Facial Expression Detector

SCS3003 – Computer Graphics and Image Processing

INTRODUCTION

ABSTRACT

Human emotional facial expressions play an important role in interpersonal relations. This is because humans demonstrate and convey a lot of evident information visually rather than verbally. Although humans recognize facial expressions virtually without effort or delay, reliable expression recognition of emotional state, machines must be taught to understand facial gestures.

WHAT ARE EMOTIONS?

Emotions are feelings or response to particular situation or environment. Emotions are one of the important and integral part of our existence, as one smiles to show greeting, frowns when confused, or raises one's voice when enraged. When we looking at the emotion classification, there are two main emotions there, Love – fear. With respect to this, we can classify emotions into positive and negative emotions. So according to that six basic emotions are angry, happy, sad, surprise, disgust and fear. And one more expression is neutral.
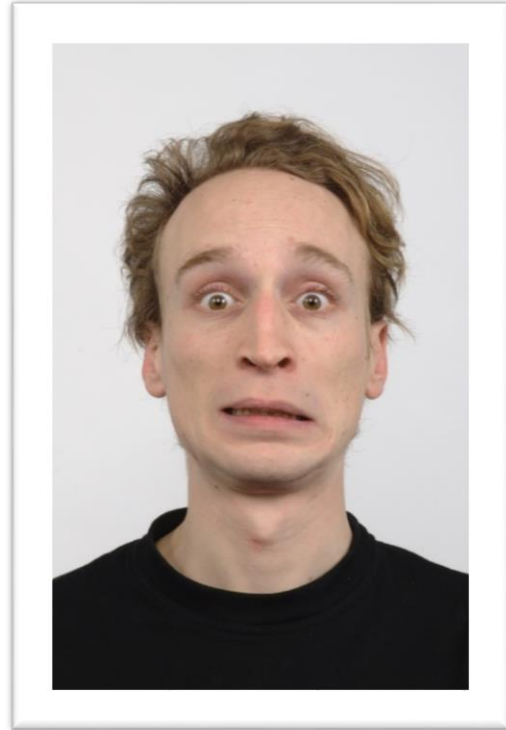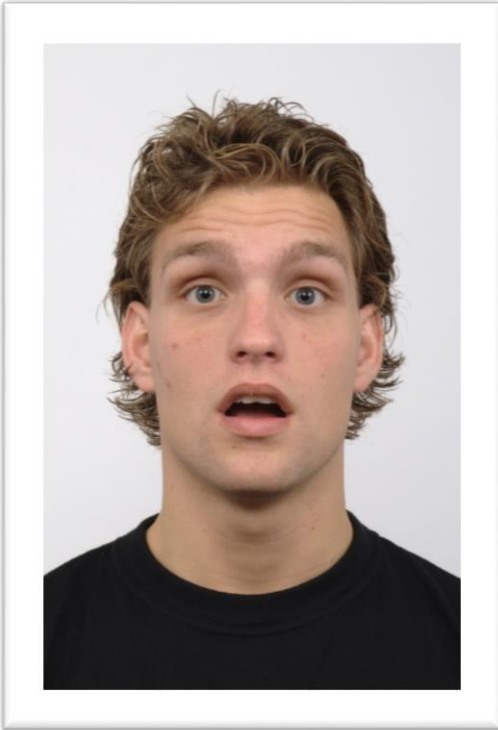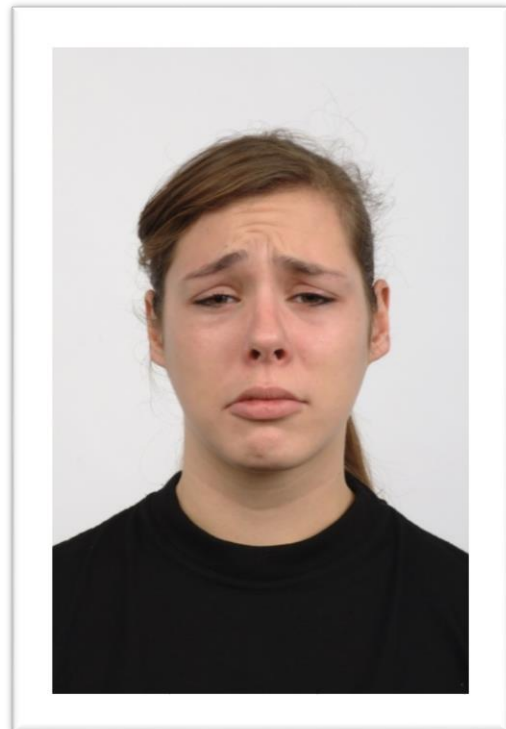
BASIC EMOTIONS
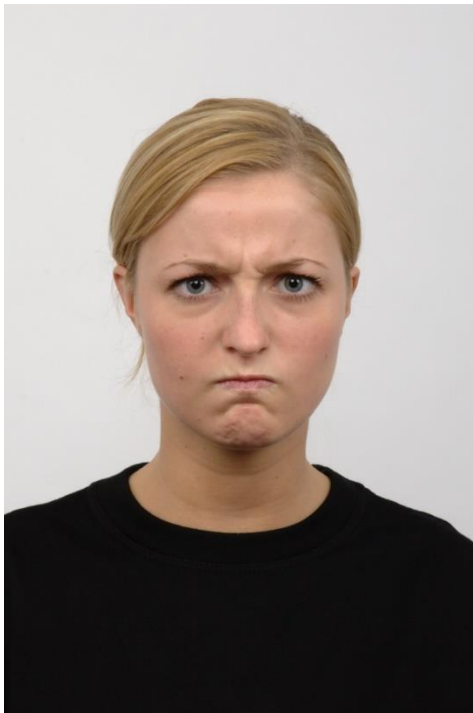
ANGRY	DISGUST
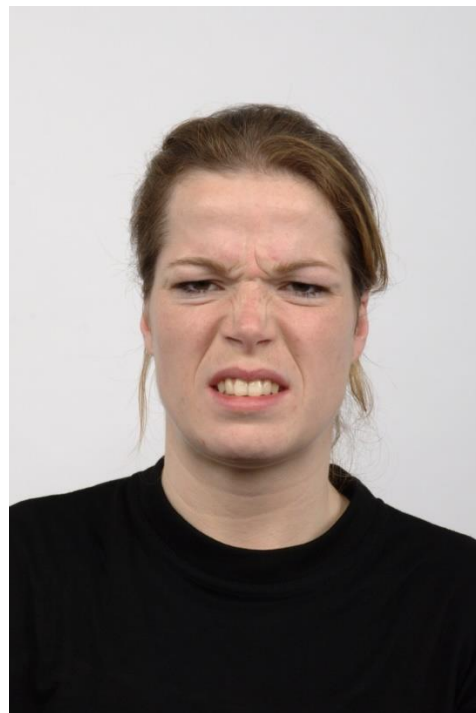
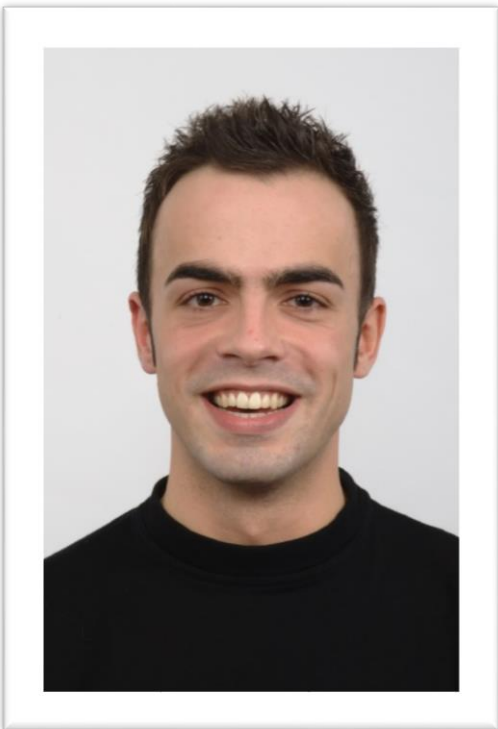| SURPRISE	FEAR

HAPPY

SAD

NEUTRAL

According to researches carried out by Paul Ackerman, he describes how are facial landmarks differ in different facial expressions.
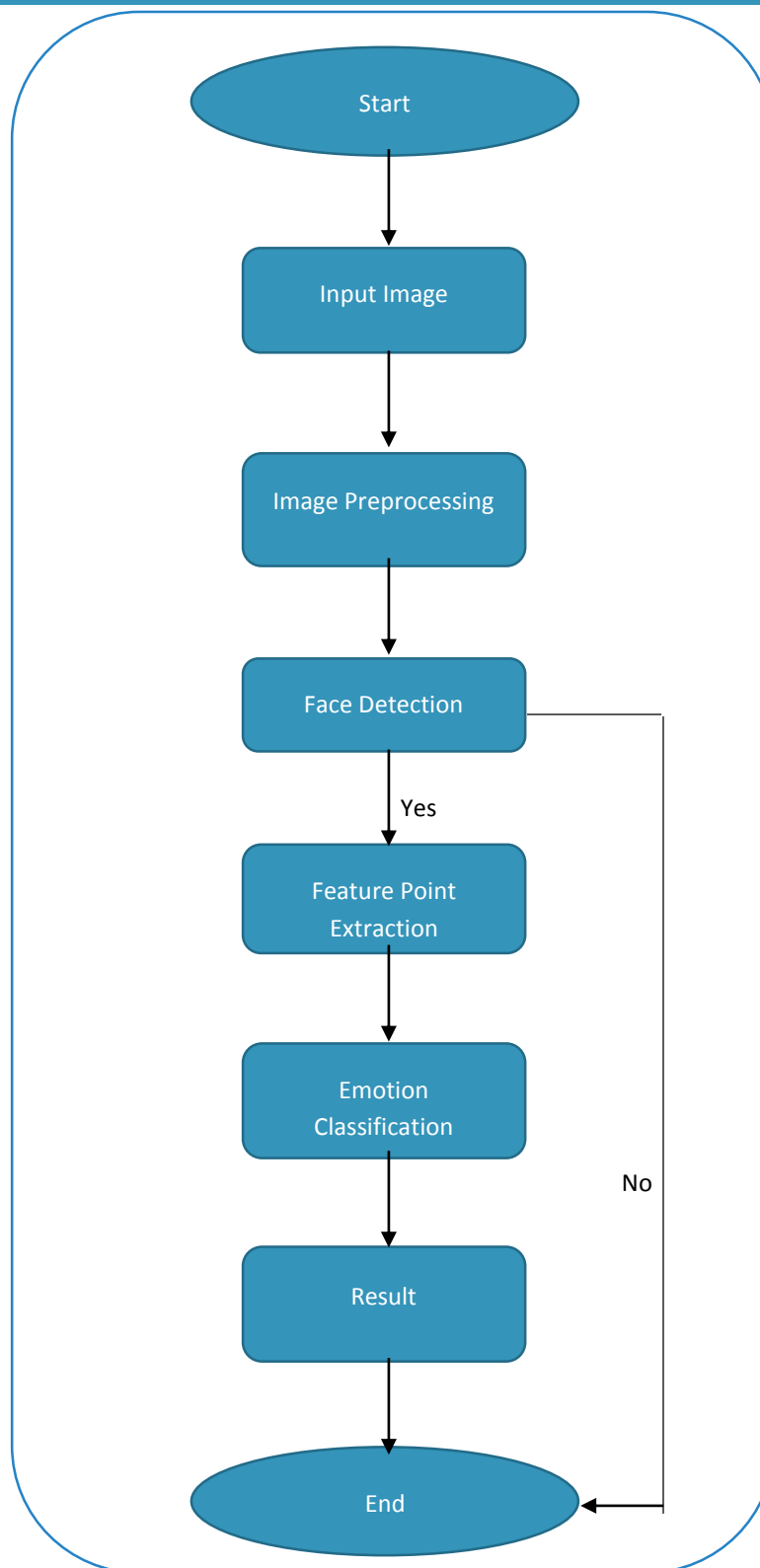
In emotional expression face, If we are angry, the brows are lowered and drawn together, Vertical lines appear between the brows, lower lid tensed, eyes hard stare or bulging, lips can be pressed firmly together with corners down or square shape as if shouting, nostrils may be dilated, the lower jaw juts out.

If we are happy, corners of the lips are drawn back and up, mouth may or may not be parted, teeth exposed, a wrinkle runs from outer nose to outer lip, cheeks are raised, lower lid may show wrinkles or be tense, crows feet near the outside of the eyes. Disgust has been identified as one of the basic emotions.

Its basic definition is "bad taste" secondarily to anything which causes a similar feeling, through the sense of smell, touch and even of eyesight. The well-defined facial expression of disgust is characterized by furrowing of the eyebrows, closure of the eyes and pupil constriction, wrinkling of the nose, upper lip retraction and upward movement of the lower lip and chin, drawing the corners of the mouth down and back.

Therefore our motive is to identify these expressions.

PROCESS WORKFLOW

```
                    ┌──────────────┐
                    │    Start     │
                    └──────────────┘
                           │
                           ▼
                    ┌──────────────┐
                    │  Input Image │
                    └──────────────┘
                           │
                           ▼
                    ┌──────────────────┐
                    │ Image Preprocessing │
                    └──────────────────┘
                           │
                           ▼
                    ┌──────────────┐
                    │ Face Detection │ ──────────┐
                    └──────────────┘            │
                           │ Yes                │
                           ▼                    │
                    ┌──────────────┐            │
                    │ Feature Point │           │
                    │  Extraction  │            │
                    └──────────────┘            │
                           │                    │
                           ▼                    │ No
                    ┌──────────────┐            │
                    │   Emotion    │            │
                    │ Classification │          │
                    └──────────────┘            │
                           │                    │
                           ▼                    │
                    ┌──────────────┐            │
                    │   Result     │            │
                    └──────────────┘            │
                           │                    │
                           ▼                    │
                    ┌──────────────┐            │
                    │     End      │ ◄──────────┘
                    └──────────────┘
```

METHODOLOGY

STEP 01 – IMAGE PREPROCESSING

As the initial step we preprocess the image already selected to enhance the quality of the image. In order to enhance the quality we follow three steps.

1. Convert the image into a gray scale image
2. Contrast Stretching
3. Noise Removal-median filter
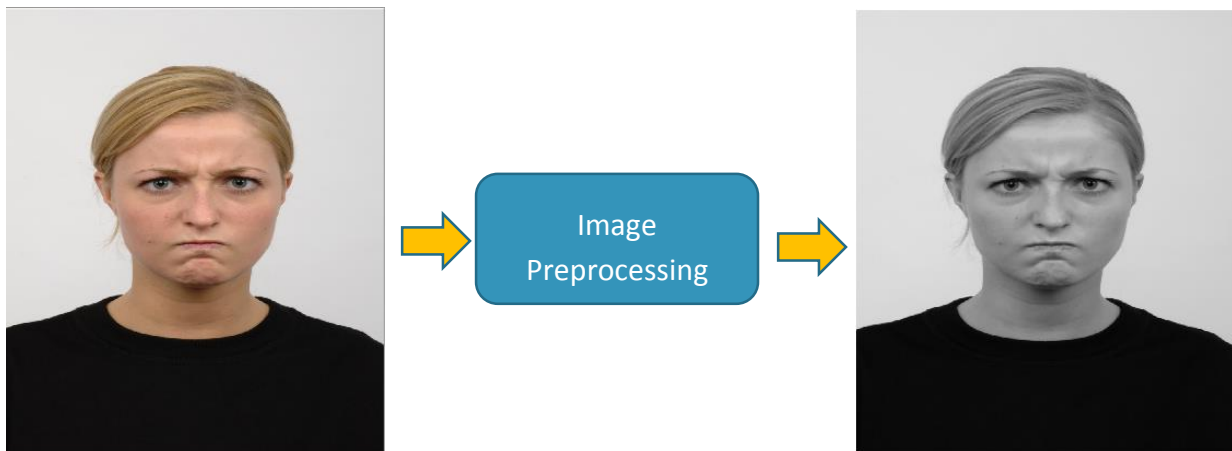
STEP 02 – FACE DETECTION

We used the Viola-Jones face detection algorithm in JavaCV. Here the OpenCV repository contains a Haar cascade classifier that will find frontal faces.

Here this step basically decides whether to proceed further or not. If a face is detected it prompts the application to proceed to the next step. Otherwise it will prompt an alert specifying that no faces are detected.
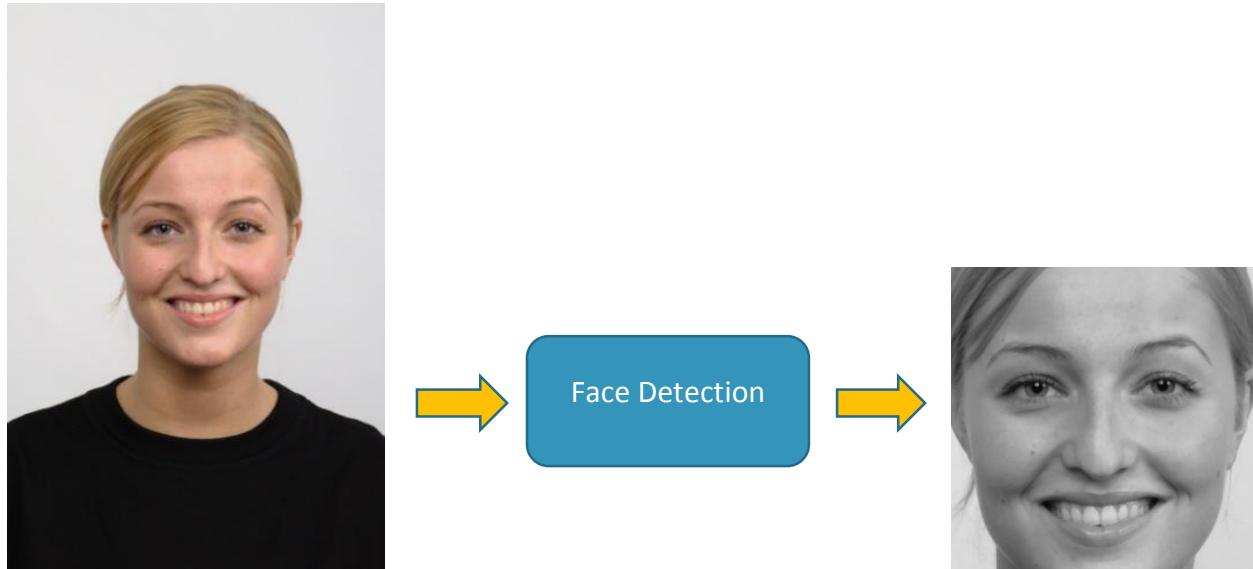
IMPLEMENTATION

```java
IplImage faceDetection(opencv_core.IplImage img, String classifier) {
    // Create a new Haar classifier & Load the HaarClassifierCascad
    opencv_objdetect.CvHaarClassifierCascade cascade = new
opencv_objdetect.CvHaarClassifierCascade(cvLoad(classifier));
    // Check whether the cascade has loaded successfully. Else report and error and
quit
    if (cascade.isNull()) {
        System.out.println("ERROR: Could not load classifier cascade\n");
        return null;
    }
    // Allocate the memory storage
    opencv_core.CvMemStorage storage = opencv_core.CvMemStorage.create();

    opencv_core.CvSeq faces = cvHaarDetectObjects(img, cascade, storage, 1.5, 3,
CV_HAAR_DO_CANNY_PRUNING);
    // Find whether the cascade is loaded, to find the faces. If yes, then:

    cvClearMemStorage(storage);

    int total = faces.total();
    // There can be more than one face in an image. So create a growable sequence of
faces. Detect the objects and store them in the sequence

    if (total == 0) {
        return null;
    } else {
        // Create a new rectangle for drawing the face
        opencv_core.CvRect r = new opencv_core.CvRect(cvGetSeqElem(faces, 0));

        // Find the dimensions of the face,and scale it if necessary
        cvSetImageROI(img, new opencv_core.CvRect(r.x(), r.y(), r.width(),
r.height()));

        return img;
    }
```
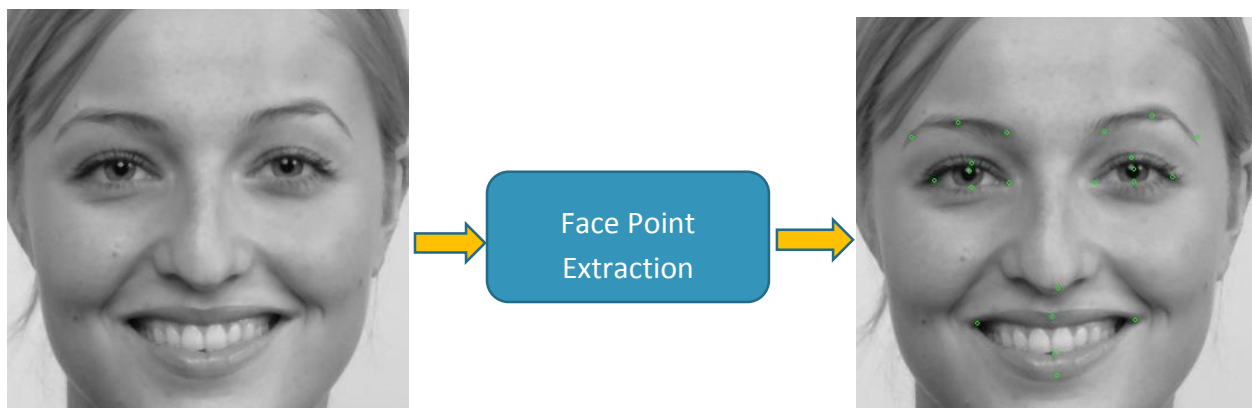
STEP 03 – FEATURE POINT EXTRACTION

This is one of most important steps that you find. In order to classify human facial expressions we have to extract facial landmarks out of the human face. Here we use Luxand FaceSDK to achieve this.
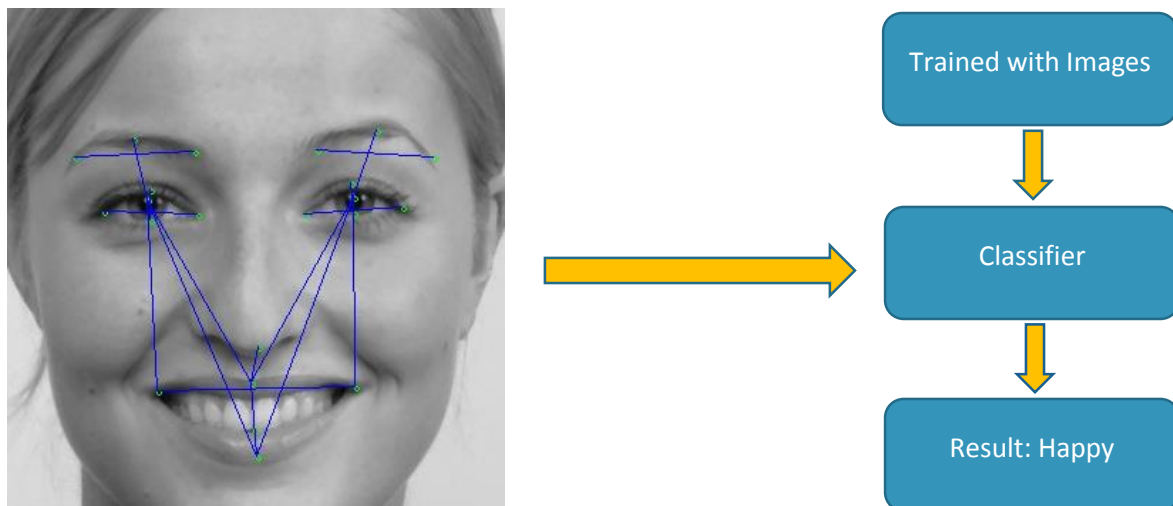
STEP 04 - EMOTION CLASSIFICATION

Here we extracted distances among the facial feature points marked in the above step and created neural networks for each emotion type.

Here we used multi-layer perceptron as the neural network to represent the emotions and use the training datasets to train the Neural Network using backpropagation with momentum learning rule.

In order to create order training dataset we used about 400 images downloaded from the Radboud Faces Database: http://www.socsci.ru.nl:8180/RaFD2/RaFD?p=main
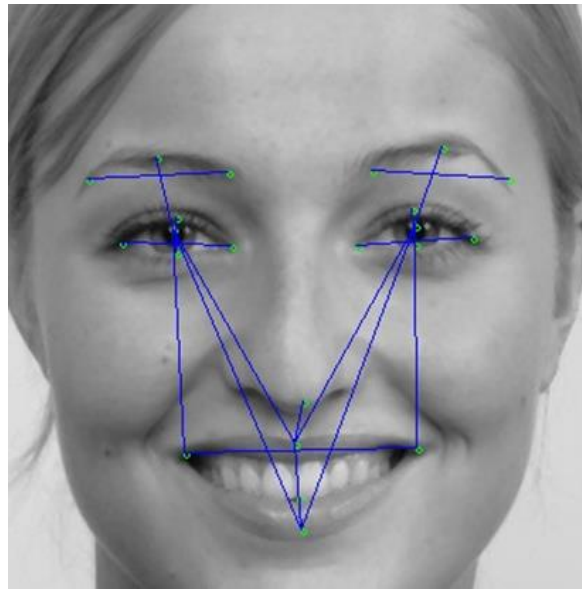
This image shows the distances that we used to create the training dataset.

Trained with Images
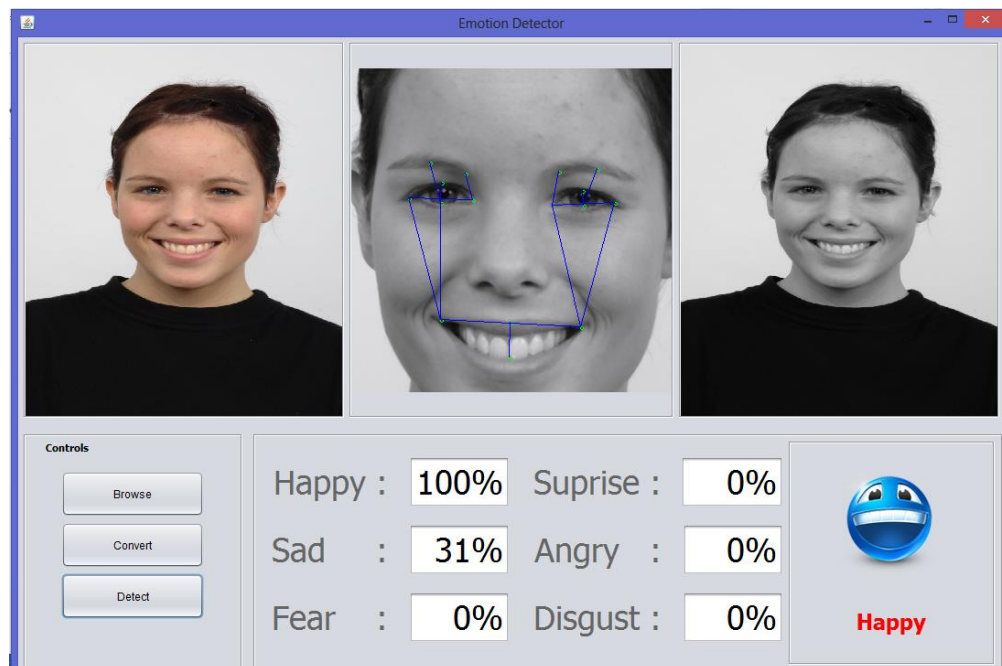
Classifier

Result: Happy

TOOLS USED

- ➢ Netbeans IDE
- ➢ Luxand FaceSDK
- ➢ Neuroph – Java Neural Network Framework
- ➢ OpenCV 2.4.0
- ➢ JavaCV

SUCCESS RATES OF TESTING

- ➢ Anger - 90.5%
- ➢ Disgust - 83.5%
- ➢ Fear - 88.5 %
- ➢ Happy – 100%
- ➢ Sad - 78.4%
- ➢ Surprise - 86.3%

APPLICATION DEMO

REFERENCE

http://neuroph.sourceforge.net/tutorials/HebermanSurvival/HabermansSurvival.html

https://sites.google.com/site/pdopencvjava/face-detection

Emotion classification using facial expression

Luxand FaceSDK

Neuroph

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