

DAYANANDA SAGAR UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
SCHOOL OF ENGINEERING
DAYANANDA SAGAR UNIVERSITY
KUDLU GATE
BANGALORE - 560068



MAJOR PROJECT REPORT (Phase-I)

ON

"Human Facial Expression (Emotion) Recognition"

**SUBMITTED TO THE 7th SEMESTER
MAJOR PROJECT (16CS481)
COURSE**

**BACHELOR OF TECHNOLOGY
IN
COMPUTER SCIENCE & ENGINEERING**

Submitted by

Abhijit Jadhav	(ENG17CS0005)
Aditya Singh	(ENG17CS0011)
Afeera Fathima	(ENG17CS0014)
Akshita Mishra	(ENG17CS0023)
Amit Kumar Gupta	(ENG17CS0026)

Under the supervision of
Prof. Anusha Ashoka

DAYANANDA SAGAR UNIVERSITY

School of Engineering, Kudlu Gate, Bangalore-560068



CERTIFICATE

This is to certify that Abhijit Jadhav, Aditya Singh, Afeera Fathima, Akshita Mishra ___ and Amit Kumar Gupta bearing USN ENG17CS0005, ENG17CS0011, ENG17CS0016, ENG17CS0023 and ENG17CS0026 has satisfactorily completed his/her Major Project (Phase-I) as prescribed by the University for the 7th semester B.Tech. programme in Computer Science & Engineering for Major Project (16CS481) course during the year 2020 at the School of Engineering, Dayananda Sagar University., Bangalore.

Date: _____

Signature of supervisor

Max Marks	Marks Obtained

Signature of Chairman

Department of Computer Science & Engineering

ACKNOWLEDGEMENT

From the very core of our heart, we would like to express our sincere gratitude to Prof. **Anusha Ashoka** for her invaluable guidance, support, motivation and patience during the course of this mini- project work. We are always indebted to her for her kind support and constant encouragement.

We extend our sincere thanks to our **Chairman Dr. Sanjay Chitnis** who continuously helped throughout the project and without his guidance, this project would have been an uphill task.

It requires lots of efforts in terms of cooperation and support to fulfill various tasks involved during the project. We are always grateful to our peers and friends who have always encouraged us and guided us whenever we needed assistance.

Abhijit Jadhav	(ENG17CS0005)
Aditya Singh	(ENG17CS0011)
Afeera Fathima	(ENG17CS0016)
Akshita Mishra	(ENG17CS0023)
Amit Kumar Gupta	(ENG17CS0026)

TABLE OF CONTENTS

SL.NO	TITLE	PAGE. NO
i.	Cover Page	1
ii.	Certificate	2
iii.	Acknowledgement	3
iv.	Content	4
v.	Abstract	5
1.	Introduction	6
2.	Problem Statement	6
3.	Literature Survey	7
4.	Requirement Analysis	14
5.	Design	15
6.	Conclusion	16
7.	Future Work	16
8.	References	17

ABSTRACT

Facial expression is the visible manifestation of the affective state, cognitive activity, intention, personality and psychopathology of a person and plays a communicative role in interpersonal relations. Automatic recognition of facial expressions can be an important component of natural human-machine interfaces; it may also be used in behavioral science and in clinical practice. An automatic Facial Expression Recognition system needs to perform detection and location of faces in a cluttered scene, facial feature extraction, and facial expression classification.

This work proposes an approach to find and learn informative representations from 2 dimensional gray -level images for facial expression recognition application. The learned features are obtained from a designed convolutional neural network (CNN). The developed CNN enables us to learn features from the images in a highly efficient manner by cascading different layers together. The developed model is computationally efficient since it does not consist of a huge number of layers and at the same time it takes into consideration the overfitting problem. The outcomes from the developed CNN are compared to handcrafted features that span texture and shape features. The experiments conducted on the Bosphours database show that the developed CNN model outperforms the handcrafted features when coupled with a Support Vector Machines (SVM) classifier

1. INTRODUCTION

Pattern recognition is the automated recognition of patterns and regularities in data. It has applications in statistical data analysis, signal processing, image analysis, information retrieval, bioinformatics, data compression, computer graphics and machine learning.

Pattern recognition is the process of recognizing patterns by using a machine learning algorithm. Pattern recognition can be defined as the classification of data based on knowledge already gained or on statistical information extracted from patterns and/or their representation.

Image processing is the field of signal processing where both the input and output signals are images. One of the most important applications of Image processing is Facial expression recognition. Our emotion is revealed by the expressions in our face. Facial Expressions plays an important role in interpersonal communication. Facial expression is a non-verbal scientific gesture which gets expressed in our face as per our emotions.

2. PROBLEM STATEMENT

- Develop a facial expression recognition model in Keras
- Build and train a convolutional neural network (CNN)
- Deploy the trained model to a web interface with Flask
- Apply the model to real-time video streams and image data.

3. LITERATURE SURVEY

[1] Effective Facial Emotion Recognition using Convolutional Neural Network Algorithm

Authors: Malyala Divya, R Obula Konda Reddy, C Raghavendra

Conference Name and Place: International Journal of Recent Technology and Engineering (IJRTE)

Publishing Year: November 2019

Algorithm Used: CNN

Dataset Used: FER 2013

Procedures and Results:

- They detect emotion by scanning (static) images or with the (dynamic) recording.
- Features extracting can be done like eyes, nose, and mouth for face detection.
- Each emotion is expressed with different facial features like eyebrows, opening the mouth, Raised cheeks, wrinkles around the nose, wide-open eyelids and many others.
- The convolutional neural network (CNN) algorithm follows steps as max-pooling (maximum feature extraction) and flattening.
- The outcome of the project is to display the percentage of every emotion classifier to each individual i.e., 66% of accuracy is achieved.

[2] Emotion Recognition from Physiological Signal Analysis: A Review

Authors: Egger Maria, Ley Matthias, Hanke Sten

Conference Name and Place: AIT Austrian Institute of Technology GmbH, Vienna, Austria

Publishing Year: 4th May 2019

Algorithm Used: Support Vector Machine, Canonical Correlation analysis, Artificial Neural Network, K-Nearest Neighbor, Adaptive Neuro-Fuzzy Interference System (ANFIS), Bayesian Network

Dataset Used: International Affective Picture System (IAPS) database

Procedures and Results:

- This review paper uses an entirely contact-less method is to analyze facial features with the help of a video camera.
- They included computers, smart-phones or tablets with integrated cameras and Smart wearables that provide contact with the skin and physiological parameters such as electro-dermal activity and heart related signals can be recorded unobtrusively also during dynamical tasks.
- Accuracy varies based on the amount of detected emotions, extracted features, classification method and the quality of the database. Electroencephalography achieves 88.86 % accuracy for four emotions, multimodal measurements 79.3 % for four emotive states, facial recognition 89 % for seven states and speech recognition 80.46 % for happiness and sadness.

[3] A real time face emotion classification and recognition using Deep learning Model

Authors: Dr. Shaik Asif Hussain, Ahlam Salim Abdallah Al Balushi

Conference Name and Place: Journal of Physics: Conference Series, ICT4CT

Publishing Year: 2019

Algorithm Used: CNN

Dataset Used: KDEF dataset

Procedures and Results:

- This work presents deep learning algorithms used in facial recognition for accurate identification and detection.
- The proposed work presented is simplified in three objectives as face detection, recognition and emotion classification. In support of this work OpenCV library, dataset and python programming is used for computer vision techniques involved. In order to prove real time efficacy, an experiment was conducted for multiple students to identify their inner emotions and find physiological changes for each face.
- The performance measures are validated with the CNN model designed with an accuracy of 88%. However the results prove that the network architecture designed has better advancements than existing algorithms.

[4] Emotion Recognition of Students Based on Facial Expressions in Online Education Based on the Perspective of Computer Simulation

Authors: Weiqing Wang, Kunliang Xu, Hongli Niu, and Xiangrong Miao

Conference Name and Place: University of Science and Technology Beijing, China

Publishing Year: 11 September 2020

Algorithm Used: CNN with RNN

Dataset Used: CK+ and FER 2013 dataset

Procedures and Results:

- They are combining the existing online education platforms with facial expression recognition model based on the architecture of convolutional neural network, this work proposed a framework that enables real-time monitoring of students' emotions in online courses and ensures that the feedback expressed by facial expression can be provided to teachers timely, so that they can flexibly adjust the teaching programs and ultimately improve the quality and efficiency of online education.
- The small FER databases usually only contain a few hundreds of images, obviously this is not enough for model training; we adopt online augmentation strategy with both horizontal flipping and random shifting to increase the images of training sets.
- The model in the proposed framework currently performs well, it will be replaced by models with higher learning capabilities and higher classification accuracy in the future. In order to ensure the competitiveness of the framework in a longer period, it needs to be adjusted and maintained regularly, and more advanced algorithms and technologies should be adopted to update it.

[5] Facial Emotion Detection Using Deep Learning

Authors: Akriti Jaiswal, A. Krishnama Raju, Suman Deb

Conference Name and Place: 2020 International Conference for Emerging Technology (INCET), Belgaum, India.

Publishing Year: June 5-7, 2020

Algorithm Used: CNN, SVM

Dataset Used: Facial emotion recognition challenge (FERC-2013) and Japanese female facial emotion (JAFPE)

Procedures and Results:

- It discusses the procedure of emotion detection, which includes basically three main steps: face detection, features extraction, and emotion classification.
- This paper proposed a convolutional neural network (CNN) based deep learning architecture for emotion detection from images.
- The performance of the proposed method is evaluated using two datasets Facial emotion recognition challenge (FERC-2013) and Japanese female facial emotion (JAFPE).
- The accuracies achieved with the proposed model are 70.14 and 98.65 percentage for FERC2013 and JAFPE datasets respectively.

[6] Frame attention networks for facial expression recognition in videos

Authors: Debin Meng, Xiaojiang Peng, Kai Wang, Yu Qiao

Conference Name and Place: International Conference on Image Processing (ICIP 2019), scheduled for 22-25 September 2019 in Taipei, Taiwan

Publishing Year: 2019

Algorithm Used: CNN and FAN

Dataset Used: CK+ and AFEW 8.0 dataset

Procedures and Results:

- They proposed the Frame Attention Networks (FAN), to automatically highlight some discriminative frames in an end-to-end framework.
- The network takes a video with a variable number of face images as its input and produces a fixed-dimension representation.
- The whole network is composed of two modules. The feature embedding module is a deep Convolutional Neural Network (CNN) which embeds face images into feature vectors. The frame attention module learns multiple attention weights which are used to adaptively aggregate the feature vectors to form a single discriminative video representation.
- Accuracy Achieved: 51.18%

[7] Emotion Recognition from 2D Facial Expressions

Authors: Bilal Taha, Dimitrios Hatzinakos

Conference Name and Place: IEEE Canadian Conference of Electrical and Computer Engineering (CCECE)

Publishing Year: December 2019

Algorithm Used: CNN, SVM

Dataset Used: Bosphorus database

Procedures and Results:

- 2-dimensional grey-level images for facial expression recognition application.
- Designed convolutional neural network (CNN).
- The outcomes from the developed CNN are compared to handcrafted features that span texture and shape features.
- The experiments conducted on the Bosphorus database show that the developed CNN model outperforms the handcrafted features when coupled with a Support Vector Machine classifier.
- The accuracy obtained by this method was 87%.

[8] Facial Emotion Recognition of Students using Convolutional Neural Network

Authors: Imane Lasri, Anouar Riad Solh, Mourad El Belkacemi

Conference Name and Place: Third International Conference on Intelligent Computing in Data Sciences (ICDS)

Publishing Year: 2019

Algorithm Used: CNN, SVM

Dataset Used: FER 2013 database

Procedures and Results:

- Our system consists of three phases: face detection using Haar Cascades, normalization and emotion recognition using CNN on FER 2013 database with seven types of expressions.
- Obtained results show that facial emotion recognition is feasible in education, consequently, it can help teachers to modify their presentation according to the students' emotions.
- The proposed model achieved an accuracy rate of 70% on FER 2013 database.

[9] Facial Emotion Recognition System A Machine Learning Approach

Authors: V V Ramalingam, A Pandian, Lavanya Jayakumar

Conference Name and Place: National Conference on Mathematical Techniques and its Applications (NCMTA 18)

Publishing Year: 2018

Algorithm Used: mGA-Embedded PSO Algorithm(Genetic Algorithm)

Dataset Used: FER-2013

Procedures and Results:

- The proposed mGA-Embedded PSO Algorithm is used to diagnose the powerful features for individualize unique frown interpretations.
- Using Multi task sparse machine Learning approach we have analysed the frown exposition by scrutinizing some regular and distinct data among various expositions.
- The suggested frown expression realization system consists of 3 stages:
 - Feature Extraction
 - Feature Optimization
 - Emotion Recognition
- This system exhibits the problem of frown interpretation realization using frown transfer aspects.

[10] Emotion recognition using facial expressions

Authors: Paweł Tarnowski, Marcin Kołodziej, Andrzej Majkowski, Remigiusz J. Rak

Conference Name and Place: International Conference on Computational Science, ICCS 2017, 12-14 June 2017, Zurich, Switzerland

Publishing Year: 2017

Algorithm Used: k-NN classifier and MLP neural network.

Dataset Used: KDEF database

Procedures and Results:

- They used Microsoft Kinect for 3D modeling and used kinect coordinating system for

extracting features from 3D images.

- Experiments were carried out under the same conditions and at a fixed position of a user in relation to the Kinect unit.
- They obtained classification accuracy of emotions of 96% (3-NN), 90% (MLP) for random division of data. For “natural” division of data the classification accuracy was 73% (for MLP classifier). In the same case, for the 3-NN classifier we obtained a classification accuracy of 10% worse.
- The result was obtained for MLP classifier and “natural” division of data for all users (subject-independent).

[11] Automatic Face Emotion Recognition and Classification Based on Dee Networks

Authors: Vibha. V. Salunke, Dr C. G. Patil

Conference Name and Place: International Conference on Computing, Communication, Control and Automation (ICCUBEA)

Publishing Year: 2017

Algorithm Used: CNN, SVM

Dataset Used: FER2013 dataset and RaFD dataset

Procedures and Results:

- The network in this paper consists of three convolutional layers each followed by max-pooling and ReLU.
- The network is trained on FER2013 dataset and tested on RaFD dataset thus giving a wide range of training images to the network so that it can overcome the basic problem of recognition of unknown faces.
- The pertinence of the final model is depicted in a live video application that can instantaneously return users emotions based on their facial posture.
- The accuracy obtained by this method was 68%.

4. REQUIREMENT ANALYSIS

Functional Requirements:

System Purpose:

- To be able to detect face from live feed.
- To be able to fetch the images per second and give the desired output accordingly.

Users:

- Users should be able to use the app efficiently in order to detect facial emotion.
- Users must be able to use the camera for providing input for the app or there must be option to input pre-recorded video.

Responsibilities:

Primary responsibility is to provide users direct access for accurate result information on given input.

Software Requirements:

- Anaconda environment
- Jupyter Notebook
- Python3 with libraries such as TensorFlow, Keras, pandas etc.
- Ubuntu 16.04 or above

Hardware Requirements:

- Processor: 64 bit
- RAM: 8 GB
- Hard Disk: 1 TB

5. DESIGN

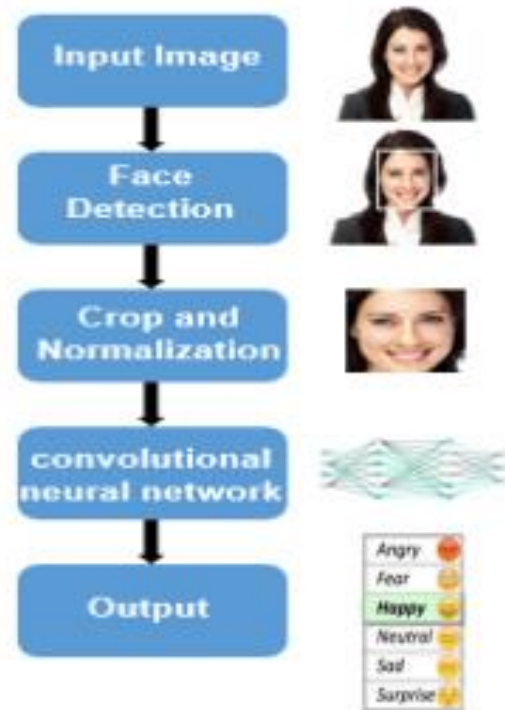


Fig. 1. Proposed Approach

6. CONCLUSION

The proposed work is designed to develop a real time system to detect, recognize and classify human faces. The classified expressions are represented in seven states as happiness, neutral, sadness, anger, surprise, disgust, fear. The softwares used to test the functionality are Anaconda and python 3.8. Similarly FER 2013 dataset is used with convolution neural network model for face recognition and classification. The performance measures are validated with the CNN model accuracy.

This application is widely used in many areas such as education, industry, medical and electronics etc. FER 2013 dataset is built to achieve face classification and recognition. The above seven facial expressions show different conditions of a person. Some of the applications directly related are Autism which can be helpful to interpret expressions of a person or child. The emotions of a student's E-learning techniques could also be evaluated easily through the proposed work.

7. FUTURE WORK

Future work should entail improving the robustness of the classifiers by adding more training images from different datasets, investigating more accurate detection methods that still maintain computational efficiency, and considering the classification of more nuanced and sophisticated expressions.

In future work, I will also try to add the application of Gabor filter based feature extraction in combination with neural network for the recognition of different facial emotions with more accuracy and better performance.

8. REFERENCES

1. Malyala Divya, R Obula Konda Reddy, C Raghavendra, “Effective Facial Emotion Recognition using Convolutional Neural Network Algorithm”, International Journal of Recent Technology and Engineering (IJRTE),2019
2. Egger Maria, Ley Matthias, Hanke Sten, “Emotion Recognition from Physiological Signal Analysis: A Review”, AIT Austrian Institute of Technology GmbH, Vienna, Austria, 2019
3. Dr. Shaik Asif Hussain, Ahlam Salim Abdallah Al Balushi, “A real time face emotion classification and recognition using Deep learning Model”, Journal of Physics: Conference Series, ICT4CT, 2019
4. Weiqing Wang, Kunliang Xu, Hongli Niu, and Xiangrong Miao, “Emotion Recognition of Students Based on Facial Expressions in Online Education Based on the Perspective of Computer Simulation”, University of Science and Technology Beijing, China, 2020
5. Akriti Jaiswal, A. Krishnama Raju, Suman Deb, “Facial Emotion Detection Using Deep Learning”, International Conference for Emerging Technology (INCET), Belgaum, India, 2020.
6. Debin Meng, Xiaojiang Peng, Kai Wang, Yu Qiao, “Frame attention networks for facial expression recognition in videos”, International Conference on Image Processing (ICIP 2019), scheduled for 22-25 September 2019 in Taipei, Taiwan
7. Bilal Taha, Dimitrios Hatzinakos, “Emotion Recognition from 2D Facial Expressions”, IEEE Canadian Conference of Electrical and Computer Engineering (CCECE), 2019
8. Imane Lasri, Anouar Riad Solh, Mourad El Belkacemi “Facial Emotion Recognition of Students using Convolutional Neural Network” Third International Conference on Intelligent Computing in Data Sciences (ICDS), 2019

9. V V Ramalingam, A Pandian, Lavanya Jayakumar, “Facial Emotion Recognition System A Machine Learning” National Conference on Mathematical Techniques and its Applications (NCMTA 18), 2018
10. Paweł Tarnowski, Marcin Kołodziej, Andrzej Majkowski, Remigiusz J. Rak, “Emotion recognition using facial expressions”, International Conference on Computational Science, ICCS 2017, 12-14 June 2017, Zurich, Switzerland
11. Vibha. V. Salunke, Dr C. G. Patil, “Automatic Face Emotion Recognition and Classification Based on Deep Networks”, International Conference on Computing, Communication, Control and Automation (ICCUBEA), 2017