Rock Paper Scissors

Gesture Recognition

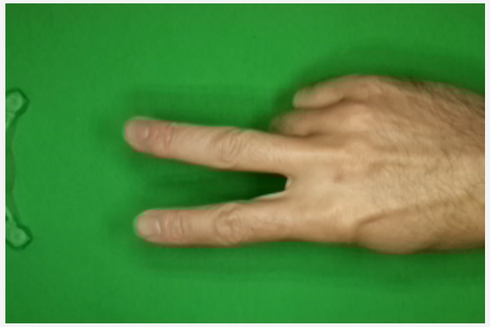
Goal of the Project

The goal of this project is to develop a classifier able to correctly recognize the gesture among the three of the famous rock paper scissor game. The input is an image

It would be interesting to apply the techniques used in this project for a more noble purpose, for example the recognition of sign language gestures

Raw Dataset

Paper
712 Images



Scissors
750 Images

Rock
726 Images

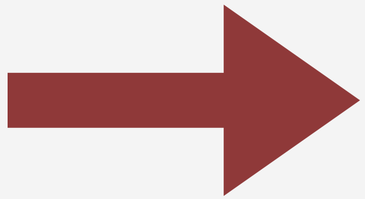
All the hand in the images are pointing in the same direction, the background is green and the light is always the same; there isn't much variability

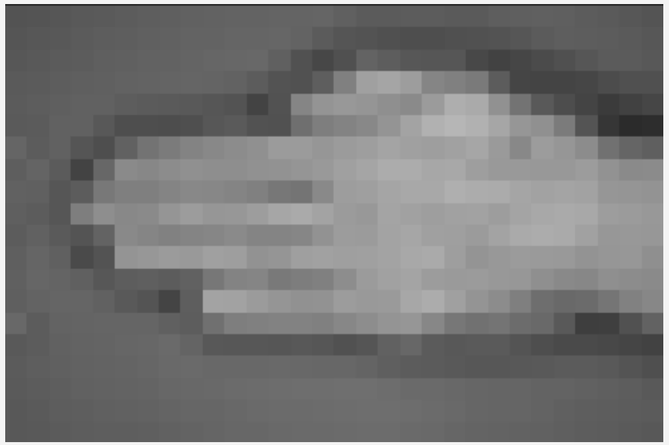
The dataset is not fully balanced but is very close to it

Source: www.kaggle.com/datasets/drgfreeman/rockpaperscissors

Data Transformation

- Pixel Values as features





200x300 pixels

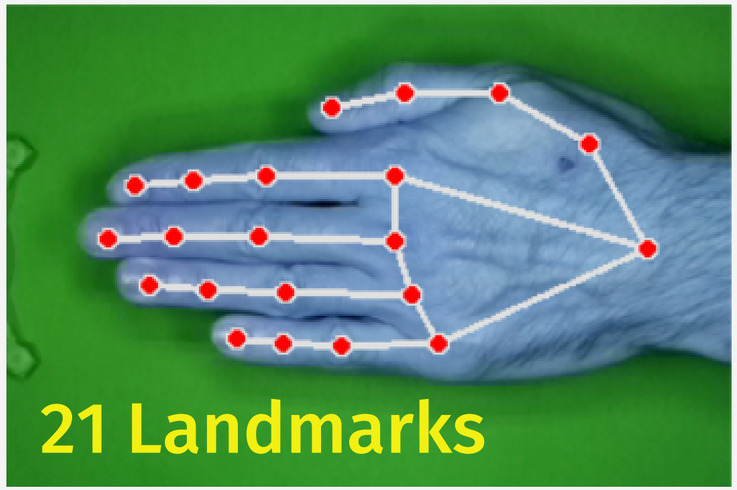
20x30 pixels

Records: 2188

Features: 600

Data Transformation

- Landmarks as features



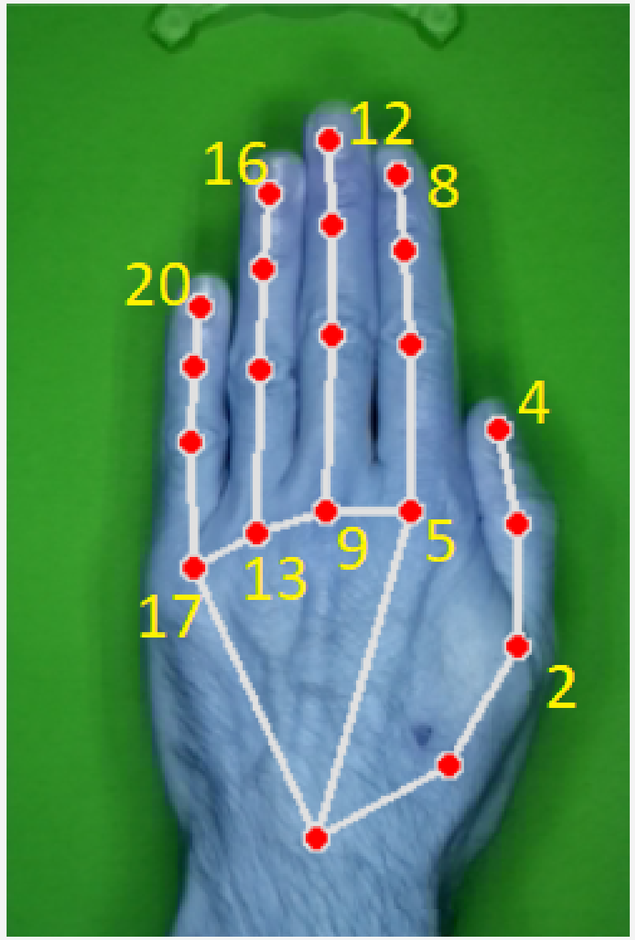
At each Landmark are associeted 3 values that is the coordinates of the Landamark itself. Since all hand are placed at the same distance from the camera I discarded the third coordinate which indicates the depth.

Records: 2091

Features: 42

Data Transformation

- Distances as features



Euclidian Distance between the landmarks:
(4, 2) (5, 8) (9, 12) (13, 16) (17, 20)

Records: 2091

Features: 5

Data Augmentation

The dataset created with the distances is unaffected by the fact that all the hand, in the images, point in the same direction

A classifier trained on ones of the other two datasets, probabily will not be able to correctly classify an image where the hand is directed in a different way

Data Augmentation

Padding

300x300

Rotation

Rotation

Data Augmentation

Pixels

Records: 2188

Features: 600

Landmarks

Records: 2091

Features: 42

Distances

Records: 2091

Features: 5

Data Augmentation

Aug. Pixels

Records: 8752

Features: 625

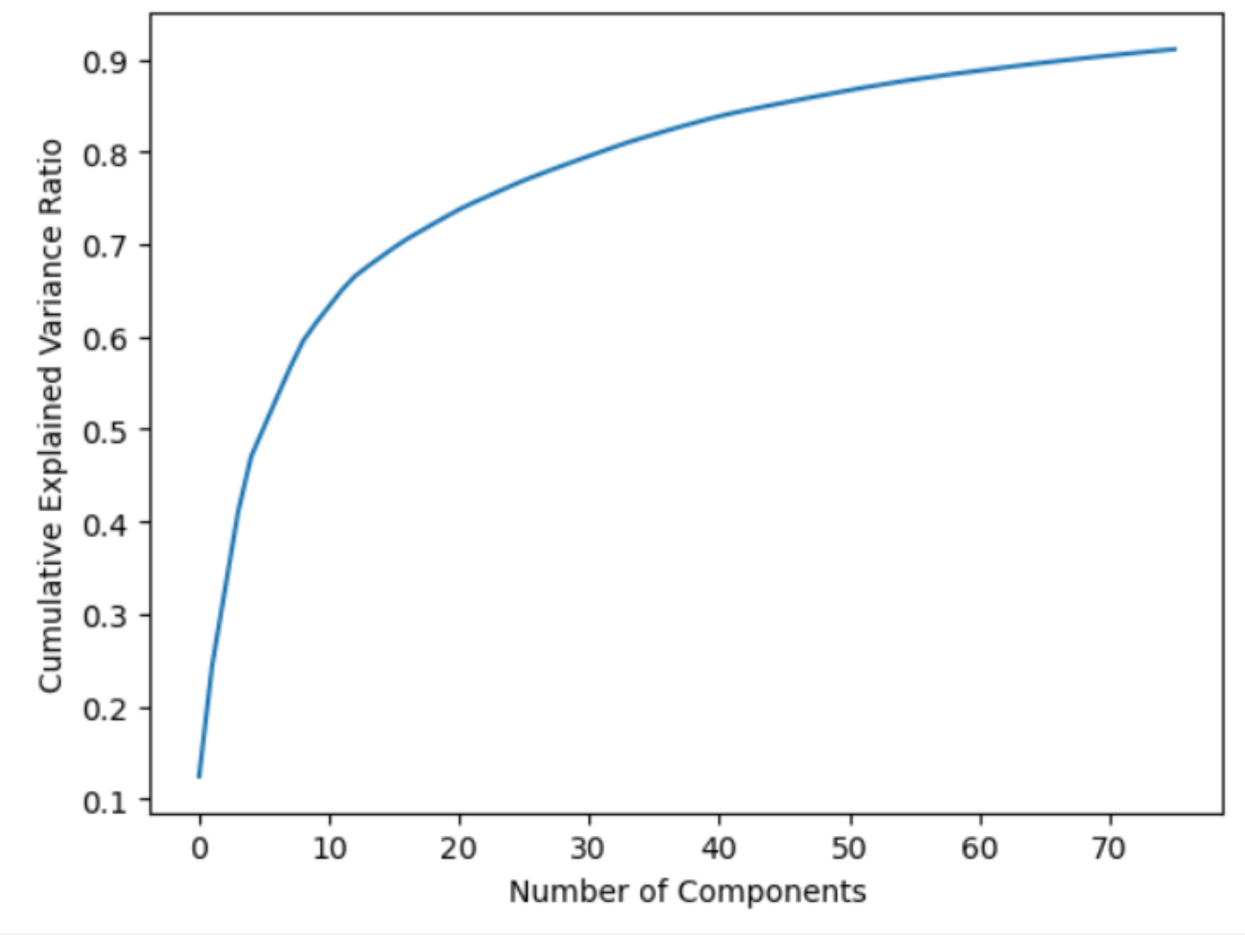
Aug. Landmarks

Records: 4219

Features: 42

PCA

In the dataset that have the pixel values as features, the number of features is too high. I decide to performe Principal Component Analysis in order to reduce it



625 Features

70 Features

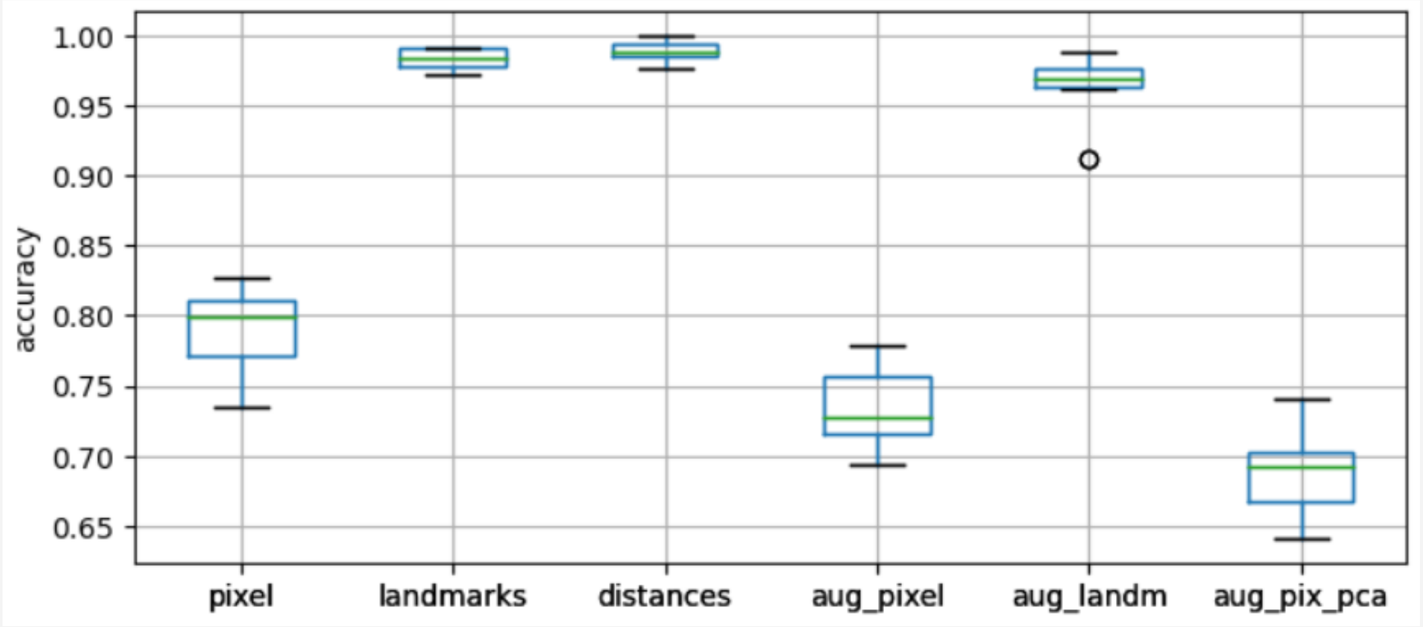
Classification

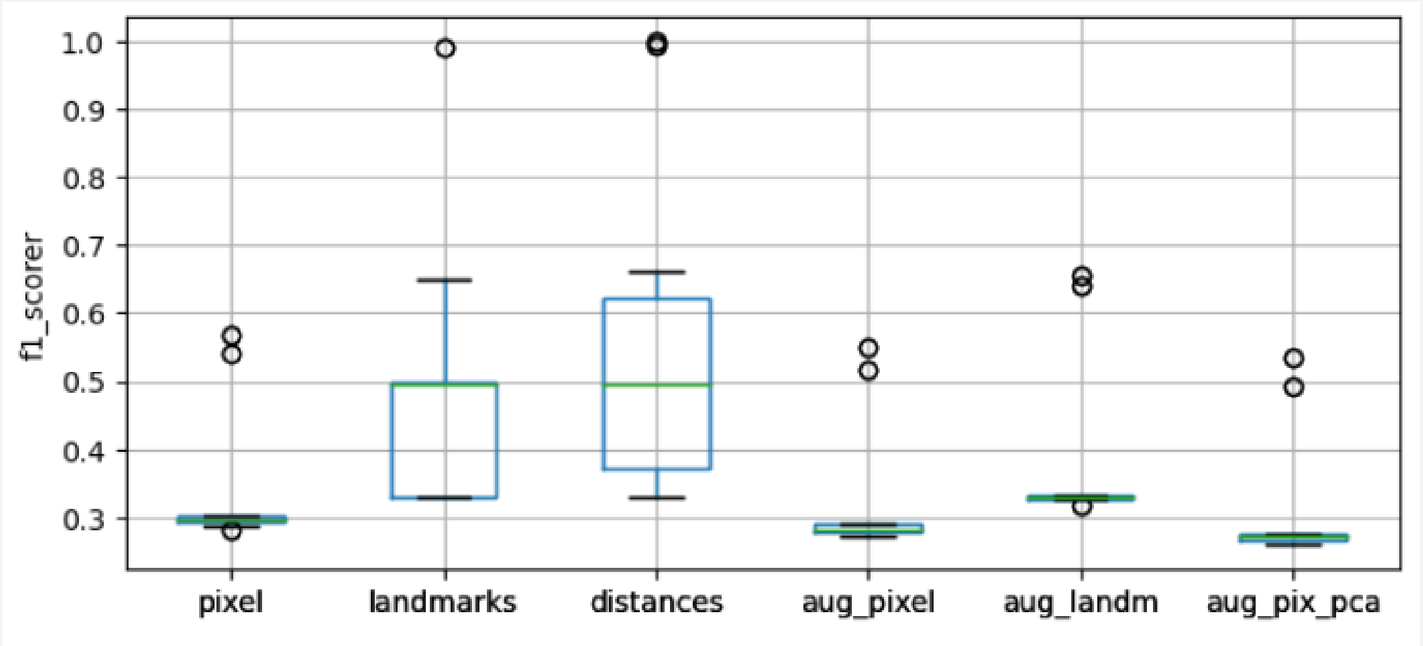
Decision Tree

(criterion: gini)

Confusion Matrix:

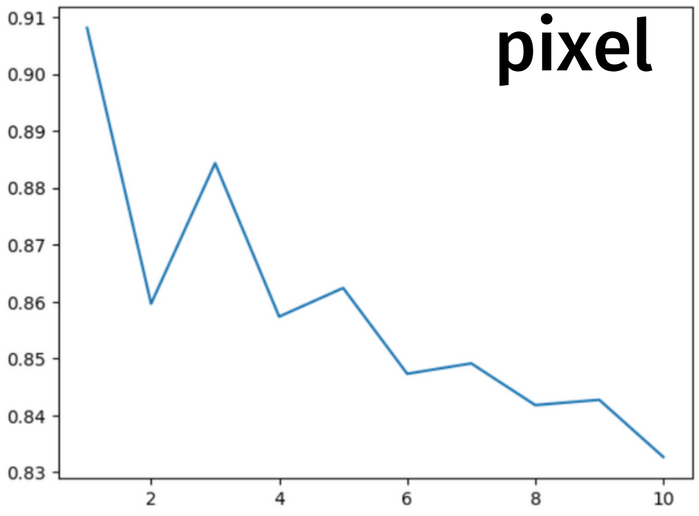
	paper	rock	scissors
paper	683	5	4
rock	5	680	1
scissors	6	1	706

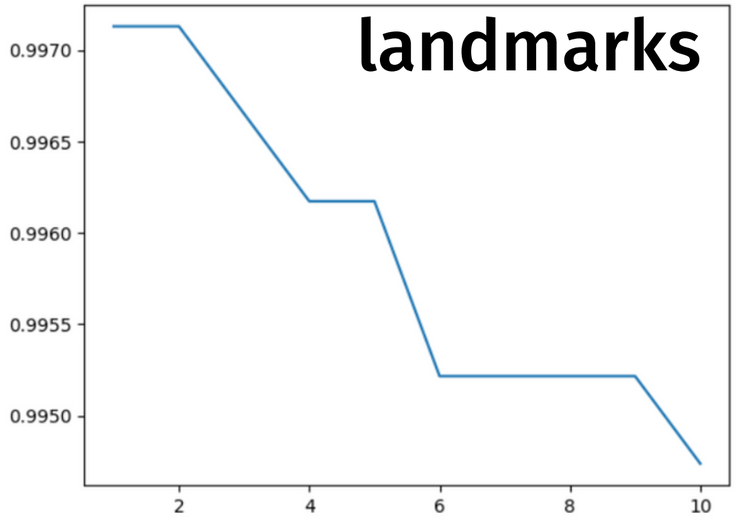


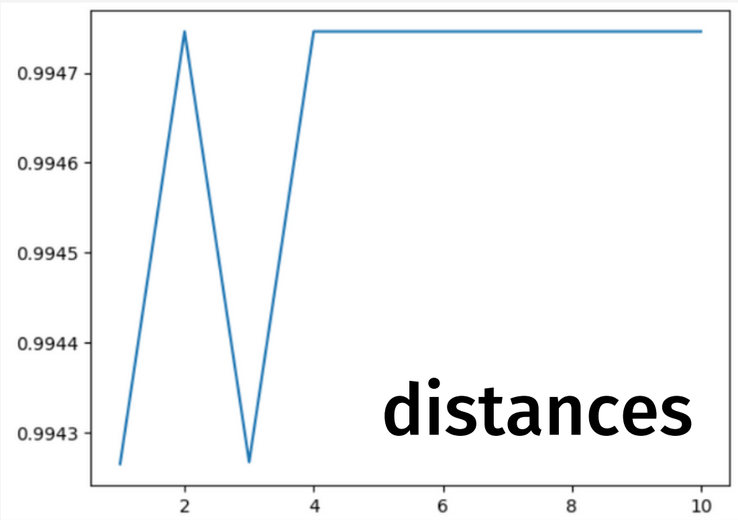


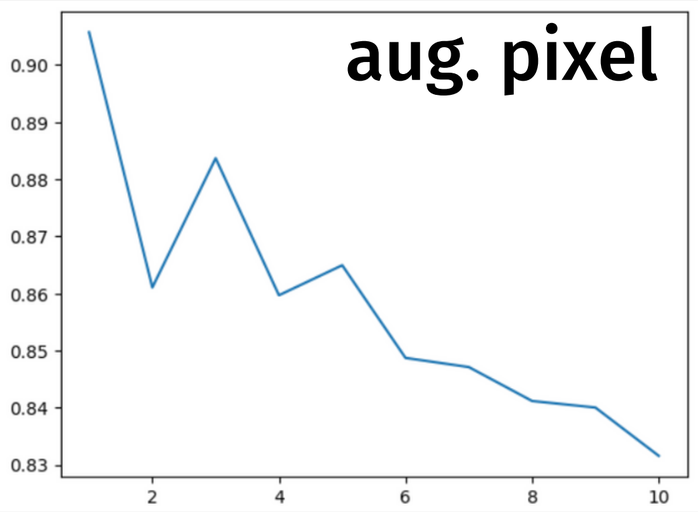
Classification

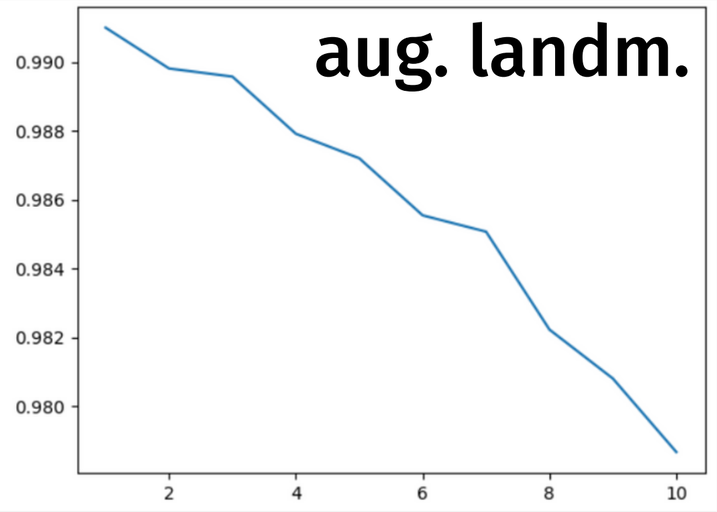
K-Nearest Neighbor (k = 1 ÷ 10)

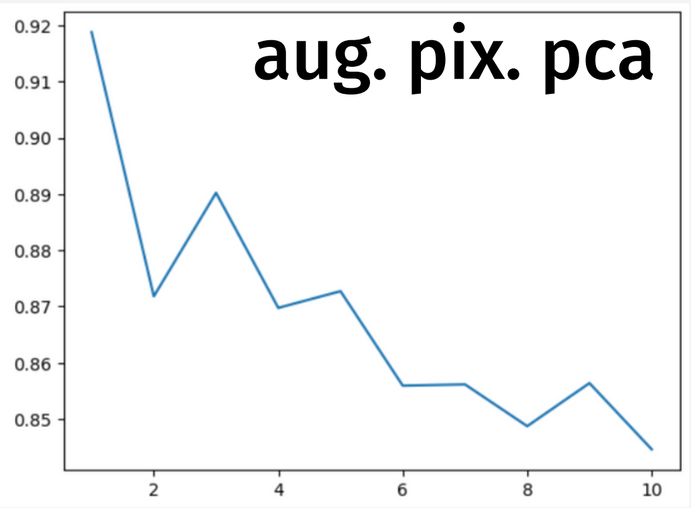












Classification

Classifier	Pixel			Landmarks		
	Accuracy	F1	Score time	Accuracy	F1	Score time
Decision Tree (gini)	0.791	0.346	0.0197	0.983	0.494	0.0107
Decision Tree (entropy)	0.797	0.348	0.0205	0.985	0.528	0.0086
K-Nearest Neighbor	0.908	0.394	0.1922	0.997	0.798	0.0484
Naive Bayesian	0.763	0.335	0.0410	0.944	0.531	0.0116
Random Forest (50)	0.902	0.377	0.0420	0.994	0.664	0.0253
Random Forest (100)	0.914	0.380	0.0555	0.993	0.698	0.0402

Classification

Classifier	Distances			Aug. Pixel		
	Accuracy	F1	Score time	Accuracy	F1	Score time
Decision Tree (gini)	0.989	0.563	0.0096	0.732	0.331	0.0344
Decision Tree (entropy)	0.989	0.578	0.0226	0.735	0.332	0.0356
K-Nearest Neighbor	0.994	0.714	0.0375	0.905	0.394	2.4051
Naive Bayesian	0.991	0.564	0.0109	0.649	0.299	0.0986
Random Forest (50)	0.992	0.647	0.0239	0.894	0.375	0.0792
Random Forest (100)	0.992	0.664	0.0389	0.903	0.377	0.1212

Classification

Classifier	Aug. Landmarks			Aug. Pixel PCA		
	Accuracy	F1	Score time	Accuracy	F1	Score time
Decision Tree (gini)	0.966	0.391	0.0104	0.687	0.318	0.0624
Decision Tree (entropy)	0.968	0.408	0.0096	0.681	0.314	0.0543
K-Nearest Neighbor	0.990	0.614	0.1582	0.918	0.381	0.5829
Naive Bayesian	0.793	0.348	0.0141	0.693	0.316	0.0680
Random Forest (50)	0.985	0.530	0.0281	0.857	0.364	0.0850
Random Forest (100)	0.985	0.630	0.0408	0.865	0.366	0.1196