Facial Expression Prediction using Information Theoretic Learning

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Outline

1. Introduction
   - Motivation
   - Data Description
2. Methodology
   - Proposed Models
   - Models Description
3. Experiments and Results
   - Dataset
   - Results
4. Conclusion

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Motivation

- The aim of this work is to identify the expression reflected on the face of a single person.
- This is a classification problem that consists of six different expressions

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Dataset

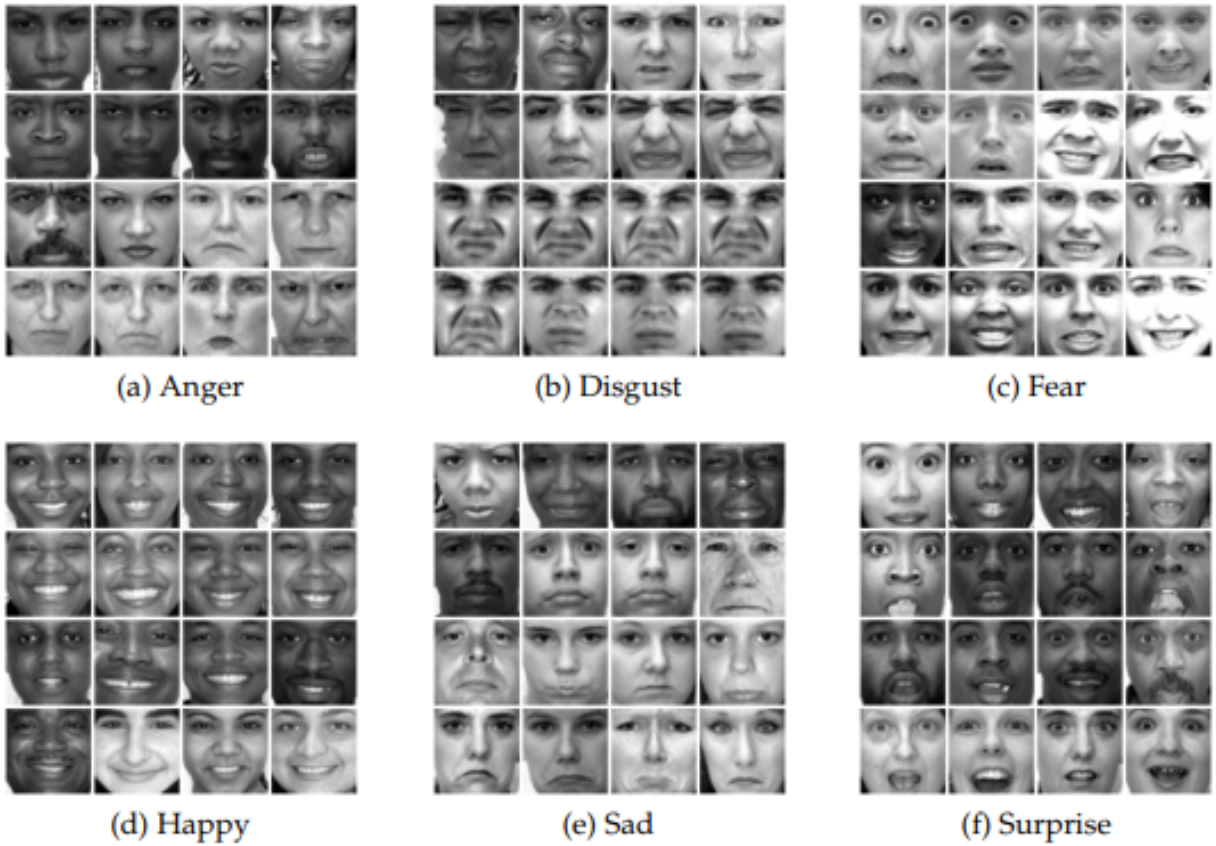

Figure: Example images of the six emotions in the FERA-2013 dataset

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Roadmap

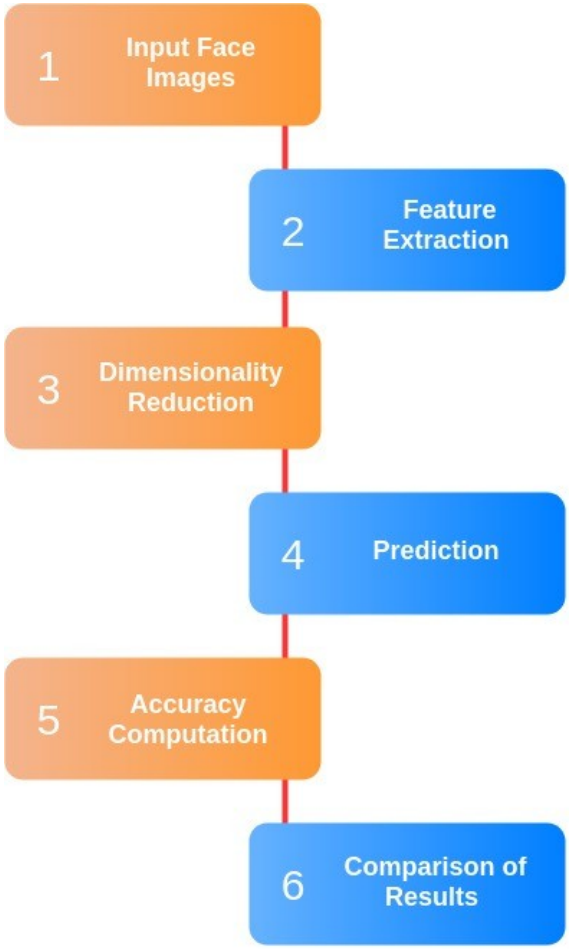

Figure: Roadmap of the Project

Feature Extraction using LBP

The value of the LBP code of a pixel (x_c, y_c) is given by:

$$LBP_{P,R} = \sum_{p=0}^{P-1} s(g_p - g_c)2^p \qquad s(x) = \begin{cases} 1, if\ x \geq 0; \\ 0, otherwise. \end{cases}$$

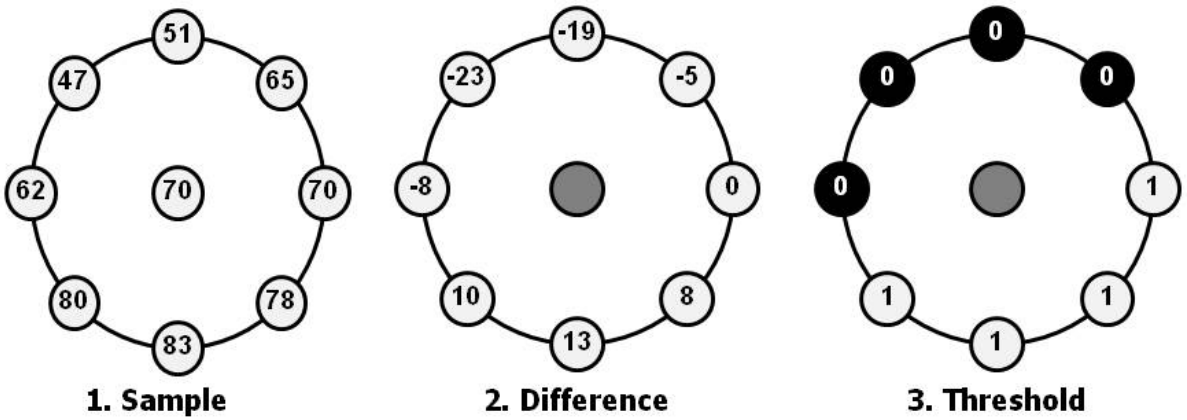

Figure: Local Binary Pattern

Dimensonality Reduction

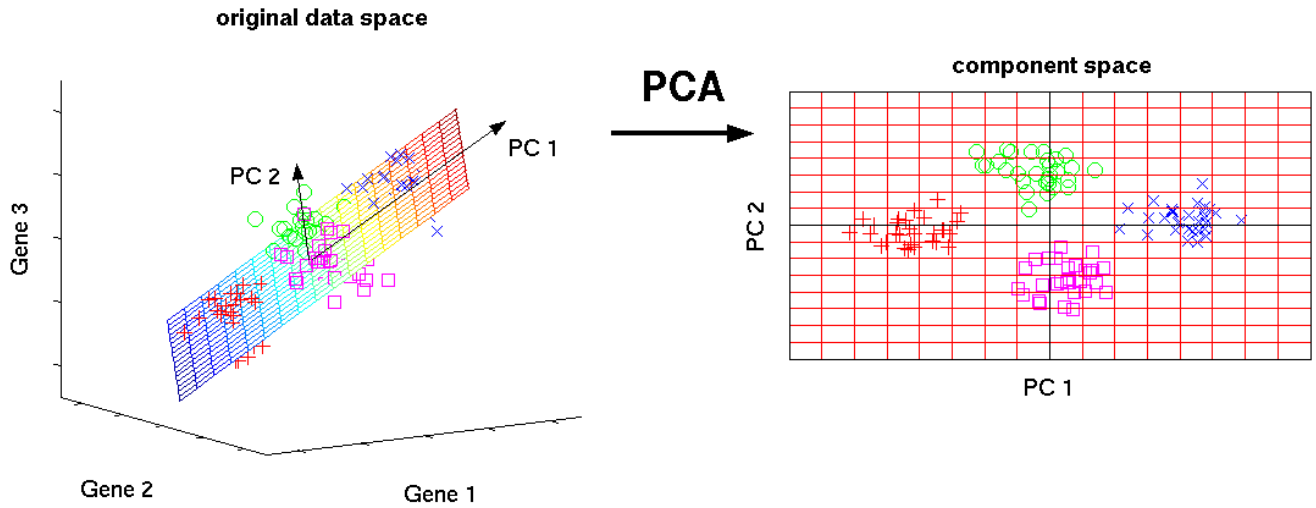

Figure: Principal Component Analysis

Classification Algorithms

- Support Vector Machine (SVM)
- K-Nearest Neighbors (KNN)
- Probabilistic Neural Network (PNN)
- Least Mean Square (LMS)
- Kernel Least Mean Square (KLMS)
- Maximum Correntropy Criterion (MCC)
- Kernel Maximum Correntropy (KMC)

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Models Description

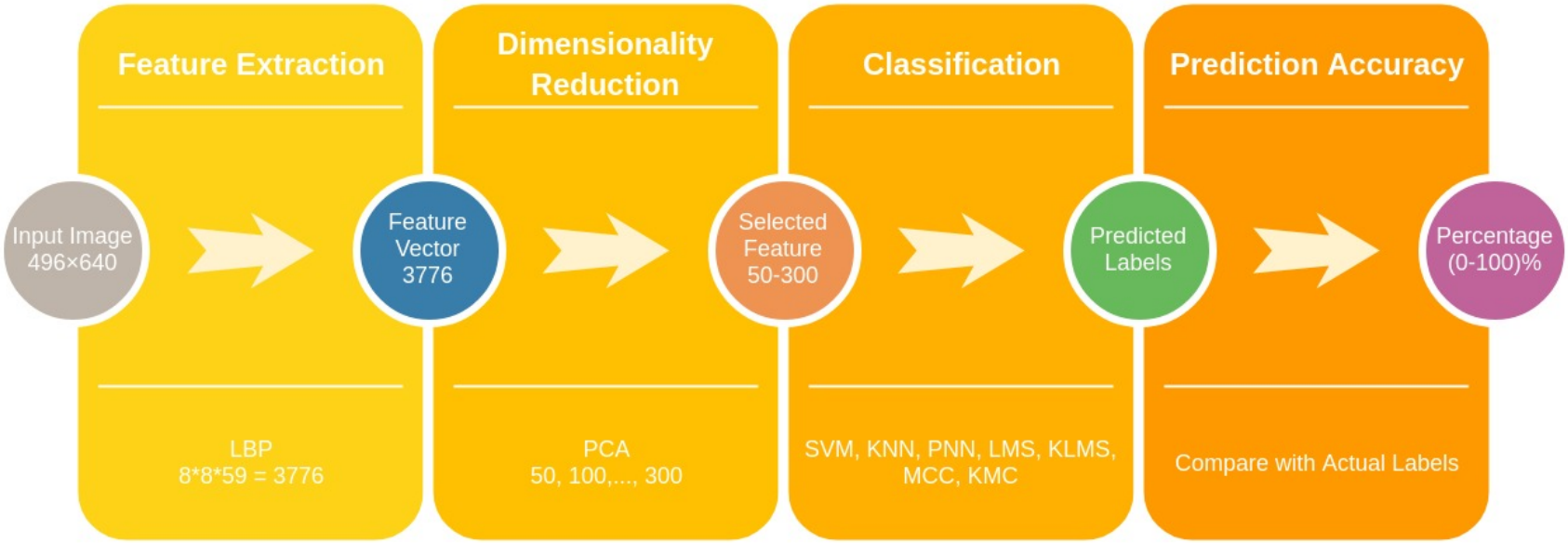

Figure: Facial Expression Prediction System

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Dataset Description

- **Type of the Dataset:** Image
- **Name :** FERA-2013
- **Number of Image:** 1314
- **Image Dimension:** 496×640
- **Number of Class :** 6
- **Class Type :** Anger, Disgust, Fear, Happy, Sadness, Surprise
- **Training Set:** 75%
- **Testing Set:** 25%

Distribution of the Dataset

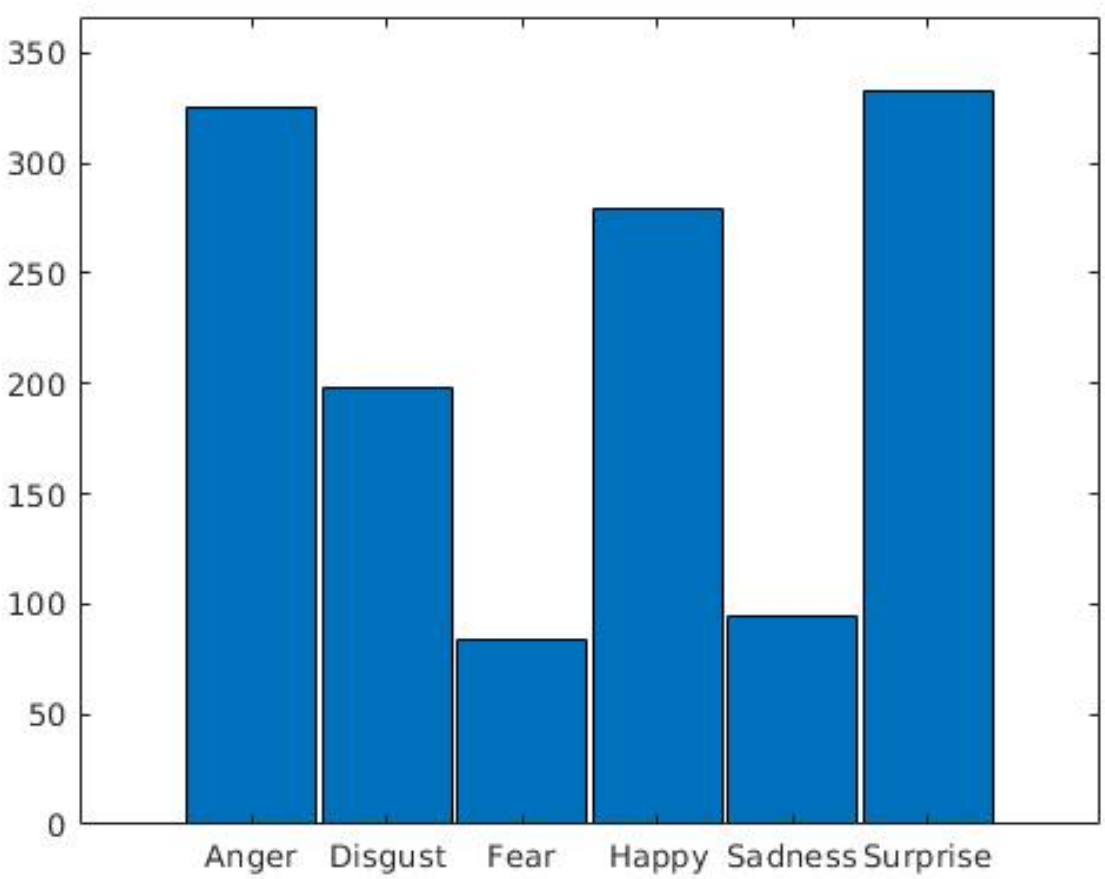

Figure: Distribution of the six emotions in FERA-2013 dataset

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Results

PCA Features	SVM	KNN	PNN	LMS	KLMS	MCC	KMC
50	79.03%	80.85%	87.84%	22.80%	97.87%	16.72%	98.78%
100	85.11%	87.84%	91.49%	21.88%	97.87%	16.11%	98.76%
150	85.11%	88.45%	88.15%	17.93%	97.87%	16.41%	98.78%
200	88.15%	87.23%	91.19%	19.76%	96.05%	19.15%	99.08%
250	86.93%	85.71%	91.79%	13.37%	98.18%	17.63%	99.09%
300	87.23%	85.71%	89.36%	15.20%	97.26%	17.02%	99.39%

Table: Classification Accuracy for Different Algorithms

Confusion Matrix

73	0	0	3	0	3
2	44	0	1	3	1
0	1	10	3	6	2
10	1	0	60	0	4
3	0	0	0	14	0
10	1	0	3	3	68

Figure: SVM

71	0	0	2	3	3
0	48	0	0	0	0
1	0	13	4	0	0
3	1	0	57	0	2
6	0	2	0	23	1
1	2	0	5	0	81

Figure: PNN

89	0	0	0	0	0
1	33	0	0	0	0
0	1	25	0	0	0
0	0	2	59	0	0
0	0	0	0	24	0
0	0	0	0	1	94

Figure: KLMS

66	2	0	0	0	0
1	51	1	0	0	0
0	0	25	0	0	0
0	0	0	75	0	0
0	0	0	0	26	0
0	0	0	0	0	82

Figure: KMC

ROC Courve

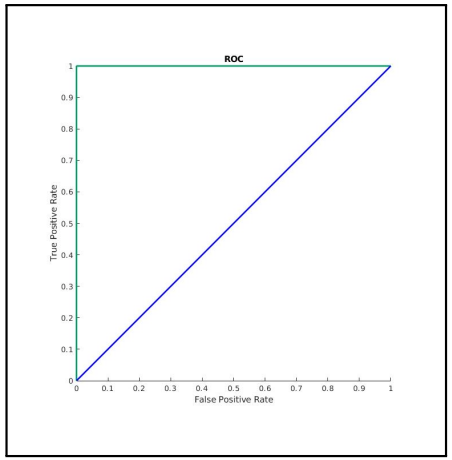

Figure: SVM

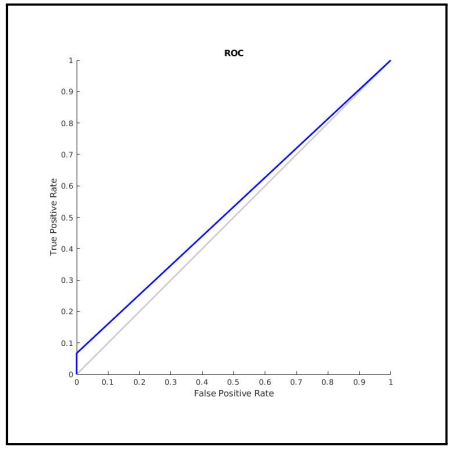

Figure: PNN

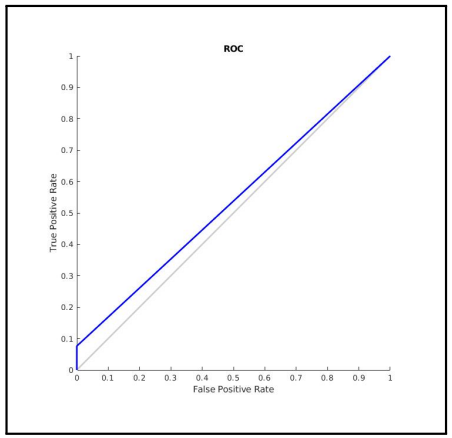

Figure: KLMS

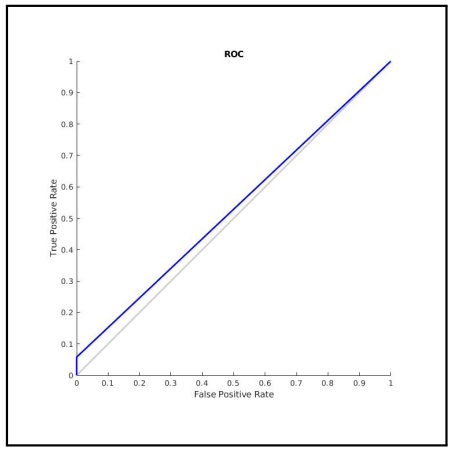

Figure: KMC

Conclusion

- In this work, the kernel-based Least Mean Square (KLMS) and Maximum Correntropy Criterion (KMC) algorithms are outperformed than other algorithms.
- In future, this work can be extended to increase the classification accuracy using different feature descriptor, dimensionality reduction and classification algorithms for a big dataset.
- The source code of this project is available in github: https://github.com/soumenca/facialExpressionPrediction

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Thank You