IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Facial Emotion Recognition Using CNN and HaarCascade Classifier

[1]Mrs. Bhavana P, [2] Aishwarya N, [3] Asha R, [4] Rajeshwari P , [5] Usha Kumari

[1]Assisstant Professor,

[1]Cambridge Institute of Technology,

[1]Bengaluru, India

Abstract: In computer vision, the field of face emotion for circumstances that comprises a pre-processing detection is expanding with the goal of identifying and comprehending human emotions from facial expressions. We provide a system in this project that combines the CNN (Convolutional Neural Network) and Haar Cascade classification techniques. A sizable dataset of labeled facial expressions is used to train the CNN model, which 21 then uses these characteristics and patterns to identify various emotions. It allows for accurate emotion categorization by extracting high-level abstract features from the input photos. However, the Haar Cascade classifier adds more data for emotional analysis by identifying face landmarks like the lips, nose, and eyes. This cyclical method makes it easier to analyze the emotional states.

***Index Terms* - Convolutional Neural Network, Haar Cascade Classifier, Facial Emotion.**

I. INTRODUCTION

Humans experience emotions as physiological states in reaction to internal or external stimuli [1]. The absence of vocal modulation and facial expressions makes it challenging to identify emotions. It is challenging to identify human facial emotions with a machine. Face emotion recognition is used in many applications because it is a reliable security method for identifying facial expressions, as opposed to other biometrics like fingerprints [2]. We proposed that particular facial muscle patterns and emotions (happy, sadness, anger, fear, surprise, disgust, and interest) can be 12 used to identify the universals. The problem of computer assisted emotion detection is challenging, demanding, and fascinating [5]. Computer vision problems were extremely challenging to resolve, but with the introduction of new Article Title 3 employs Convolutional Neural Networks (CNN) to identify facial expressions and determine if a person is pleased, sad, or angry. Understanding facial features and their behavior is crucial because face emotion recognition software makes it simpler to identify and validate individual emotions based on their facial features [6]

II. RELATED WORK

An FRS strategy that incorporates the image improvement methodology of image recognition was proposed by Olyed et al. [7]. In order to efficiently combine the feature map of the 24 updated data and enhance picture quality, the heuristic optimization algorithm for image classification used a model for circumstances that comprises a pre-processing augmentation methodology as well as set of retrieved characters. They use two cutting-edge CNN classifications together with extra augmentation approaches and a picture enhancing method. In order to identify phase and compare algorithms such as the principal-component algorithm, local-binary algorithm, and K nearest-neighbors algorithm techniques, Patrick et al. [8] employed the CNN algorithm. They provide an evaluation of the proposed CNN's performance through experimentation.The method for image recognition, called facial emotion recognition, was proposed by Sepas et al. [9]. Singh et al. [10] focused on facial feature detection and emotion recognition, aiming to improve upon previous studies by utilizing an advanced visual database and algorithm optimization. Alenzay et al. [11] proposed a methodology for predicting facial emotions using the Gravitational Search Algorithm (GSA) to enhance accuracy in emotion classification. They developed a semi-supervised Deep Belief Network (DBN) technique and employed various features such as 2D-Discrete Wavelet Transform and Histogram Oriented Gradients for facial emotion extraction. Their work, rooted in nonverbal communication, found applications in diverse fields such as human psychology, image processing, and classification.

The paper [12] suggested a method wherein they conducted more in-depth research and experimentation. Physical attributes are the most crucial when it comes to reading facial expressions. Pictures are categorized and organized based on the feelings they convey.

During the test, faces that symbolized common emotions were hidden behind a screen. This work refers to the discovery that regions matching the action units of the facial action coding system are often home to face parts with the highest diagnostic value for recognizing expressions. Jaiswal et al. presented a method that uses CNN with the HOG (histogram) model over raw pixel data. [13]. Emotions are categorized using a standardized system. Regularization and dropout tactics were employed to increase the training's generalizability Dachapally et al. [14].

III. DATASET FER2013

To train the CNN model using the FER2013 dataset, which consists of 35,887 entries, we partition the data into training (28,709), validation (3,589), and test (3,589) images, each associated with one of seven facial emotions. Figure 9 displays examples of emotions from the FER-2013 dataset, while Figure 1, illustrates the distribution of facial emotions within the dataset. We utilize the "fer2013.csv" file as our training data after preprocessing. Training parameters such as batch size and epoch settings are configured during the training process. The resulting trained model is saved for future predictions, with the model architecture stored in a file named "fer.json" with a JSON extension (.json), and the model weights saved in a file named "fer.h5" with a Hierarchical Data Format extension (.h5), as outlined in Fig.1.

Fig. 1 FER dataset Emotions sample

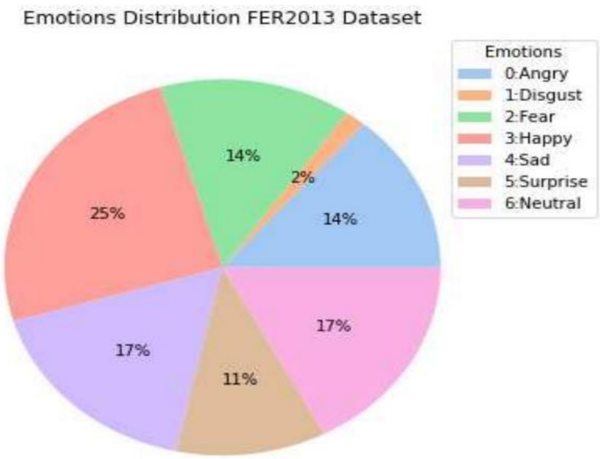


Fig. 2 Emotions Distribution FER2013

IV. PROPOSED WORK AND ALGORITHM

A. Convolutional Neural Network

Convolution is the initial layer of the CNN architecture, and its purpose is to extract significant characteristics from the input image. Each input image is represented by the pixel values in a matrix. A filter is the first component used in the convolution process. The movement of the filter over the image is determined by the Convolution operation's stride parameter[26]. One pixel at a time is how the filter moves over the image when the stride value is 1, and the filter moves over the imagewhen the stride value is 2. two pixels in size. Multiplying the two matrices yields the convolution process. the input image, which is the first matrix, is completed by adding each image element to the weights of its neighbors; the filter/kernel is represented by the second matrix.

B. Haar Cascade Classifier

To recognize objects in pictures or video streams, one object detection approach based on machine learning is called a Haar cascade classifier. In order to identify patterns linked to the object being identified, it analyzes features in the image at various scales and locations. In computer vision applications, this method is frequently used for tasks including object recognition, pedestrian detection, and face detection.

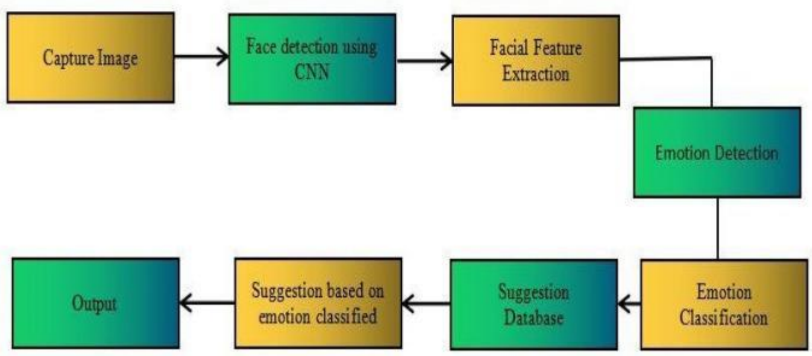


Fig. 3 Block Diagram

C. Methodology

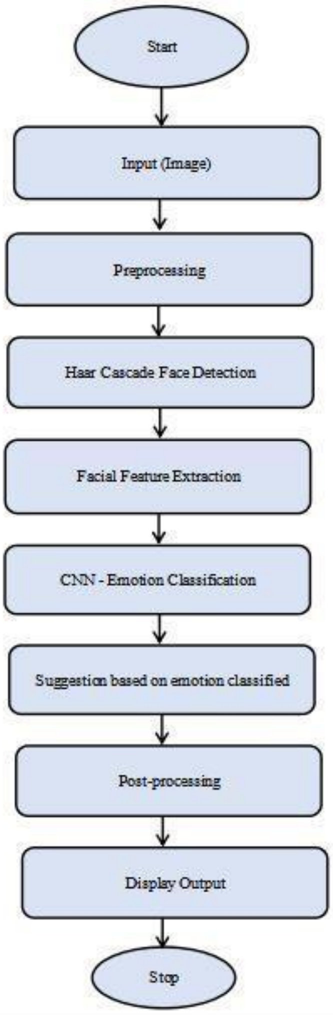


Fig. 4 Flowchart

1. **Input (Webcam, Image):** To recognize facial emotions, the system first receives an input image or webcam feed.

2. **Preprocessing**: To ensure uniform processing, the input is resized and normalized at this stage. It is also possible to increasedataset variability by using data augmentation techniques.

3. **Haar Cascade Face Detection**: In the preprocessed input, faces are identified using Haar Cascade, which also extracts particularfacial regions for additional analysis.

4. **Facial Feature Extraction**: In order to improve the quality of the input data, this phase entails locating landmarks and featureson the face and preprocessing the facial areas.

5. **Convolutional Neural Network (CNN)** – Emotion Classification: A CNN is used to classify emotions. It is trained on a variety

of datasets, then its performance is adjusted and relevant features are extracted. Based on the trained CNN, the system categorizes feelings according to

6. **Post-processing**: To improve the anticipated emotions and ensure correctness and coherence in the findings, this step usesaggregate analysis and smoothing techniques.

7. **Output**: The final output gives a thorough summary of the face expression identification process by showing the

recognizedemotions and, if applicable, visualizing the results on the input stream.

The accurate face emotion recognition and categorization utilizing the Haar Cascade Classifier and CNN.Effective real-time processing to enable timely reactions to emotional states that are observed. Personalized suggestions are generated effectively with the KNN algorithm. Effective cooperation amongst CNN, Haar Cascade, and KNN to improve system efficiency. Sturdy system that adapts to different people, lighting, and facial expression fluctuations. Good user experience thanks to a responsive and intuitive system that offers pertinent ideas. Enhancing context through the identification of significant elements associated with face emotion recognition. An examination of the general emotions conveyed by facial expressions (aggressive, affirmative, and neutral). Producing metadata to arrange information according to categories and keywords. Improving accessibility by potentially producing transcripts for people who prefer to read or have hearing problems. All of these results work together to produce a user-friendly emotion states.

D. Evaluation Parameters

Accuracy: Measures overall correctness by considering true positives and true negatives.

$$\text{Accuracy} = \frac{TP+TN}{TI\ldots} \quad (1)$$

Precision: Quantifies the accuracy of positive predictions, minimizing false positives.

$$\text{Precision} = \frac{TP}{TP+FP} \quad (2)$$

Recall : Measures the ability to capture actual positive instances, minimizing false negatives.

$$\text{Recall} = \frac{TP}{TP+FN} \quad (3)$$

F1 Score: Harmonic mean of precision and recall, providing a balanced metric.

$$\text{F1 Score} = \frac{\text{Precision}\times\text{Recall}}{\text{Precision}+\text{Recall}} \quad (4)$$

V. RESULTS AND DISCUSSIONS

This section begins by detailing about the results obtained, which employs OpenCV in Python along with a Haar cascade classifierfor face detection, achieving a detection rate of 95% on diverse input images. Once executed successfully, the model accurately identifies faces within the input images. Performance evaluation, illustrated in Fig.9, underscores the efficacy of face detection, emphasizing the minimal time (in seconds) needed for the process. Following this, the training data undergoes processing using the CNN algorithm to extract essential features for facial emotion recognition and once the emotions is recognized the suggestions are given to the users.

A. INPUT AND OUTPUTS

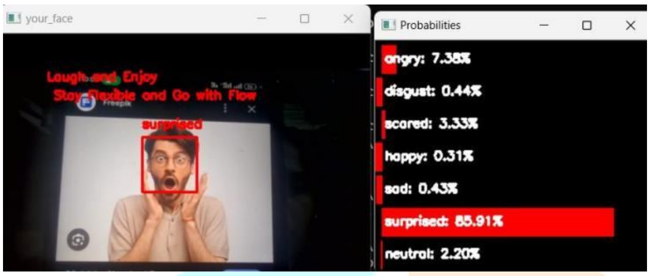


Fig 5: Surprised Emotion.

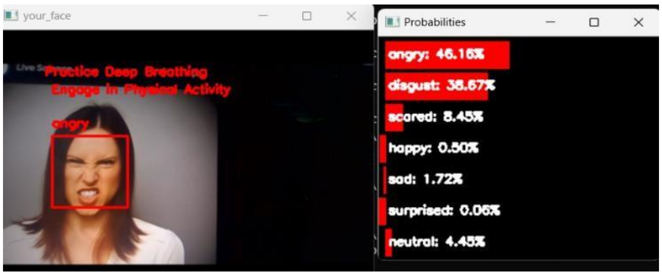


Fig 6 : Angry Emotion.

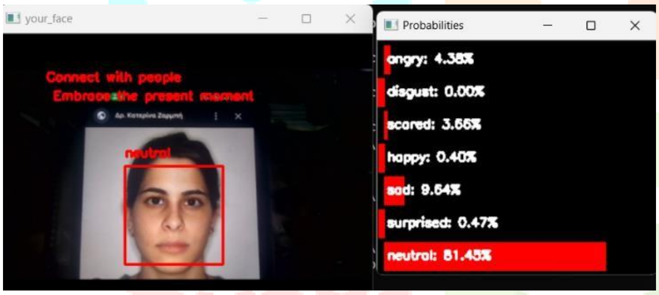
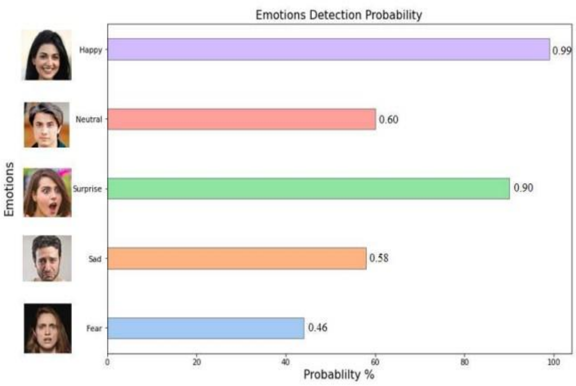


Fig 7 : Neutral Emotion

B. PERFORMANCE RESULTS



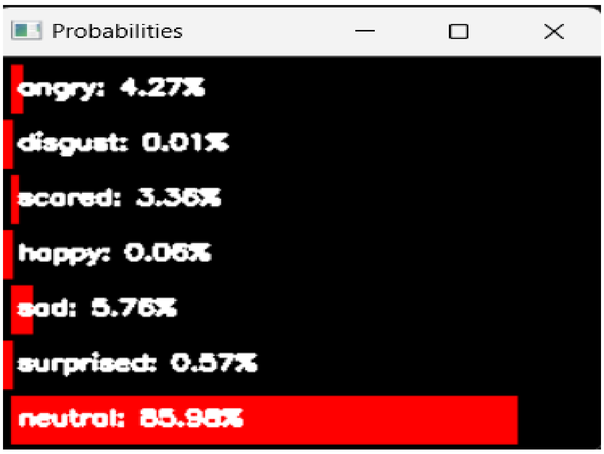


Fig 8 : Probability of Emotions Detection Chart

Fig 9 : Probability of Emotions Detected

VI. CONCLUSION

The convolutional neural network (CNN) algorithm stands 11 out as highly effective in image processing, particularly for achieving precise results in recognizing various facial emotions. In this study, we introduce a CNN model designed 10 to detect human facial emotions across seven distinct classes. To begin, we utilized a Haar-Cascade Classifier for face detection. Our CNN model was then trained on the FER-2013 dataset, with the data split into training, testing, and validation sets. Through a series of experiments, we observed promising results. Specifically, our proposed system attained a validation accuracy of 70% at epoch 115, with corresponding training and validation losses of 0.6 and 1.0, respectively. Looking ahead, we aim to enhance this work by integrating diverse patterns through various deep learning algorithms.

To enhance accuracy and robustness in facial emotion recognition, future research can harness advanced convolutional neural networks (CNNs) such as ResNet, DenseNet, or EfficientNet. Transfer learning from models like those trained on ImageNet and ensemble methods like bagging or boosting can also prove effective. Integrating temporal information can benefit from recurrent neural networks (RNNs) or convolutional LSTM networks. Moreover, exploring multimodal fusion techniques, including algorithms for combining facial expressions with other modalities like speech and body language, can enrich understanding.

REFERENCES

[1] Gupta, U., et al., A sentiment-and-semantics-based approach for emotion detection in textual conversations. 2017.

[2] Ravi, R. a

[3] Ekman, P., W.V.J.J.o.p. Friesen, and s. psychology, Constants across cultures in the face and emotion. 1971. 17(2): p. 124.

[4] Applications, G.J.N.C. Nandi, and S. Jaiswal 2020. 32(15): p. 11253-11262. Robust real-time sentiment identification system applying CNN architecture.

[5] Minaee, S., Abdolrashidi, A.J.S., and M. Minaei Deep Six Emotion: Attentional Convolutional Network-Based Face Expression Recognition. 2021. 21(9):3046.

[6] Al Balushi, A.S.A. and Hussain, S.A. A deep learning model for real-time face emotion classifying and recognition. Journal of Physics: Conference Series. 5 2020. IOP Publishing.

[7] L. Zahara et al. IEEE, Fifth International Conference on Informatics and Computing (ICIC), 2020. The facial emotion recognition (fere2013) dataset for prediction system of micro-expressions face using the convolutional neural network (cnn) 1 approach using raspberry pi.

[8] Wang, Y., et al., random-forest and convolutional neural network-based emotion-based facial interpretation. 10(12): 375 (2019).

[9] Bhatti, Y.K., et al., "Use deep features and an extreme learning machine to figure out instructor facial emotions." 2021. 2021.

[10] Review of deep learning: Concepts, CNN architectures, issues, applications, and future approaches, by L. Alzubaidi et al. 8 (2) 2021: pp. 1-74.

[11] Machine Learning Algorithm for Development of Enhanced Support Vector Machine Technique to Predict Stress, T. Mohana Priya, Dr. M. Punithavalli, & Dr. R. Rajesh Kanna, The International Journal of Technology and Computer Science: C Volume 20, Issue 2, No. 2020, pages 12–20, Software & Data Engineering

[12] A survey of recent deep convolutional neural network architectures was conducted by Khan, A., and collaborators. p. 5455–5516 in 2020. 53(8).

[13] Yan Wang, "Forecasting Method of Stock Market Volatility in Time Series Data Based on Mixed Model of ARIMA and XGBoost",2021

[14] Enhancing face recognition systems employing an original image enhancement way, hybrid features, and convolutional neural network Oloyede, M.O., Hancke, G.P., and Myburgh, H.C.J.I.A. Pages 75181–751891, the same year, No. 6.

[15] Kamencay, P., et al., A new method for face recognition using convolutional neural network. 2017.

[16] Sepas-Moghaddam, A., et al. Facial emotion recognition using light field images with deep attention-based bidirectional LSTM. in ICASSP 2020- 2020 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP). 2020. IEEE.

[17] Lopes, A.T., E. De Aguiar, and T. Oliveira-Santos. A facial expression recognition system using convolutional networks. in 2015 28th SIBGRAPI Conference on Graphics, Patterns and Images. 2015. IEEE.

[18] Shin, M., M. Kim, and D.-S. Kwon. Baseline CNN structure analysis for facial expression recognition. in 2016 25th IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN). 2016. IEEE.

[19] T¨umen, V., O.F. S¨oylemez, and B. Ergen. Facial emotion recognition on a ¨dataset using convolutional neural network. in 2017 International Artificial Intelligence and Data Processing Symposium (IDAP). 2017. IEEE.

[20] Zhang, S., et al., Refineface: Refinement neural network for high performance face detection. 2020.

[21] Poulose, A., et al. Foreground Extraction Based Facial Emotion Recognition Using Deep Learning Xception Model. in 2021 Twelfth International Conference on Ubiquitous and Future Networks (ICUFN). 2021. IEEE.

[22] S.L.Happy and A. Routray,"Automatic facial expression recognition using features of salient facial patches,"in IEEE Transactions on Affective Computing, vol. 6, no. 1, pp. 1-12, 1 Jan.-March 2015

[23] https://www.researchgate.net/publication/354855186_Music_Recommendation_Based_o n_Face_Emotion_Recognition

[24] Rahul ravi, S.V Yadhukrishna, Rajalakshmi, Prithviraj, "A Face Expression Recognition Using CNN &LBP",2020 IEEE.

[25]

Fan, Yin, et al. "Video-based emotion recognition using CNN-RNN and C3D hybrid networks." Proceedings of the 18th ACM International Conference on Multimodal Interaction. ACM, 2016.