

# Facial Gesture Recognition System Revisited: A scikit-learn Exploration

## Introduction

This repository represents a re-examination of my thesis project titled 'Facial Gesture Recognition System for Accessibility Applications', which utilized the *dlib* library for facial landmarks detection. The primary focus of this revisit is to explore the capabilities of the *scikit-learn* library, contrasting it with the original implementation that employed custom clustering and classification algorithms developed in C++.

## Methodology

### Data Selection

The study focuses on mouth gestures utilizing the original data from a single individual. The data was separated by gesture, capturing all the facial landmark positions (as returned by *dlib*) of an individual transitioning from a resting state to performing the gesture and back, repeated multiple times.

### Clustering algorithms

In the initial version of this study, manual classification was utilized to determine the activation of gestures by visually inspecting a scatter plot depicting mouth length versus mouth width. In the subsequent version, the k-means clustering algorithm was employed to categorize the gestures.

For the analysis, two datasets were generated: one containing raw data, encompassing all landmark positions, and another exclusively comprising the relevant measurements previously outlined.

### Classification Algorithms

Several classification algorithms were applied to both the original and new datasets, aiming to evaluate their performance and suitability. The algorithms considered include Logistic Regression, k-nearest neighbors, Linear SVM, Kernel SVM, Naive Bayes, Decision Tree, and Random Forest.

# Results

## Manual Clustering

	Logistic Regression	k-nearest neighbors	Linear SVM	Kernel SVM	Naive Bayes	Decision Tree	Random Forest
measurements	0,957	0,973	0,963	0,963	0,968	0,992	0,995
all landmarks	Failed to converge	0,968	0,981	0,909	0,707	0,981	0,976

## Algorithmic Clustering

	Logistic Regression	k-nearest neighbors	Linear SVM	Kernel SVM (rbf)	Naive Bayes	Decision Tree	Random Forest
all landmarks	Failed to converge	0,984	0,988	0,98	0,724	0,972	0,976

# Conclusion

The exploration into scikit-learn yielded promising outcomes in the classification of mouth gestures. A notable advantage compared to our original algorithm is the ability to directly feed raw data into the classifiers, eliminating the need for pre-calculating relevant measurements (although they remain essential for clustering purposes). Moreover, the simplicity of code is significantly enhanced by not having to implement custom algorithms. These findings underscore the versatility and efficiency of scikit-learn in the realm of facial gesture recognition for accessibility applications.

# Future Work

Future work could delve into the optimization of the algorithms and the integration of deep learning techniques for enhanced facial gesture recognition. Additionally, I'm interested in investigating how to add hysteresis to the classification algorithms.