Number Plate Recognition Using SVM and Neural Networks (pg.161-pg.188; 28 pages)

My ideas :
- as this is for Spain. Try for Germany.
- find some more number plates of Spain and try to add it to the available dataset

- Algorithms used: Support Vector Machines, Artificial Neural Networks

- Topics covered: Auto(ANPR), Plate detection, Plate recognition

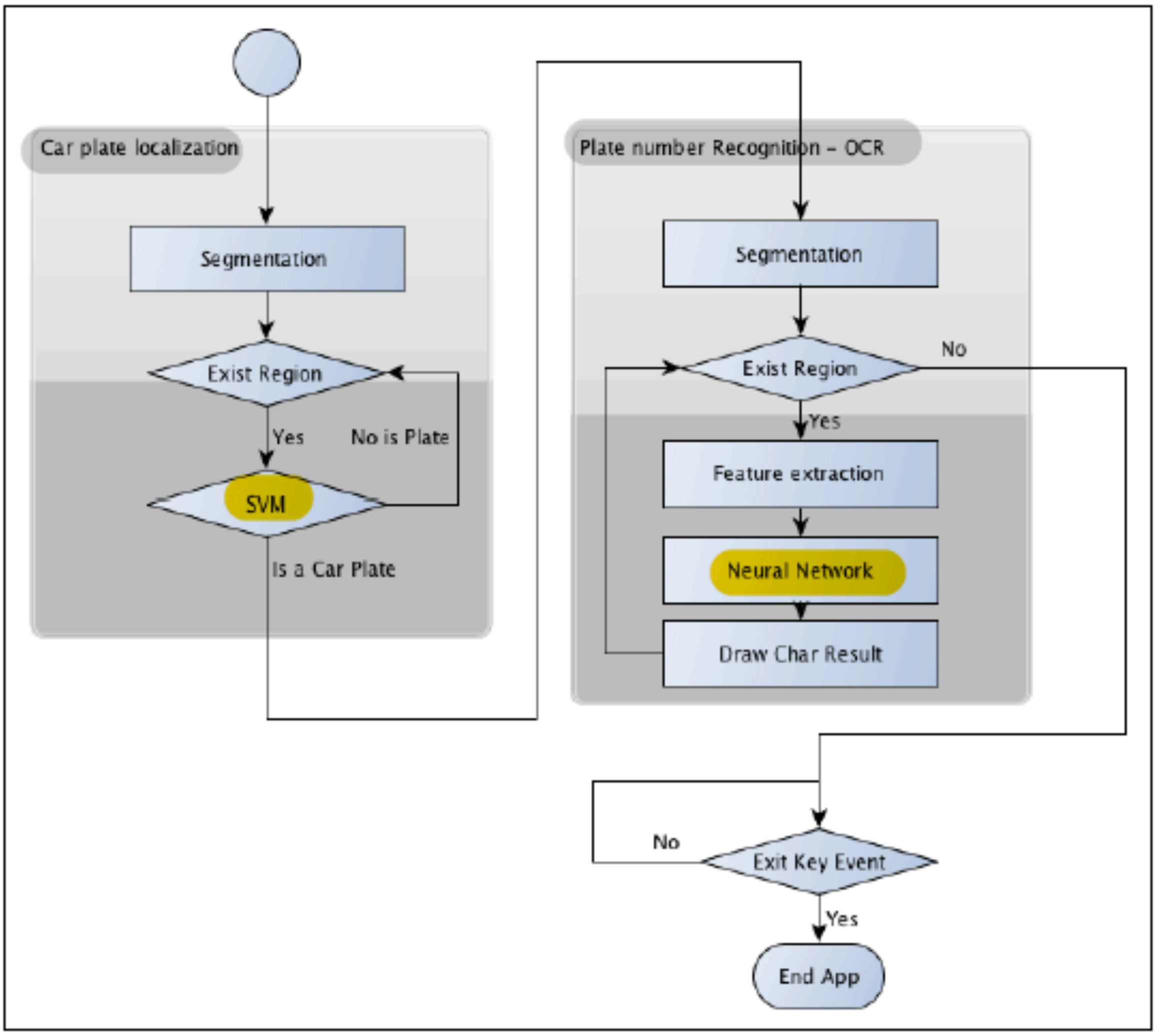
- Surveillance method: Optical Character Recognition - easy, clean and minimise errors

- Light principle: Retro-reflection

- Number plate country: Spain
  - Dimensions: license plate 520 x 110 mm , two groups of characters separated by 41mm space and 14 mm width between two characters, first group has 4 number values, second has 3 letters without vowels, dimensions of all characters is 45 x 77 mm

- ANPR algorithm
  - Two main steps: plate detection and plate recognition
  - Plate detection: detect plate in the whole camera frame
  - Plate recognition: OCR algorithm to determine the alphanumeric characters

- Pattern recognition algorithm:
  - step 1: Segmentation - detects and removes the region of interest
  - step 2: Feature extraction - extract set of characteristics
  - step 3: Classification - classify each character



- Two more important tasks:
  - how to train a pattern recognition system
  - how to evaluate such a system

- Plate detection:
  - detect plates in a camera frame : 1. Segmentation 2. Segment classification
  - 1. Segmentation : filters, morphological operators, contour algorithm - retrieve parts of image that could have a plate

- 2. Segment classification: apply SVM to each image patch(feature)- train with plate and non plate classes

- Segmentation:
  - dividing image into multiple segments
  - simplify the image for analysis and make feature extraction easier
  - lots of vertical edges present in number plates
  - eliminate regions that don't have vertical edges
  - remove noise by applying a gaussian blur or else you get fake vertical edges
  - apply sober filter
  - apply threshold using OTSU's method
  - closing morphological operation - possible regions that contain plates - most won't contain plate
  - find connected components using contours algorithm
  - draw minareaRectangle around the contours found
  - make preliminary validations while drawing rectangles - check if they are proper(needed) rectangles - check area and aspect ratio - 520/110 = 4.727272 with error margin of

40%
- https:/
www.dipolnet.comlicense_plate_recognition_lpr_systems__part_1_camera_positioning_bib318.htm
- more info on the formulae and its construction
- the code to compare the plate detected to our set limits is decoded. Check the PDF comments for explanation
- more code was given. I studied it and tried to understand what it meant. Understood some and should observe the result while coding

———UNDERSTAND THE CODE STRUCTURE —————

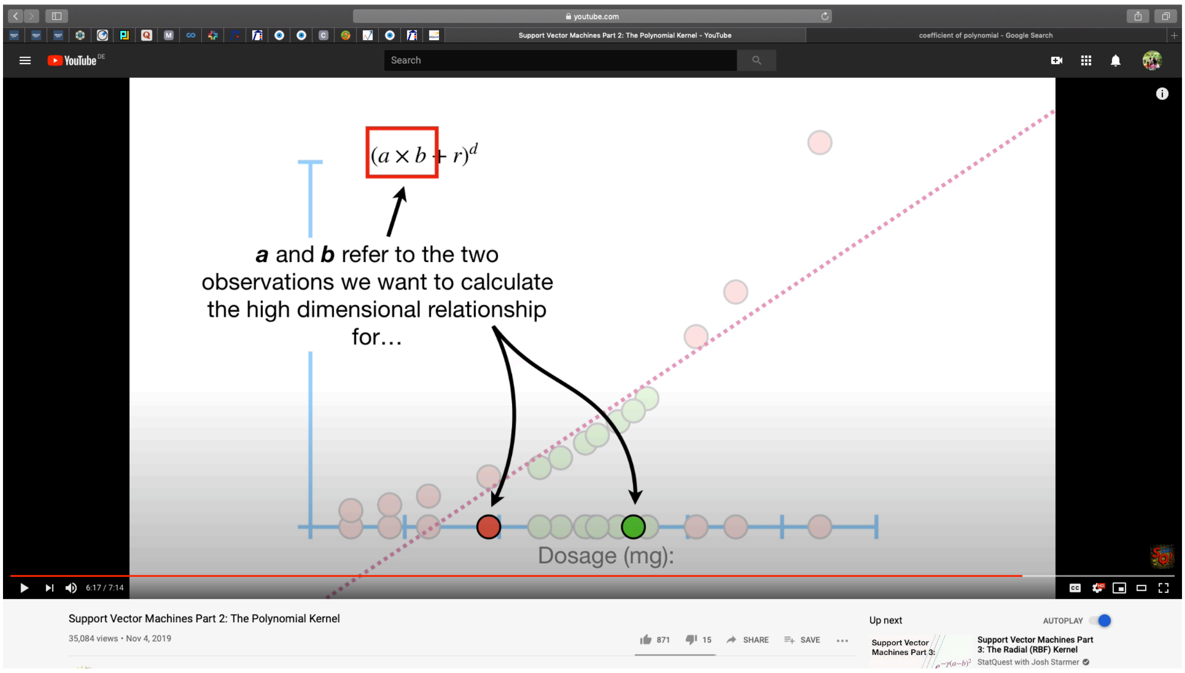
- Classification:
  - use **SVM** to classify
  - first task is to train our classifier but not easy. Need a large dataset but doesn’t mean good results.
  - take hundreds of photos, pre-process and then segment all the photos
  - training done on 75 license-plate image and 35 images without licence plates - 144 x 33 pixels

- real world application needs more training data
- trainSVM.cpp creates a .XML file which has the trained data
- Training data for ML algorithm for OPENCV is saved as NxM matrix with N samples and M features
- OPENCV easily manages data file in XML or JSON format - training data from SVM.xml can be extracted by using the FIleStorage class
- using the CvSVMParams structure define basic SVM parameters to be used in the algorithm
- SVM is used here to classify whether the image has a plate or not
- NEED TO UNDERSTAND THE SVM(Support Vector Machines) ALGORITHM

-> SVM Algorithm

- uses a kernel to change data from 1D to 2D
- if it were a polynomial kernel and if data was in 2D, then the polynomial kernel finds the 2-D relationship between each pair of observations
- polynomial kernel: (a x b + r)^d; ‘a’ and ‘b’ refer to two different observations in the

dataset; ‘r’ determines to the co-efficient of the polynomial; ‘d’ sets the degree of the polynomial; ‘r’ and ‘d’ are determined using Cross Validation



$(\boxed{a \times b} + r)^d$

a and ***b*** refer to the two observations we want to calculate the high dimensional relationship for…

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StatQuest with Josh Starmer

- Cross Validation : Say if there is a dataset and say if 75% of the data is used for training the data and 25% is used for testing the data. A question arises on how do I decide it s a 75:25 ratio. Cross validation uses all possible ratios and find the results. It compares the results and whichever ratio gives the best result then it is used.

- Coming back to the PDF(pg.176), we label a plate class with 1 and no plate class with 0.

- Plate recognition:
  - it is the second step

  - this section retrieves the characters of the plate and the algorithm used is the **optical character recognition**(OCR)
  - after the plate is detected in the previous step, we proceed to segment the plate to get each character
  - artificial neural network is used to recognise the character
- OCR segmentation: pg.177
  - plate image patch is received as input
  - apply equalise histogram algorithm
  - apply a threshold filter
  - find the contours using the findContours() algorithm - use the CV_THRESH_BINARY_INV parameter in the algorithm to invert the binary image - contour algorithm only see the white pixels as contours
  - size verification after the contour algorithm
  - remove all regions which do not meet the desire size or aspect ratio
- Feature extraction: pg.178