that uses for its fun- ctioning: SMAT, RANSAC and POSIT. To the best of our knowledge they had never been used before in that way.

This method works in real time (30 images per second) and it takes 33 milliseconds to execute the algorithms. It is a very robust system that keeps on working even in situations for which the model has not been designed (sudden turns of face, strong shadows, etc.). The system works with increased estimation error but tracking of the face is not lost.

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NOVEL FULL FIELD 3D DISPLACEMENT MEASUREMENT DEVICE

Patent
ES2498592

Code

TRANSP_UAH_03

Application areas

- Industrial Manufacture, Material and Transport technologies

- Measures and standards

Type of Collaboration

- Agreement of "Joint Venture"

- License agreement

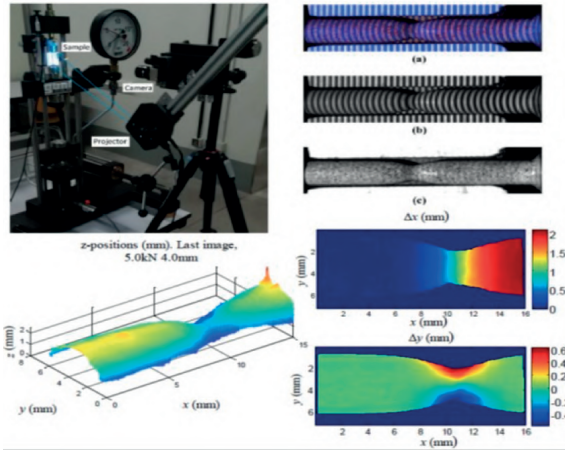**Main Researchers**

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z-positions (mm). Last image, 5.0kN 4.0mm

ABSTRACT

It is proposed to further promote the implementation of an alternative technique for measuring 3D displacements in the industries and research centers and, eventually, develop a commercial device. It is a low cost alternative technique to 3D Digital Image Correlation (3D-DIC), used for evaluating the mechanical performance of new designs and materials under real working conditions.

The alternative proposed system combines the two techniques of Fringe Projection and 2D Digital Image Correlation (FP+2D-DIC). It allows measuring large areas and displacements of surface elements in the three spatial direction (from which the corresponding deformation maps can be calculated).

Measurements are acquired in real-time but the sample surface must be painted with a random speckle pattern.

The main advantages of FP+2D-DIC in comparison to 3D-DIC: requires one camera in addition to a fringe projector, processing algorithms are much more simple and less expensive, especially for highs speed measurements (since it uses only one camera). However, the camera that uses FP+2D-DIC has to be RGB.

Sought cooperation types:
-Financial support for further improvement of the FP+2D-DIC,
-Industry interested in testing the equipment
-Commercialization of the equipment.

ADVANTAGES AND INNOVATIONS

- The device developed for the combined FP+2D-DIC technique is unique and has already provided results comparable to the one obtained with the commercial alternative technique of 3D-DIC.

- The improved FP+2D-DIC device will increase its performance by using new equipment (mainly a special camera and fringe projector) as well as by implementing new image processing algorithms that already have demonstrated to increase performance beyond the one offered by the commercially available 3D-DIC equipment.

The FP+2D-DIC device has been a result of collaboration between two universities, the Universidad of Alcalá and the Universidad of Jaén.

METHOD AND SYSTEM TO IMPROVE THE ASFA DIGITAL SYSTEM INCORPORATING VIRTUAL ASFA BEACONS

Patent
ES 2418929

Code

TRANP_UAH_04

Application areas

- Information and Communication Technologies

- Industrial Manufacture, Material and Transport technologies

Type of Collaboration

- Technical cooperation

- Commercial agreement with technical assistance

- License agreement

Main Researchers
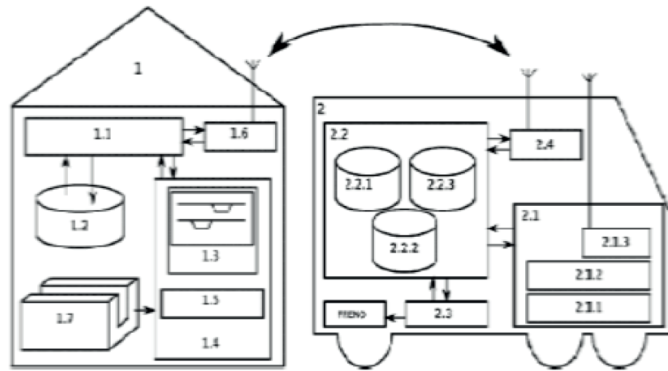
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ABSTRACT

Geintra Spanish research group from the Department of Electronics of Alcala University has developed a process and system to improve the performance of ASFA Digital system, through the inclusion of virtual ASFA beacons, which replace or supplement the information of the physical ASFA beacons. The virtual beacons allow monitoring temporary speed restrictions even in the absence of physical ASFA beacons. The group is looking for companies in the railway sector to reach licensing agreements or collaboration and commercial agreements for technical assistance

ADVANTAGES AND INNOVATIONS

- It Include virtual ASFA beacons which replace or supplement the information of physical ASFA beacons located in the rail track, and especially those of temporary speed restrictions (LTV).

- The system increases the railway transport safety significantly.

- It gives accurate and updated information, at all times, that enables proper supervision of trains speed, depending on the signs and on particular conditions of each section, etc.

- Clearing potentially dangerous situations that may occur in the train circulation. In fact a large percentage of train accidents occur due to a detection fault of physical ASFA LTV beacons in track.

- It allows the detection of defective ASFA beacons and thus better maintenance of rail infrastructure, going from a corrective maintenance (once the fault occurred) to a predictive maintenance (based on the monitoring of certain characteristic parameters, to predict when the beacons will fail).

- The response time from breakdowns is reduced dramatically, it automates various processes related to operating of railway vehicles.

- The solution proposed in this patent is 100% compatible with the current ASFA Digital equipment. This solution allows to insert new functionalities in current ASFA Digital systems.

INTELLIGENT TRANSPORT SYSTEM FOR THE OPTIMIZATION OF INDOOR SHARED RESOURCES: ROUTES, COMMUNICATION CHANNELS AND SENSOR NETWORKS

TECHNOLOGY OFFER

Code

TRANSP_UAH_06

Application areas

- Information and Communication Technologies.

- Industrial Manufacture, Material and Transport Technologies

Type of collaboration

- License Agreement

- Services Agreement

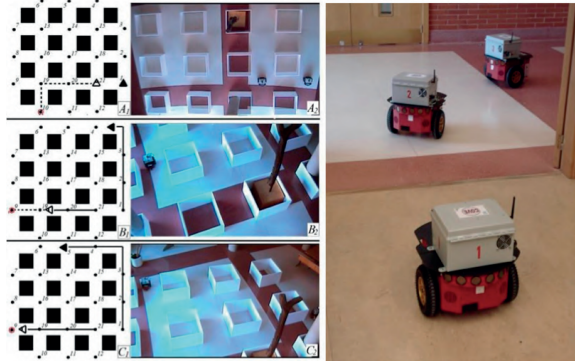### Main researches

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ABSTRACT

GEINTRA is a research group from the Electronics Department of the University of Alcala. The group offers solutions for route selection and digital control with adaptive sampling. It is a useful system for transport optimization and functionality of indoor mobile units.

The system has application for optimal routing techniques, with on-line adjustment along the path for the travel time optimization between two points. The solution avoids units' breakdown and waiting times in an industrial environment with multiple transport units and alternative routes.

The system also has application of remote control digital techniques with event-based sampling for indoor path tracking transport, both independently and in several units formation.

The solution uses the implementation of sensing and estimation techniques for information only when it is required to optimize the units transport, that allows to improve both energy consumption and computational cost for the sensory modules distribution.
The proposed system manages access to the shared communications network by multiple transport units and the sensors location distributed by the industrial environment, reducing the effects of channel delays and packets dropout.

ADVANTAGES AND INNOVATIONS

- The route optimization techniques represent an improvement in execution times and they can be adapted to any changes in the environment from a priori planned route solutions.

- Digital aperiodic sampling techniques, for motion control and the estimation of information from the sensor measurements, have a proven shared resources optimization compared to the classical solution of periodic sampling, such as the communication channel and the sensors network.

- With competitive advantages such as travel time optimization, selective use of the wireless communication channel and energy cost reduction for sensors distributed in the environment.

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METHOD AND SENSOR SYSTEM FOR THE DETECTION OF TRAINS' AXLES USING FIBER OPTICS AND TIME OF FLIGHT CAMERAS

Patent
ES2506590

Code

TRANSP_UAH_07

Application areas

- Industrial Manufacture, Material and Transport technologies

- Information and Communication Technologies

Type of Collaboration

- Technical cooperation

- Commercial agreement with technical assistance

- License agreement

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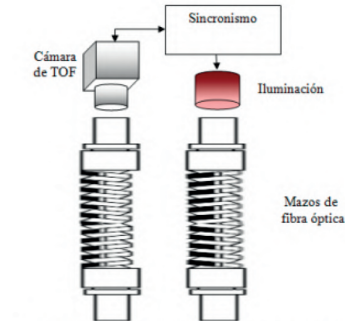Dr. Javier Macías Guarasa

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Block diagram of the proposed sensor system.

ABSTRACT

Method and a sensor system for the detection and counting of the train's axles. This sensor may be used to verify the integrity and speed of the railway convoys. This method and sensor system is characterized by its high auscultation speed.

Nowadays there are rail systems solutions to detect the train axles. One of which is the use of electromechanical and optical pedals which sends out an electrical signal when it is pressed by a wheel. Those solutions have the disadvantage that the physical contact with the wheels or track causes physical wear and the life expectancy is short. Also in high-speed trains it may skip the step of consecutive axles due to the inertia of the mechanical parts of the sensors.

Other solutions, which do not require physical contact with the trains, are electromagnetic sensors, which are not commonly used because they have problems related to the difficulty of their location. There are also possible faults arising from their sensitivity to the relative position of the transmitter, the receiver and the vibration. In order to resolve those problems, a non-invasive optical sensing system has been designed which detects the wheels without including any electronics in the tracks. This system is completely immune to electromagnetic interferences. Furthermore, by the method used for the measurements is immune to the sensor system vibration.

With this solution the measurements are made without physical contact with any element of the train, it has total immunity to electromagnetic interference (absence of electronics in the pathway) and to the sensor vibration.

ADVANTAGES AND INNOVATIONS

- Axles detector without any electronics included in the track.

- Completely immune to electromagnetic interference and sensor's vibration.

- Significantly increases the safety in railway transport.

- No electronics in railway are required.

- The system is immune to electromagnetic interference.

- There is no mechanical wear of the components.

- The system is immune to vibration.

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TECHNOLOGY OFFER

Code

TRANSP_UAH_10

Application areas

- Information and Communication Technologies
- Industrial Manufacture, Material and Transport technologies

Type of collaboration

- Interested in companies or institutions to conform a consortium for a project proposal to make it the system real
- Commercial agreement with technical assistance

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DRIVESAFE: APP THAT MONITORS AND SCORES YOUR DRIVING, GENERATING ALERTS WHEN IT IS NOT SAFE

ABSTRACT

DriveSafe evaluates the driver behavior and generates real-time alerts based on seven indicators: accelerations, braking, steering wheel turns, position within the lane, how the driver makes the lane changes, driver behavior respecting the allowed speed in the different sections of a road and the approach maneuvers to the previous vehicle. It classifies each trip among normal, drowsy and aggressive, using the sensors of the mobile phone itself (accelerometers, GPS, rear camera), as well as access to map services (OpenStreetMap) through Internet. It uses an augmented reality interface that allows to improve the driving experience through a feedback, provided by the App, of how it is being done.

The information obtained is always available for the driver to consult after the trip, including maps with location information and risk maneuvers. All this along with videos recorded automatically in the moments in which the driving has been more dangerous.

DriveSafe also generates a series of alerts during driving, typical of advanced driving assistance systems services available in premium vehicles: accelerations, brakes and sudden turns, irregular lane changes, zig-zag within the lane, overrun of the permitted speed and dangerous approach to the previous vehicle.

ADVANTAGES AND INNOVATIONS

DriveSafe is able to calculate its position within the lane and the distance/time it is from the ahead vehicles in real time using an exclusive algorithm based on the rear camera of your Smartphone and provides real-time alerts of ADAS services that would otherwise only be available in premium vehicles.

Drivesafe provides a user-friendly interface with access to all calculated real-time indicator ratios. The information obtained is always available for the driver to consult after the trip, including maps with location information, risk maneuvers made, and automatically recorded videos at times when driving has been more dangerous. This application works in any type of vehicle and is effective even in adverse weather conditions: rain, fog, moderate snow or at night.

DriveSafe is respectful of the privacy of its users. It only uses the rear camera (focused towards the road) to analyze the route, without taking pictures of the inside of the vehicle. The information generated is stored in the vehicle itself and it is only sent to a remote server for analysis if the user consents. The application can be available in the market store of the leading mobile companies on the market, allowing global visibility and easy access to it from anywhere in the world. This application improves, on the one hand, the safety of drivers (a service that otherwise would only be available in high-end or premium vehicles), and on the other hand, a history of driving behavior is generated.

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PROCEDURE FOR MEASURING THE SPEED OF MOTOR VEHICLES IN THE SHORT SECTION, WITH MINIMUM ERROR GEOMETRY, USING 2 CAMERAS AND ARTIFICIAL VISION ALGORITHMS

Patent
ES2665939

Code
TRANSP_UAH_12

Application areas

- Industrial Manufacture, Material and Transport technologies
- Measures and standards
- Information and Communication Technologies

Type of Collaboration

- Technical cooperation
- Commercial agreement with technical assistance
- License agreement

Main Researchers

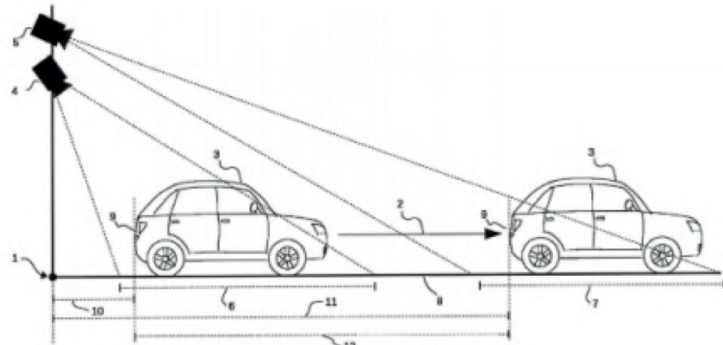Prof. David Fernández-Llorca

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Side view of the general operation diagram. In this figure the two vehicles correspond to the same vehicle in two different time instants.

ABSTRACT

The research group in Intelligent Vehicles and Traffic Technologies of the Automation Department of the University of Alcalá has developed a procedure for the punctual measurement of the speed of motor vehicles, through the use of at least two cameras, pointing to two different regions of the track, calculating the relative distances of the vehicle from the cameras by detecting the license plate and its internal elements, storing timestamps, calculating the speed for all possible combinations of distances between cameras that are at the optimum distance that generates minimum error in the calculation of the speed and calculating the average speed of all the speed measurements obtained for optimal distances of minimum error.

ADVANTAGES AND INNOVATIONS

- The invention proposes a novel method for the punctual measurement of the speed of motor vehicles by using at least two high-resolution cameras each pointing to two different regions of the same lane.

- By using that cameras to detect the known dimensions of the license plate, the measurement error is reduced to a minimum. Artificial lighting systems are used to improve the contrast of images and maintain their effectiveness in low light conditions. All information is managed in a processor, which also allows the storage of timestamps.

- This new procedure establishes a specific criterion for minimum error of speed measurement, which is not found in other systems, by using at least two cameras located in the same point, either on a pole or on a portico, pointing each one of them to two different regions of the same lane. In this way the problems resulting from the errors in the punctual measurement of the speed are considerably reduced.

- High commercial potential at national and international level with a much lower cost than the relative cost associated with radar or laser-based point-based kinemometers.

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SUPERVISION SYSTEM THROUGH ARTIFICIAL VISION TO MONITOR CHILDREN WHEN TRAVELING IN CHILD RETENTION SYSTEMS

Patent
ES2684607

Code
TRANSP_UAH_15

Application areas

- Industrial Manufacture, Material and Transport technologies
- Security
- Information and Communication Technologie

Type of Collaboration

- Technical cooperation
- Commercial agreement with technical assistance
- License agreement

Main Researchers

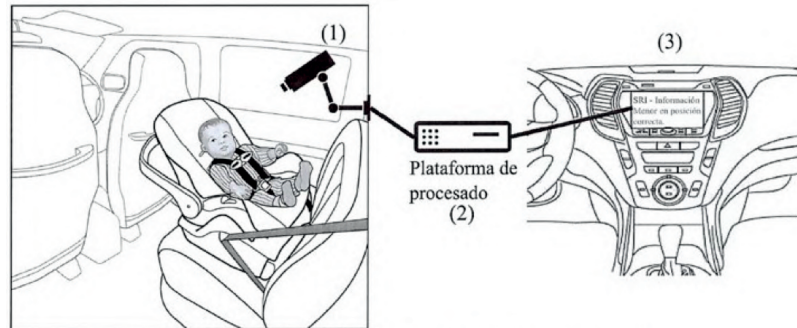Dr. Roberto López Sastre

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(1) Image capture system; (2) Image processing platform; (3) Communications interface

ABSTRACT

For the first time, a monitoring system is developed, which applies artificial vision and artificial intelligence techniques, to accurately monitor the pose adopted by a child traveling in a Child Retention System, notifying the driver immediately of the risk situations.

The device monitors the child continuously, automatically detecting his head, and estimating his pose accurately, while locating the different parts of the body and some fastening elements of the Retention System. The system is therefore capable of detecting situations that entail risk for the child.

The interface system allows the driver to be informed of the detected risk situations, either through audible alarms or through the vehicle's information systems.

The present invention has its field of application in the field of road safety in general, and child retention systems for vehicles in particular.

ADVANTAGES AND INNOVATIONS

- The present invention is the first to focus on the monitoring of the child traveling subject in a retention system. Unlike other similar technologies that only focus on the analysis of the driver of the vehicle (attention, fatigue, etc.) and what happens in the environment of the vehicle.

- Furthermore, the present invention monitors the head pose of the child traveling in a retention system, detecting dangerous positions in case of accident and notifying the driver.

- This invention allows to monitor not only the head but also the different parts of the body of the child, such as the torso and upper extremities, and the safety belts, to alert if the child has got rid of them or if they are in an wrong position.

- This system can be implemented in any architecture for image processing that can be embedded in a vehicle.

- It uses only artificial vision techniques and artificial intelligence, so there is no need to use additional mirrors or anti-escape systems. Only the proposed system.

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SENSOR SYSTEM FOR THE DETECTION OF OBJECTS/OBSTACLES IN CRITICAL POINTS OF RAILWAY LINES

Patent
ES2377802

Code
TRANSP_UAH_16

Application areas

- Industrial Manufacture, Material and Transport technologies
- Environment and risk prevention Electronics
- Information and Communication Technologies

Type of Collaboration

- Technical cooperation
- Commercial agreement with technical assistance
- License agreement

Main Researchers

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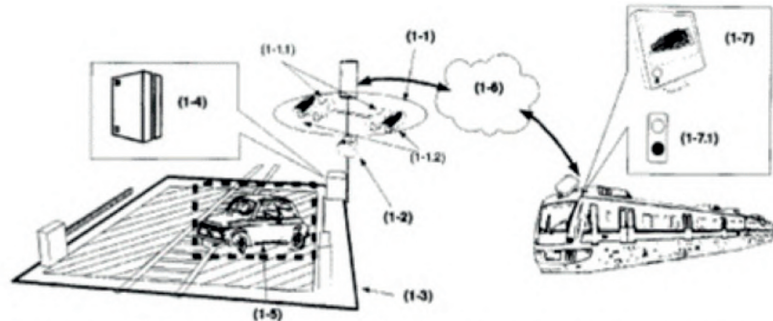Dr. Marta Marrón
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ABSTRACT

The research group in Electronics Engineering Applied to Intelligent Spaces and Transport (GEINTRA) of the Department of Electronics of the University of Alcalá has developed a sensor device and its corresponding procedure to detect the presence of any type of objects (vehicles, people, animals, etc...) in points of interest of the railway route (level crossings, tunnels, etc.), sending to the train the visual information and corresponding warning signs.

The device consists of a set of cameras located in the environment of each point of interest, an infrared lighting system, an image processing module and a wireless communication system with the train.

The system contributes to the increase of safety in rail transport, providing the machinists with visual information about the state of the conflicting points and notifying the presence of obstacles. The system is capable of detecting the presence of objects in daylight and nighttime conditions.

ADVANTAGES AND INNOVATIONS

The system includes an intelligent video processing module, whose mission is the automatic detection of possible elements that can cause an accident (with danger for the personnel on the ground, like a run over, and also with danger for the train, like a derailment).

In addition, the image processing system allows image transmission from the risk area to the train approaching the area and the detection of anomalous objects in that area and the transmission of the corresponding alarm to the train.

The proposed invention has the following advantages:

- Images in real time, and continuously, of what is happening at a specific point.

- Quick assessment of whether there is a risk situation.

- Increased safety in circulation.

- Elimination of possible human errors and facilitates the function of the machinist.

- High commercial potential at national and international level with moderate cost.

IDENTIFICATION OF VEHICLE BRANDS FOR TRAFFIC CONTROL AND ACCESS CONTROL APPLICATIONS

Patent
ES2684607

Code
TRANSP_UAH_17

Application areas
- Industrial Manufacture, Material and Transport technologies
- Automatic

Type of Collaboration
- Technical cooperation
- Commercial agreement with technical assistance
- License agreement

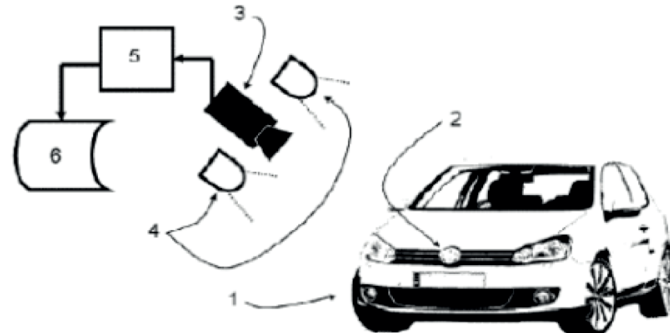## Main Researchers
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(1) Dispositivo de reconocimiento de marcas de vehículos (2) Logo del fabricante (3) Cámara (4) Sistema de Iluminación (5) Procesador (6) Sistema de almacenamiento.

ABSTRACT

Vehicle branding recognition device based on a classification procedure of the manufacturer's logo. The device consists of a camera, a lighting system, a processor and a storage system. The procedure uses the images provided by the camera that are analyzed by a processor that is also connected to a storage system.

The processor is adapted to extract information from the spatial distribution of the module and the orientation of the logo gradient, forming a vector of characteristics. The processor is adapted to classify the feature vector by running a multi-class classifier, previously trained with feature vectors from vehicle logos, to provide the most credible estimate of the vehicle's brand that appears in the images captured by the camera.

In low light conditions, the device activates one or more artificial lighting systems to improve the contrast of the images. The processor is adapted to store the images and the result of the recognition of the brand of the vehicle in the storage system for later use.

The patent object of this invention has its field of application in the industry of intelligent transport systems, companies in charge of traffic control, access control to restricted environments, as well as those in charge of integrating detection of infraction systems of vehicles on the road.

ADVANTAGES AND INNOVATIONS

- The present device proposes for the first time a mechanism for the classification of logos by means of a pattern recognition scheme.

- For the identification of the logo of the vehicles, this invention is based on the distribution of the module and orientation of the gradient of the region containing the logo.

- The present system, in addition to locating the logo of a vehicle manufacturer, is capable of classifying and recognizing it.

- So, the information that facilitates about the vehicle in question is more useful and solid than that provided with the previous classical optical.

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SYSTEM FOR RELIABLE DETECTION OF OCCUPANCY OF PARKING SPACES

Patent
ES2684607

Code

TRANSP_UAH_18

Application areas

- Industrial Manufacture, Material and Transport technologies

- Information and Communication Technologies

Type of Collaboration

- Technical cooperation

- Commercial agreement with technical assistance

- License agreement

Main Researchers

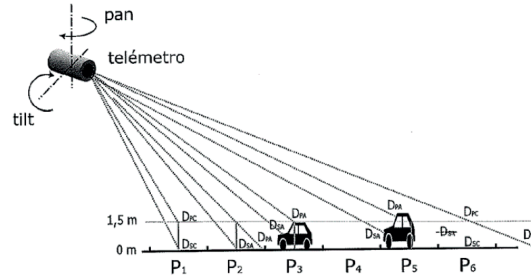Prof. Alfredo Gardel Vicente

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ABSTRACT

This system proposes a device that obtains the occupation status of each of the parking spaces within the area supervised by a sensor node that is composed of a video camera, a laser telemeter on a pantilt platform and a processing algorithm.
Its main features are the following:

- Camera and telemeter on a pan-tilt movement platform, as a single set of remote sensing for the detection of the occupation status of the parking spaces.

- Calibration in the installation to guide the system conveniently to the different squares of the supervised parking area.

- Algorithm of data fusion and its application to the detection of occupation of parking spaces: identification of empty spaces; vehicle entry / exit detection; fusion of video and distance data to indicate the occupation status of a place.

Once the parking occupation has been detected entirely, the system can guide the driver through his mobile phone, through an application to be developed.

ADVANTAGES AND INNOVATIONS

The novelty of the patent is mainly in the combination of the information obtained from both systems: image of the square, recognition of the space (floor) that corresponds to each parking space, detection of movement of a car in an area in the sequence of images that can mean that it occupies or leaves free a parking space close to a particular area, and the measurement of distances to the parking spaces of interest of the affected area, so that there are results of occupation of parking spaces more reliable, allowing its use in surface parking systems.

The new system includes a new distance measurement device, merging the video and distance measurements to provide an appreciable improvement in the detection of occu- pied spaces.

This new invention provides occupancy detection values of correct spaces even in low lighting conditions, brightness, occlusions, shadows, flashing lights, night operation, etc.

In addition, compared to other methods, this system gives specific information of where there is a parking space and it could also guide the user to it.

The system does not need a fixed visual demarcation of the squares in the ground, being able to vary its structure, position and dimensions of the parking spaces.

The system has a very low installation cost per space.

It does not require civil works, which is a great advantage with respect to systems that use specific luminaires and therefore require an installation in most cases very expensive.