CSE 573 CVIP - Interim Report

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0.1 changes from mid-report implementation

Our initial idea of Face detection using neural networks was getting a little cumbersome and taking a lot of time. so we went ahead with another algorithm taught in class named "Viola Jones". even though it's a simple,straightforward algorithm, it needs extreme amount of time and resources to run, so our implementation is kind of limited which we have mentioned in the below sections).

1 Title : Face Detection

The Full Title of our Project is "Face Detection using Viola Jones Algorithm"

2 Problem

During Training, we'll provide a set of pgm images as training data and labels(1 - Face , 0 - Non-face) to the Algorithm/Model which will process it and generate a ViolaJones FaceDetection Model and saves it.

During Testing, we'll provide a set of images to the trained model and will get the prediction for each image whether it's a face or a non-face.

3 Dataset

We have used an open source dataset from MIT containing 2429 face, 4548 non-face images(19*19 resolution).

Algorithm: Viola-Jones Face Detection Algorithm

```
Input: original test image
Output: image with face indicators as rectangles
for i ← 1 to num of scales in pyramid of images do
    Downsample image to create image_i
    Compute integral image, image_ii
    for j ← 1 to num of shift steps of sub-window do
        for k ← 1 to num of stages in cascade classifier do
            for l ← 1 to num of filters of stage k do
                Filter detection sub-window
                Accumulate filter outputs
            end for
            if accumulation fails per-stage threshold then
                Reject sub-window as face
                Break this k for loop
            end if
        end for
        if sub-window passed all per-stage checks then
            Accept this sub-window as a face
        end if
    end for
end for
```

Figure 1: Viola Jones Algorithm

4 Algorithm Implementation

We are using Viola Jones Face Detection Algorithm to accomplish the task at hand. the details of the algorithm is shown below in Figure-1.we have not implemented it exactly but took it as a reference.

The main steps of our algorithm are given below:

- Input Images Preparation (Loads images)
- Image Compute Integral Images and store.
- Build Haar like face features (shown in fig-2 below)
- Apply the built features to the training images
- Select the best features from built ones
- Train weak classifiers with these best features to score each weak classifier and improve them sequentially based on score
- Validate the classifier(average of all weak classifiers) against the entire training set and record scores.
- Evaluate the classifier against the testing set and record the scores
- Save the result plots.

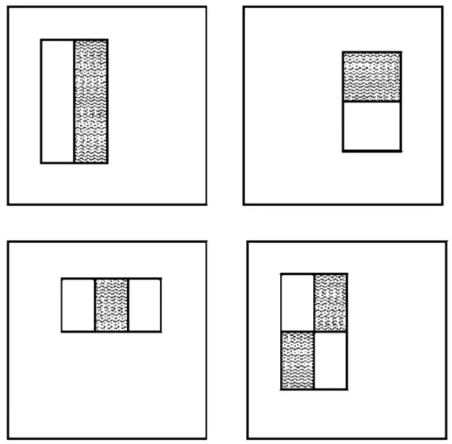

Figure 2: Haar Like Features

We have coded the algorithm in entirety with some references(mentioned in refercenes section).we are using opencv, numpy, matplotlib and other necessary python libraries.

5 Results

We have used False Positive Rate(FPR), False Negative Rate(FNR) and Accuracy(F1-score) to validate our algorithm. we have run the model for different no of weak classifiers mainly 5,10,20,30 etc

The accuaracy has taken a rise we increased the weakclassifier count and the FPR and FNR has decreased as expectedly. the best accuarcy we have achieved is 100% while training, 84% on test, while the state-of-the-art opencv multi-detect-scale(based on haarcascades) has achieved 90% accuracy.

the results are shown below in Fig-3,4,5.

6 Analysis

6.1 Limitations of the Algorithm

1. Training is very slow(took us 4-5 hours to run just for 1000 images)
2. Restricted to binary classification(which is what we have also did)
3. Mostly effective when face is in frontal view
4. Our Algorithm doesn't have the cascaded implementation and as a result is a little less efficient.

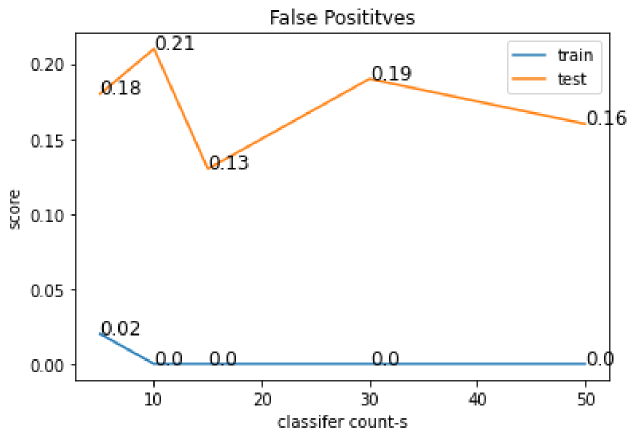

Figure 3: False Positive Rate

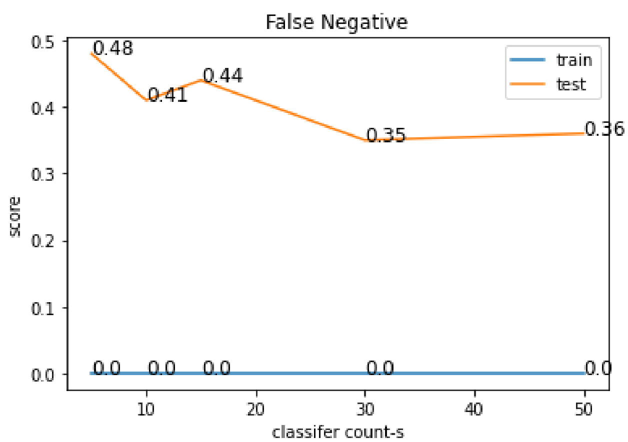

Figure 4: False Negative Rate

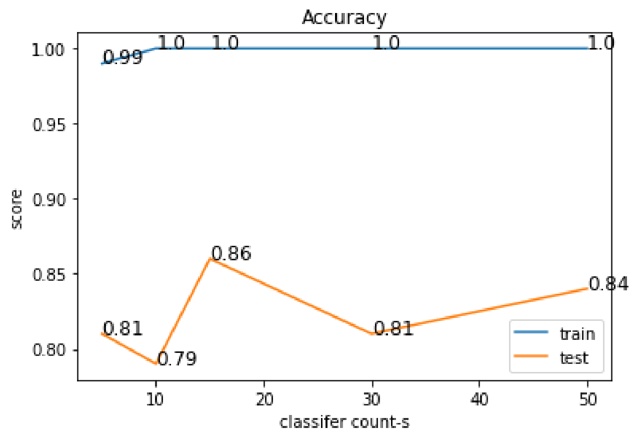

Figure 5: Accuracy

5. having too many classifiers will overfit the Model for the particular training data and as a result won't be able to learn properly.

6.2 Limitations due to Size Constraints

1. Training time will increase wrt to the image size. this is directly proportional to our image size as bigger images computes more features.

   We have not included any bounding box images as input images itself are very small and there is no point in drawing a box in it and showing them.

7 Conclusion

With this project we are able to generate a face detector using viola-jones algorithm. though it's not exact implementation, it did gave us good results. as a next step we can try to make cascaded implementation and make another face detector using neural networks and can compare them/use them in real time for real world applications.

8 Contributions

work shared and done evenly (50% and 50%)

9 References

1. Viola Jones

2. Wikipedia
3. fpcv
4. Lecture Slides
5. Medium Articles(for reference)