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Efficient Vehicle Parking Lot System Using Circular Hough Transform For Enhancement Smart City Program

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Abstract: ***On a daily basis the parking of a vehicle in a parking lot is done by the driver implementing his or her driving skills and upto some extend, guidance by an external person as of where he/she could park the vehicle which is a real challenge to the driver. The guiding person may be well versed in guiding but a miss judgement can cause a miss-parking of vehicle. In some situations a vehicle might be parked at certain place the there is no room for other vehicles to even to remove from the parked entry. This can cause block of space and waste of time. This can lead to an argument between the drivers or the vehicle owner. In a smart city intelligent transportation system (ITS) plays an important role in finding parking places specifically for car owners to avoid time computation. This project includes openCV application that would help us gain knowledge to execute the ideas of hardware modelling using Circle Hough Transformation.***

Keywords: OpenCV, Circular Hough Transform (CHT), Python, Image processing

1. Introduction

In a busy schedule of an individual on a day-to-day basis, parking vehicle, looking for space and judging as in where to place the vehicle has been and is a tough job. The project we are implementing is a hardware implementation of a thesis that gives us idea as in how to implement the parking lot in a systematic manner, making use of camera, circuits and a concept of modelling. Traffic very congested from last decade due to the increasing rise of automobile companies offers to a customer, privatization of that mainly more and more used in present day matched to old data and it's also increasing in the may be with same or more speed, so now government is thinking of how to solve this problem in real time by imposing certain programs for smart city within specified time duration. Here is an concept that is an cheapest way to solve the problem of traffic and managing in a efficient way.

1.1 Hough Transformation

Generalized Hough Transform (GHT) uses the parametric representation of a line by making use of OpenCV, which in-turn uses a trickier method, Hough Gradient Method, which uses the gradient information of edges(From OpenCV Python Help).

Actually, our aim is shape-circle, detection, and recognition for Parking spot checking, which has currently manually operated in the city. Here specific threshold used for detection of the accurate result. Here as shown in different simulation results, the circle detection are done in a directly captured image or it can also be done using first convert any image to gray scale then CHT or GHT can be applied.

In the thesis that we have referred, there was an analysis done using colored caps along with a non colored or white colored circle that was of same color of the base (surface of detection). The uncolored cap was not detected, so here illumination gets a very important role in any computer vision related work, try to minimize as early as possible.

Python is a world-wide used general-purpose, programming language. Python design philosophy emphasize the code readability, and the syntax allowscoder to express concept in lesser linesthan would be possible in languages like C++ or Java. Python supports a multiple programming paradigm, that include object oriented, imperative and functional programming. Its feature is a dynamic type system and automatic memory management along with libraries.

OpenCV (Open Source Computer Vision) is a library of programming functions mainly aimed at real-time computer vision, originally developed by Intel research centre in Nizhny Novgorod (Russia), later supported by Willow Garage and now maintained by Itseez.The library is cross-platform and free for use under the open-source BSD license.

Digital image processing is an usage of computer algorithms that perform image processing on digital images. As an sub category or the field of digital signal processing, digital image processing has a vast advantage over analog image processing. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing. Since images are defined over two dimensions (perhaps more) digital image processing may be modeled in the form of multidimensional systems.

2. Literature Survey

In the analysis of all the detection system S. Seo and M. Kim [1] proposed an efficient structure of circle detection using Hough Transform. This structure adopts a scan line based ball detecting algorithm of the edge detection stage and the edge flag algorithm for the voting procedure. To increase the performance of the voting procedure, during circle drawing, we divide it into 16 subdivision and compute the parts in a

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parallel manner. The given design establishes an inter-memory block for the list of edge**.**

H. Ye, G. Shang, L. Wang, and M. Zheng[6], proposed an new concept based on Hough Transform for quick line and circle detection. The Hough Transform is a powerful tool in image analysis, e.g. circle detection is a fundamental issue in image processing applications of industrial parts or tools. Because of its drawbacks, various modifications of the basic circle Hough transform (CHT) method have been suggested.

This demonstrates a modified process based on the basic CHT algorithm and using no trigonometric calculations in order to improve the computing performance of vote method for accurate and robustness of circle detection in a binary image. This also provides error analytic of the given method against the basic CHT method to illustrate that it can replace the basic CHT method for small values of the resolution ε of the angle θ. It then compete the CORDIC algorithm.O. E. Okm an and G. B. Akar[3], proposed a Circle Detection Approach Based on Radon Transform.This paper presents a novel fast circle detection algorithm is proposed which depends on the spatial properties of the connected components on the image.

Circles are detected using the similarities of detected peaks on the transformed functions and the characteristics of the values in between those peaks. X. Li, Q. wu,Y. Kou, L. Hou, and H. Yang[2], gave a description about Lane Detection Based on Spiking Neural Network and Hough Transform. This paper implements a spiking neural model methodology inspired on the Hough Transform. License Plate Recognition(LPR) is one of the most important types of intelligent transport system and is considered interest due to its justified application to many areas like highways electric toll collection, traffic monitored system. It was developed so that it could identify a vehicle by the contents of its license number plate.In this paper, we will describe a fast algorithm for automatic license plate detection system for the Egyptian license plates that achieves a high detection rate without the need for a high quality images from expensive hardware. The system captures images of the vehicles with a digital camera. An algorithm for the extraction of the license plate has been explained and designed using Matlab, they achieved about 96% detection rate for small dataset. Keywords-license plate detection (LPD), license number plates segmenting, License Plates Recognition (LPR), principal component analysis (PCA).This was presented by D. Harwood and L. S. Davis[4].

Night driving is one of the major factors which affect traffic safety. Although detecting oncoming vehicles at night time is a challenging task, it may improve traffic safety. Automated detection of vehicles in front can be used as a component of systems for forward collision avoidance and mitigation. When driving in dark conditions, vehicles in front are generally visible by their tail and brake light. They presented an algorithm that would detect vehicle at night using a camera by searching for tail lights[13].If the oncoming vehicle is recognised in good time, this will motivate drivers to keep their eyes on the road.[5]The purpose of detection vehicle using psl Hough Transform is to present an approach to detect vehicles at night based on the employment of a single onboard camera.

A pairing algorithm was designed to pair vehicle headlights ensuring that the two headlight are ofone vehicle[12].Then A new approach on concentric circle detection is proposed by X. Chen, L. Lu, and Y. Gao[7],where Firstly, the image is preprocessed by denosing, edge detection, and then the circle centers are allocated by the gradient Hough transform, at last, the radius are detected by the improved 1D Hough Transformation. Detecting efficiency is enhanced by image discretization and reduced resolution ratio in the method of center circle detection also proving that the circle center is on the gradient line of circle edge points; meanwhile, the radius detection accuracy is improvised by clubbing same radius in the method of radius detection.

The Circle Hough Transform (CHT) is one of the popular circle detection algorithm in image processing and machine vision application, which was proposed by A. O. Djekoun e, K. Messaoudi , and K. Amara[8], favored for its tolerance to noise. In that paper they presented a new modification for CHT process developed for an automatic biometric iris recognition system. The software implementation and the validation have been done in C++ and MATLAB on real images**.** There is a problem of too long computation time in Circle detection of Hough transform. Experimental result showed that circle detecting algorithm proposed has extremely good result of acceleration which was presented by N. H. Lestriandoko[11]**.**

P. Doungmala and K. Klubsuwan[9]was proposed Helmet wearing detection in Thailand using haar like feature and circle Hough Transform on image processing,. Since, motorcycles are affordable and a daily mode of transport there has been a rapid increase in motorcycle accidents, due to the fact that most of the motorcyclists do not wear a helmet which has made it an ever-present danger every day to travel by motorcycle. The existing video surveillance based system is effective but it requires significant human assistance whose efficiency decreases with time and human biasing also comes into picture. Expressways, highways and roads are getting overcrowded due to increase in number of vehicles. Vehicle detection, tracking, classification and counting is very important for military, civilian and government applications, such as highway monitoring, traffic planning, toll collection and traffic flow[14].

[10]Traffic light identification with a status detection system is applied, which is an evaluation of a generic point-view, but the application ranges from Intelligent Transportation System(ITS) to the visual impaired and color vision deficiency aided for safety of a cross street. The algorithm is alliedon color segmenting in HSV color spacing, after which the candidate reducing is performed by usage of pipeline-approach to fasten the algorithm. For training, often usage of Support Vector Machine a database with image collected at Chicago is done. Rather than other works the purpose here is for evaluation of performance according to the extraction of feature. Specifically the HOG, HAAR and the LBP feature is compared. Theaim is to generate a DB to be used from differentresearchers. Result accuracy and

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reliability that provide good quality image is input to the setup. For the traffic management, vehicles detection is the critical step. Computer Vision based techniques are more suitable because these systems do not disturb traffic while installation and they are easy to modify.Here we present inexpensive, portable and Computer Vision based system for moving vehicle detection and counting. The system is developed using OpenCV image development kits and experimental results are demonstrated from real-time video taken from single camera. [14].

3. Methodology

The problem is concerned with the hardware modeling of the simulated demo parking lot system, where an effective solution that gives out aGraphical User Interface (GUI) directly for parking so gets parking slot availability with the help of visual. Camera taking picture of the real time parking lot and then feeding into the image processor is time consuming.

In this system, simultaneous processes happen which could be detection or updating. Let us know things in detail; the driver drives vehicle for parking his/her vehicle and were in at the barrycade there is WebCamera at one side of the parking entrance that identifies the persuaded vehicle is a car. Hence simulating another WebCamera placed at the parking lot to capture the photo of the parking lot. A display interface that gives the driver the information as of where the parking can be done and which slot of parking lot is empty after the means of image processing.

In the proposed software system, the processing of the captured images is delivered by simulation using Circular Hough Transform. In an instance of time the output of the processed image is converted into the result that is to be displayed at the screen.

3.1 System Design

The problem is concerned with the hardware modeling of the simulated demo parking lot system, where an effective solution that gives out a Graphical User Interface (GUI) directly for parking so gets parking slot availability with the help of visual. Camera taking picture of the real time parking lot and then feeding into the image processor is time consuming.

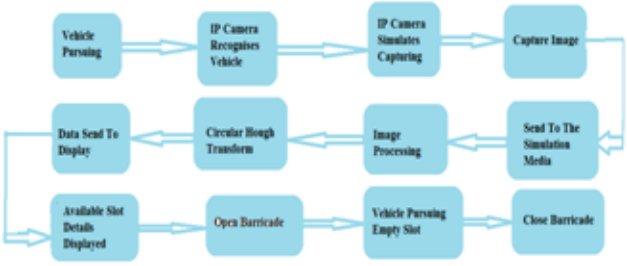

Figure 1: Design of working of the project

The proposed solution would have the hardware implementation of the problem using the simulation by the usage of OpenCV, further modelled installation of a camera in the parking lot model. The driver will be provided with a user interface which is nothing but the results of the simulation that is done. The display updates using the timer hence helping the driver as of where to parking his/her 4 wheeler car. The vehicle will be detected by the usage of WebCamera that is an easy to install setup. User friendly interface that displays the 3 minimal distance empty slot would be easy to understand for every background user.

An automated barrycade opens for the 4 wheeler car hence allowing the driver to park his/her slot.

4. Results

The result of the setup will be able to automatically detect the vehicle pursuing the parking lot and at the instance WebCamera detects the vehicle the enhancing of the simulation occurs which previously used to be a situation where an external person had to lookup for the vehicle pursuing which was a hectic job.

An real-time hardware setup should be helpful to demonstrate the proper working of the idea using OpenCV.

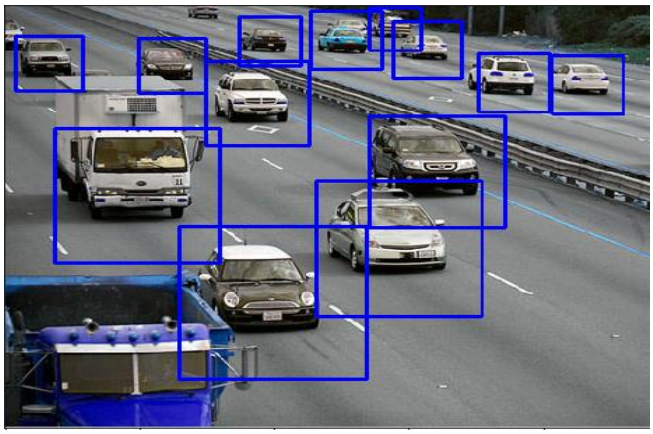

Figure 1: Car detection in random photo with cars using python

At the beginning an random photo as shown in figure(1) of vehicles was fed to the machine that gave an proper idea as to detect the vehicles.

Figure 2: Soda bottle image used for basic circle detection

A soda top photo in random was fed to the machine with python coding in OpenCV that would implement the algorithm of Circular Hough Transform(CHT) that detects an circle in a given image by the concept of masking.

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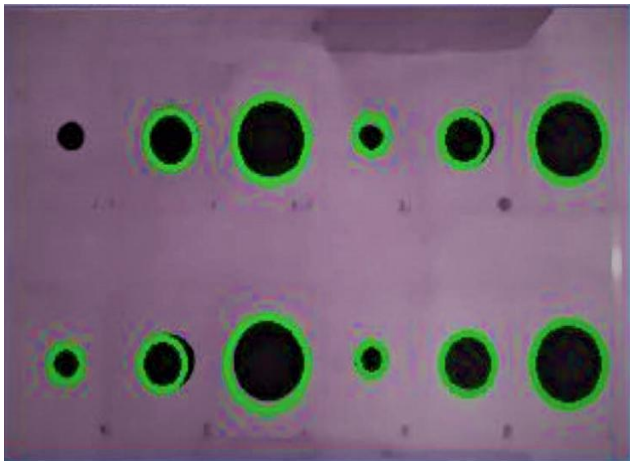


Figure 3: Real time implementation to detect circle in a specific format using Hough Transform.

The identification of the persuing vehicle is done by the blobing of the image frame from an video file. The snippet of extraction is given below:

```
prop = cv2.cv.CV_CAP_PROP_FRAME_COUNT if imutils.is_cv2() \
else cv2.CAP_PROP_FRAME_COUNT
Total = int(vs.get(prop))
```

Blob is an efficient way to simulate an action when it is confirm that the persued vehicle is a car and is done by using the below snippet:

```
blob = cv2.dnn.blobFromImage(frame, 1 / 255.0, (416, 416),
 swapRB=True, crop=False)
 net.setInput(blob)
 start = time.time()
 layerOutputs = net.forward(ln)
 end = time.time()
```

An implementation of the Circular Hough Transform in the demonstration parking lot that would have an circle as shown in the above figure(3) and every slot or the circle would have a lot number allocated which is an efficient way making an masking(color combinations turned into a black and white image) and Circular Hough Transformation(an perfect means to clear the noise in an captured image).

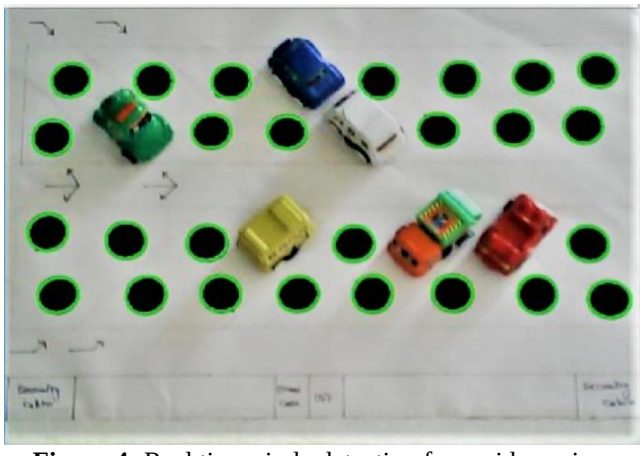
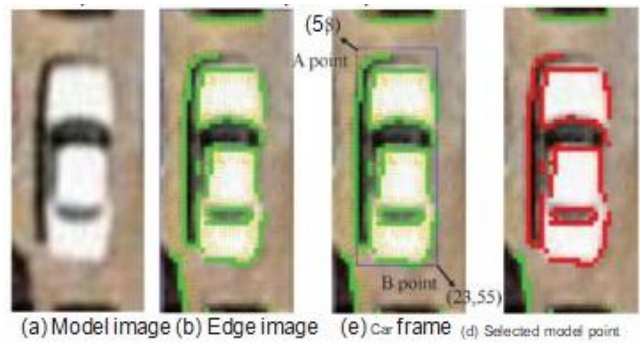


Figure 4: Real time circle detection from video using OpenCV python

Further the slot that is empty and detected by the simulation would be displayed at the digital display for the rider to park his/her car at any of the slots provided. An simplified parking allotment would be the key and hence would be very helpful and efficient way in an traffic smart city and enhance the smart city program.

In contrast to the previously proposed ideas there are many improvisation and additional features in our proposed idea. The main features are Circular hough Transformation and Time complexity.



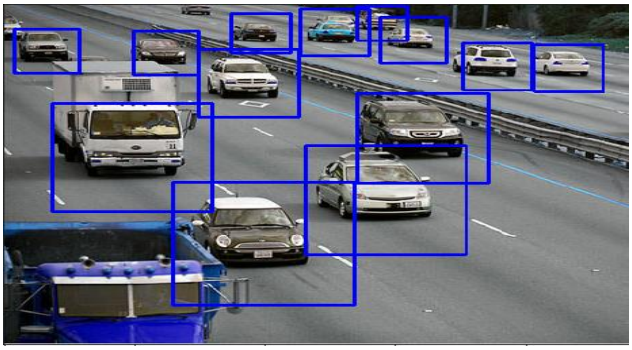


Figure 5: Up. A fixed point capture from top and **Down.** Vehicle Detection from front

There many concepts we came across many strategy and optimization one of which was the detection of an car from top view of it using the Generalized Hough Transform from which an idea came up to have an Circular Hough Transform which requires just an function of hough transformation.

```
HoughCircles(src_gray,circles,CV_HOUGH_GRADIENT,1,
src_gray.rows/8,200,100,0,0);
```

In accordance to the base paper we have tried to develop algorithms with minimum false positive(masking), all correct detection of specific shapes, with minimum time which was one of the drawback in the previously proposed idea. When an undergone was analysis done comparing the base paper it just had a obstacle detection(cap or a toy car) from a still parking lot, whereas in the proposed system we have added on the real time demonstration of arrival of vehicle detection and meanwhile simulation to capture the parking lot image for Hough Transform that is a systematic system of a smart city is demonstrated.

Some of the reference paper had the feature of the detection of edges may it be traffic lights signal, human walk signal or edge detection of car but all the concepts used huge algorithms

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that would include concepts of coordinates. We brought in the concept of OpenCV and coding via python that simplified the concept of masking in Circular Hough Transform.

As traffic clearance was a huge issue in the society which directly effected the industry in may means where an employ or any industry person who would not want to waste time in parking will find this an very efficient process. Man-power is completely automated as the WebCameras completely take-up the responsibility.

5. Conclusion

As demonstrated in simulation results of the thesis referred, for circle shape detection using OpenCV python and Real time detection from the camera is used to capture that photo, for parking lot detection is very useful for future work as automatic parking slot detection in a smart city, where time and energy both can save using a focus on the Parking Deposit system.As an good Graphical User Interface based simulation so get parking slot availability with the help of the message. Develop algorithms with minimum false positive, all correct detection of specific shapes, with minimum time. As seen in thesis simulation result compare, lout of 5 caps not detected, whereas in other concept can be detected using Open CV Python. So we hereby will be trying to reduce all this error as minimum as possible.

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