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PARKING LOT DETECTION

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Abstract - A problem faced in major metropolitan areas, is the search for parking space. In this paper, we proposed a novel way for automatic parking lot detection. In our approach, we first extract features by generating detection patches and building Gaussian ground model from input video frames. Then this model is used to train an eight-class multi-SVM classifier. Finally, the classification is optimized globally via applying Markov Random Field. Current systems detecting vacant parking spaces are either very expensive due to their hardware requirements or do not provide a detailed occupancy map. While several sensor types feature individual parking space surveillance, their installation and maintenance costs are relatively high. The system developed in this research group has minimal hardware requirements, which makes it less expensive and easy to install. At the same time, our video-based approach offers flexibility regarding information usage and site of operation.

1.1 INTRODUCTION

A parking lot or car park also known as a car lot, is a cleared area that is intended for parking vehicles. Usually, the term refers to a dedicated area that has been provided with a durable or semi-durable surface. In most countries where cars are the dominant mode of transportation, parking lots are a feature of every city and suburban area. Shopping malls, sports stadiums, mega churches and

Simili ar venues often feature parking lots of immense area. See also multistory car park Parking lots tend to be sources of water pollution because of their extensive impervious surfaces. Most existing lots have limited or no facilities to control runoff. Many areas today also require minimum landscaping in parking lots to provide shade and help mitigate the extent of which their paved surfaces contribute to heat islands. Many municipalities require a minimum number of parking spaces, depending on the floor area in a store or the number of bedrooms in an apartment complex. In the United States, each state's Department of Transportation sets the proper ratio for disabled spaces for private business and public parking lots. Various forms of technology are used to charge motorists for the use of a parking lot. Modern parking lots use a variety of technologies to help motorists find unoccupied parking spaces, retrieve their vehicles, and

improve their experience. In recent years, parking has become a serious problem under the increasing of the private vehicles but the available spaces in car parking lot are not enough. Looking for parking space always wastes travelling time. The driver has to drives a car to find an available space to park. They cannot predict whether there is an available space or not, so it wastes the fuel and time. For the driver's convenience, public parking lots should be responsible to inform the availability and location of parking space. However, maintaining such kind of parking space system manually needs lots of human resource. Therefore, unsupervised parking lots detection has been currently employed in many systems for counting the number of parking space, identifying the location, monitoring the changes of space status over the time. Autonomous driving research aims to develop cars without human operation, which can lead to a revolution of our modern industry. The autonomous driving will effectively provide more accurate environment information with different sensors, reduce the operation complexity for human driver, and increase the safeness in driving. These techniques will contribute in building a smart transportation system, for a more safety modern city and lower-energy cost environment. One of the important techniques for autonomous driving is automatically detection of the traffic markings, which is very helpful for the analysis of the road information with vision sensors such as cameras. Compare with the traffic signs that appear at the side or on top of roads, road markings refer to the signs on the road surface that divide the road surface into different lanes and also provide certain vehicle parking policy information. Although many information provides by road markings is redundant to traffic signs, some of the information are only provided by road markings, such as parking lot markings.

2. LITERATURE SURVEY

Road markings feature extraction from Omni-directional image Author-Chuanxiang Li, Naixin QI, Xiaogang Yang Year – 2017 Description-Road markings are important information of transport systems for drivers or intelligent vehicle. Efficient road markings feature extraction is pre-requisite to road markings detection, recognition and visual localization. However, most of previous lane markings feature extractors are operating on conventional images, the feature extraction methods for Omni directional images are rarely considered in road markings detection research. In this paper, three road markings feature extractors for Omni-directional images are presented based on different characteristics of road markings. Those lane markings feature extractors are evaluated on real world panoramic image dataset. Experimental results show the feature extractor combing the edge and intensity distribution performs best.

A Lane Marking Extraction Approach based on Random Finite Set Statistics Author-Feihu Zhang, Hauke Stahle, ¨ Chao Chen, Christian Buckl and Alois Knoll Year-2015 Description**:**Within the past few years, lane detection technology has become of high interest in the field of intelligent vehicles; however, robustness is still an issue. The challenge is to extract the lane markings effectively from the complex urban environment. In this paper, we present a novel approach based on Random Finite Set Statistics for estimating the position of lane markings. We rely on Probability Hypothesis Density (PHD) filtering and apply this technique to lane marking extraction in urban environment. Our method is based on two phases: an image preprocessing phase to extract pixels that potentially represent lanes and a tracking phase to identify lane markings. Compared to other approaches, our method presents a recursive filtering algorithm

which extracts lane markings in the presence of clutter and non-lane markings.

Parking Slots Detection on the Equivalence Sphere with a Progressive Probabilistic Hough Transform Author-Giulio Bacchiani, Marco Patander, Alessandro Cionini, Domenico Giaquinto Year-2017

Dexcription-Autonomous vehicles and modern Advanced Driver Assistance Systems require a module for detecting parking lot markings, in order to locate free parking slots and to assist the driver with the parking maneuver or to entirely accomplish it. Equipping those systems with multiple fisheye cameras is a common design solution, since fisheye sensors provide a wide field of view at a cost and size comparable with rectilinear cameras. Unfortunately, a straight line in the world corresponds to a segment of conic section in fisheye images, hence the detection of parking lot markings have to deal with non trivial problems. This paper proposes a method that implements the Progressive Probabilistic Hough Transform in the space obtained from the re -projection of the fisheye image points in the equivalence sphere. The presented solution allows identifying road marking segments directly on the fisheye image, providing long range accuracy unlike typical bird's-eye view based approaches. A simple parking slots detector based on the detected road markings has been developed in order to verify the feasibility of such a system.

Multi-lane detection based on Omni directional camera using anisotropic steerable filters Author-Chuanxiang Li, Bin Dai1, Ruili Wang, Yuqiang Fang, Xingsheng Yuan, Tao Wu Year-2016 Description-Automated lane detection is a vital part of driver assistance systems in intelligent vehicles. In this study, a multilane detection method based on unidirectional images is presented to conquer the difficulties stemming from the limited view field of the rectilinear cameras. The contributions of this study are twofold. First, to extract the features of the lane markings under various illumination and road-surface scenarios, a feature extractor based on anisotropic steerable filter is proposed. Second, a parabola lane model is used to fit the straight as well as curved lanes. According to the parabola lane model, the straight lines and curves of feature maps can be represented as straight lines in a linear space coordinate system. Then lane modeling can be treated as an optimisation question in linear space and the parameters of lanes can be estimated by minimizing the objection function. The method has been tested on publicly available data sets and the real car experiments. Experimental results show that the proposed method outperforms state-of-the-arts approaches and obtains a detection accuracy of 99% in real world scenes.

Lane detection using Randomized Hough Transform Author-Peerawat Mongkonyong1, Chaiwat Nuthong, Supakorn Siddhichai2 and Masaki Yamakita3 Year-2018

Description-According to the report of the Royal Thai Police between 2006 and 2015, lane changing without consciousness is one of the most accident causes. To solve this problem, many methods are considered. Lane Departure Warning System (LDWS) is considered to be one of the potential solutions. LDWS is a mechanism designed to warn the driver when the vehicle begins to move out of its current lane. LDWS contains many parts including lane boundary detection, driver warning and lane marker tracking. This article focuses on the lane boundary detection part. The proposed lane boundary detection detects the lines of the image from the input video and selects the lane marker of the road surface from those lines. Standard Hough Transform (SHT) and Randomized Hough Transform (RHT) are considered in this article. They are used to extract lines of an image. SHT extracts the lines from all of the edge pixels. RHT extracts only the lines randomly picked by

the point pairs from edge pixels. RHT algorithm reduces the time and memory usage when compared with SHT.

Precise Localization of an Autonomous Car Based on Probabilistic Noise Models of Road Surface Marker Features Using Multiple Camera Author-Kichun Jo, Yongwoo Jo, Jae Kyu Suhr Year-2015 Description-The sensor system is composed of onboard motion sensors, a low-cost GPS receiver, a precise digital map, and multiple cameras. Data from the onboard motion sensors, such as yaw rate and wheel speeds, are used to predict the vehicle motion, and the GPS receiver is applied to establish the validation boundary of the ego–vehicle position. The digital map contains location information at the centimeter level about road surface markers (RSMs), such as lane markers, stop lines, and traffic sign markers. The multiple images from the front and rear mono-cameras and the around-view monitoring system are used to detect the RSM features. The localization algorithm updates the measurements by matching the RSM features from the cameras to the digital map based on a particle filter. Because the particle filter updates the measurements based on a probabilistic sensor model, the exact probabilistic modeling of sensor noise is a key factor to enhance the localization performance. To design the probabilistic noise model of the RSM features more explicitly, we analyze the results of the RSM feature detection for various real driving conditions.

Parking Space Recognition for Autonomous Valet Parking Using Height and Salient-Line Probability Maps Author-Seung-Jun Han and Jeongdan Ch Year-2015 Description- An autonomous valet parking (AVP) system is designed to locate a vacant parking space and park the vehicle in which it resides on behalf of the driver, once the driver has left the vehicle. In addition, the AVP is able to direct the vehicle to a location desired by the driver when requested. In this paper, for an AVP system, we introduce technology to recognize a parking space using image sensors. The proposed technology is mainly divided into three parts. First, spatial analysis is carried out using a height map that is based on dense motion stereo. Second, modelling of road markings is conducted using a probability map with a new salient-line feature extractor. Finally, parking space recognition is based on a Bayesian classifier. The experimental results show an execution time of up to 10 ms and a recognition rate of over 99%. Also, the performance and properties of the proposed technology were evaluated with a variety of data. Our algorithms, which are part of the proposed technology, are expected to apply to various research areas regarding autonomous vehicles, such as map generation, road marking recognition, localization, and environment recognition.

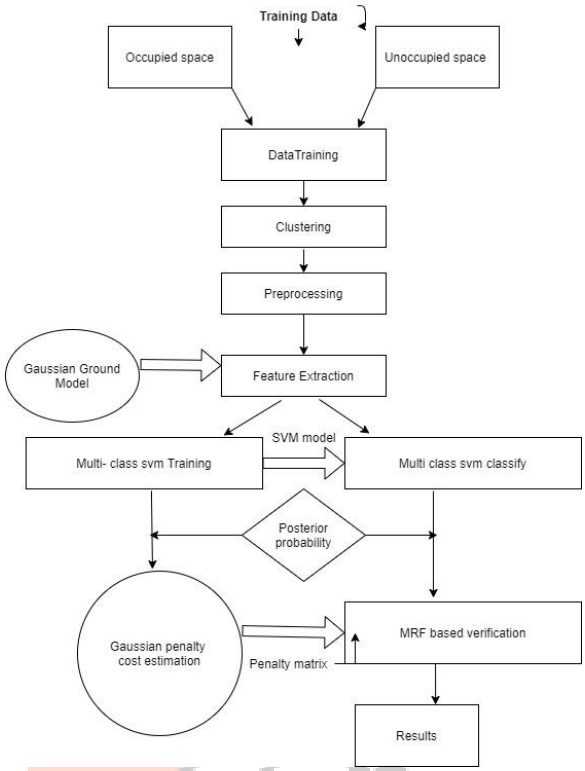
Parking Space Detection Using Ultrasonic Sensor in Parking Assistance System Author- Wan-Joo Park, Byung-Sung Kim, Dong-Eun Seo, Dong-Suk Kim and Kwae-Hi Lee Year- 2010 Description- Using the multiple echo function, the accuracy of edge detection was increased. After inspecting effect on the multiple echo function in indoor experiment, we applied to 11 types of vehicles in real parking environment and made experiments on edge detection with various values of resolution. We can scan parking space more accurately in real parking environment. We propose the diagonal sensor to get information about the side of parking space. Our proposed method has benefit calculation and implementation is very simple. Therefore we confirmed utility of the multiple echo function. Next step, we applied to 11 types of vehicles in real parking environment. Using the multiple echo function we got more accurate edge detection than the single echo function. We made experiments on edge detection with various value of Rres from 10cm to 100cm. We could get good performance at 70cm Rres. We propose the

diagonal sensor to get information about the side of parking space. We experimented to get the data of the side by rotating diagonal sensor with various angles within 0 ~ 90°.

Cost-Effective Ultrasonic Sensor-Based Driver-Assistance System for Congested Traffic Conditions Author- Vivek Agarwal, N. Venkata Murali Year-2009 Description -In urban areas, congested traffic results in a large number of accidents at low speeds. This paper describes an accurate and fast driver-assistance system (DAS) that detects obstacles and warns the driver in advance of possible collisions in such a congested traffic environment. A laboratory prototype of the system is built and tested by simulating different weather conditions in the laboratory. The proposed DAS is also suitable as a parking-assistance system. Ultrasonic sensors are used to detect obstacles in this paper because they have several advantages over other types of sensors in short-range object detection. Multiple sensors are needed to get a full-field view because of the limited lateral detectable range of ultrasonic sensors. Furthermore, crosstalk is a common problem when multiple ultrasonic sensors are used. A simple microcontroller-based method to reduce crosstalk between sensors is described, which is achieved by firing each transducer by a pseudorandom number of pulses so that the echo of each transducer can uniquely be identified.

Parking Space Detection Using Ultrasonic Sensor in Parking Assistance System Author- Wan-Joo Park, Byung-Sung Kim, Dong-Eun Seo, Dong-Suk Kim and Kwae-Hi Lee Year- 2008 Description- This paper deals with parking space detection by using ultrasonic sensor. Using the multiple echo function, the accuracy of edge detection was increased. After inspecting effect on the multiple echo function in indoor experiment, we applied to 11 types of vehicles in real parking environment and made experiments on edge detection with various values of resolution. We can scan parking space more accurately in real parking environment. We propose the diagonal sensor to get information about the side of parking space. Our proposed method has benefit calculation and implementation is very simple .

3. ARCHITECTURE



The outline of our proposed parking lots space detection system .this system consists four parts: Preprocessing, ground model feature extraction, multi-class SVM recognition and MRF based verification. In the first section, we rotate the raw input frames into the uniform axis and segment them into small patches which include 3 parking spaces each. Then, the probability of ground color of these patches are extracted as the input features, via applying a ground model. Next, Multi-class SVM is trained to analyze and classify the patches into 8 classes (status). Finally, Markov Random Field (MRF) are builded to solve the latent conflicts between two neighboring patches. In this step, we use the posterior probability generated by the SVM to improve the accuracy.

4. RESULTS

According to existing system, Finally, this project shows the application of car detection as a means to track throughput and capacity in parking lots over time without the expenses of hardware such as GPUs or labor of parking lot managers patrolling at regular intervals. The level of accuracy in detecting cars in a parking lot depends greatly on the training set and by extensive the method of data collection. Fixed camera angles present greater challenges in object detection than top-down drone vantages.

CONCLUSION

We proposed a system for unsupervised parking lot space detection. Comparing with other pervious methods, we just use one camera and take a few frames over seconds. Then, we use 2 parking spaces, instead of one space or the whole row space, to compose a patch for Multi-class SVM classification. This reduces the error rate of SVM classification and improves the recognition accuracy. The experiments results show that our approach is rather robust with high precision.

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