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FACE EXPRESSION DETECTION AND RECOGNITION SYSTEM USING MACHINE LEARNING ALGORITHM

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ABSTRACT

The problem of automatic recognition of facial expressions is still an ongoing research, and it relies on advancements in Image Processing and Computer Vision techniques. Such systems have a variety of interesting applications, from human-computer interaction, to robotics and computer animations. Their aim is to provide robustness and high accuracy, but also to cope with variability in the environment and adapt to real time scenarios. This paper proposes an automatic facial expression recognition system, capable of distinguishing the six universal emotions: disgust, anger, fear, happiness, sadness and surprise. It is designed to be person independent and tailored only for static images. The system integrates a face detection mechanism using Viola-Jones algorithm, uses uniform Local Binary Patterns for feature extraction and performs classification using a multi-class Support Vector Machine model

Keywords: *Face Recognition, Detection, Emotion.*

I. INTRODUCTION

Face expression is the most effective form of non-verbal communication and it provides intimation about emotional state, mindset, and intention. Face Detection is one of the most important techniques, which is used in many use cases like tagging a person in an image, real-time, monitoring of people, identifying people. “Face Expression Detection” would help in emotion analysis (happy, anger, sad, confused, shocked and neutral) and multi face detection. We can track faces in a video. It would be an open source script.

Face Recognition is a biometric solution that measures unique characteristics but once face. To perform facial recognition, we will be uniquely representing a face, among this features were the location of hairline, eyes and nose. Facial recognition is a computer application composes for complex algorithms that use mathematical and metrical techniques, these get the image in raster mode (digital format) and then process and compare pixel by pixel using different methods for obtain a faster and reliable results, obviously these results depend of the machine use to process this due to the huge computational power of the algorithms.

II. PROBLEM STATEMENT

At a quick glance, one is not able to predict the facial expression of the entire person in the image or video. Making automation in face detection will give a quick output of the facial expression of all the people in the image and can give the count of the faces. It will help in emotion analysis (happy, anger, sad, confused, shocked, neutral) of the faces. It can be integrated with any camera application and can be used for the security purpose. The problem of finding faces can be viewed as a segmentation problem (in machine vision) or as a detection problem (in pattern recognition). It refers to identification of all regions in the scene that contain a human face. The problem of finding faces (face localization, face detection) will be solved regardless of clutter, occlusions and variations in head pose and lighting conditions. The presence of non-rigid movements owing to facial expression and a high degree of variability in facial size, color and texture make this problem even more difficult. It will be solved in our application.

Some limitations of the existing system are:

- Existing system is not able to detect multiple faces.
- Existing system is not able to detect multiple expressions for multiple faces.
- Time Taken to find faces is very high and it’s not reliable.

III. PROPOSED SOLUTION

The proposed system is "Facial Recognition". The user has to send a request to the server through a camera then the algorithm will find faces in the image sent then fetch the information from the server. The Algorithm on the server is purely based on machine learning which will give 99% accuracy in the result. Machine learning is a type of artificial intelligence (AI) that allows software applications to become more accurate in predicting outcomes without being explicitly programmed. The basic premise of machine learning is to build algorithms that can receive input data and use statistical analysis to predict an output value within an acceptable range. In this we used Open CV (Open Source Computer Vision) is a library of programming functions mainly aimed at real-time computer vision. Originally developed by Intel, it was later supported by Willow Garage and is now maintained by It seez. The library has more than 2500 optimized algorithms, which includes a comprehensive set of both classic and state-of-the-art computer vision and machine learning algorithms. These algorithms can be used to detect and recognize faces, identify objects, classify human actions in videos, track camera movements, track moving objects, extract 3D models of objects, produce 3D point clouds from stereo cameras, stitch images together to produce a high resolution image of an entire scene, find similar images from an image database, remove red eyes from images taken using flash, follow eye movements, recognize scenery and establish markers to overlay it with augmented reality, etc.

The proposed FER system has been developed as a standalone application, with no communication with other services or applications. The most important component incorporates all the functionality, which is itself divided into 3 modules, while the second one is a simple Graphical User Interface that allows user access to the system's features. The elements of the system are illustrated in

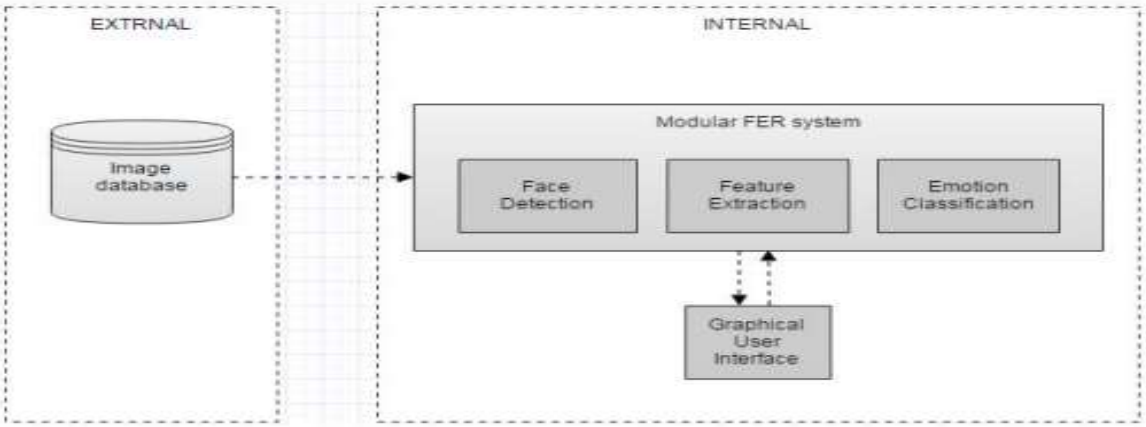

Figure 1: External and internal components of the system

IV. METHODOLOGY

The proposed solution for the Automatic Face Expression Recognition System is composed of a series of modules, with well-defined properties and actions that follow sequential processes. If we look at the system from a high grain perspective, its main attributes are identifying the face from a given image, mapping the face pixels into a higher representation and ultimately decide the emotion class. The sequence of steps undertaken by the system is depicted in Figure given below:

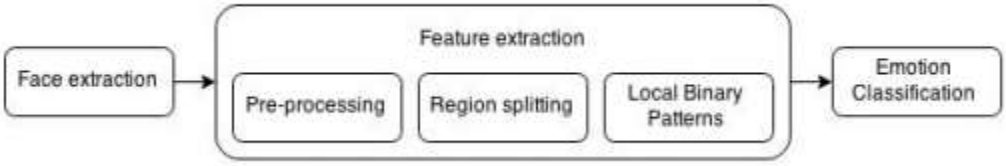

Figure 2: The constituent modules of the system

Detection of faces using Viola-Jones

Due to its efficiency and universality, I have chosen the Viola-Jones algorithm for this project, in order to detect and extract the faces. For this, I have used the OpenCV library (namely Cascade Classifier) integrated with Matlab, which offers an implementation of the algorithm.

For detecting frontal faces, I have used one of the provided trained Haar classifiers, called 'haar cascade fron alface alt.xml', which successfully extracted 306 faces out of the total 309 images of the dataset. To ensure that the extracted faces are positioned in the same location, I have used an additional classifier, from the same OpenCV library, called 'haarcascade mcs eyepair big.xml'. This detects the region of the eyes, which is then used to adjust the left and right margins of the face window, to ensure equal distance between eyes and the sides of the face. In this way, unnecessary information (such as hair, ears, background) is discarded and the extracted faces will have normalised positions. The first two pictures of Figure 5.4 show the face and eyes regions returned by the Viola-Jones detectors, outlining the side areas with non-essential elements, while the third image displays the area which is ultimately extracted.

(A) Two examples of the regions detected for face and eyes.

(B) The red rectangles depict the original face and eyes areas; the green rectangle outlines the final extracted region.

Figure 3: Face and Eye Detection Area

V. CONCLUSION

The proposed solution delivers a recogniser system for facial expressions. The most important achievement consists in the integrated functionalities and the obtained results. The system includes an automatic face detection mechanism and implements feature extraction techniques, tailored for the current problem. A Support Vector Machine model is trained on examples of faces and extended to support multi-classification. This successfully expands the system with the capability of classifying all six emotions, ultimately achieving an accuracy of 86%.

There are a series of approaches that would either increase the performance of the system or extent its functionality. A major improvement would be replacing the current method of face division with one of the geometric techniques, Active Shape Models or Active Appearance Models. These techniques allow identification of landmark points, surrounding important face regions, such as eyes, nose and mouth. This enables feature extraction to be applied only on key areas, hence improve the results or even eliminate the need of using a face detection mechanism

REFERENCES

[1] J¨orgen Ahlberg. Candide-3 – an updated parameterized face. Technical Report LiTH-ISY-R-2326, Dept. of Electrical Engineering,Link¨oping University, Sweden, 2001.

[2] Ethem Alpaydin. Introduction to Machine Learning, second edition. 2010.

[3] Marian Stewart Bartlett, Gwen Littlewort, Ian Fasel, and Javier R. Movellan. Real time face detection and facial expression recognition: Development and applications to human computer interaction. In Computer

Vision and Pattern Recognition Workshop, 2003. CVPRW '03. Conference on, volume 5, pages 53–53, 2003.

[4] Michel Beaudouin-Lafon and Wendy Mackay. The human-computer interaction handbook. chapter Prototyping Tools and Techniques, pages 1006–1031. 2003.

[5] Christopher Bishop. Pattern Recognition and Machine Learning (Information Science and Statistics). Springer-Verlag New York, Inc., 2006.

[6] Betul Bostanci and Erkan Bostanci. An evaluation of classification algorithms using mc nemar's test. In Proceedings of Seventh International Conference on Bio-Inspired Computing: Theories and Applications (BIC-TA 2012), volume 201, pages 15–26. 2013.

[7] Ira Cohen, Nicu Sebe, Larry Chen, Ashutosh Garg, and Thomas S. Huang. Facial expression recognition from video sequences: Temporal and static modelling. In Computer Vision and Image Understanding, pages 160–187, 2003.

[8] Corinna Cortes and Vladimir Vapnik. Support-vector networks. Machine Learning, 20(3):273–297, 1995.

[9] Charles Darwin. The expression of the emotions in man and animals. AMS Press, 1972