Pattern Recognition and Machine Learning

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ENSIMAG 3 - MMIS Fall Semester
Lab Project 1: 14 October 2020

The Viola Jones Face Detector

In 2001, Paul Viola and Mike Jones at MERL (Misubishi Research Labs) demonstrated a revolutionary new technique to detect faces in images using (1) a sliding window approach, (2) Haar like features and (3) a cascade of committee classifiers learned with Adaboost. The resulting face detection system was published in the OpenCV toolkit and is now widely used in practical applications. (See https://docs.opencv.org/master/db/d28/tutorial_cascade_classifier.html).

The objective of this project is to evaluate the effectiveness the Viola Jones face detector using publicly available data sets found on the course web site or on the internet. Start with the "FDDB: Face Detection Data Set and Benchmark Home" of the University of Massachusetts. You can use code obtained over the internet, provided the source is documented. Each programming team should do one or more of the following

1) Evaluate the Viola Jones detector in OpenCV as a sliding window detector using the images in FDDB, WIDER and other data sets. Plot Precision, Recall, F1 and execution time when applied with different scale factors, min-neighbors and other of parameters.
2) Construct a balanced data set of labeled windows (imagettes) drawn from the FDDB and other data sets and use this to compute ROC curves and error rates for the implementation of Viola-Jones in Open CV (processing windows rather that images).
3) Extend this data set to include images with different face orientations, and document precision, recall, ROC etc as a function of face orientation.
4) Implement and demonstrate a real time face detection system using the camera on you computer. Show examples of successful detections and discuss failure conditions (such as back-lit faces, profile views, etc).
5) Train your own Viola Jones style detector using the code in Open CV
6) Use the face detector to build something cool such as an eye detector.

Lab work will be reported with a written report in either French or English. Work will be evaluated based on the effectiveness of the experimental evaluations, and the clarity and depth of the explanation of experimental results.

Project Team presentations of results by 3 (or 4) teams will be given on 4 November 2020. Written reports are due on 11 November 2020. The following is an indicative Barometer for Grading. Actual grades will depend on a subjective appreciation for the amount of effort deployed and the depth of understanding displayed in the results. Creativity is encouraged and will be rewarded!

Grade	Example of Criteria
10	Plot Precision, Recall and F1 for the OpenCV version of Viola Jones using images in the FDDB data set. Description of experiments. Discussion of results.
12	Plot Precision, Recall and F1 for the OpenCV version of Viola Jones using images in the FDDB data set. Tests over a range of scale factors and min-neighbors. Clear description of experiments. Insightful discussion of results and errors. .
14	Plot Precision, Recall and F1 for the OpenCV version of Viola Jones using images in the FDDB data set. Tests over a range of scale factors and min-neighbors. Construct a balanced test data set of face images and provide ROC and AUC for the open CV version of Viola jones.

16	Plot error curves and other metrics showing results of face detection with OpenCV version of Viola Jones using several different data sets. Construct a balanced test data set of face image and use this to document the effects of face orientation. Provide a clear description of experiments, insightful discussion of results and analysis and explanation of common sources of errors. Demonstrate Viola Jones running in real time on a laptop computer using the computer's web cam.
18	Plot error curves and other metrics showing results of face detection with OpenCV version of Viola Jones using several different data sets. Construct a balanced test data set of face image and use this to document the effects of face orientation. Provide a clear description of experiments, insightful discussion of results and analysis and explanation of common sources of errors. Demonstrate Viola Jones running in real time on a lap-top computer using the computer's web cam. Proved insightful explanations of the problems with real time demonstration in real world environments. Train your own Viola Jones style detector using the code in Open CV to detect faces at profile or other error conditions.
20	All of the above plus any additional unexpected insights, results, or cool implementations.