Faculty of engineering, Ain Shams University

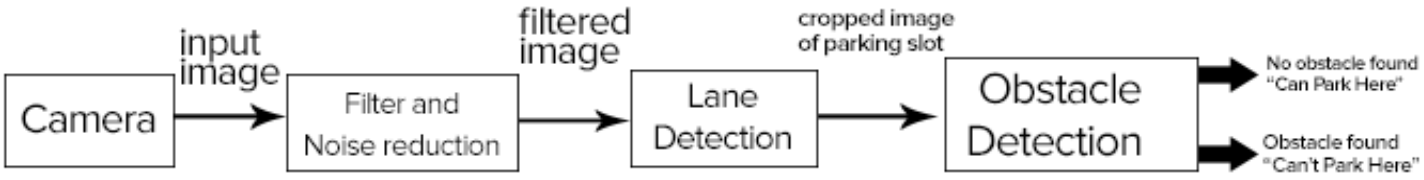
Graduation Project 2018

Parking slot detection using digital image processing and computer vision

1. Introduction

Due to the lack of free parking space, the search for a place to leave one's vehicle, especially in urban areas, is often time-consuming. The aim of the automotive industry and traffic management is therefore to automate parking as far as possible. Most solutions rely on permanently installed systems in the parking deck to manage availability of free parking lots. However, in our project we present an on-vehicle single camera system that is able to locate parking lots while driving by at a moderate speed.

2. System design implementation



System components:

1- Camera

On-vehicle camera installed on the lateral side of the car to take live image/video feed from the parking lot to be processed.

OpenMV Cam M7 camera can be used: https://openmv.io/products/openmv-cam-m7

2- Filtering and noise reduction

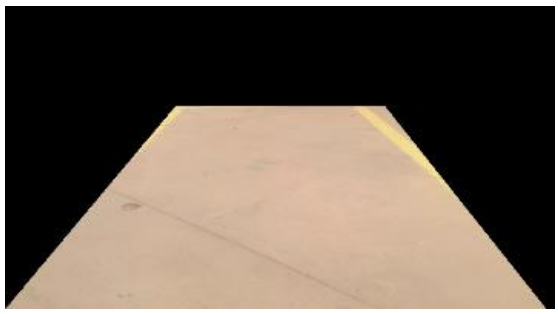
Using median filter, which is a nonlinear digital filtering technique, to remove any noise in the photo and remove any cracks in the floor, which the obstacle detector could detect as an obstacle later.

Original image

Filtered image

3- Lane detection

This module main function is detecting the right and left lanes of the parking slot and then cropping the original photo taken by the camera to extract only the parking slot area between the lanes. Lane detection module works for white and yellow lanes as well.



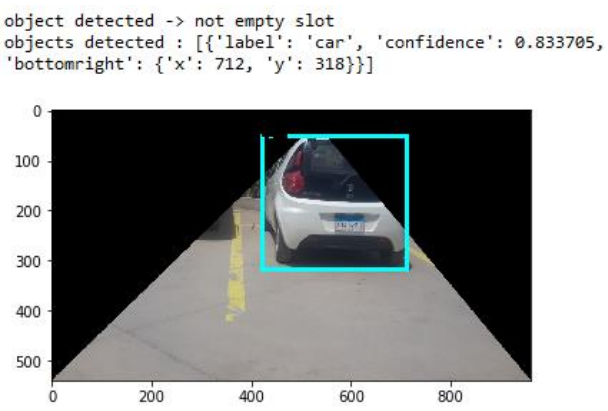
Output image from lane detector

4- Obstacle detection

In our project, we implemented two different approaches for detecting whether there is an obstacle in the slot or not.

Approach 1: Using YOLO object detector

The input to YOLO object detector is the cropped parking slot image. If there is an obstacle between the two lines, YOLO will detect and identify it and in this case, this slot is not available for parking as in **Figure 1** and if Yolo detect no object then the slot is empty and the car can be parked in this area as in **Figure 2**.



S Figure 1

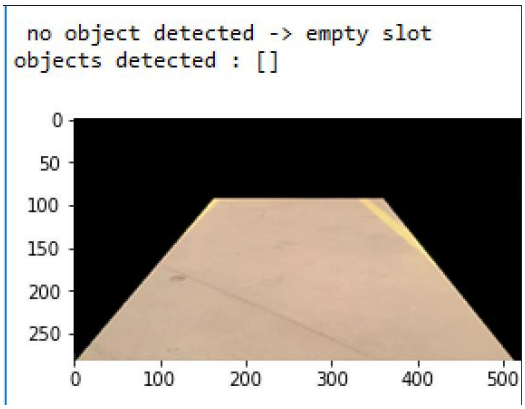


Figure 2

Approach 2: Using Histogram comparison between empty and non-empty parking slot

This method is completely image processing based approach. There's a stored photos of cropped empty parking slot area. The module then compare the histogram between the taken image from the camera and the empty parking slot stored photo. If the similarity in histogram is less than a certain limit, then there's an object in the taken photo and car cannot park in this slot.

The taken image is converted to a grey scale image and after applying a median filter to the grey scale image the empty slot histogram is enclosed in a certain narrow range. By experiment, this range always starts after a certain value while an image of a slot containing a car or any obstacle histogram always has low values due to the black regions that exist at least at the car wheels. As illustrated in the following graphs.