MASTER OF COMPUTER APPLICATIONS

Instant feedback system (Using Face recognition)

Prepared by

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CANDIDATE'S DECLARATION

We thus attest that the project work titled "**Instant feedback system (Face Recognition)"** which was turned in to the AI Cluster at the School of Computer Science, University of Petroleum & Energy Studies, Dehradun, in partial fulfillment of the requirements for the award of the Degree of MASTER OF COMPUTER APPLICATIONS with a specialization in Artificial Intelligence and Machine Learning, is an authentic record of our work completed between July 2023 and December 2023 under the direction of **Miss Saroj Shivagunde**, School of Computer Science.

The matter presented in this project has not been submitted by us for the award of any other degree of this or any other University.

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This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

Date: _____2023 **Miss Saroj Shivagunde**

Project Mentor

ACKNOWLEDGEMENT

We would like to sincerely thank our guide for all of her guidance, inspiration, and unwavering assistance during this effort. He provided invaluable support and suggestions without which our task would not have been possible.

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We would like to express our gratitude to all of our friends for their support and helpful advice throughout this effort. Lastly, we can never enough thank our parents for showing us this world and for all of their support.

ABSTRACT

The purpose of this project is to leverage advanced computer vision to enhance the services and experiences offered by various businesses, including restaurants, malls, art galleries, and transportation services. By deploying CCTV cameras equipped with face recognition, face recognition, and emotion recognition capabilities, this project aims to achieve the following objectives. Advanced facial recognition technology is poised to transform a number of areas related to client engagement and surveillance. Our system will use face recognition technology to locate and follow people in videos that are recorded by CCTV cameras. This invention has enormous potential for monitoring consumer interactions and determining visitor interest in a variety of contexts, including art exhibitions. Moreover, the incorporation of facial recognition technology will greatly improve security protocols by permitting the identification of persons according to their distinct facial characteristics. This feature helps organizations to improve customer experience and personalize offers by making it easier to measure downtime for returning customers and strengthening security protocols. An essential component of our system will be our emotion recognition algorithms, which offer a comprehensive examination of face expressions.

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1. INTRODUCTION

1.1 Purpose of the Project

The purpose of this project is to leverage advanced computer vision to enhance the services and experiences offered by various businesses, including restaurants, malls, art galleries, and transportation services. By deploying CCTV cameras equipped with face recognition, face recognition, and emotion recognition capabilities, this project aims to achieve the following objectives:

- **Face Recognition:** Face recognition allows us to recognize and follow the faces of certain people in CCTV camera-captured video. This can be used in a variety of situations, including tracking customer interactions and gauging visitor interest in art exhibits.
- **Face Recognition:** Face recognition technology will be incorporated into the system to recognize and identify people based on their face traits. This can be used to improve security, track returning clients, and customise offerings.
- **Emotion Recognition:** We intend to employ emotion recognition algorithms to analyze the face expressions of individuals. This will help in gauging customer satisfaction, employee performance, and viewer reactions in different settings.
- **Database Integration:** Our system will include a database component for saving reviews and related data, enabling businesses to analyze customer feedback and improve their services.

1.2 Target Beneficiaries

The primary beneficiaries of this project include:

- Restaurants: Restaurants can use the system to assess customer satisfaction in real-time, identify frequent diners, and improve service quality.
- Malls: Malls can utilize the technology to gauge shopper emotions, analyze foot traffic patterns, and optimize store layouts.
- Art Galleries: Art galleries can capture viewer reactions to specific artworks, helping curators understand which pieces are more engaging.
- Reception Areas: Businesses with reception areas can employ an instant feedback system to evaluate employee performance in responding to visitor inquiries.
- Transportation Services: In the context of transportation services, such as cabs, the system can be used to detect drowsy drivers and prevent accidents.

1.3 Project Scope

The scope of this project encompasses the following key functionalities:

- Implementation of face recognition, face recognition, and emotion recognition using Python libraries such as OpenCV, face_recognition, Keras, and numpy.
- Extracting frames (2D pictures) from video clips captured by CCTV cameras.
- Integration with a SQLite3 database for storing reviews and related data.

- Real-time analysis of face expressions to determine the emotional state of individuals.

1.4 Pert Chart Legend:

Stages of research	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7
Selection of topic							
Data collection from sources							
Literature review							
Research methodology plan							
Selection of the Appropriate Research Techniques							
Analysis & Interpretation of Data							
Findings and recommendations							
Final research project							

2. LITERATURE REVIEW

In the foundational paper, "A Convolutional Neural Network Cascade for Face Detection," the authors introduce a cascade approach using Convolutional Neural Networks (CNNs) for efficient face detection. This method forms a crucial basis for our project, as it addresses the initial step of identifying faces efficiently, providing a solid foundation for subsequent facial analysis.

The paper on "Deep learning using Face recognition: Face Expression Recognition" delves into the application of deep learning techniques for face expression recognition. This research likely explores neural network architectures tailored for classifying facial expressions, aligning with the emotion recognition component of our project.

Another relevant contribution comes from the paper on "Real-Time Emotion Detection: Real-time Convolutional Neural Networks for Emotion and Gender Classification." This paper emphasizes real-time emotion detection using CNNs, which is vital for our project's objectives. Insights from this paper could inform the implementation of our real-time emotion recognition system, ensuring timely and accurate analysis.

The research on "A Multi-Task Neural Approach for Emotion Attribution, Classification, and Summarization" proposes a comprehensive multi-task neural approach for emotion analysis. This approach is valuable for handling various tasks related to emotion analysis, providing potential insights into the design of our emotion recognition system.

As we integrate these findings, our project aims to combine efficient face detection techniques, utilize deep learning for expression recognition, achieve real-time processing using CNNs, and adopt a multi-task approach for comprehensive emotion analysis in diverse scenarios. Moreover, we emphasize ethical considerations, aligning with industry best practices to ensure responsible and ethical deployment of face recognition and emotion analysis technology. Looking forward, our project also considers future enhancements, such as exploring multi-modal emotion recognition or expanding the system's capabilities to meet evolving industry demands.

3. PROPOSED METHOD

3.1 Algorithm

Convolutional Neural Network (CNN) for recognizing face and emotions : Convolutional Neural Networks' capacity to learn and extract significant elements from face photos makes them essential for face identification. They are especially well adapted for capturing the complexity of face geometry because to their hierarchical and weight-sharing architecture, which enables applications ranging from security to emotion recognition. The ethical and privacy issues raised by face recognition technology must be addressed, though.

Reference algorithm for Face recognition and emotion recognition includes:

1. Data Collection and Preprocessing:

Collect a dataset of labeled face images, including images of individuals displaying various emotions. Preprocess the images by resizing them to a consistent resolution, normalizing pixel values, and augmenting the dataset with transformations like rotation and flipping to increase diversity.

2. Model Architecture Design:

Design a deep CNN architecture that comprises several convolutional layers for feature extraction, followed by fully connected layers for classification.
For face recognition, the output layer should have as many neurons as there are individuals in the dataset, using softmax activation for multi-class classification.
For emotion recognition, the output layer should have neurons corresponding to the different emotions (e.g., happiness, sadness, anger), using softmax activation.

3. Model Training:

Train the face recognition model using the labeled dataset for individual identification.
Train the emotion recognition model using the labeled dataset for emotion recognition.
Utilize techniques like transfer learning if a pre-trained CNN model is available.

4. Model Evaluation:

Evaluate both models separately using appropriate metrics (metric such as accuracy , precision and F1 score) on a test dataset not used during training.

5. Real-Time Emotion Recognition (Optional):

Integrate the trained emotion recognition model with a webcam or camera feed for real-time emotion recognition.
Apply the model to video frames, capturing face expressions in real-time.

6. User Interface (UI) Development:

Create a user-friendly UI that displays recognized individuals (in the case of face recognition) and recognized emotions (in the case of emotion recognition).
Provide options for users to interact with the system.

7. Security and Privacy Measures:

Implement security measures to protect the data and ensure responsible use of the technology, including user data privacy.

8. Testing and Validation:

Conduct thorough testing to validate the system's accuracy, robustness, and real-time capabilities.

9. Documentation:

Document the project comprehensively, including data collection, model architecture, implementation details, and user instructions.

10. Future Enhancements (Optional):

Consider future enhancements, such as multi-modal emotion recognition or expanding the system's capabilities.

11. Presentation and Reporting:

Prepare a presentation and report to communicate project objectives, methodology, results, and potential applications to stakeholders.

3.2 CHARACTERISTICS OF DATA

Dataset Characteristics:

- Size: The dataset consists of a total of 29,000 images of human faces, with each image having dimensions 224 pixels in width and 224 pixels in height.

- Labels: Each image in the dataset is associated with one or more labels, including individual identities for face recognition and emotion categories for emotion recognition (e.g., happy, sad, angry, surprised).

- Diversity: The dataset contains images of individuals from diverse ethnicities, age groups, and genders. It also covers a wide range of emotions expressed in various face expressions.

- Variability: The dataset includes variations in lighting conditions, face poses, and face expressions to ensure robust model training and testing.

- Imbalance: Emotion categories may exhibit some class imbalance, with certain emotions being less frequent than others. This is accounted for during data preprocessing.

- Secondary Source of Data:
  In addition to the primary data, supplementary data was obtained from publicly available datasets to augment the training dataset:

- FER-2013 (Face Expression Recognition 2013): This publicly available dataset includes a Approx 29,000 of face images labeled with seven different emotions. It provides diversity and helps increase the size of the dataset.

3.3 SWOT Analysis

Strengths (S):

1. Highly Relevant: Face recognition and emotion recognition are highly relevant in various fields, including security, healthcare, education, and human-computer interaction, addressing critical needs in these domains.

2. Advanced Technology: Leveraging Convolutional Neural Networks (CNNs) and deep learning techniques demonstrates the use of state-of-the-art technology to solve complex problems.

3. Wide Applicability: The project's outcomes can have broad applications, from improving security measures to enhancing user experiences in various technological domains.

4. Ethical Considerations: Addressing ethical and privacy concerns demonstrates a responsible approach to the development and deployment of face recognition technology.

Weaknesses (W):

1. Data Collection Challenges: Gathering a diverse and representative dataset for face recognition and emotion recognition can be time-consuming and resource-intensive.

2. Privacy Concerns: The use of face recognition technology raises privacy concerns, and addressing these concerns may require additional efforts in terms of system design and compliance.

3. Complexity: Developing and fine-tuning CNN models can be complex and may require expertise in deep learning and computer vision.

Opportunities (O):

1. Market Demand: The increasing demand for face recognition and emotion recognition technology presents opportunities for potential applications and commercialization.

2. Research Contribution: The project can contribute valuable research findings and datasets to the fields of computer vision, machine learning, and ethics in AI.

3. Innovation: There is room for innovation in improving the accuracy and robustness of face recognition and emotion recognition systems.

Threats (T):

1. Regulatory Changes: Evolving regulations related to face recognition technology may impose restrictions or compliance requirements that could affect project implementation.

2. Competitive Landscape: The field of face recognition is competitive, and keeping up with advancements and staying ahead of competitors may be challenging.

3. Privacy Advocacy: Continued advocacy for privacy and ethical use of face recognition technology may result in public resistance and calls for stricter regulation.

3.4 Project Features

The project involves the development of an Instant Feedback system that leverages face recognition and emotion recognition technologies to perform various functions:

1. **Video Frame Extraction:** The system will be capable of processing video clips, likely from CCTV cameras, and extracting individual frames or 2D pictures. This step is crucial for subsequent face expression analysis.

2. **Emotion-Based Experience Assessment:** By analyzing face expressions within these frames, the system will determine the emotional experiences of individuals in the video clips, categorizing them as favorable, negative, or neutral. This application can be used for security monitoring or customer satisfaction assessment, depending on the context.

3. **Art Gallery Viewer Engagement:** Cameras placed in art galleries will capture viewers' face expressions as they observe artworks. The system will use this data to assess which art pieces attract more attention based on viewer reactions.

4. **Driver Fatigue Recognition:** In vehicles, especially cabs, cameras will monitor the driver's face expressions to detect signs of drowsiness or fatigue. If the system identifies these signs, it will sound an alarm to alert the driver and enhance road safety.

5. **Visitor Inquiry Assessment:** At receptions, the system will evaluate how effectively employees respond to visitor inquiries by analyzing the visitors' face expressions and reactions. This feedback can help assess and improve customer service quality.

6. **Saving in database**: Doing some calculations and storing the Realtime reviews of the customers

Key benefits and applications of this system include enhancing security, monitoring viewer engagement in art galleries, improving road safety by preventing driver fatigue, and assessing and enhancing customer service quality in various settings. However, it is essential to consider privacy and ethical implications and ensure that the technology is used responsibly and in compliance with regulations.

3.5 Design and Implementation Constraints

- **Interfaces to other applications:**

  face_expression_model_structure.json
  face_expression_model_weights.h5

- **Specific technologies:**

  BERT

- **Tools to be used:**

  Jupyter Notebook

- **Language requirements:**
  Python:
  numpy
  Open CV
  keras
  face_recognition
  SQLite3
  marshal
  mathplotlib

3.6 Assumption and Dependencies

Assumed Factors:

1. Hardware Resources: Assumption that the project will have access to the necessary hardware resources, including GPUs or TPUs for training deep learning models and sufficient computing power for real-time processing.

2. Privacy and Legal Compliance: Assumption that the project will comply with privacy and legal regulations related to face recognition technology. Changes in privacy laws or ethical considerations could impact system requirements and data usage.

3. Camera Quality: Assumption that the quality and resolution of cameras used for video frame extraction and real-time analysis meet the system's requirements. Lower-quality cameras may affect the accuracy of face recognition and emotion recognition.

4. Lighting Conditions: Assumption that lighting conditions in the environments where the system is deployed are adequate for face analysis. Poor lighting conditions can lead to inaccuracies in face recognition and emotion recognition.

External Dependencies:

1. Regulatory Changes: Changes in privacy and face recognition regulations imposed by external regulatory bodies can necessitate updates to the system's requirements and compliance measures.

2. Hardware Procurement: Dependencies on the timely procurement of hardware resources, such as GPUs or specialized cameras, to support system development and deployment.

3. Ethical Considerations: The project may depend on ethical guidelines and considerations from external advisory boards or ethics committees, especially when dealing with sensitive data or real-world deployments.

4. External Testing Environments: If the system requires testing in real-world environments (e.g., art galleries, cars), the availability of these environments and cooperation from external stakeholders can impact testing and validation phases.

5. User Feedback: If user feedback is an integral part of system evaluation, dependencies on users' willingness to provide feedback and their availability for testing sessions.

6. Security Protocols: The project may rely on external security protocols or APIs for data encryption and user authentication, impacting the security requirements outlined in the SRS.

4. EXPERIMENTAL RESULT AND ANALYSIS

4.1 Existing Systems

Existing systems that leverage advanced computer vision for face recognition, emotion analysis, and related applications have seen substantial development in recent years. One notable example is the implementation of facial recognition technology in various sectors, each with its unique applications and challenges.

In the realm of security, facial recognition systems have been deployed for access control in secure facilities, airports, and public spaces. These systems identify individuals based on facial features, enhancing security measures by providing efficient and contactless identity verification.

In the retail and marketing sector, facial recognition technology is employed to analyze customer behavior and preferences. For instance, some stores use facial recognition to track customer demographics, assess the effectiveness of marketing displays, and personalize the shopping experience based on individual preferences.

Emotion analysis systems, often integrated with facial recognition, find applications in diverse domains. In customer service, these systems help gauge customer satisfaction by analyzing facial expressions and reactions. In education, emotion analysis is utilized to understand student engagement and tailor learning experiences accordingly.

Real-time emotion detection has found applications in the entertainment industry, particularly in gaming and virtual reality. Video games can adapt gameplay based on the player's emotions, creating a more immersive and personalized experience.

In the healthcare sector, facial recognition technology aids in patient identification, ensuring accurate medical record management. Additionally, emotion analysis systems are used to monitor mental health, with the ability to detect signs of stress, anxiety, or depression through facial expressions.

Transportation services, especially in the automotive industry, have implemented driver monitoring systems that use facial recognition and emotion analysis. These systems can detect signs of drowsiness or distraction, enhancing road safety by alerting drivers in real-time.

While these existing systems showcase the potential benefits of advanced computer vision technologies, they also raise ethical considerations and privacy concerns. Striking a balance between innovation and responsible use is crucial to ensure the widespread acceptance and ethical deployment of these systems. Additionally, continuous advancements in machine learning, deep learning, and computer vision algorithms contribute to the evolution of these systems, improving accuracy and expanding their range of applications.

4.2 Motivation

The motivation behind embarking on this project stems from the transformative potential of advanced computer vision technologies, particularly in the realms of face recognition and emotion analysis. In a rapidly evolving digital landscape, where human-machine interaction is becoming increasingly prevalent, these technologies offer innovative solutions with the potential to enhance various aspects of our daily lives.

The integration of facial recognition systems has the power to revolutionize security protocols, providing seamless and efficient identity verification in spaces such as secure facilities, airports, and public venues. Beyond security, the retail and marketing sectors stand to benefit as well, with the ability to understand customer behavior and preferences on a nuanced level, thereby personalizing and optimizing the shopping experience.

Emotion analysis, when combined with facial recognition, opens up new dimensions in understanding human expressions and reactions. This capability holds immense promise in customer service, enabling businesses to gauge satisfaction levels in real-time and respond proactively to customer needs. In the educational context, emotion analysis provides insights into student engagement, paving the way for adaptive and personalized learning experiences.

Real-time emotion detection, a key focus of this project, holds transformative potential in industries such as entertainment and healthcare. In gaming and virtual reality, the ability to adapt experiences based on real-time emotional cues enriches user immersion. Moreover, in healthcare, monitoring patient emotions can contribute to mental health assessments, offering valuable insights into stress, anxiety, and depression.

The transportation sector, particularly in automotive applications, can leverage facial recognition and emotion analysis for driver monitoring. This not only enhances road safety by detecting signs of driver fatigue or distraction but also contributes to the overall well-being of individuals on the road.

The motivation behind this project extends beyond technological innovation. It aligns with a commitment to responsible and ethical deployment of these technologies, recognizing the importance of addressing privacy concerns and ensuring the user's consent and data protection.

In essence, this project is motivated by the belief that advanced computer vision, when applied judiciously, has the potential to redefine how we interact with technology, offering solutions that are not only efficient but also deeply attuned to the nuances of human expression and emotion. Through this endeavor, we aim to contribute to the responsible advancement of technology for the betterment of various industries and the overall human experience.

4.3 CODE and OUTPUTS

Importing Libraries:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt

from keras.layers import Flatten, Dense
from keras.models import Model
from keras.preprocessing.image import ImageDataGenerator , img_to_array, load_img
from keras.applications.mobilenet import MobileNet, preprocess_input
from keras.losses import categorical_crossentropy
```

Building our Model To train the data:

```
base_model = MobileNet( input_shape=(224,224,3), include_top= False )

for layer in base_model.layers:
  layer.trainable = False

x = Flatten()(base_model.output)
x = Dense(units=7 , activation='softmax' )(x)

# creating our model.
model = Model(base_model.input, x)
```

Model Compiling:

```
model.compile(optimizer='adam', loss= categorical_crossentropy , metrics=['accuracy']  )
```

Preparing our data using data generator:

```
train_datagen = ImageDataGenerator(
    zoom_range = 0.2,
    shear_range = 0.2,
    horizontal_flip=True,
    rescale = 1./255
)
```

```
train_data = train_datagen.flow_from_directory(directory= "/content/train",
                                               target_size=(224,224),
                                               batch_size=32,
                                              )
```

train_data.class_indices

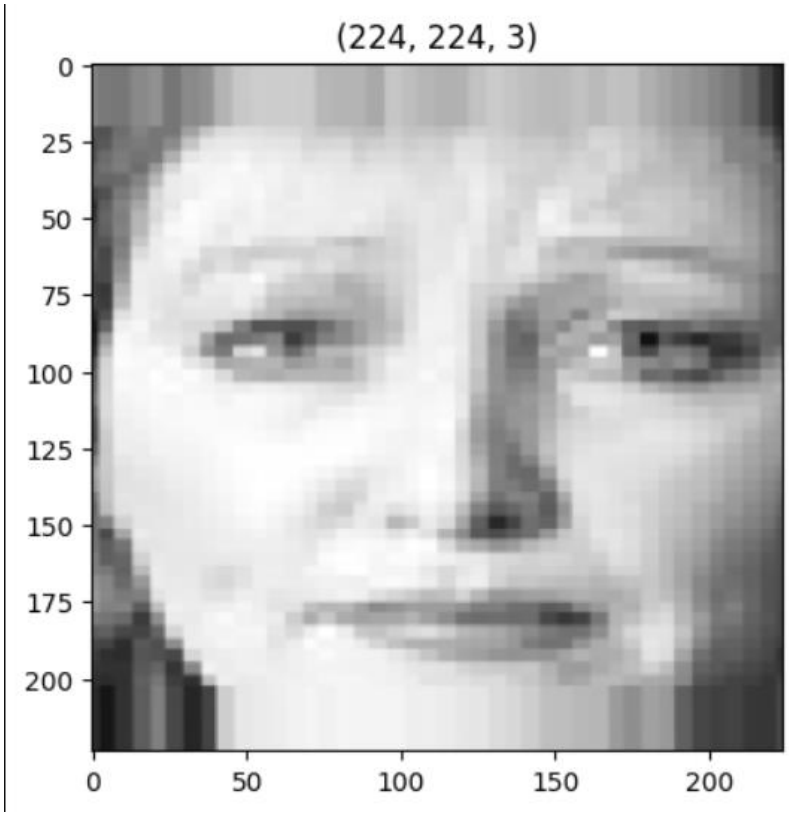
```
Found 28709 images belonging to 7 classes.
{'angry': 0,
 'disgust': 1,
 'fear': 2,
 'happy': 3,
 'neutral': 4,
 'sad': 5,
 'surprise': 6}
```

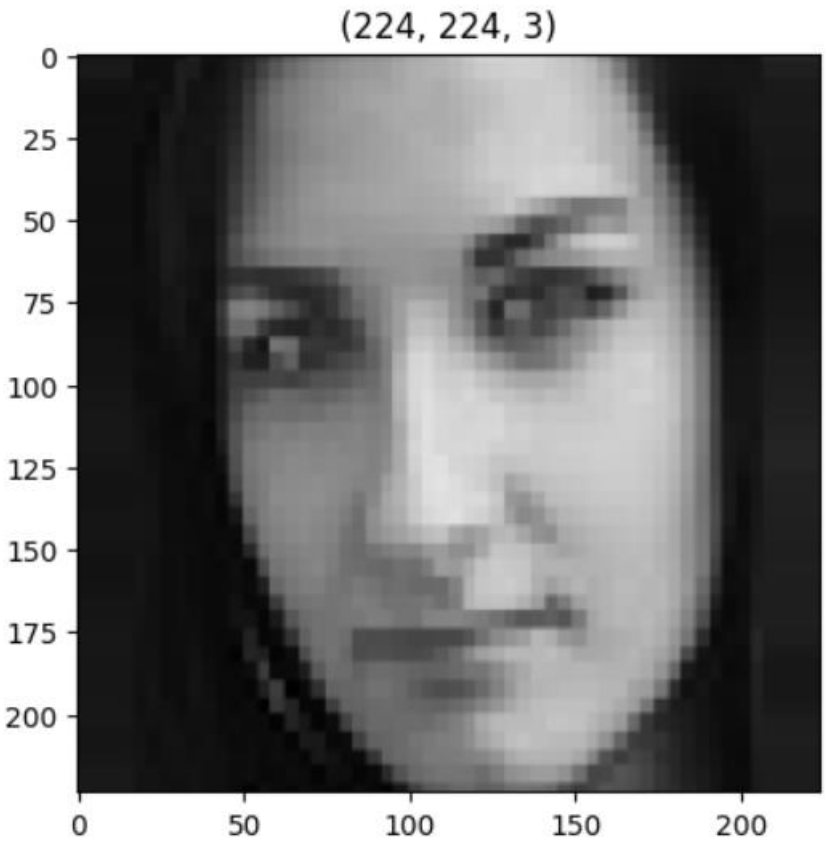
```
val_datagen = ImageDataGenerator(rescale = 1./255 )

val_data = val_datagen.flow_from_directory(directory= "/content/test",
                                           target_size=(224,224),
                                           batch_size=32,
```

```
Found 7178 images belonging to 7 classes.
```

Visualizaing the data that is fed to train data gen:

```
t_img , label = train_data.next()
# function when called will prot the images
def plotImages(img_arr, label):
  """
  input  :- images array
  output :- plots the images
  """
  count = 0
  for im, l in zip(img_arr,label) :
    plt.imshow(im)
    plt.title(im.shape)
    plt.axis = False
    plt.show()

    count += 1
    if count == 10:
      break
# function call to plot the images
plotImages(t_img, label)
```

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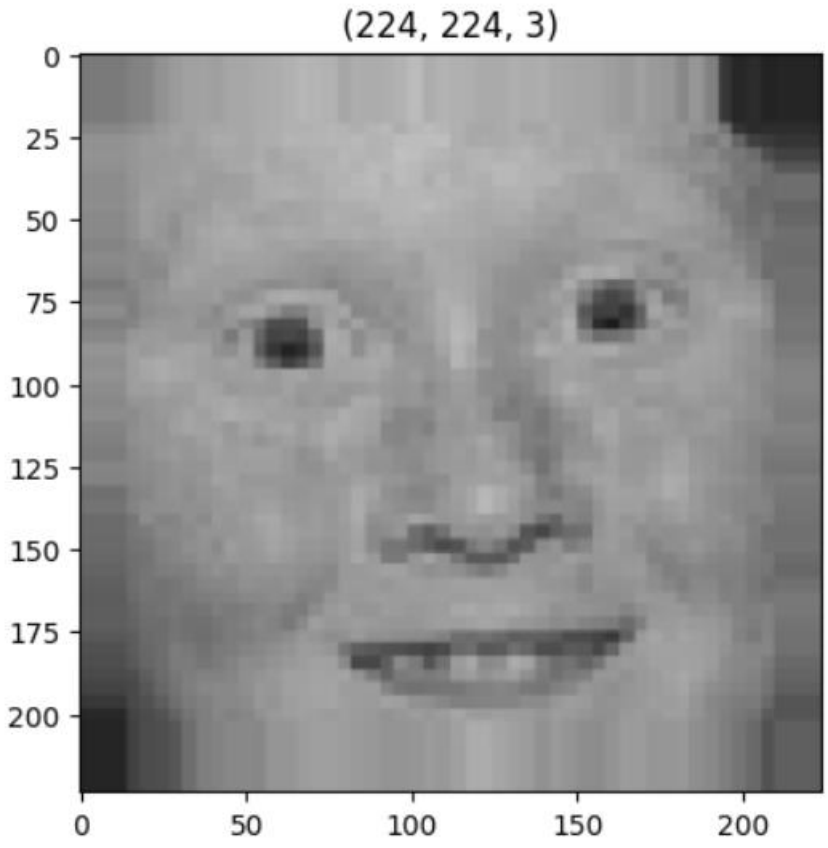
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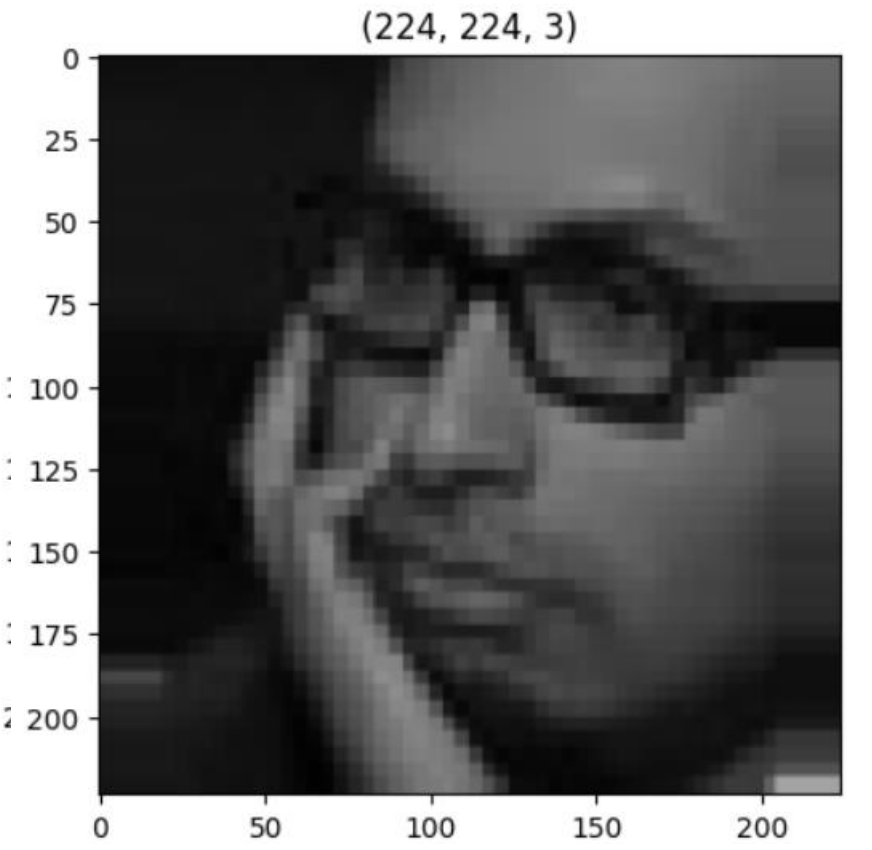
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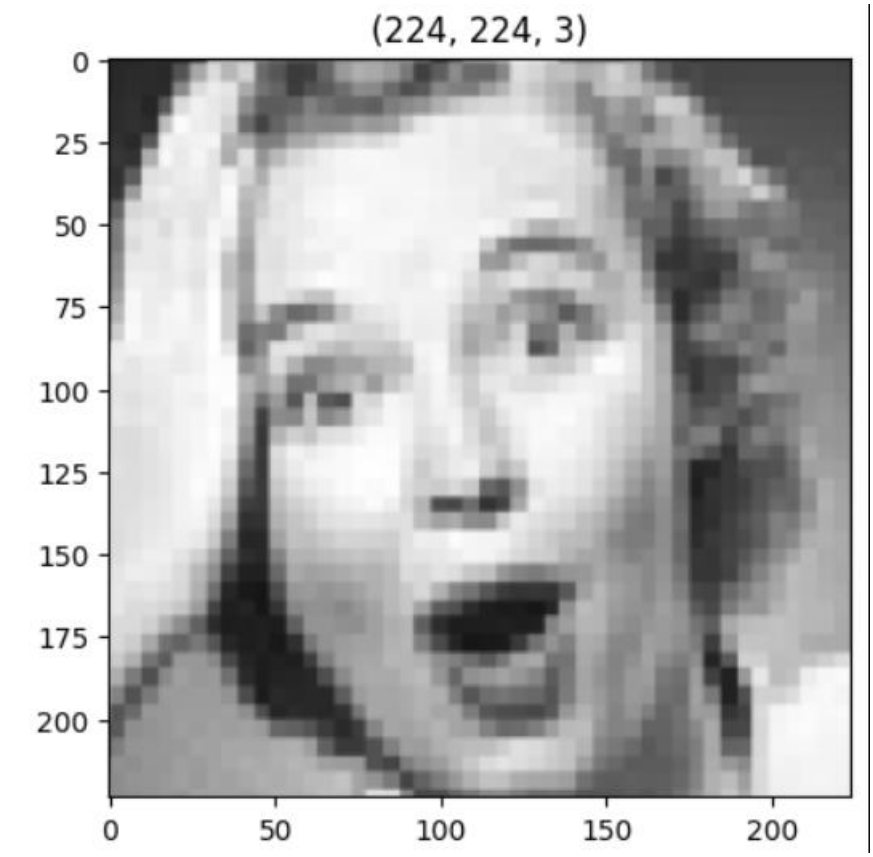
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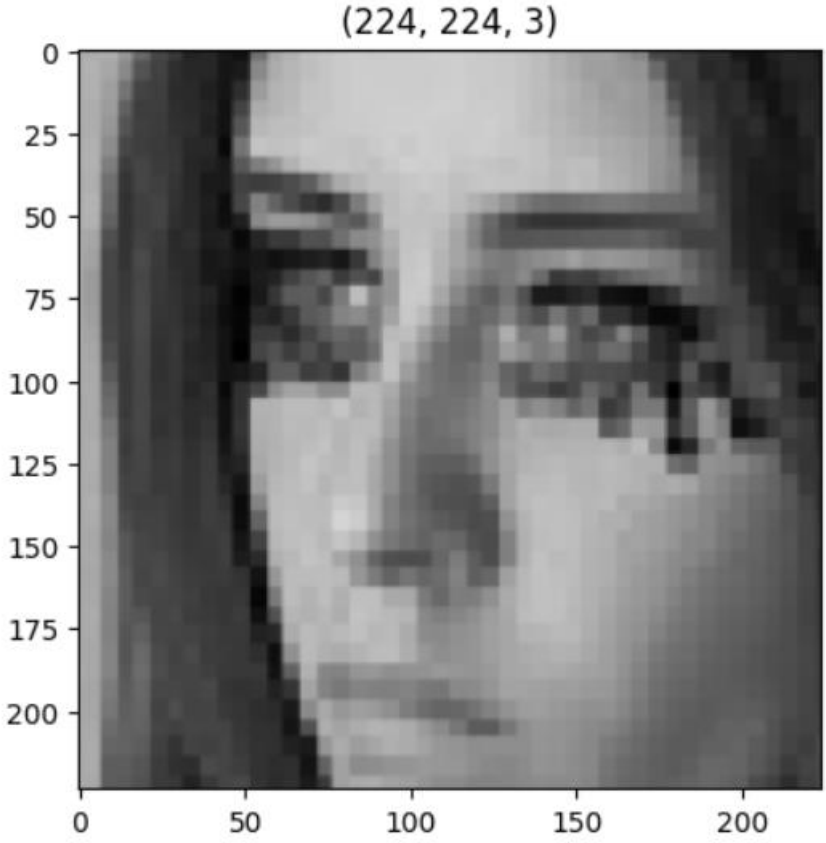
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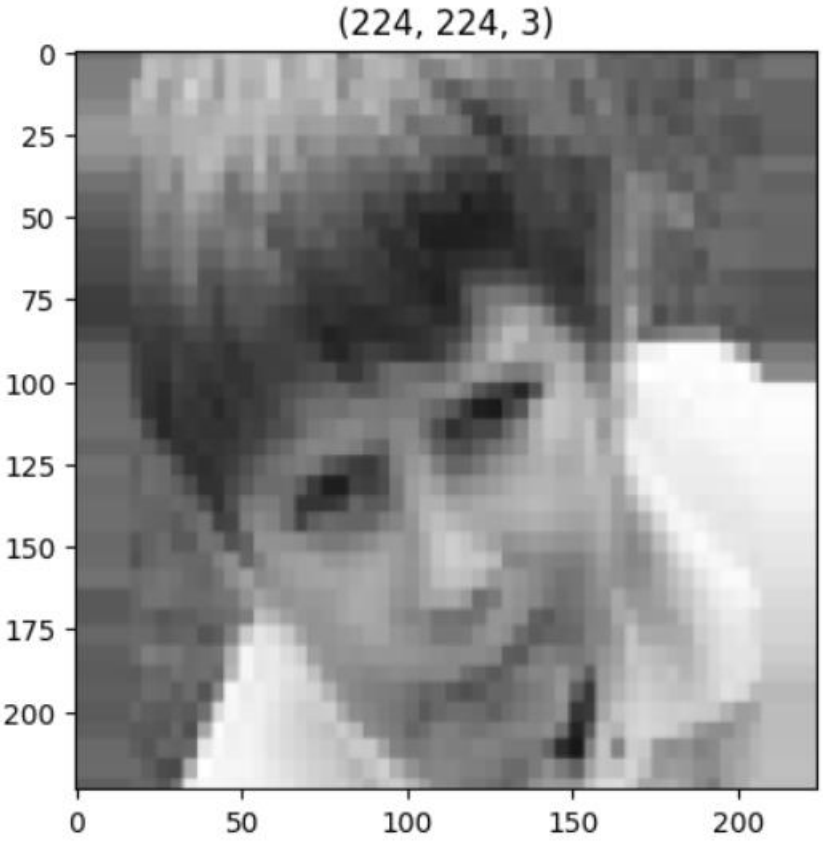
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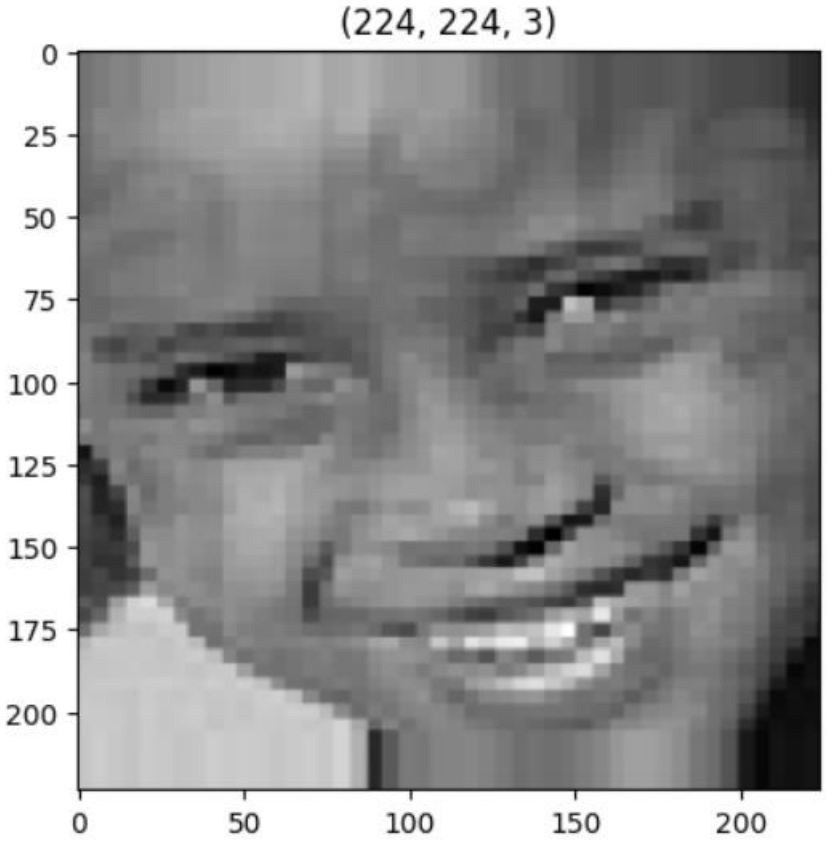
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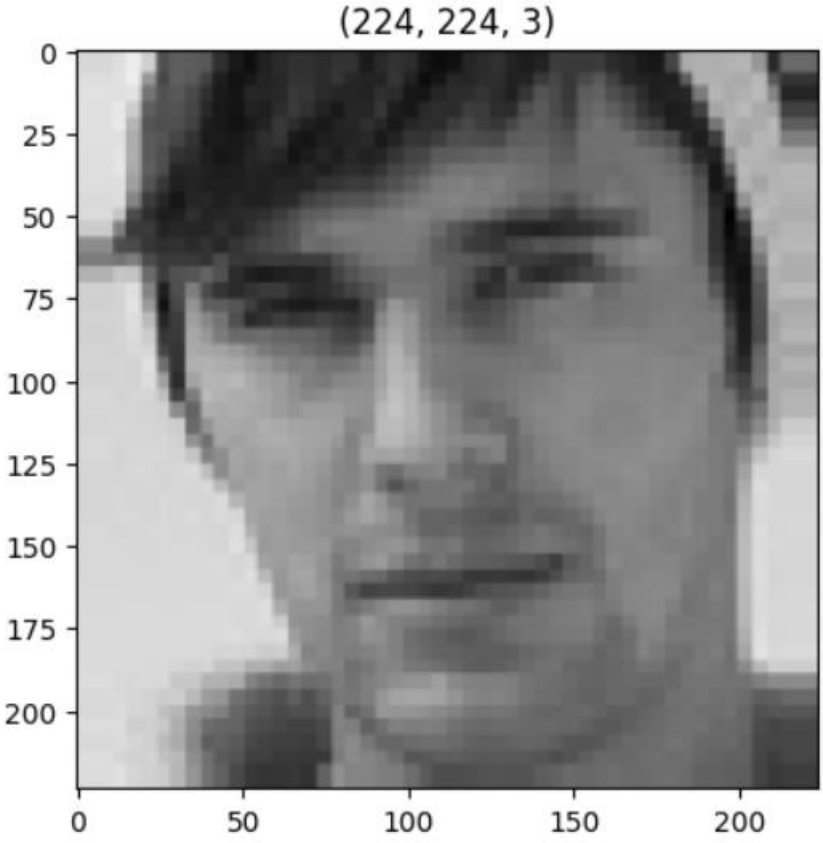
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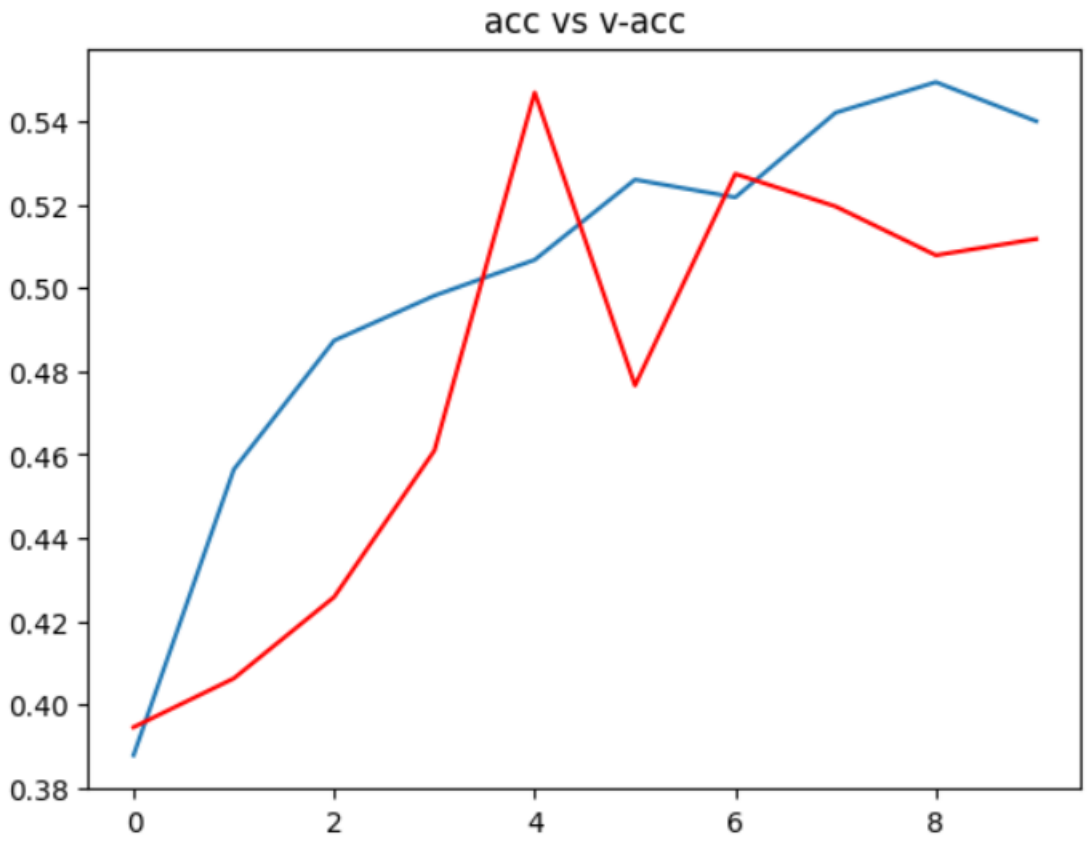
Having early stopping and model check point

```
from keras.callbacks import ModelCheckpoint, EarlyStopping

# early stopping
es = EarlyStopping(monitor='val_accuracy', min_delta= 0.01 , patience= 5, verbose= 1,
mode='auto')

# model check point
mc = ModelCheckpoint(filepath="best_model.h5", monitor= 'val_accuracy', verbose= 1,
save_best_only= True, mode = 'auto')

# puting call back in a list
call_back = [es, mc]
```

```
hist = model.fit_generator(train_data,
                           steps_per_epoch= 200,
                           epochs= 30,
                           validation_data= val_data,
                           validation_steps= 8,
                           callbacks=[es,mc])
```

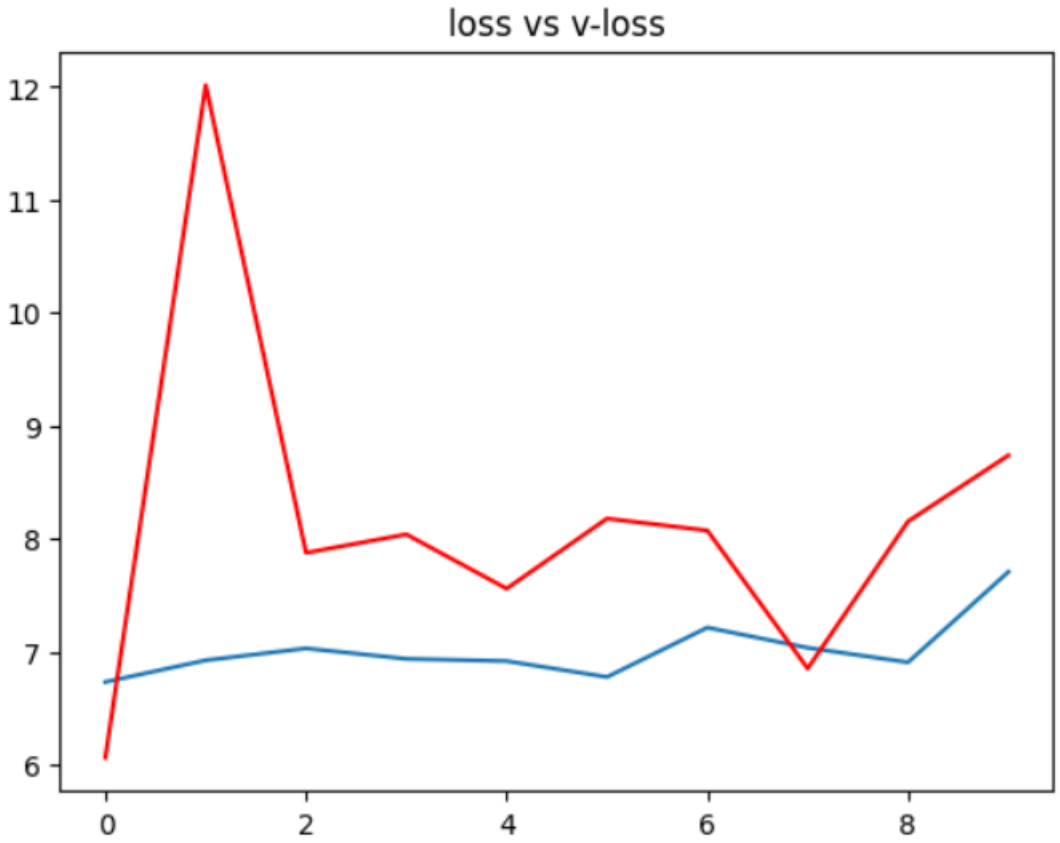
```
# Loading the best fit model
from keras.models import load_model
model = load_model("/content/best_model.h5")
```

```
plt.plot(h['accuracy'])
plt.plot(h['val_accuracy'] , c = "red")
plt.title("acc vs v-acc")
plt.show()
```



The main purpose of this graph is to see the trend of the variables "accuracy" and "val_accuracy" across a range of indices or iterations, the code creates a line plot. The training accuracy is shown by the blue line, while the validation accuracy is represented by the red line. The comparison between the training accuracy ('acc') and validation accuracy ('v-acc') is shown by the plot's title.

```
plt.plot(h['loss'])
plt.plot(h['val_loss'] , c = "red")
plt.title("loss vs v-loss")
plt.show()
```

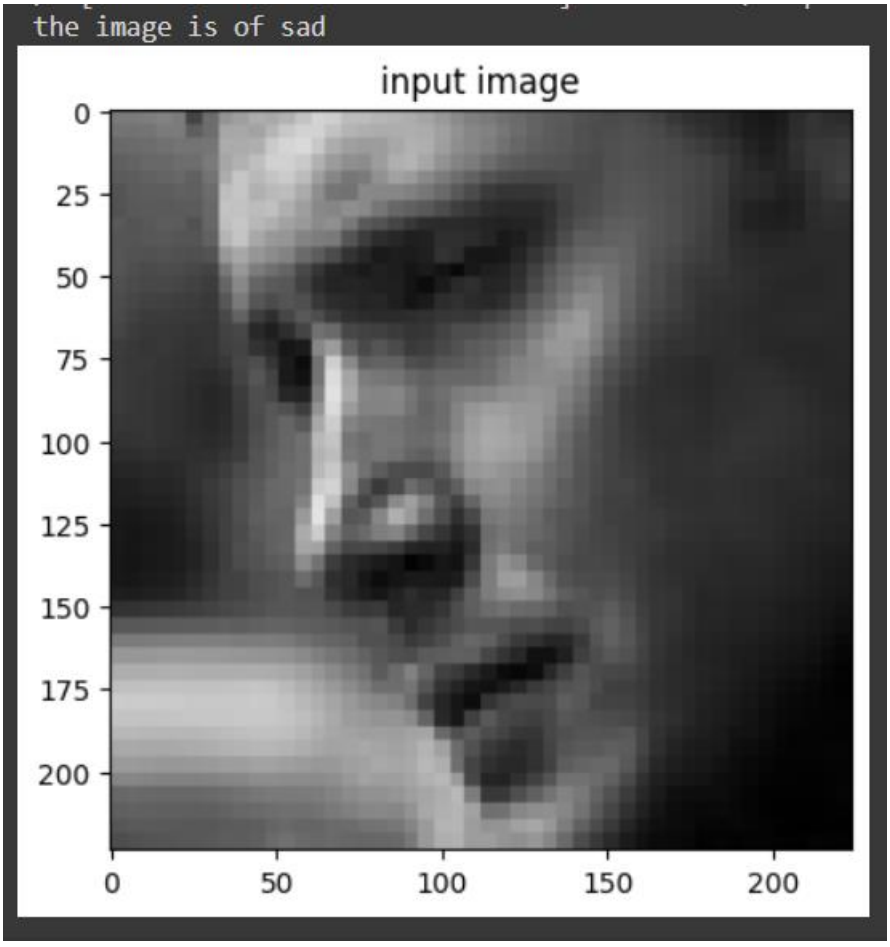


The main purpose of this graph is to see the trend of the training loss ('loss') and validation loss ('val_loss') across a range of indices or iterations, the algorithm creates a line plot. The training loss is shown by the blue line, while the validation loss is represented by the red line. The plot's title makes it clear that the training loss and validation loss are being compared.

```
op = dict(zip( train_data.class_indices.values(), train_data.class_indices.keys()))
```

Final Output:

```
# path for the image to see if it predics correct class

path = "/content/test/angry/PrivateTest_1054527.jpg"
img = load_img(path, target_size=(224,224) )

i = img_to_array(img)/255
input_arr = np.array([i])
input_arr.shape

pred = np.argmax(model.predict(input_arr))

print(f" the image is of {op[pred]}")

# to display the image
plt.imshow(input_arr[0])
plt.title("input image")
plt.show()
```



MAIN FILE:

```
import os
import cv2
import numpy as np
from keras.preprocessing import image
import warnings
warnings.filterwarnings("ignore")
from keras.preprocessing.image import load_img, img_to_array
from keras.models import  load_model
import matplotlib.pyplot as plt
import numpy as np

# load model
model = load_model("best_model.h5")

face_haar_cascade = cv2.CascadeClassifier(cv2.data.haarcascades + 'haarcascade_frontalface_default.xml')

cap = cv2.VideoCapture(0)

while True:
    ret, test_img = cap.read()  # captures frame and returns boolean value and captured image
    if not ret:
        continue
    gray_img = cv2.cvtColor(test_img, cv2.COLOR_BGR2RGB)

    faces_detected = face_haar_cascade.detectMultiScale(gray_img, 1.32, 5)

    for (x, y, w, h) in faces_detected:
        cv2.rectangle(test_img, (x, y), (x + w, y + h), (255, 0, 0), thickness=7)
          roi_gray = gray_img[y:y + w, x:x + h]  # cropping region of interest i.e. face area from  image
        roi_gray = cv2.resize(roi_gray, (224, 224))
        img_pixels = image.img_to_array(roi_gray)
        img_pixels = np.expand_dims(img_pixels, axis=0)
        img_pixels /= 255

        predictions = model.predict(img_pixels)

        # find max indexed array
        max_index = np.argmax(predictions[0])

        emotions = ('angry', 'disgust', 'fear', 'happy', 'sad', 'surprise', 'neutral')
        predicted_emotion = emotions[max_index]
```

```
                cv2.putText(test_img, predicted_emotion, (int(x), int(y)),
cv2.FONT_HERSHEY_SIMPLEX, 1, (0, 0, 255), 2)

    resized_img = cv2.resize(test_img, (1000, 700))
    cv2.imshow('Facial emotion analysis ', resized_img)

    if cv2.waitKey(10) == ord('q'):  # wait until 'q' key is pressed
        break

cap.release()
cv2.destroyAllWindows
```

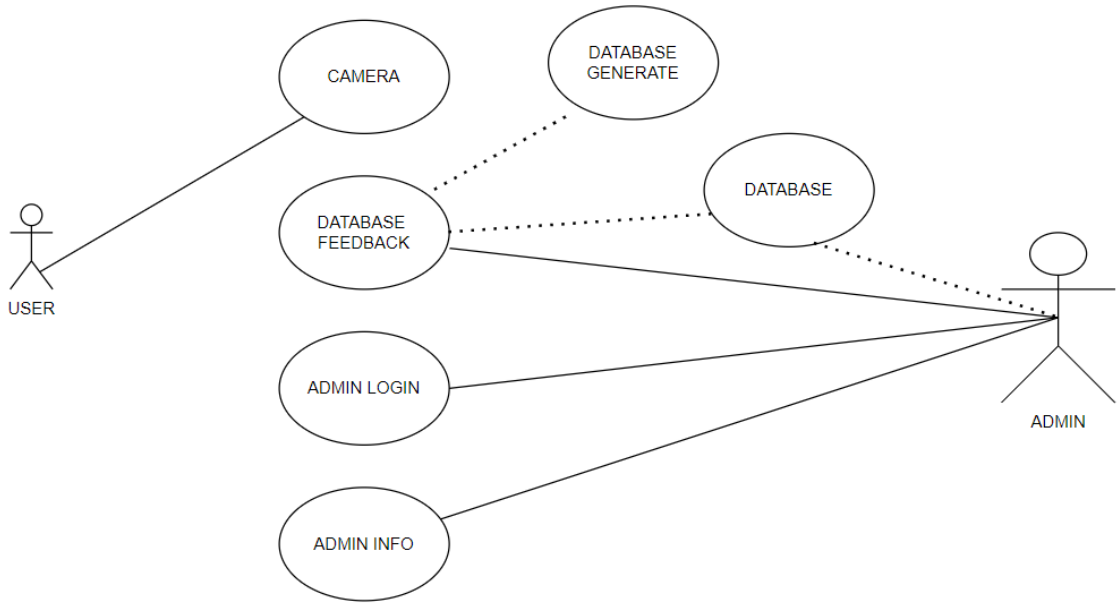
5. CONCULSION AND FUTURE SCOPE

In conclusion, this project represents a significant stride in leveraging advanced computer vision technologies, specifically focusing on face recognition and emotion analysis, to enhance diverse aspects of our daily experiences. The integration of these technologies has the potential to reshape security measures, personalize retail interactions, revolutionize customer service, and contribute to the realms of education, entertainment, healthcare, and transportation.
The foundation laid by the comprehensive literature survey and the adoption of proven methodologies, inspired by notable research papers, ensures the robustness of the project. The emphasis on real-time processing and ethical considerations underscores the commitment to responsible technology deployment, addressing privacy concerns and ensuring user consent.
As we navigate through the implementation phases, the convergence of facial recognition and emotion analysis becomes a key strength, offering a nuanced understanding of human interactions. The project's scope encompasses real-time emotion detection, contributing to sectors such as gaming, healthcare, and driver monitoring, where timely and accurate responses are crucial.

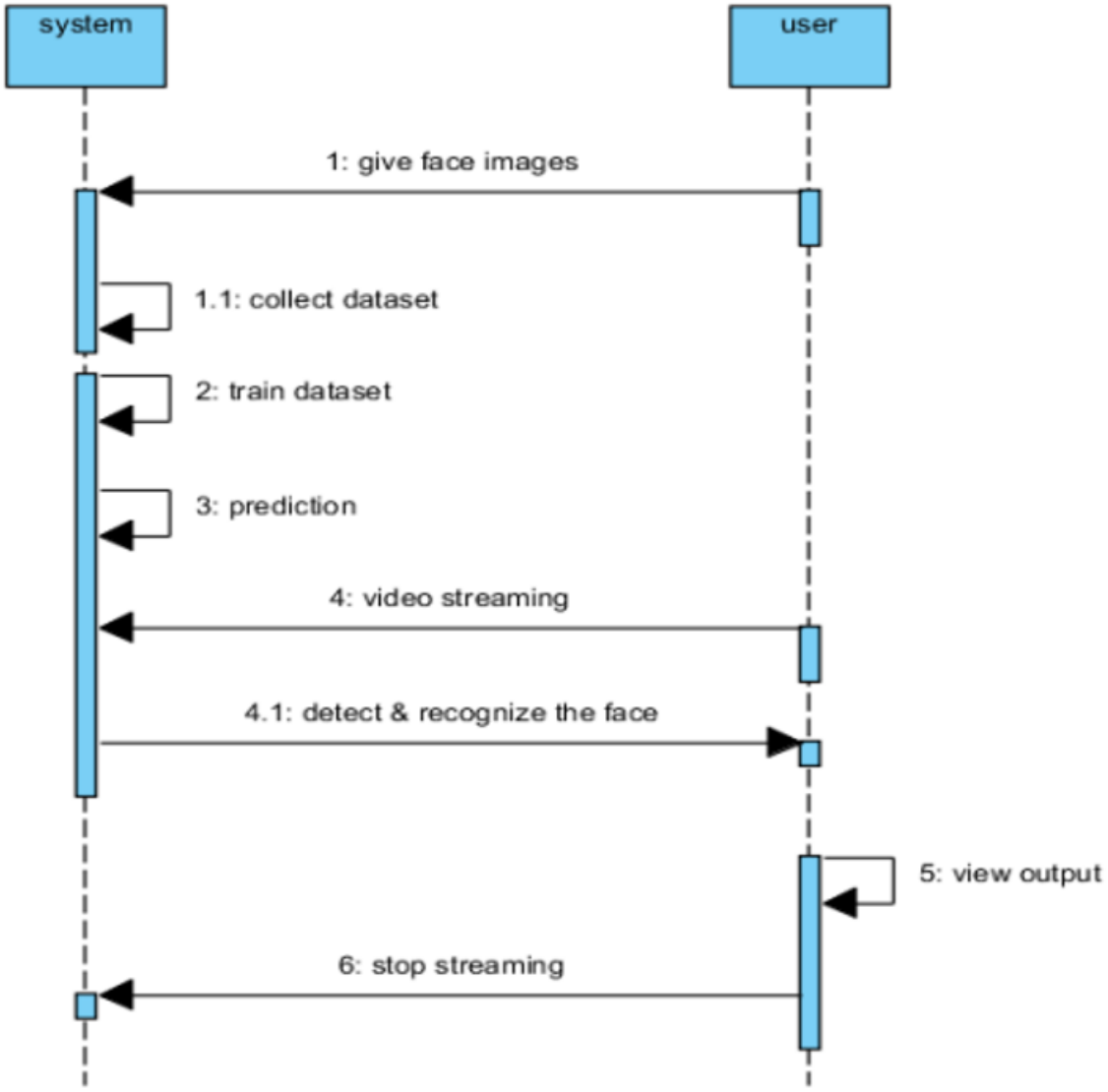
Future Scopes:
Looking ahead, the project opens avenues for exciting future enhancements and applications. The incorporation of multi-modal emotion recognition, combining facial expressions with other physiological signals, could provide a more comprehensive understanding of human emotions. Additionally, exploring the integration of natural language processing (NLP) for sentiment analysis could further enrich the project's capabilities, especially in customer service scenarios. The user interface, currently designed for configuration and interaction, could evolve to incorporate more intuitive and immersive elements, enhancing user engagement. Further development in the realm of augmented reality (AR) could extend the project's applications into new dimensions, offering interactive and dynamic experiences based on real-time emotional cues.
Moreover, collaboration with industry experts, psychologists, and ethicists could refine the ethical considerations and privacy protocols, ensuring the project remains at the forefront of responsible technology development.
In conclusion, this project not only marks a milestone in harnessing advanced computer vision for practical applications but also lays the groundwork for future innovations in emotion analysis and human-machine interaction. The continuous evolution of technology and a commitment to ethical practices ensure that this project remains adaptive, responsible, and positioned at the forefront of technological advancements in the years to come.

6. FIGURES

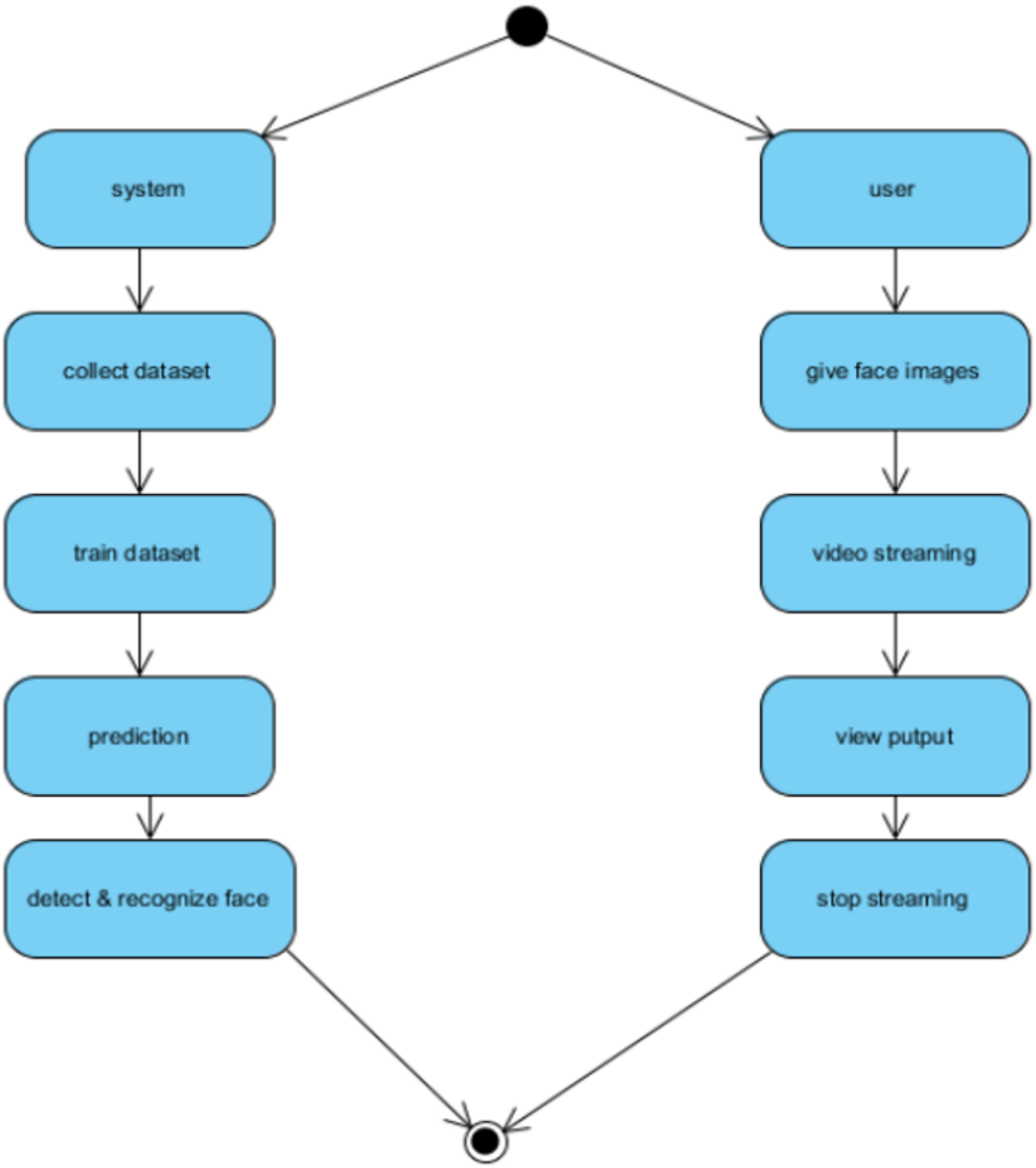
6.1 USECASE DIAGRAM:



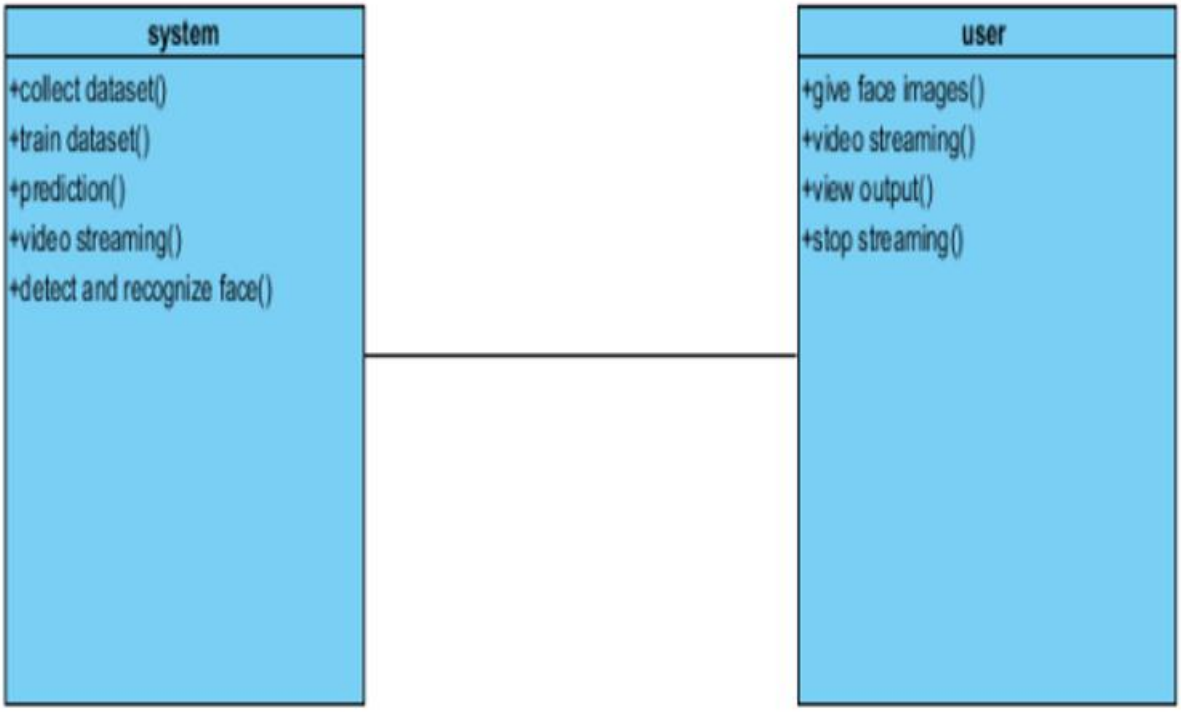
6.2 SEQUENCE DIAGRAM:



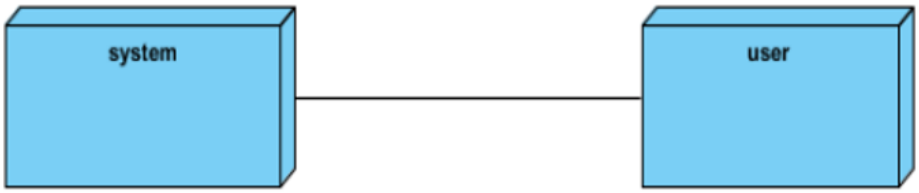
6.3 ACTIVITY DIAGRAM:



6.4 CLASS DIAGRAM:



6.5 DEPLOYMENT DIAGRAM:



6.6 COLLABORATION DIAGRAM:

7. REFERENCES

Research Papers :

- **A Convolutional Neural Network Cascade for Face Detection :** Haoxiang Li, Zhe Lin, Xiaohui Shen, Jonathan Brandt, Gang Hua; Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2015, pp. 5325-5334
- **Face Expression Recognition :** Face Expression Recognition: A Brief Tutorial Overview Claude C. Chibelushi, Fabrice Bourel Chibelushi, C.C. and Bourel, F., 2003. Face expression recognition: A brief tutorial overview. CVonline: On-Line Compendium of Computer Vision, 9
- **Real-time Convolutional Neural Networks for Emotion and Gender Classification :** Arriaga, Octavio, Matias Valdenegro-Toro, and Paul Plöger. "Real-time convolutional neural networks for emotion and gender classification." arXiv preprint arXiv:1710.07557 (2017)
- **A Multi-Task Neural Approach for Emotion Attribution, Classification, and Summarization :** G. Tu, Y. Fu, B. Li, J. Gao, Y. -G. Jiang and X. Xue, "A Multi-Task Neural Approach for Emotion Attribution, Classification, and Summarization," in IEEE Transactions on Multimedia, vol. 22, no. 1, pp. 148-159, Jan. 2020, doi: 10.1109/TMM.2019.2922129

Books:

- "Practical Python Projects" by Lee Vaughan (Chapter on Computer Vision)
- "Computer Vision: Algorithms and Applications" by Richard Szeliski