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SMART PARKING GUIDANCE SYSTEM

Sathya Priya M. S[1], Muthu Kumar.S[2]

[1]*M.E. Student, Department of Electronics and Communication Engineering, SVCE, Sriperambadur*
[2]*Professor, Department of Electronics and Communication Engineering, SVCE, Sriperambadur*

Abstract - *Considering the increase of urban, sub-urban population and traffic congestion, smart parking is an efficient and reliable strategy to overcome all the parking related issues. The existing technique involves the disposition of physical sensors in and around the parking lot. The proposed system involves the technique of Image Processing to overcome the major issues such as computation efficiency, cost management and enables real time parking methodology. The proposed system consists of a camera which could acquire images from the top view of parking space and the reason for using the camera is that it could sense the entire parking lot at once. The captured images are treated as frames and processed to exactly know the vacant space detection. Meanwhile the vacant spots are assigned a unique number tag and the driver is provided with the information of unoccupied slots. An automatic parking system is a less complex method for parking vehicles for both the drivers and administrators*

Key Words: **Digital Image Processing, Matlab, Video Dataset, Computer Vision.**

1. INTRODUCTION

Nowadays car has become an essential luxury good for the people. Though it has made a significant impact in people's life, the problem of traffic jam is inevitable. The misfortune contributed by the traffic jam is hardly avoidable. The concept of urbanization has made a negative impact on the quality of people's life. The wastage of fuel, road accidents and emission of harmful gases such as carbon-di-oxide has led to miscellaneous innovations in researcher's perspective. Plenty of research works are contributed solely in the field of efficient ways of transportation and the methods to overcome the issues faced in the particular sector. Summarizing all the issues, we have designed a smart parking guidance system which could assist the drivers to park their respective vehicles in a particular lane without interference to the adjacent cars. The driver does not know the empty parking slot when he enters the parking area. So, inorder to aid him throughout the complete process of parking, few cameras are fixed at the top angle to direct him towards the process of parking the car. Here we have used a video dataset to locate the availability of vacant slots. The concept of Image Processing [1] has been utilized in the entire research work and the Computer Vision algorithm has added a major value to it.

The system provided not only gives the exact location of unoccupied slot but also assigns a unique number to the particular lot which could provide more information to the driver and the driver could park his vehicle in the dedicated slot provided to him.

2. RELATED WORK

i. Sensor Based Methods

The sensor based methods [2], [3], [4] use the deployment of physical sensors and it could cost more money which is a very potential problem to be addressed. The sensors could make the work very easier but the sensors (for example, ultrasonic sensors, IR sensor) should be kept in and around the parking lot which is a very tedious process and a bit expensive. For example, the ultrasonic sensor could accurately calculate the distance and tell us the vacant space where the car needed to be parked. Many kinds of sensor technologies have been discussed [5] which could be installed on the grounds where the car is about to be parked, in and around the parking lot.

ii. RFID tag based Intelligent Parking Assistant

The Intelligent Parking System (IPA) [6] aimed at mitigating current public parking management problems. The architecture deals with the on-street parking availability and allows the driver to reserve a convenient parking space. When a car enters or leaves the particular parking area the RFID reader and magnetic loop detect the action and it automatically sends the information regarding the car parking status. This system is applicable only to a minimized area and it could not cover an entire parking area. This is the major disadvantage of this RFID system which is been incorporated in the process of Intelligent Parking Assistant.

iii. VANET based parking reservation system

Vehicular Adhoc Network(VANET) [7] is a kind of network created in Adhoc manner where different kind of vehicles exchange the information with each other vehicle over a wireless medium. It aims to mitigate the cost of installing physical sensors but it requires a special kind of equipment to be installed in cars and also along the roadside. It requires more cost, labour and time and this kind of system could not be realistically implemented. Certain kind of intelligent transportation system aims to reserve a parking spot prior to their trip. Instead of introducing dynamic message signs which could update the available parking space, these schemes introduce many optimization strategies. The proposed work deals with the usage of camera alone for the entire parking reservation system.

3. PROPOSED METHOD

In this system the video footage of the entire parking area is captured via a camera. The video is acquired from the top view of the building at a particular angle so that the entire parking space could be covered at once. The camera could also be the surveillance camera fixed for the security purpose thereby it is made sure that the cost involved in this system is considerably reduced without installing various other sensors. The video is captured and the captured video is segmented into many frames. The video dataset we have, consists of 1400 frames and out of these 1400 frames, a key frame is selected at an interval of every twenty frames to reduce the computational complexity.

The pre-processing phase is performed by the conversion of captured RGB image into gray scale image and unwanted noise is eliminated using median filters besides improving the algorithm and efficiency rate thus enhancing the image frame. The features are extracted using key points from different regions of the image frame using Speeded Up Robust Features(SURF) based feature extraction method and the features are matched based on a threshold value to notify the driver whether the slot is vacant or full. Meanwhile the empty slot number is informed to the driver based on the threshold value fixed with respect to each and every slots. Fig -1 shows the basic flow of the system.

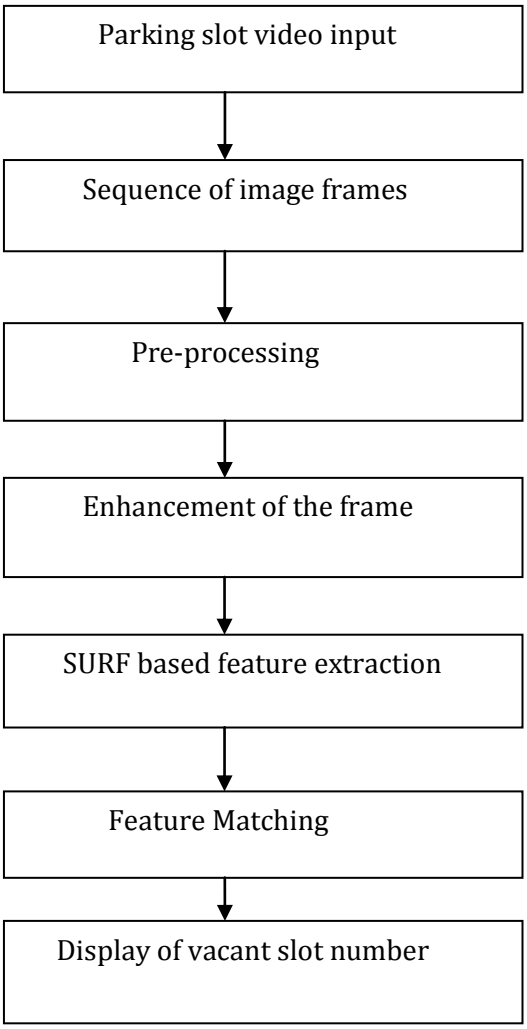

Fig -1: Basic flow of the system

4. SOFTWARE TOOL REQUIRED

We use MATLAB image processing components here. MATLAB is a high level language and serves as an interactive environment for various numerical computation and programming analysis. It can be used to analyze miscellaneous data, develop powerful algorithms and create models. Besides Image processing MATLAB is also used in different domains like signal processing, video processing etc.

4.1 OPERATIONS IN MATLAB

The prediction of vacant slots and occupied slots could be determined by the operations performed in the MATLAB: -

- The RGB image is converted into grey scale image for easier computation.

- Extraction of key points and descriptors are taken into account for feature extraction.

5. SYSTEM IMPLEMENTATION

A. Input Video Frame Selection

The video dataset is segmented into 1400 images or frames and a key frame is selected at an interval of nearly 20 frames for easier computation. These frames are given as an input for processing. These images are captured by camera which senses the real time parking space. Fig -2, Fig -3 and Fig- 4 are the examples of some key input frames that we have used in our project which are selected for processing and computation. After selecting the key frames, the frames are subjected to various processing which are discussed in the further subdivisions.

Fig -2: Sample input frame 1

Fig -3: Sample input frame 2

Fig -4: Sample input frame 3

B. Pre-Processing and Enhancement

The input frame selected is read and the RGB image frame is converted into gray-scale image. The rgb2gray(RGB) converts the original three dimensional image to gray image. This is done by eliminating both the hue and saturation while retaining only the luminance. The RGB image has to be first converted to gray-scale image in order to avoid coding complexities and to facilitate easier computations. The pre-processed image is enhanced using median filters to remove the unwanted noise.

C. SURF Based Feature Extraction

The detection of a particular parking space needs much effort. But with the good parking cameras and with wide angle of view, the parking space detection could be approached with ease. The edges of each and every boundary of a parking lot is classified via edge detection technique using blob detection method. SURF is a detector-descriptor scheme. Many feature extraction techniques are known such as Scale-Invariant Feature Transform(SIFT), Speeded-Up Robust Features (SURF) etc. It is proved that SURF has outperformed SIFT in feature extraction and matching. Its fast performance originates from a detection stage of interest points, where the detector uses a scale invariant blob detector based on a mathematical determinant. With the help of Hessian matrix, the determinant is calculated. This collection of data that relies on the Hessian matrix can later be used for both scale selection and location placement with the help of a set of box filters and the usage of integral images, the detector can approximate the second order Gaussian derivatives. This approach can be mathematically described, where the input image is (x, y) and S stores the sum of all pixel within a rectangular region and is explained by the below equation: -

$$S(x,y) = \sum_{x}^{i=0} \sum_{y}^{j=0} I(i,j) \quad (1)$$

As described before, SURF utilizes a blob detector to find so called keypoints in given image. The algorithm is using the Hessian matrix, which is used to compute the local maxima around the chosen points. The given Equation (2) below represents the determinant operation, where L is the local maxima, ρ illustrates the coordinates (x, y) and σ are chosen as the scale in given image and H is the hessian matrix.

$$H(\rho,\sigma) = \begin{pmatrix} L_{xx}(\rho,\sigma) & L_{xy}(\rho,\sigma) \\ L_{yx}(\rho,\sigma) & L_{yy}(\rho,\sigma) \end{pmatrix} \quad (2)$$

D.Feature Matching

The most common way to find a similarity between two descriptors say A and B is to use a Brute Force Matcher. The reference frame and the current frame are simultaneously compared to find the similarities between two frames. The aim of the Brute Force Matcher is to find the similarity of features and is performed by calculating Euclidean distance which is represented by the equation (3) where x represents the 128-dimension vector, n could be an integer and x_n is the distance between points A and B.

$$|x| = \sqrt{\sum_{n}^{k=1} |x_k|^2} \quad \text{where matrix } x = \begin{Bmatrix} x_1 \\ x_2 \\ x_3 \\ \vdots \\ x_n \end{Bmatrix} \quad (3)$$

These all are achieved by computer vision algorithm in which a camera senses an image as the human could perceive an image.

EMPTY SLOT IDENTIFICATION

The empty slot is identified when a car goes out of its respective slot. The empty slots are found by fixing a threshold value with the help of intensity values between the previous and current frame. Based on the threshold value between previous and current frames, the empty slots are continuously updated to the user identified with ease. The vacant slots are numbered with a unique number which provides an easy accessibility to the user for identification of parking lots. The vacant spaces are displayed on the Matlab console. Fig- 5 and Fig -6 depicts parking lot numbering and vacant spaces display for a sample frame.

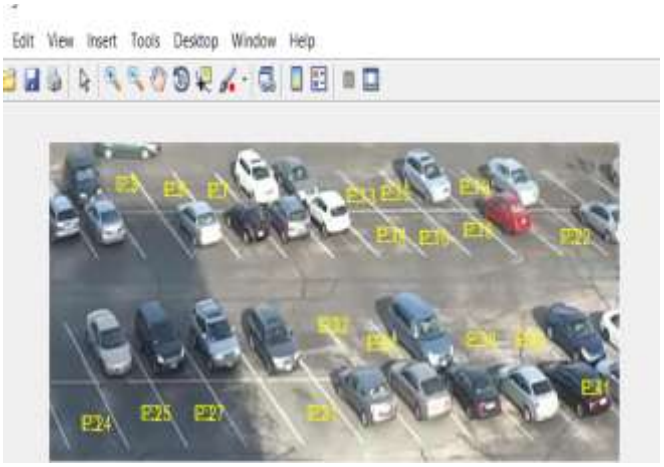

Fig -5: Parking Lot Identification

Fig -6: Vacant Space Display

6. CONCLUSION

An image based method of detecting the availability of a car park was modelled and tested with different occupancy scenarios of car parks using MATLAB. The method of analyzing an aerial view of the car park has been presented step by step. This method consists of converting the RGB image to grey for simple analysis, finding car park coordinates from a parking space thereby removing noise and determining whether car parks are vacant or filled. The concept behind the work is to discover the parking system solely based on image processing rather than introducing costly physical sensors. Intelligent parking system is developed using the concept of image processing thereby reducing the cost of miscellaneous sensors and wiring hassle. Future research will be focused on machine learning and artificial intelligence algorithms as a complement of the intelligent parking system.

FUTURE SCOPE

Computer Vision has achieved its heights of peak with the advancement of deep learning algorithms specifically convolutional neural networks (CNN). CNNs have the ability to classify even the dense pixel segmentation. From the perspective of automated car parking, CNN could be considered as a glimpse into next generation and cameras could play a major role in future automated parking systems

REFERENCES

[1] Paula Tatulea, Florina Calin,Remus Brad,Lucian Brancovean and Mircea Greavu, "An Image Feature-Based Method For Parking Lot Occupancy", Future internet ,2019.

[2] Fabio Duarte and Carlo Ratti, "The impact of autonomous vehicles on cities", Journal of Urban Technology, pp. 1–16, 2018.

[3] Muhammad Alam,Davide Moroni, Gabriele Pieri,Marco Tampucci, Miguel Goes,Jose Fonseca, Joaquim Ferreira and Giuseppe Riccardo Leone, "Real-Time Smart Parking Systems Integration in Distributed ITS for Smart Cities, Journal of Advance Transportation, Wiley Publications,2018.

[4] Rachapol Lookmuang, Krit Nambut, Sasiporn Usanavasin," Smart Parking using IOT technology", International Conference on Business and Industrial Research(ICBIR),2018.

[5] Trista Lin, Herve Rivano and Frederic Le Mouel ,'A Survey of Smart Parking Solutions", IEEE Transactions on Intelligent Transportation Systems Vol 18, NO 12,2017.

[6] LucaMainetti, Palano, L. Patrono, M.L.Stefanizzi, R.Vergallo "Integration of RFID and WSN technologies in a Smart Parking System", IEEE International Conference on Software, Telecommunications and Computer Networks, 2014.

[7] Azizur Rahim, Feng Xia, Xiangjie Kong, Zhaolong Ning, Noor Ullah, Jinzhong Wang, Sajal K.Das, "Vehicular Social Networks:A survey", Pervasive and Mobile Computing ,Elsevier,2017.

[8] Bill Yang Cai,Ricardo Alvarez,Michelle Sit,Fabio Duarte,Carlo Ratti ,"Deep Learning Based Video System for Accurate and Real Time Parking Measurement",IEEE Internet of Things Journal:special issue on enabling a smart city:Internet of Things Meets AI ,2019.