Human Sentiment Recognition using Deep Learning

Project report submitted
in
Partial fulfillment of requirement for the award of the degree of

Bachelor of Technology
in

Computer Science & Engineering

by

Ayush Gokhale
Purva Morey
Shivam Naik
Shrivansh Damahe
Siddhant Tiwari
Subodh Malve

Under the guidance of

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Department of Computer Science & Engineering
G H Raisoni Institute of Engineering and Technology, Nagpur
(An Autonomous Institute Affiliated to Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur)
Accredited by NAAC with A+ Grade

2023-2024

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2023-2024

G H Raisoni Institute of Engineering and Technology, Nagpur

(An Autonomous Institute)

Department of Computer Science & Engineering

Certificate

The report of project titled **Human Sentiment Recognition using Deep Learning** submitted by **Ayush Gokhale, Purva Morey, Shivam Naik, Shrivansh Damahe, Siddhant Tiwari, Subodh Malve** in the partial fulfillment of the degree of Bachelor of Technology in **Computer Science and Engineering** during academic year 2023-24, has been carried out under my/our supervision at the Department of Computer Science and Engineering of G H Raisoni Institute of Engineering and Technology, Nagpur. The work is comprehensive, complete and fit for evaluation.

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Declaration

We certify that

a. The work contained in this project has been done by us under the guidance of my supervisor(s).
b. The work has not been submitted to any other Institute for any degree or diploma.
c. We have followed the guidelines provided by the Institute in preparing the project report.
d. We have conformed to the norms and guidelines given in the Ethical Code of Conduct of the Institute.
e. Whenever we have used materials (data, theoretical analysis, figures, and text) from other sources, we have given due credit to them by citing them in the text of the report and giving their details in the references. Further, we have taken permission from the copyright owners of the sources, whenever necessary.

Name & Signatures of the Projectees

Name of the candidate Signature

1. Ayush Gokhale
2. Purva Morey
3. Shivam Naik
4. Shrivansh Damahe
5. Siddhant Tiwari
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Lastly, we would like to thank all those who were directly or indirectly related to our project and extended their support to make the project successful.

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Name of the candidate	Signature
1. Ayush Gokhale	
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6. Subodh Malve	

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Abbreviations

2D	-	2-Dimensional
AI	-	Artificial Intelligence
CNN	-	Convolutional Neural Network
HSR	-	Human Sentiment Recognition
PCA	-	Principal Component Analysis
ML	-	Machine Learning
SVM	-	Support Vector Machine
KNN	-	k-Nearest Neighbor
NB	-	Naïve Bayes
LR	-	Logistic Regression
RF	-	Random Forest
MLP	-	Multilayer Perceptron
DMM	-	Deep Boltzmann Machine

Abstract

In this project we focus on ‘Human Sentiments’ that has played a major role in the human evolution. These sentiments can be recognized by factors such as body movement, gestures, speech, and facial expressions. Over the past few decades as the technologies has grown followed by the advancement in the artificial intelligence and machine learning techniques it has now became possible for us to make research on the human sentiments using vast number of datasets and applying them to these methods. This field has attracted many researchers to study and find an efficient and accurate technique using which sentiments of a human can be recognized using their facial expressions. The application of these can be used in a wide range of fields like human-machine interaction, criminal detection, taking review from the customers, etc. Some researchers have mapped techniques which can be used to do so. The purpose of this project is to develop a model using Deep Learning algorithm which can detect human sentiments by training it on a large labelled dataset of different sentiments.

CHAPTER 1
INTRODUCTION

1.1 Overview

The captivating world of human sentiments has played a significant role in the evolution of the human species. Human sentiments encompass a rich spectrum of emotions and feelings that define the inner world. These sentiments find expression through various means, such as the movement of human bodies, the gestures they make, the words they speak, and the expressions that dance across their faces. The ability to recognize and understand these sentiments has been a timeless endeavour, but recent technological advancements have opened up exciting possibilities for research and practical applications.

Over the past few decades, an incredible growth in technology, particularly in the fields of artificial intelligence and machine learning, has empowered researchers to explore the domain of human sentiments with unprecedented depth and precision. With the availability of vast datasets and sophisticated analytical methods, researchers can now conduct research on human sentiments on a scale that was once unimaginable.

This field of study has become a magnet for researchers from diverse backgrounds, all drawn by the promise of uncovering efficient and accurate techniques for recognizing human sentiments, particularly through facial expressions. Faces serve as powerful canvases that convey a wealth of emotions, and researchers aim to read and interpret these expressions more effectively than ever before by harnessing the potential of technology.

The implications of this research extend far beyond the realm of academia. Practical applications touch various aspects of human life. There is potential for enhancing human-machine interaction, where machines can become more coordinated to human emotions and respond accordingly. There is also potential in applying sentiment analysis to criminal detection, where subtle facial cues could provide crucial insights into falsehood. Even in the world of commerce, analysing customer sentiment can be a game-changer, helping businesses understand their customer’s needs and satisfaction levels.

While researchers have made significant steps in mapping out techniques for sentiment analysis, there is still a wealth of unexplored territory. In this context, the core purpose of their research paper comes into focus. Researchers aim to develop a robust and sophisticated model using Deep Learning algorithms. This model will be the result of training on a vast and meticulously labelled dataset encompassing a wide spectrum of human sentiments. The ultimate goal is to create a powerful tool that can not only detect but also understand human sentiments through facial expressions. By doing so, they hope to make a meaningful contribution to the field, enhancing the understanding of human sentiments and their far-reaching impact on our evolving society.

As they embark on this journey of exploration, it's important to recognize the profound implications of their work. The ability to decipher human sentiments has the potential to reshape how we interact with technology, solve complex problems, and meet the needs of individuals and society as a whole. It's a testament to the power of science and technology in unlocking the secrets of the human experience, and they are excited to be part of this endeavour.

1.2 Problem Statement

The problem revolves around developing an AI-based human sentiment recognition model that can effectively decipher and respond to people's emotions based on various cues of facial expressions and gestures. The central challenge is creating a system that accurately identifies different sentiments and does so in real-time, making it practical for applications like human-computer interaction, healthcare, and customer service.

The task is further complicated by the need for the model to be adaptable to diverse cultural and individual differences in expressing emotions. People from different backgrounds and personalities exhibit their feelings in unique ways, and the model must be capable of understanding this variation. This adaptability is crucial to ensure that the system is inclusive and useful to a wide range of users.

However, it's not just about accuracy and adaptability. Ethical considerations are very important. The developers must navigate issues related to privacy and potential bias in the recognition process. Respecting individual’s privacy while using AI to recognize emotions is a fundamental concern, as is ensuring that the model does not unfairly judge or discriminate against certain groups of people.

In essence, the goal is to construct an AI-based human sentiment recognition system that enhances our understanding of human sentiments and elevates our interactions with technology and each other. The developers are committed to addressing these challenges while creating a responsible, accurate, and universally applicable model that respects privacy and fosters inclusivity. Through this work, the aim is to harness the power of AI algorithms for the betterment of society while addressing the ethical implications and practical hurdles associated with this groundbreaking technology.

1.3 Objectives

- Accurate Emotion Detection - The primary objective of creating a human sentiment recognition model is to make a system that's good at understanding how people are feeling. This means it can tell if someone is happy, sad, angry, or experiencing any other emotion, and it should do this accurately. Imagine a computer program that can read your emotions just like your best friend would.

- Real-Time Responsiveness - This system should work quickly and recognize how someone is feeling right at the moment. Think about devices that can respond to your emotions in real-time. For example, your computer could tell if you're frustrated and offer help or show something funny to cheer you up.

- Healthcare Support - This technology can be a helpful tool for doctors and healthcare professionals. It allows them to better understand how their patients are feeling emotionally. This can be especially useful when diagnosing and treating mental health issues like anxiety or depression.

- Customer Feedback Analysis - Businesses want to know if their customers are happy or not with their products and services. This system can assist by analyzing what customers say in reviews and feedback, helping businesses make improvements.

- Human-Machine Interaction - The idea is to make computers and devices better at understanding your emotions. They can respond to your feelings in a way that makes sense. For example, if you're feeling down, your device might suggest watching a funny video to cheer you up.

CHAPTER 2
LITERATURE SURVEY & REVIEW

2.1 Review of Literature

[1] Ali I. Siam, Naglaa F. Soliman, Abeer D. Algarni, Fathi E. Abd El-Samie, and Ahmed Sedik, Deploying Machine Learning Techniques for Human Emotion Detection, ID-8032673. 2 February 2022. The proposed approach consists of four phases: preprocessing, key point generation, key point selection and angular encoding, and classification. The main idea is to generate key points using MediaPipe face mesh algorithm, which is based on real-time deep learning. In addition, the generated key points are encoded using a sequence of carefully designed mesh generator and angular encoding modules. Furthermore, feature decomposition is performed using Principal Component Analysis (PCA). This phase is deployed to enhance the accuracy of emotion detection. Finally, the decomposed features are enrolled into a Machine Learning (ML) technique that depends on a Support Vector Machine (SVM), k-Nearest Neighbor (KNN), Naïve Bayes (NB), Logistic Regression (LR), or Random Forest (RF) classifier. Moreover, we deploy a Multilayer Perceptron (MLP) as an efficient deep neural network technique. The presented techniques are evaluated on different datasets with different evaluation metrics. The simulation results reveal that they achieve a superior performance with a human emotion.

[2] Gagandeep Kaur Saini, Harshit Chouhan, Sharlabh Kori, Akanksha Gupta, Mohammad Shabaz, Vishal Jagota, Bhupesh Kumar Singh, Recognition of Human Sentiment from Image using Machine Learning, Vol.25 Issue:5, **2021,** The paper explores emotions as a crucial aspect of human intelligence and suggests the potential for machines to acquire emotional understanding. It discusses the intersection of emotions in art, literature, and technology, emphasizing the need for studying emotions in the context of artwork. It also touches upon the application of machine learning, specifically Tensor Flow, for emotional analysis in literature. The mention of transfer learning and image separation highlights the role of technology in understanding and replicating human emotional experiences. Overall, it introduces the interdisciplinary nature of emotions, connecting them to both human and artificial intelligence.

[3] Wafa Mellouka, Wahida Handouzi, Facial emotion recognition using deep learning: review and insights, Vo1.75, 9-12 August, 2020. Automatic emotion recognition based on

facial expression is an interesting research field, which has presented and applied in several areas such as safety, health and in human machine interfaces. Researchers in this field are interested in developing techniques to interpret, code facial expressions and extract these features in order to have a better prediction by computer. With the remarkable success of deep learning, the different types of architectures of this technique are exploited to achieve a better performance. The purpose of this paper is to make a study on recent works on automatic facial emotion recognition FER via deep learning. We underline on these contributions treated, the architecture and the databases used and we present the progress made by comparing the proposed methods and the results obtained. The interest of this paper is to serve and guide researchers by review recent works and providing insights to make improvements to this field.

[4] J. Zhang, Z. Yin, P. Chen, S. Nichele, Emotion recognition using multi-modal data and machine learning techniques: A tutorial and review, Vol.59, January 2020. It shows progress in machine learning and information fusion which led to the development of emotion recognition in machines, crucial for enhancing human-computer interaction. Emotions, which impact decision-making and communication, can be recognized through physiological signals, particularly electroencephalogram (EEG) signals. This paper reviews various EEG-based emotion recognition techniques, covering feature extraction, reduction, and machine learning classifiers. It explores the correlation between different brain areas and emotions, compares algorithms, and identifies open challenges in this rapidly growing field of artificial intelligence.

[5] Yassin Kortli, Maher Jridi, Ayman Al Falou and Mohamed Atri, Face Recognition Systems, Vol.20 Issue:2, 7 January 2020. Various techniques are being developed including local, holistic, and hybrid approaches, which provide a face image description using only a few face image features or the whole facial features. The main contribution of this survey is to review some well-known techniques for each approach and to give the taxonomy of their categories. In the paper, a detailed comparison between these techniques is exposed by listing the advantages and the disadvantages of their schemes in terms of robustness, accuracy, complexity, and discrimination. One interesting feature mentioned in the paper is about the database used for face recognition. An overview of the most commonly used databases, including those of supervised and unsupervised learning, is given. Numerical results of the most interesting techniques are given along with the context of experiments and challenges handled

by these techniques. Finally, a solid discussion is given in the paper about future directions in terms of techniques to be used for face recognition.

[6] Neha Jain, Shishir Kumar, Amit Kumar, Pourya Shamsolmoali, Masoumeh Zareapoor, Hybrid deep neural networks for face emotion recognition, Vol.115 April 2018. This research introduces a powerful method for accurately recognizing facial expressions using a Hybrid Convolution-Recurrent Neural Network (CNN-RNN). Unlike existing methods, this model effectively captures both spatial and temporal aspects of facial images, crucial for real-time applications. By combining Convolutional and Recurrent layers, it extracts relationships within images and considers temporal dependencies during classification. Evaluation on public datasets demonstrates superior performance compared to state-of-the-art methods, showcasing its potential impact on Human-Machine Interaction, healthcare, and gaming.

[7] Ma xiaoxi, Lin Weisi, Huang Dongyan, Dong Minghui, Haizhou: Facial Emotion Recognition,77-81, 2017. This paper mainly focuses on different learning methods, and has implemented several methods: Support Vector Machine (SVM) and Deep Boltzmann Machine (DBM) for facial emotion recognition. The training and testing data sets of facial emotion prediction are from FERA 2015, and geometric features and appearance features are combined together. Different prediction systems are developed and the prediction results are compared. This paper aims to design an suitable system for facial emotion recognition.

[8] T. B. Sheridan, "Human-robot interaction," Human Factors: De Journal of the Human Factors and Ergonomics Society, Vol.58, Issue:4, 2016. This paper mainly focuses on Human Robot interaction. Robots have evolved from simple master-slave servomechanisms for handling nuclear waste to a broad range of robots incorporating artificial intelligence for many applications. This mini-review describes the development of human-robot interaction (HRI) in four application areas and discusses the challenges for human factors research. The review concludes that HRI is a rapidly evolving field with many promising applications.

[9] Christopher Pramerdorfer, Martin Kampel, Facial Expression Recognition using Convolutional Neural Networks: State of the Art, December 2016. This paper investigates the use of Convolutional Neural Networks (CNNs) for facial expression recognition (FER) and

highlights the impact of various factors on performance. By reviewing existing CNN-based FER methods and empirically comparing CNN architectures, the study identifies bottlenecks and proposes directions for improvement. Overcoming one identified bottleneck, the simplicity of CNN architectures, significantly boosts performance. The ensemble of modern deep CNNs achieves a high FER2013 test accuracy of 75.2%, surpassing previous methods without requiring additional data or face registration.

[10] T. Bai, Y.-F. Li, and X. Zhou, "Learning local appearances with sparse representation for robust and fast visual tracking," IEEE Transactions on Cybernetics, Vol.45 Issue:4, 2014. This paper has presented a novel appearance using sparse representation and online dictionary learning technique for visual tracking. This paper have unified a spatial the sparse representation and online dictionary by defining a constraint that facilitates the generative and discriminative capabilities of the local appearance model. they have finally proposed appearance model with partial filter framework to form a virtual tracking algorithm.

CHAPTER 3
WORKDONE

3.1 Methodology

A Convolutional Neural Network (CNN) is a deep learning algorithm designed for processing and analyzing visual data, such as images and videos. CNNs have revolutionized the field of computer vision and have found applications in numerous domains, ranging from image classification and segmentation to object detection and facial emotion recognition. CNNs were developed to mimic the human visual system's ability to recognize and extract features from visual data. There are multiple layers used in CNN instead of only one layer of neural network. There are major three layers in CNN i.e., Input Layers, Hidden Layer and Output Layer.

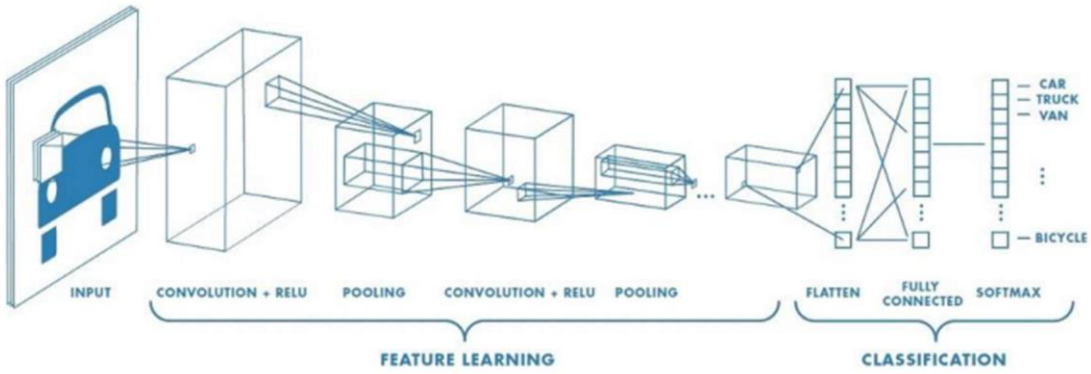

Fig 3.1 Standard architecture of CNN

Input Data:

CNNs are designed to work with grid-like data, typically images, which are represented as 2D arrays of pixel values. The input data can be grayscale or color (RGB), and it's passed through the network for feature extraction and classification.

Convolution:

The core operation in a CNN is convolution. Convolutional layers apply a set of learnable filters (also known as kernels) to the input image. These filters slide over the input, performing element-wise multiplications and summing the results. This produces feature maps that capture local patterns and features in the input data. Convolution helps the network learn spatial hierarchies, from simple features like edges to more complex features like textures and shapes.

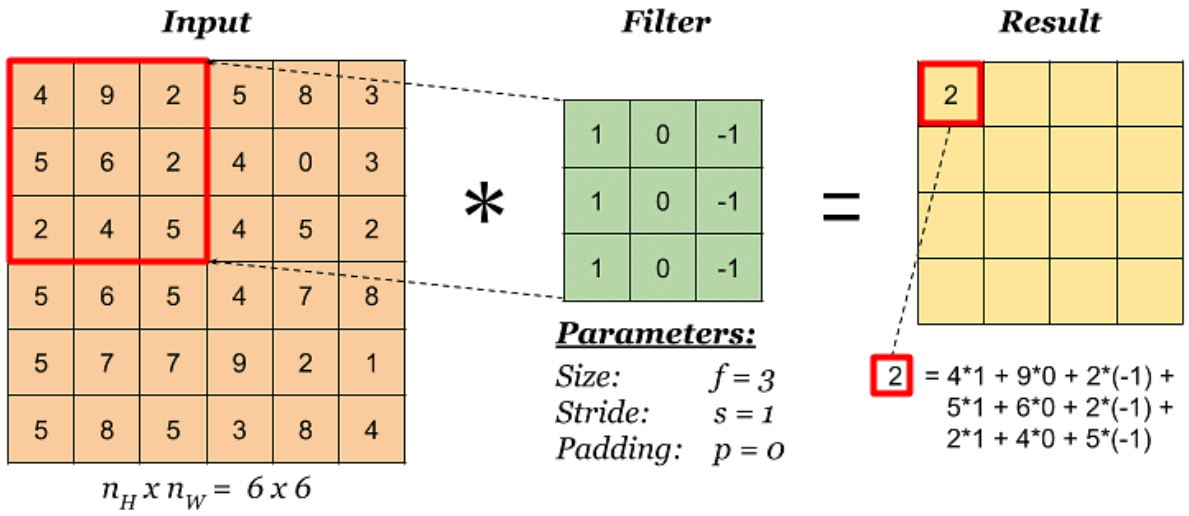

Fig 3.2 Convolutional layer

Conv2D (Convolutional 2D) Layer:

The Conv2D layer is used to perform convolution operations on the input data. Convolution is a mathematical operation that involves applying a filter (also known as a kernel) to the input image to extract various features, such as edges, textures, and patterns. In a Conv2D layer, multiple filters are applied to the input image, each detecting different features.

Pooling:

Pooling layers are used to downsample the feature maps obtained from the convolutional layers. Max-pooling is a common operation, which selects the maximum value from a small region of the feature map. This reduces the spatial dimensions and helps reduce computational complexity.

MaxPooling Layer:

The MaxPooling layer is used to reduce the spatial dimensions of the feature maps produced by the Conv2D layer while retaining the most important information. MaxPooling works by selecting the maximum value from a group of neighboring values in a given region of the feature map. It helps in reducing the computational complexity and the number of parameters in the model, making it more efficient. Common configurations for MaxPooling include 2x2 or 3x3 pooling windows with a stride of 2, which reduces the size of the feature maps by half.

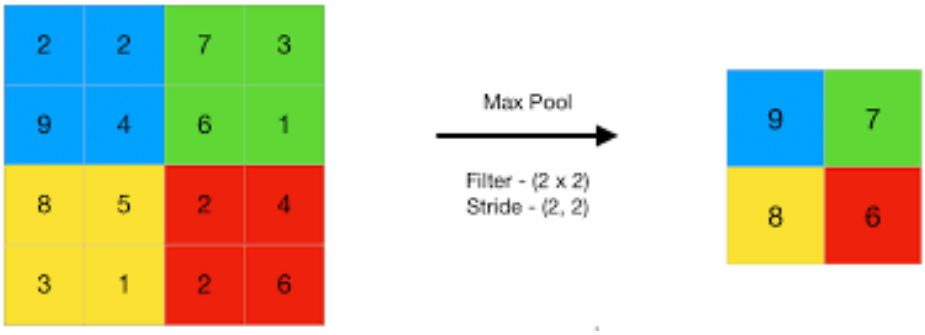

Fig 3.3 MaxPooling2D

Fully Connected Layers:

After several convolutional and pooling layers, CNNs often have one or more fully connected layers. These layers perform the final classification or regression task by taking the high-level features learned from the previous layers and mapping them to the output classes or values.

Flatten Layer:

Before passing data to the fully connected layers, a flatten layer is used to convert the output of the previous layer (usually 2D) into a 1D vector.

Dropout:

Dropout layers can be added to prevent overfitting during training. During training, dropout randomly sets a fraction of neuron activations to zero, which encourages the model to learn more robust features.

Loss Function:

The loss function measures the difference between the predicted output and the true labels. For classification tasks, common loss functions include categorical cross-entropy, while for regression tasks, mean squared error is often used.

3.2 Dataset description

Face emotion recognition dataset is one of the most effective and largescale datasets from Kaggle. Kaggle is the world's largest data science community with powerful tools and resources to help you achieve your data science goals. It consists of seven different emotions such as happy, sad, anger, fear, disgust, surprise and neutral.

Fig 3.4 Data Visualization

The FER2013 dataset is a widely used dataset for Facial Emotion Recognition (FER) tasks. It contains a collection of facial images with associated emotion labels. This dataset contains over 35,000 labeled facial images depicting various facial expressions, including happiness, anger, sadness, and more.

Number of Images: FER2013 consists of 35,887 grayscale images of size 48x48 pixels.

Emotion Labels: Each image in the dataset is labeled with one of seven different emotions:

0: Angry

1: Disgust

2: Fear

3: Happy

4: Sad

5: Surprise

6: Neutral

Data Split: The dataset is divided into three subsets for training, validation, and testing:

Training: 28,709 images

Validation: 3,589 images

Testing: 3,589 images

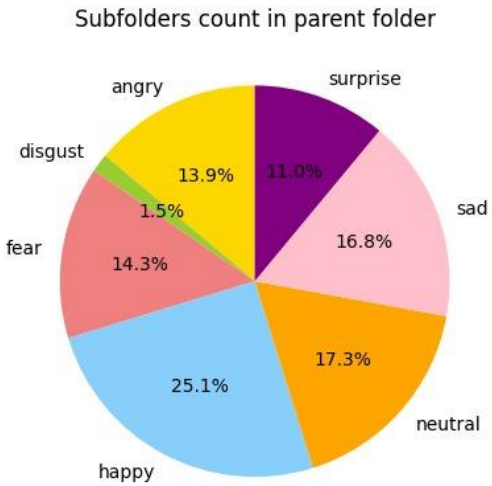

Fig 3.5 Pie chart of Dataset

3.3 Flow Chart of Project Process

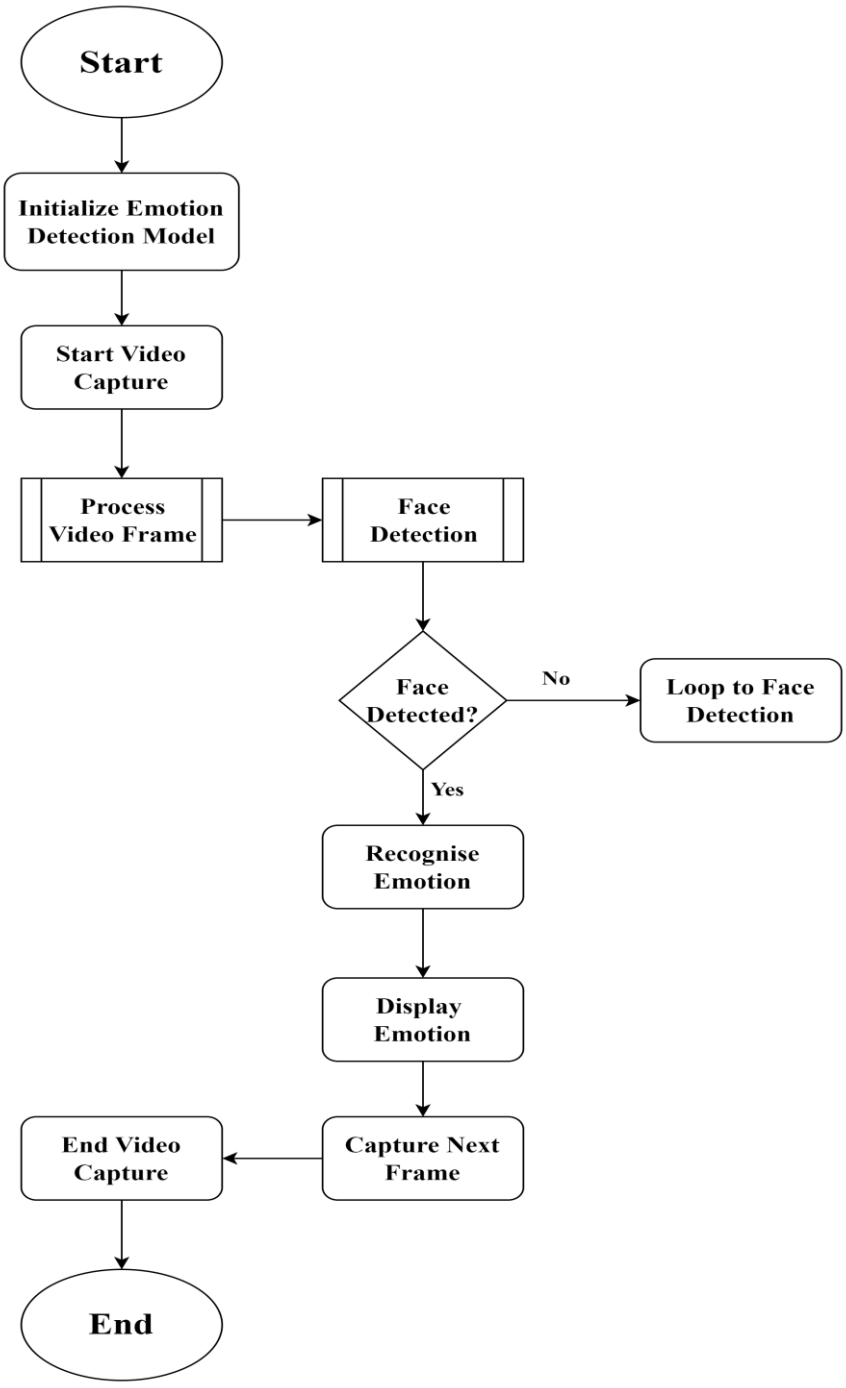

Fig.3.6 Human Sentiment Detection workflow diagram

Human Sentiment Detection workflow:

1. First of all, when the user starts the Human Sentiment Detection System, it will initialize Emotion Detection Model and start capturing the video.
2. Next step would be the process of video frame in which it will detect the face using Face Detection. If the face is not detected then it will move forward to the loop of Face Detection until face is detected.
3. Once the face is detected, it will recognize the emotion using the CNN model.
4. After detection emotion, the captured emotion is displayed.
5. Then the video frame captures the next frame and repeats the process.
6. This repetition is the real time feed of the user and it will continue to capture the frame until user ends video capture.
7. Finally, when user end video captures the Human Sentiment Detection model ends.

3.4 Block Diagram

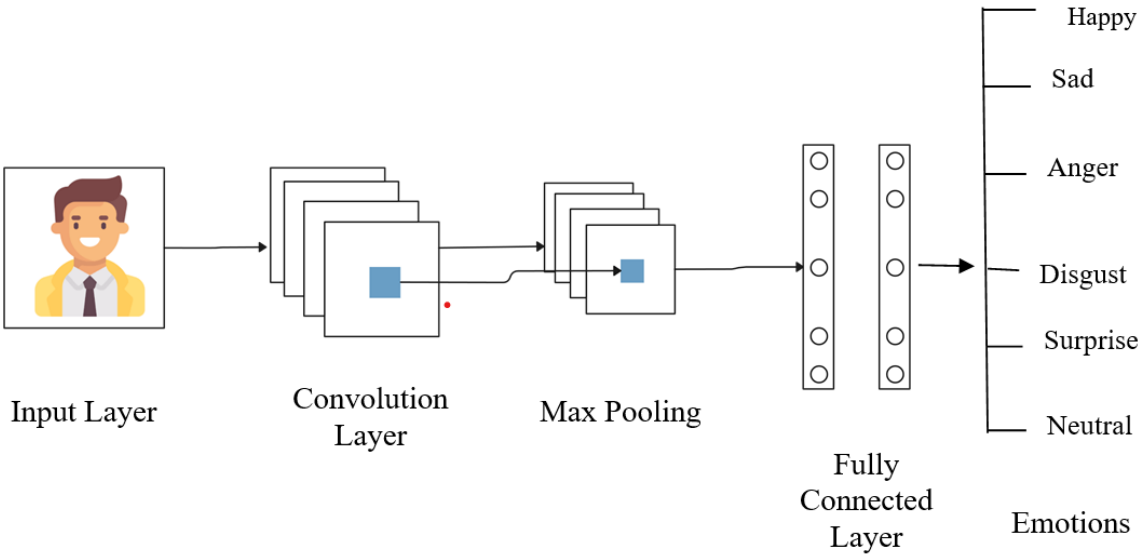

Fig.3.7 Human Sentiment Detection block diagram

Input Image: This is the face image you want to recognize.

Convolution Layers: Convolutional layers consist of multiple convolutional filters that scan the input image to extract features. Each filter learns to recognize different patterns, such as edges or textures. Multiple convolution layers are typically used to capture more complex features.

Max Pooling Layers: Max pooling layers reduce the spatial dimensions of the feature maps produced by the convolution layers. This helps to reduce the computational load and focus on the most important information.

Flatten: The flatten layer transforms the 2D feature maps into a 1D vector, which can be used as input to fully connected layers.

Fully Connected Layers: These layers are densely connected and perform high-level reasoning on the features extracted by the previous layers. These layers are responsible for learning to recognize specific faces or face-related patterns.

Output Layer: The output layer typically consists of as many neurons as there are classes. The values in this layer represent the class scores.

3.5. Training, Validation and Testing of CNN Model

Data Preprocessing:

Load and preprocess your FER dataset. This typically involves resizing images to a consistent size (e.g., 48x48 pixels) and normalizing pixel values to a specific range (usually 0 to 1).

Data Splitting:

Divide your dataset into three parts: the training set, the validation set, and the testing set. The most common split ratios are 70-80% for training, 10-15% for validation, and 10-15% for testing. These percentages can vary based on the size of your dataset.

Data Augmentation:

To enhance your model's generalization, you can apply data augmentation techniques to the training data. Common augmentations include random rotations, flips, zooming, and color adjustments. Data augmentation helps your model become more robust to variations in the data.

Model Building:

Create a CNN model for your FER task. Design your architecture with convolutional layers, pooling layers, and fully connected layers. You can experiment with different CNN architectures and hyperparameters to find the best model for your specific task.

Model Training:

Train your CNN model using the training dataset. Use a suitable loss function (e.g., categorical cross-entropy) and an optimization algorithm (e.g., Adam) to update the model's weights. Monitor training performance and adjust hyperparameters as needed.

Model Validation:

Periodically evaluate your model's performance on the validation dataset. This helps you detect overfitting and fine-tune your model. You can use metrics like accuracy and loss to assess your model's performance.

Model Testing:

After training, evaluate your model's performance on the testing dataset, which it has never seen before. This provides an unbiased assessment of your model's generalization.

Performance Evaluation:

Use appropriate evaluation metrics for your FER task. Common metrics include accuracy, precision, recall, F1-score, and confusion matrices. Visualize the results if necessary.

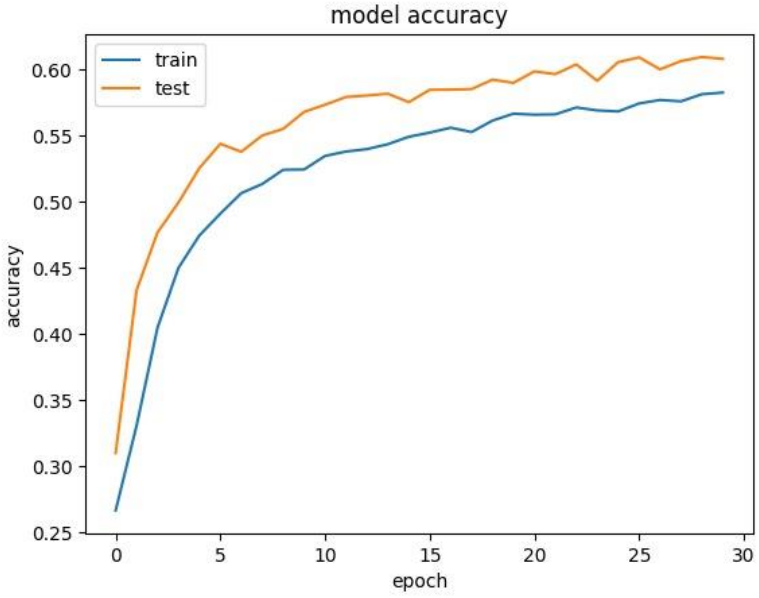

Fig.3.8 CNN model accuracy

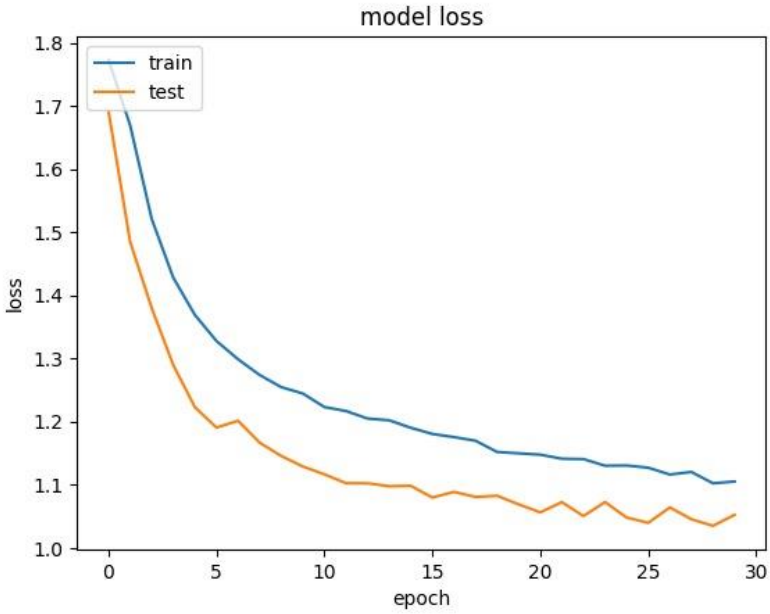

Fig.3.9 CNN model loss

CHAPTER 4
RESULT AND DISCUSSION

4.1 Result

In this study, we use the FER 2013 dataset for Facial Expression Recognition (FER), which contains many facial images labelled with seven different emotions: happy, sad, neutral, angry, fear, surprise and disgust. Our goal is to develop a deep learning model to clarify these assumptions.

4.1.1 Happy sentiment

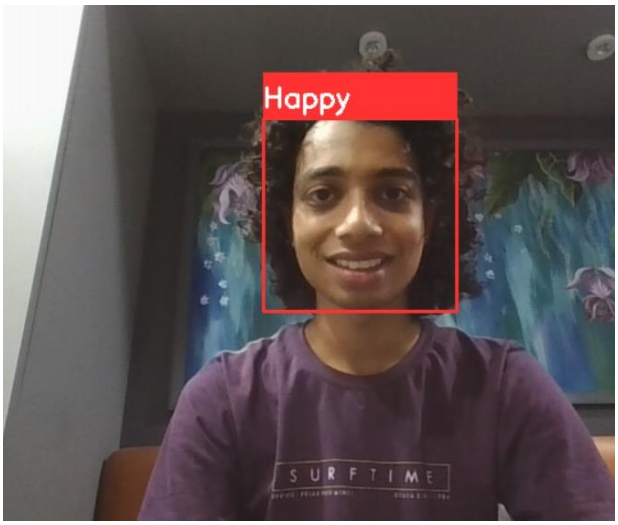

Fig 4.1.1 Model capturing object's 'Happy' sentiment

- The image is from the real time feed of the project.
- The that model has successfully detected the emotion and generated the result.
- The detected emotion is HAPPY.

4.1.2 Sad Sentiment.

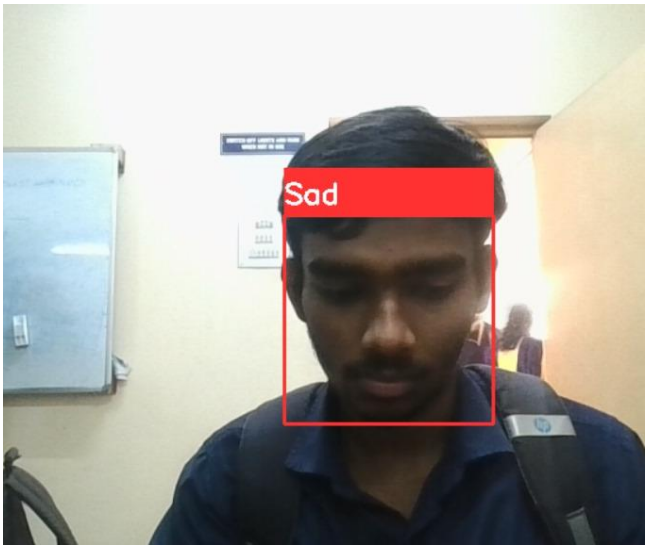

Fig 4.1.2 Model capturing object's 'Sad' sentiment

- The image is from the real time feed of the project.
- The that model has successfully detected the emotion and generated the result.
- The detected emotion is SAD.

4.1.3 Neutral sentiment

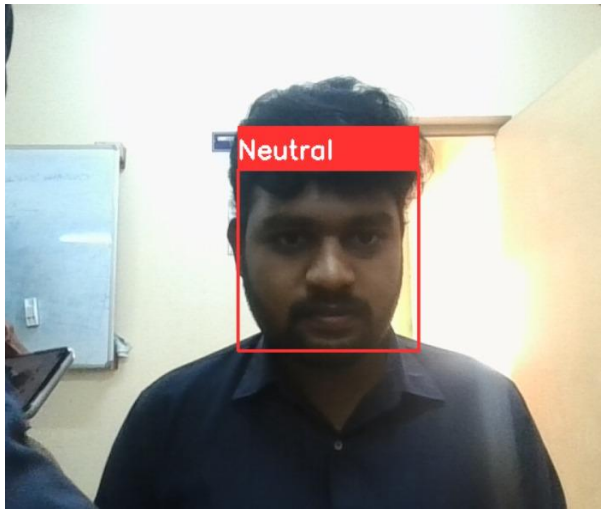

Fig 4.1.3 Model capturing object's 'Neutral' sentiment

- The image is from the real time feed of the project.
- The that model has successfully detected the emotion and generated the result.
- The detected emotion is NEUTRAL.

4.1.4 Angry Sentiment

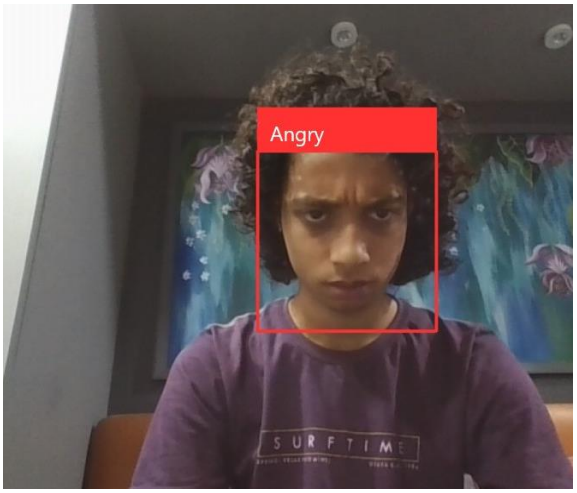

Fig 4.1.4 Model capturing object's 'Angry' sentimen

- The image is from the real time feed of the project.
- The that model has successfully detected the emotion and generated the result.
- The detected emotion is ANGRY.

4.1.5 Surprise Sentiment

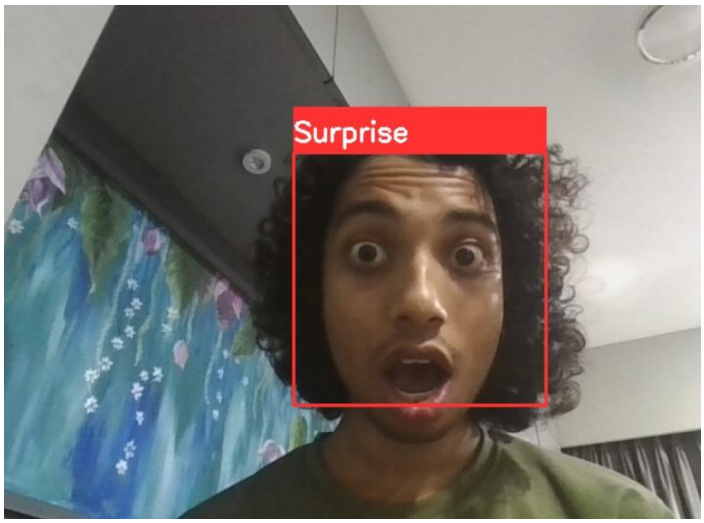

Fig 4.1.5 Model capturing object's 'Surprise' sentiment

- The image is from the real time feed of the project.
- The that model has successfully detected the emotion and generated the result.
- The detected emotion is SURPRISE.

4.2 Discussion

The model is capable of detecting the emotion and then it classifies the emotion into one of the seven emotions by comparing it with the dataset, namely: happy, sad, neutral, angry, fear, surprise and disgust based on the DEEP LEARNING CNN algorithm.

CHAPTER 5
CONCLUSION

5.1 Conclusion

The project ‘Human Sentiment Recognition’ (HSR) has shown higher rate of accuracy and it can be used in daily life. The model is very promising in the field of psychology and generates reviews based on facial emotion. In HSR we have used deep learning, CNN which consists of collecting data, data processing, and feature extraction and finally generating the results based on facial sentiments. The model successfully analyzes the face and generates result (happy, sad, anger, fear, disgust, surprise, and neutral). HSR has the potential to advance many applications, from personalization of experiences to mental health assessments and generating honest reviews. By solving challenges and ethical issues, we can use the power of HSR to improve people and society as a whole.

CHAPTER 6
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LIST OF PUBLICATIONS

Sr. No.	Authors	Title of Paper	Name of International Journals / International Conference	Place and date of Publication with **Citation** Index
1.	Mr. AYUSH GOKHALE Mrs. PURVA MOREY Mr. SHIVAM NAIK Mr. SHRIVANSH DAMAHE Mr. SIDDHANT TIWARI Mr. SUBODH MALVE	HUMAN SENTIMENT RECOGNITION USING DEEP LEARNING	International Research Journal of Modernization in Engineering Technology and Science (IRJMETS), Impact Factor: 7.868 Volume: 05, Issue: 11, November-2023	e-ISSN: 2582-5208 03 November 2023 Paper Id: IRJMETS1100007488 DOI: https://www.doi.org/ 10.56726/ IRJMETS45899

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HUMAN SENTIMENT RECOGNITION USING DEEP LEARNING

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ABSTRACT

In this article we focus on 'Human Sentiments' that has played a major role in the human evolution. These sentiments can be recognized by factors such as body movement, gestures, speech, and facial expressions. Over the past few decades as the technologies has grown followed by the advancement in artificial intelligence and machine learning techniques it has now became possible for us to make research on the human sentiments using vast number of datasets and applying them to these methods. This field has attracted many researchers to study and find an efficient and accurate technique using which sentiments of a human can be recognized using their facial expressions. The application of these can be used in a wide range of fields like human-machine interaction, criminal detection, taking review from the customers, etc. Some researchers have mapped techniques which can be used to do so. The aim of this research paper is to develop a model using Deep Learning algorithm which can detect human sentiments by training it on a large labelled dataset of different sentiments.

Keywords: Human Sentiment Recognition (HSR), Facial Expression, Deep Learning, Emotion, CNN.

I. INTRODUCTION

The facial emotion recognition mainly consists of two phases – facial changes according to emotions (psychological) and use of AI based models. The emotions are conveyed by two ways i.e. Verbal (consciously) and nonverbal (unconsciously). These emotions can be conveyed by three main signs which include changes in facial expression, change in tone of voice and physiological changes. Out of these facial emotions are those which can be easily detected and are also some of the first signs that appears first and can be used to detect a person's emotion.

Many scientists have worked in these emotion recognition techniques and have also developed some methods on it. Ali I. Siam, Naglaa F. Soliman [1] have used mesh angular encoding to extract facial emotion and has detected ten emotions. At those times it was not possible to implement such methods on persons with different facial structures, different ages, different skin tones, facial hair growth, etc. But now as the technological advancement has grown and many algorithms can be applied to diverse real-life situations and cases using AI and ML algorithms it became easy for us to recognize facial emotions using a proper algorithm.

In this paper, we enhance the accuracy of sentiment recognition using a model which uses a dataset having numerous images of different human facial expressions and an algorithm to determine the facial emotions.

II. METHODOLOGY

2.1 Dataset

The Facial Emotion Recognition dataset (FER-2013) is a dataset taken from Kaggle, introduced on the International Conference on Machine Learning (ICML) in 2013 brought with useful resource of Pierre-Luc carrier and Aaron Courvill. FER2013 is a properly-studied dataset utilized in ICML competitions and numerous research. Among all strategies for FER, profound deep learning models, in particular Convolutional Neural Networks (CNNs) have regarded notable ability due to their effective computerized feature extraction and computational performance. FER-2013 is a grayscale picture containing about 30,000 facial RGB pictures of various expressions with dimensions restricted to 48×48 pixels, and the primary labels of it could be divided into 7 kinds: 0=angry, 1=disgust, 2=fear, 3=happy, 4=sad, 5=surprise, 6=neutral.

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Fig 1: Images from dataset

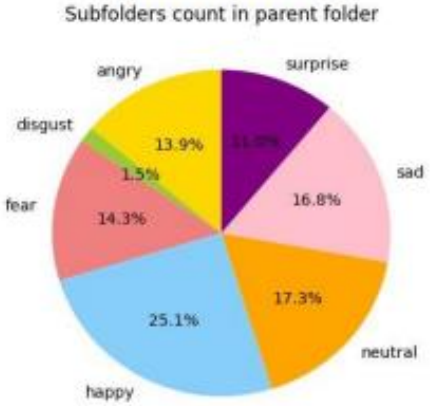

Fig 2: Content of dataset

2.2 Data pre-processing

Data pre-processing is a crucial step in human emotion recognition because it helps prepare the raw data for analysis and model training. Some pre-processing steps may vary depending on the data to be processed (e.g., facial expressions, audio, physiological signals, or text).

Face Detection and Alignment: Detect and align faces in images or videos to ensure consistent placement of emotional cues.

Grayscale conversion: Convert colour images to grayscale, which can simplify processing and reduce the effects of light variations.

Normalize: Normalize pixel values to a selected range (e.g., 0-1 or -1-1).

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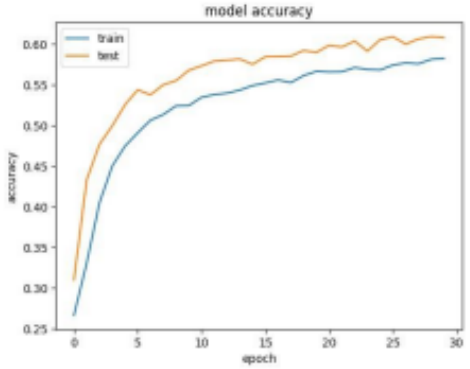

Fig 3: Accuracy of model

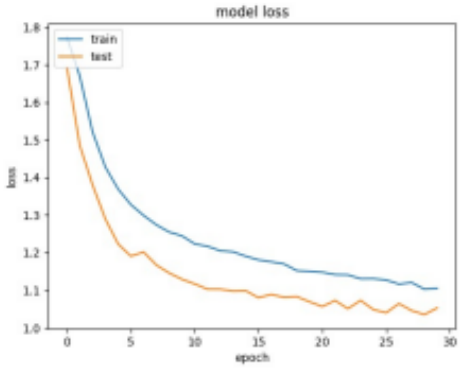

Fig 4: Loss of model

III. MODELING AND ANALYSIS

CNN Architecture

The CNN architecture is composed of various layers – input layer, hidden layers and output layer. The input layer will take picture of a facial expression as an input from the dataset. The input taken from the input layer is then feed into the hidden layers. The convolutional layer will extract features from the input images by considering them as a cuboid having 3 dimensions. It applies a set of filters/kernels to the image. Kernels can also be seen as a small neural network running on a small patch of the image. Kernels are matrices having dimensions of 2x2, 3x3 or 5x5 pixels. These kernels slide over the image of a facial expression and computes the dot product of the patch of the image pixels taken by them. Now this dot product is given to the pooling layer, lowering the chances of overfitting of the model. The main purpose of the pooling layer is to reduce the extent of the previously generated end result making the computation fast. It will also reduce the memory. The resulting feature matrices are the flattened in one dimensional vector by taking the input from the pooling layer. Now they are passed to the fully connected layers which will compute the final classification task. The output from the fully connected layers is taken to the output layer. A logistic function is used for classification tasks which converts the output of each class into the probability score of each class.

IV. RESULTS AND DISCUSSION

In this study, we use the FER 2013 dataset for Facial Expression Recognition (FER), which contains many facial images labelled with seven different emotions: angry, hate, fear, happy, sad and indifferent. Our goal is to develop a deep learning model to clarify these assumptions.

V. CONCLUSION

The paper 'Human Sentiment Recognition' (HSR) has shown higher rate of accuracy and it can be used in daily life. The model is very promising in the field of psychology and generates reviews based on facial emotion. In HSR we have used deep learning, CNN which consists of collecting data, data processing, and feature extraction and finally generating the results based on facial sentiments. The model successfully analysed the face and generated result (happy, sad, anger, fear, disgust, surprise, and neutral). HSR has the potential to advance many applications, from personalization of experiences to mental health assessments and generating honest reviews. By solving challenges and ethical issues, we can use the power of HSR to improve people and society as a whole. We are limited to only a few emotions and this research will lead and encourage the upcoming generation to dig deep into this topic and make future development.

VI. FUTURE WORK

In the model, seven basic emotions are defined: Anger, Disaffection, Fear, Happiness, Neutrality, Sadness and Surprise. Future work can look at categorisation of emotion into a number of categories, including shame, anger, dominance, envy, hope, optimism, love and guilt.

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Photo of Projectees along with the Guide and Project