# Facial Expression Recognition and Classification

**Haoran Wang, Yi Yang, Chongxin Luo**
Graduate Student
Department of Electrical and Computer Engineering
NetId: `hwang293, yiyang4, cluo5`

## 1 Introduction

Facial expressions plays a significant role in people's communication. Human use facial expressions to transmit information about their emotional states. Understanding human emotions is one of the most challenging tasks for a machine. It is an interesting way for the machines to better understand the world, and act in an intelligent manner. That's an important area of Human Computer Interaction(HCI).

## 2 Objective

Nowadays, there are two main ways to train the machine to learn and understand people's emotions. The first is sentimental analysis via text information, and second is facial expression recognition, which is more straight forward and effective. Especially, real-time facial expression recognition is boosted as the development of machine learning theories, and the necessary practical components, for example, huge amounts of available image or video resources, high-speed GPUs and so on.

The main objective of this project is to try to achieve automatic facial image recognition via existed machine learning algorithms. Because it is a great application of machine learning, image processing and even computer vision. Besides, automatic facial expression recognition is also a trend to analyze human behaviors via available videos and images.

## 3 Related work

There are many literature works that focused on this specific area in machine learning and computer vision. One of the approach to this problem is to extract features from video streams for real-time recognition. An very effective algorithm can be developed by employing automatic feature tracker and Support Vector Machine(SVM) to implement the classification of the facial expression.[6] Other approaches such as Bayesian network classifier,[2] and various machine learning models for recognizing facial expression via images [1] are also suitable for this task. It is actually a comprehensive comparison among the algorithms to do the classification over the same dataset, Cohn-Kanade expression dataset, which is a famous dataset for facial expression recognition. The available algorithms include Adaboost, Linear Discriminant Analysis(LDA) and SVM.

## 4 Proposed Approach

For the scope of this project, we planed to approach this problem in two steps. In the first step, we implement a SVM model to classify the facial image. It is the basic step to understanding the facial expression recognition in the project. Then, we are going to analyze the real-time facial expression from video resources. Because it is closer to real life recognition and the real-time recognition. We plan to determine human face from live video, it requires more advanced data preprocessing technique to deal with face localization and feature extraction. As we only care about the image with facial expression, so we may need pre-classification for the frame of the video using deep Convolutional Neural Networks(CNN) for high-resolution images classification. [4] It may not be necessary to employ the CNN for pre-classification, but we hope to borrow some ideas about how to improve the performance of our work from this method.

For the second step, we plane to implement different algorithms and compare their performance on the same dataset. By doing so, we experience with different strategies and implementations in order to find out the best performance for the given problem. It is worth to mention that we are planning to try AdaBoost or other ensemble algorithms over this dataset. Because we notice that researchers didn't go deeply in this direction and

we may get different outcome for this task. If we still have time after finishing the mentioned part, we may figure out use advanced feature to implement this task.

## 5 Reading List

1. Real Time Facial Expression Recognition in Video using Support Vector Machines.[6]

2. Learning Bayesian Network Classifiers for Facial Expression Recognition using both Labeled and Unlabeled Data. [2]

3. Recognizing Facial Expression: Machine Learning and Application to Spontaneous Behavior. [1]

4. ImageNet Classification with Deep Convolutional Neural Networks. [4]

5. Dynamic of Facial Expression Extracted Automatically from Video. [5]

6. Facial expression recognition based on Local Binary Patterns. [7]

7. Pattern classification of sad facial processing: toward the development of neurobilogical markers in depression. [3]

## References

[1] Bartlett, M. S., Littlewort, G., Frank, M., Lainscsek, C., Fasel, I., Movellan, J. "Recognizing Facial Expression: Machine Learning and Application to Spontaneous Behavior". In: *IEE* (2005).

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[6] Michel P., El Kaliouby R., "Real Time Facial Expression Recognition in Video using Support Vector Machines". In: *Proceedings of the 5th international conference on Multimodal interfaces (pp. 258-264)* (2003).

[7] San, C., Gong, S., McOwan, P. W. "Facial expression recognition based on Local Binary Patterns: A comprehensive study". In: *Image and Vision Computing* (2009).