SENTIMENT ANALYSIS FROM FASCIAL IMAGE: ENHANCING EMOTION RECOGNITION THROUGH REAL-TIME OBJECTDETECTION

BY

HABIBA SURAYA SHORNA
ID: 201-15-3328

This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering

Supervised By

Zahura Zaman
Lecturer
Department of CSE
Daffodil International University

Co-Supervised By

Md. Asifur Rahim
Lecturer
Department of CSE
Daffodil International University

DAFFODIL INTERNATIONAL UNIVERSITY
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APPROVAL

This Project titled "**SENTIMENT ANALYSIS FROM FASCIAL IMAGE: ENHANCING EMOTION RECOGNITION THROUGH REAL-TIME OBJECT DETECTION**", submitted by HABIBA SURAYA SHORNA to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 14 July 2024.

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Dr. Md. Manowarul Islam — **External Examiner**
Associate Professor
Department of Computer Science and Engineering
Jagannath University

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DECLARATION

I hereby declare that this project has been done by us under the supervision of **Zahura Zaman, Lecturer, Department of CSE** Daffodil International University. I also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

Supervised by:
14.7.24

Zahura Zaman
Lecturer
Department of CSE
Daffodil International University

Co-Supervised by:

Md. Asifur Rahim
Lecturer
Department of CSE
Daffodil International University

Submitted by:
Habiba 14.7.24

HABIBA SURAYA SHORNA
ID: -201-15-3328
Department of CSE
Daffodil International University

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ABSTRACT

Now-a-days Face recognition system has become faster form of biometric system. It is a object detection system which is capable of recognizing face technically from digital image. Here in this paper, I used the latest version of YOLO algorithm that is YOLOv8 which is very capable of detecting real time object detection to detect multiple emotion of human faces in a single digital image. The purpose of this study is to find out how YOLOv8 can perform real time face detection accurately. Here I used four type of emotion of human face : happy, sad, angry and confused. For this study, dataset made from raw images taken from various people and annotated them and made dataset. Total of 209 images are used to make the dataset to achieve the accuracy. This study shows how accurately YOLOv8 works to perform real time face detection.

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CHAPTER 1
Introduction

1.1 Overview

Understanding and interpreting human emotions has become a diverse field of study in the age of artificial intelligence and computer vision. Facial sentiment analysis is a particularly interesting and difficult area within the vast field of emotion analysis. This thesis explores the core of this field with the goal of using the You Only Look Once (YOLO) object detection framework to clarify the nuances of human emotions as they are represented in face photographs. The human face, with its multitude of expressions, is a powerful medium for expressing feelings. Deep ramifications for market research, mental health diagnoses, human-computer interaction, and other fields can be derived from the capacity to identify and measure these emotions from facial photographs. Conventional sentiment analysis techniques, however effective, frequently struggle with the complex and dynamic characteristics of human emotions. In this work, we take a fresh approach by utilizing YOLO, an object detection system that operates in real time and is renowned for its effectiveness and precision. YOLO is a great option for extracting complex face traits that are essential for sentiment analysis because of its novel method of processing the full image at once. We want to improve the accuracy and performance of emotion recognition by including YOLO into the framework, in addition to addressing the difficulties caused by occlusion, different positions, and several faces in an image. The creation of a strong sentiment analysis model specifically for facial photos is the main goal of this thesis. By utilizing YOLO, we hope to improve feature extraction performance and accuracy, enabling the model to identify a wide range of emotions expressed in various facial expressions. Beyond the domain of theory, the research's implications hold promise for real-world implementations that could transform human-computer interactions and further the field of mental health analysis. By starting this journey at the nexus of emotion analysis and computer vision, this thesis hopes to add to the growing body of knowledge. We seek to reveal the nuances of human emotion captured in facial photos by utilizing artificial intelligence and YOLO, opening the door to a more in-depth and thorough comprehension of the nuances of human sentiment.

1.2 Background and Present State

The field of sentiment analysis, which is crucial to computer vision and artificial intelligence, has advanced significantly in recent years, opening up new avenues for study and interpretation of human emotions. Facial expressions are one of the rich and subtle sources of information used in sentiment analysis, among other modalities, and can provide insights into the wide range of personal emotions. Emotions can be expressed on the human face through small changes in facial characteristics, which can represent joy, sorrow, surprise, and a host of other emotions. Precise interpretation of these expressions can revolutionize various fields, such as improving user experience in HCI systems and supporting mental health evaluations and market research. In order to handle the intricacy and unpredictability of human expressions, traditional methods of sentiment analysis from facial photos frequently depended on manual feature extraction and complicated algorithms. Deep learning and convolutional neural networks (CNNs) have completely changed this field by providing a more efficient and automated way to extract features that are essential for identifying emotions. You Only Look Once version 8 (YOLOv8) object detection framework is a novel approach in the quest to improve sentiment analysis from facial photos. Enhancing the accuracy and efficiency of real-time object recognition, YOLOv8 builds upon its predecessors to represent a breakthrough in the field. Given the demands of facial sentiment analysis, where collecting subtle nuances is critical, its ability to process photos holistically in a single pass is a perfect fit. In order to advance sentiment analysis from facial photographs, this thesis will make use of YOLOv8's capabilities. In order to tackle issues like occlusion, different positions, and several faces in an image, we aim to incorporate the powerful object identification capabilities of YOLOv8. A more precise and effective comprehension of emotional expressions will be made possible by this integration, which aims to expedite the feature extraction procedure. The expanding importance of AI-driven emotion analysis, where advances in object identification, deep learning, and computer vision come together to understand the complexity of human feeling, provides the background for this study. This backdrop lays the groundwork for our exploration of the synergy between cutting-edge technology and the profound nuances of human emotional expression as we dive into the usage of YOLOv8 in the context of sentiment analysis from facial photos.

1.3 Problem Statement

Conventional techniques for sentiment analysis of facial photos frequently encounter difficulties when handling several faces in an image, changing positions, and occlusion. complicated algorithms and manual feature extraction may not be able to fully capture the nuances of complicated emotional states. To overcome these obstacles and expedite the feature extraction procedure, the study makes use of YOLOv8, a cutting-edge object identification system.

1.4 Objectives

With better accuracy and efficiency than its predecessors, YOLOv8 is a major improvement in real-time object detection. The capability of doing comprehensive image processing in a single pass is in perfect harmony with the demands of facial sentiment analysis. This project attempts to improve the accuracy of emotion recognition by utilizing YOLOv8's strong object detection capabilities by integrating it into the sentiment analysis pipeline.

1.5 Scope and Limitation

This study's findings have applications in a range of domains, such as market research, mental health diagnostics, and human-computer interaction. Enhancing user experiences and the caliber of mental health evaluations can be achieved by developing systems that better comprehend and address human emotions with the use of a more precise and effective sentiment analysis model.

1.6 Report Organization

By offering fresh perspectives on how to incorporate YOLOv8 into sentiment analysis from facial photos, the thesis is anticipated to make a significant contribution to the larger research landscape. Future studies in the field of computer vision, emotion analysis, and artificial intelligence may build on these findings. Influencing the creation and enhancement of practical applications that make use of facial image sentiment analysis is one of the anticipated results. The study's practical consequences are expected to augment user experiences and decision-making processes by improving systems that integrate emotion recognition.

1.7 Summary

YOLOv8 has the potential to be a useful tool in this developing field of research, as demonstrated by the projected outcomes, which collectively aim to increase the knowledge and use of sentiment analysis from facial photographs. The study's justifications include the identification of the distinctive perspectives provided by facial expressions, the necessity of surmounting obstacles in conventional methods, the innovations brought about by YOLOv8, and the potential applications in a variety of fields. With the use of cutting-edge technology, we hope to contribute to the continuing discussion on emotion analysis and shed light on the complexities of human mood.

CHAPTER 2

Literature Review

2.1 Overview

In this chapter examines recent research on the analysis of fascial image, with an emphasis on the use of YOLO. We will analyze a number of research that make use of YOLO and other related techniques, looking at their benefits, drawbacks, and potential for advancement.

2.2 Related Works

The work effectively provides a revised model that is prepared for use in practice as well as a generalized model for real-time flying object identification that is appropriate for transfer learning and more research.In order to extract abstract features, the models were trained on datasets containing a variety of flying object classes. They were then improved via transfer learning on datasets that presented more challenges. With an inference speed of 50 frames per second on 1080p films, the finalized generalized model produced a mAP50-95 of 0.685; the refined model kept this pace and increased the mAP50-95 to 0.835. [1].

In order to categorize digital and real-time facial photos into seven different emotion categories, the proposed hybrid model for Facial Expression Recognition (FER) combines a Deep Convolutional Neural Network (DCNN) and Haar Cascade deep learning architectures. To improve face feature extraction and filtering depth, this model makes use of various kernels, ReLU Activation functions, and additional convolutional layers. The model produces much better classification performance compared to state-of-the-art trials by using GPU compute for both training and validation. It shows up to 6% gain in accuracy, for a total improvement of up to 70%. Furthermore, the suggested architecture performs better than traditional models with a 2098.8-second execution time, demonstrating its effectiveness in real-time emotion prediction and classification. [2].

The paper emphasizes the relevance of the Real-time Facial Expression Recognition System to human-computer interaction.The system's ability to analyze facial expressions in near real- time with a reasonable level of accuracy opens up possibilities for improved human- computer interaction. The paper highlights the tradeoff achieved between accuracy and processing speed, with a processing time of 100-120 ms per 10 frames and an accuracy of around 60%ve [3].

The significance of the Real-time Facial Expression Recognition System for human-computer interaction is emphasized in the research.Potential for better human-computer interaction is created by the system's capacity to reasonably accurately and in almost real-time evaluate facial expressions. The study illustrates the balance struck between processing speed and precision, with processing taking 100–120 ms for every ten frames and approximately 60% accuracy.[4]

The YOLOV model that has been suggested tackles the difficulties associated with Video Object Detection (VID) by presenting a straightforward approach that enhances accuracy considerably while requiring less processing resources.In contrast to conventional two-stage detectors, YOLOV enhances efficiency and accuracy in VID tasks by selecting significant regions after one-stage detection to prevent processing a large number of low-quality candidates. The YOLOX-based approach is appropriate for real-time applications and large-scale scenarios since it offers remarkable performance metrics, such as 87.5% AP50 at over 30 FPS on the ImageNet VID dataset utilizing a single 2080Ti GPU. [5]

Face recognition in unrestricted open-world environments is a difficult issue. The open-world scenario requires that the system learn identities incrementally from frame to frame, discriminate between known and unknown identities, and automatically enroll every new identity in the gallery in order to be able to recognize it every time it is observed again in the future. This is different from the closed-set and open-set face recognition scenarios, which assume that the face representations of known subjects have been manually enrolled in a gallery. In practical scenarios, it is expected that performance scaling with a large number of identities will be required.In this research, we address the issue and introduce a system that can effectively recognize faces in the actual world at small- to medium-sized and large-scale scales in real time. [6].

We suggest YOLO-face, a face detector based on YOLOv3, to address the issue of different face scales being detected. This should enhance face detection performance. The current method uses a more accurate regression loss function and anchor boxes that are more suited for face detection. The enhanced detector maintained its quick detection speed while greatly increasing accuracy. Our revised method performs better than YOLO and its variants, according on experiments conducted on the FDDB and the WIDER FACE datasets. [7].

Face recognition in unrestricted open-world environments is a difficult issue. The open-world scenario requires that the system learn identities incrementally from frame to frame, discriminate between known and unknown identities, and automatically enroll every new identity in the gallery in order to be able to recognize it every time it is observed again in the future. This is different from the closed-set and open-set face recognition scenarios, which assume that the face representations of known subjects have been manually enrolled in a gallery. In practical scenarios, it is expected that performance scaling with a large number of identities will be required. In this research, we address the issue and introduce a system that can effectively recognize faces in the actual world at small- to medium-sized and large-scale scales in real time. [12].

In this research For facial recognition, the YOLOV3 algorithm can be applied, yielding faster results. This research will examine many iterations of the YOLO algorithms, examine the face detection and recognition algorithm now in use (RCNN), and conclude with the outcome of the YOLOV3 method for identifying a customized face[13].

2.3 Comparison Between Existing Works

Table 2.3.1: Research Matrix

Author	**Methodology or Using Tool**	**Description**	**Outcome Accuracy**
[1]	YOLOv8	Real time flying object detection.	Accuracy 83%.
[2]	Human comouter interaction.	Real time fascial expression recognition	60% Accuracy
[3]	Deep Convolutional Neural Network (DCNN) and Haar Cascade deep learning architectures	digital and real-time facial photos into seven different emotion categories	70% Accuracy
[8]	YOLOv5	Real-time Facial Expression Recognition System for human-computer interaction	Accuracy achieved 60%.

2.4 Open Issues

In previous papers, many researchers worked with single object datasets.. And achieved their goals with YOLOv3, YOLOv5. But in this paper, I worked with a dataset contains multiple objects. Also, I used YOLOv8 Which no one has done previously.The goal of this thesis is to improve our knowledge and skills in computer vision technologies for the purpose of interpreting human emotions. Specifically, the problem involves a thorough investigation of sentiment analysis from facial photos using YOLOv8.

2.5 Summary

YOLOv8 presents a number of challenges when it comes to sentiment analysis from facial images. These include the variability of facial expressions due to individual and cultural differences, occlusion issues caused by accessories or facial hair impacting facial feature visibility, the difficulty of accurately differentiating subtle emotional states, fluctuations in lighting conditions affecting facial visibility and requiring adaptable algorithms, the need for algorithms capable of analyzing facial expressions across varied poses and angles captured in images, the difficulty of generalizing across cultural expressions, and the technical challenges.

CHAPTER 3

Research Methodology

3.1 Overview

The study examines and assesses how well YOLOv8 recognizes things across multiple datasets in a comparison analysis dubbed "Object Detection Performance: YOLOv8." Instrumentation includes appropriately annotated datasets of varying degrees of complexity implemented, as well as high-performance computer hardware for accelerated model training and evaluation. The model's performance will be evaluated quantitatively through the use of established assessment measures, including f1 score, accuracy, precision, and recall. This will ensure a systematic setup of the experiment and objective evaluation to determine the benefits and drawbacks of each model in object detection tasks.

3.2 Proposed Methodology

The suggested strategy is to systematically assess the YOLOv8 algorithms in a methodical manner in order to detect faces. Gathering, preparing, training, and evaluating the model's performance using established. To improve the model's accuracy and efficiency, optimization strategies including regularization and fine-tuning will also be applied. Complete insights are provided by practical validation in face detection and in relation to ethical issues. These include verified models and developments in the use of deep learning for sustainable object detection.

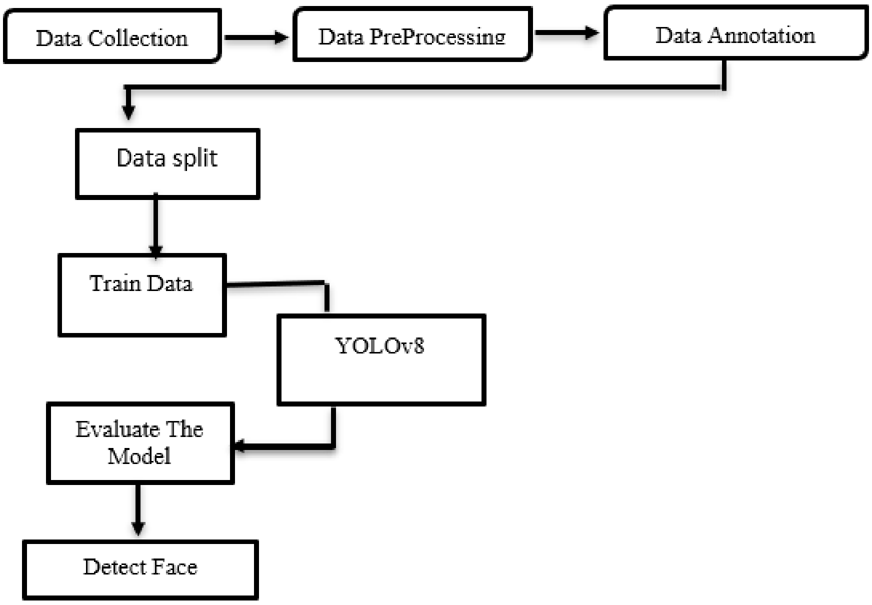

Figure: Methodology Workflow

Figure 3.2.1: Proposed Methodology Workflow

3.3 Hardware/Software Requirement

- **Hardware**

GPU: NVIDIA RTX 3080

CPU: Intel Core i5

RAM: 12BGB

Storage: 1TB

- **Software**

Operating System: Windows 11

Python: Latest version of python.

Library: Python library like Numpy.

IDE Editor: Google Colab

Data Annotation Tool: makesense.Ai

3.4 Project Management and Financial Analysis

Project management is included in part of our research report. Among these are plans for budgeting, resource allocation, communication, and risk management. Assigning resources, monitoring due dates, and ensuring efficient completion are all part of project management for a web-based heart attack prediction system powered by machine learning. Define the scope of the project by outlining its objectives, deliverables, and success criteria. Describe in depth the characteristics and functionalities of the web-based system. Resource Planning: Ascertain the required number of personnel, devices, software, and information. Assign members of the team jobs and responsibilities according to their expertise in web development, database management, machine learning, and user interface design. Calendar and Benchmarks: Make a project timeline with significant deadlines and completion dates included. Determine how much time is needed for each task by breaking the work up into smaller, more manageable chunks. The process of determining any risks and uncertainties that might have an impact on a project's trajectory or outcomes is known as risk management. To deal with unforeseen challenges, develop backup plans and risk-reduction strategies. Cooperation and Communication: Clearly lay out the lines of communication as well as the protocols for group work. To discuss issues, establish priorities, and assess the situation, call regular meetings. Establish quality assurance protocols to ensure the prediction model and web application's accuracy, dependability, and security. Conduct testing and validation to identify and address any errors or inconsistencies at every stage of development. Reporting and Record-Keeping: Maintain current, thorough documentation, including user manuals, technical specs, and project schedules. Effective project management guarantees the timely development and deployment of the web-based heart attack prediction system in accordance with quality standards, legal requirements, and user expectations. Additionally, it helps to minimize risks, maximize available resources, and complete projects on time and under budget. As I collected data from my people and worked thoroughly, no finance is required for completing the thesis.

3.5 Summary

The model's performance will be evaluated quantitatively through the use of established assessment measures, including f1 score, accuracy, precision, and recall. This will ensure a systematic setup of the experiment and objective evaluation to determine the benefits and drawbacks of each model in object detection tasks.

CHAPTER 4

Implementation

4.1 Overview

The study examines and assesses how well YOLOv8 recognizes things across multiple datasets in a comparison analysis dubbed "Object Detection Performance: YOLOv8." Instrumentation includes appropriately annotated datasets of varying degrees of complexity implemented, as well as high-performance computer hardware for accelerated model training and evaluation. The model's performance will be evaluated quantitatively through the use of established assessment measures, including f1 score, accuracy, precision, and recall. This will ensure a systematic setup of the experiment and objective evaluation to determine the benefits and drawbacks of each model in object detection tasks.

4.2 Train Model

- **Data Collection**

This Collecting high-quality and sufficient data for training is crucial. For This study, data is collected in different ways. contacted with various people, took permission of use of their image and made dataset.The sample of fascial image dataset is shown Below:

Fig 4.2.1: Sample Image

Fig 4.2.2: Output Image

- **Statistical Analysis**

This dataset consists of 209 images with 4 classes:

•Happy

•Sad

•Angry

•Confused

4.2.1 Data Pre-processing

- **Data Annotation**

Annotation is the process of labeling or tagging images or datasets to provide ground truth information in computer vision and machine learning. For testing and training models like YOLOv5, YOLOv7, and YOLOv8, this is quite helpful. This comprises finding and categorizing specific objects or features (like face detection) in an image. Annotation is a crucial step in supervised learning, as it aids algorithms in comprehending and recognizing patterns, forms, and characteristics related to different object recognition.

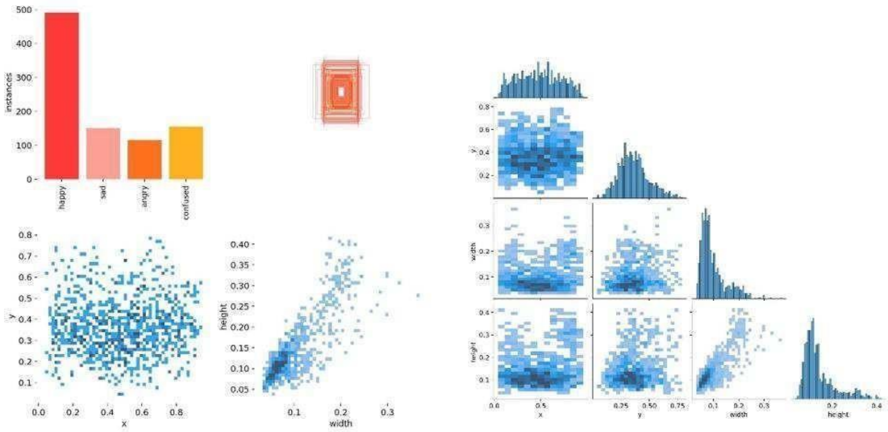

Fig 4.2.1.1: Label Instances

Fig 4.2.1.2: Annotation the classes

- **Feature Extraction**

Feature extraction plays a key role in machine learning and computer vision applications by enhancing the performance and efficacy of algorithms such as YOLOv5, YOLOv7, and YOLOv8 in object detection. From the raw data, in this example images, relevant information or features are extracted to create a more condensed, informative, and discriminative representation suitable for model training and evaluation. Detecting distinct patterns, textures, forms, color changes, and structural features may be necessary for feature extraction. By automatically learning and extracting these complicated information from annotated photographs using techniques like convolutional neural networks (CNNs), algorithms are able to discover minute changes, abnormalities, or suggestive indicators associated to a certain emotion.

4.3 Model Evaluation

We used YOLO Algorithm. There are various kind of YOLO Algorithm like:

- **YOLOv5**

Yolov5 model is part of the You Only Look Once (YOLO) family of computer vision models. Apps for recognizing objects frequently use YOLOv5. YOLOv5 is available in four different accuracy rate ranges: small (s), medium (m), large (l), and extra-large (x). four primary variations. Moreover, the training period varies for each edition.

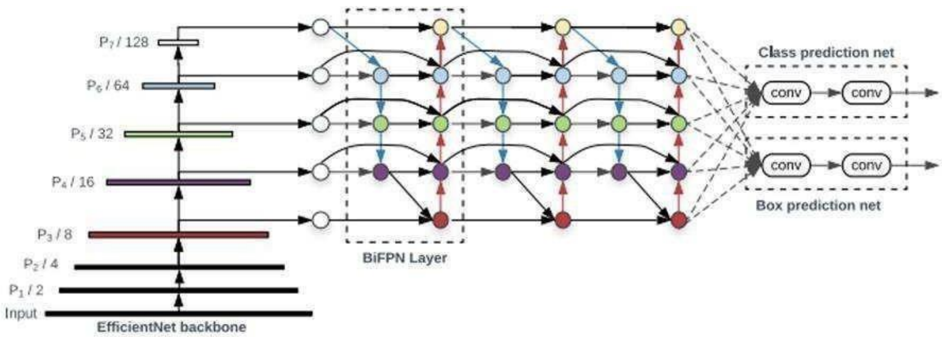

Fig 4.3.1: Architecture of YOLOv5

- **YOLOv7**

The newest model in the collection is the YOLO (You Only Look Once) v7. Models known as YOLO are single-stage object detectors. A backbone is used by a YOLO model in order to include visual frames. These qualities are transmitted to the network's head after combining and merging in the neck. YOLO predicts the kinds of objects and their locations that ought to have bounding boxes drawn around them.

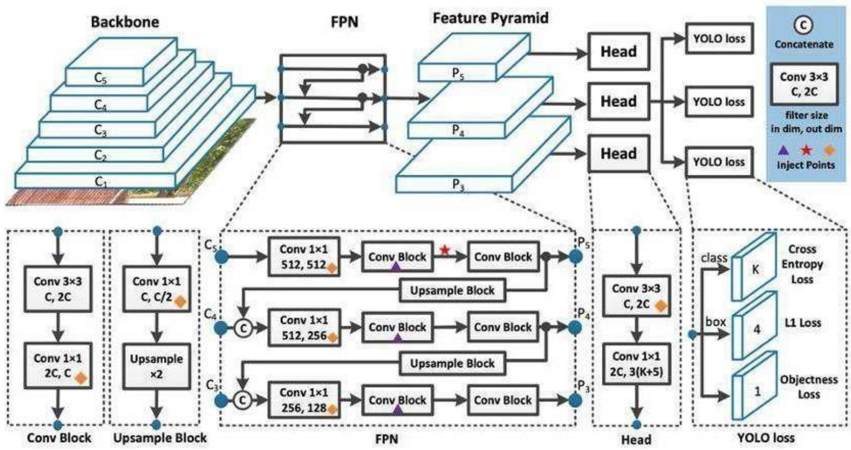

Fig 4.3.2: Architecture of YOLOv7

- **YOLOv8**

The most advanced YOLO model available now, YOLOv8, is helpful for applications including instance segmentation, object detection, and picture categorization. The same company that developed the well-known and industry-defining YOLOv5 model, Ultralytics, also manufactured YOLOv8. YOLOv8 is significantly different from YOLOv5 in terms of architecture and developer experience.

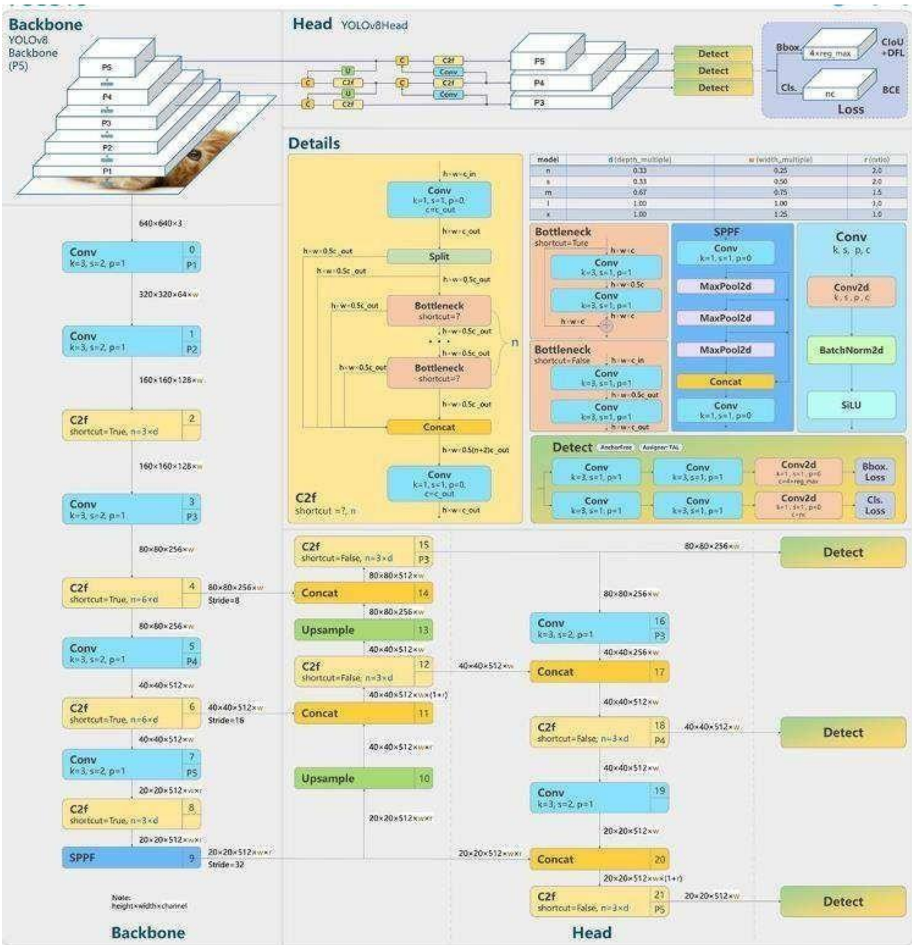

Fig 4.3.3: Architecture of YOLOv8

4.4 Summary

The model's performance will be evaluated quantitatively through the use of established assessment measures, including f1 score, accuracy, precision, and recall. This will ensure a systematic setup of the experiment and objective evaluation to determine the benefits and drawbacks of each model in object detection tasks.

CHAPTER 5

Results and Analysis

5.1 Overview

In our test setup, we took advantage of the flexibility and accessibility of Google Colab, a cloud computing platform, in addition to the processing capability of the NVIDIA T4 GPU. To ensure seamless accessibility and data integrity, we first uploaded our handpicked collection of pictures of people's faces in a range of moods to Google Colab's cloud storage. Next, we set up the Colab environment to run the v5, v7, and v8 iterations of the Yolo algorithm using GPU-accelerated deep learning frameworks like TensorFlow and PyTorch. As a result, we were able to take use of the T4 GPU's quick model training, optimization, and assessment capabilities, which guaranteed effective resource usage and quickened experimentation cycles.We used batch processing, parallelization, and memory-efficient methods designed for GPU execution to maximize speed and minimize computational restrictions in the Google Colab environment.TensorFlow was utilized in this study as the main deep learning framework for Python-based machine learning tasks, and testing was conducted using the Keras library in the Google Colab environment. Initially, research projects had access to up to 12 GB of cloud-based random-access memory (RAM) and roughly 360 GB of GPU capacity from the Colab platform. To distinguish between different emotions, the human face dataset underwent painstaking manual annotation. After that, an 80:20 split was used to break the dataset into subgroups for training and validation. A batch size of 16 was used in the training phase to improve the model's performance metrics and convergence. The main objective was to evaluate each iteration of the YOLO architecture in terms of performance, accuracy, and efficiency in order to determine which model was the most dependable for object identification.

5.2 Experimental Result

- **YOLOv8**

The most latest model in the YOLO series, the YOLOv8 real-time object detection, offers cutting-edge speed and accuracy. Building on the advancements of previous YOLO versions, YOLOv8 offers more capabilities and optimizations, making it the ideal choice for a wide range of object recognition tasks in various applications.

The research's outcome is displayed in the figure below:

epoch	train/box_loss	train/cls_loss	train/dfl_loss	metrics/precision(B)	metrics/recall(B)	metrics/mAP50(B)	metrics/mAP50-95(B	val/box_loss	val/cls_loss	val/dfl_loss	lr/pg0	lr/pg1	lr/pg2
1	2.0238	3.7889	1.8567	0.0994	0.64681	0.12038	0.06315	1.6201	23.701	1.613	0.0001375	0.0001375	0.0001375
2	1.5719	1.9381	1.4275	0.14654	0.67972	0.16267	0.08659	1.6615	3.6289	1.5765	0.00028465	0.00028465	0.00028465
3	1.5925	1.7552	1.464	0.08431	0.26629	0.03526	0.01478	2.005	inf	1.7953	0.00042884	0.00042884	0.00042884
4	1.5379	1.7238	1.456	0.03448	0.13175	0.0173	0.00808	1.918	nan	1.9242	0.00057005	0.00057005	0.00057005
5	1.5171	1.642	1.3976	0.00023	0.01365	0.00012	8.00E-05	nan	nan	nan	0.00070829	0.00070829	0.00070829
6	1.5415	1.5867	1.4651	0.00013	0.01706	7.00E-05	2.00E-05	nan	nan	nan	0.00084357	0.00084357	0.00084357
7	1.5464	1.5465	1.4036	0.00013	0.01706	7.00E-05	2.00E-05	nan	nan	nan	0.00097587	0.00097587	0.00097587
8	1.5556	1.5511	1.4483	0.00043	0.02414	0.00023	9.00E-05	nan	nan	nan	0.0011052	0.0011052	0.0011052
9	1.5547	1.6338	1.4213	0.00043	0.02414	0.00023	9.00E-05	nan	nan	nan	0.001151	0.001151	0.001151
10	1.6767	1.6547	1.4787	0.00043	0.02414	0.00023	9.00E-05	4.9508	inf	109.23	0.001151	0.001151	0.001151
11	1.5878	1.539	1.4772	0.00043	0.02414	0.00023	9.00E-05	4.3088	inf	6.6053	0.0011386	0.0011386	0.0011386
12	1.4791	1.4474	1.3803	0.10349	0.55494	0.11542	0.06199	1.7972	4.4716	1.8566	0.0011263	0.0011263	0.0011263
13	1.4658	1.3604	1.3917	0.13638	0.52219	0.2363	0.1184	1.8341	3.4884	1.7497	0.0011139	0.0011139	0.0011139
14	1.5052	1.3757	1.3991	0.16956	0.36852	0.15545	0.08852	1.948	4.0446	2.0791	0.0011015	0.0011015	0.0011015
15	1.4783	1.3551	1.3846	0.04483	0.06958	0.00777	0.00486	3.1158	inf	5.6698	0.0010891	0.0010891	0.0010891
16	1.4423	1.3377	1.3809	0.0083	0.33865	0.00524	0.00286	2.2145	inf	3.1077	0.0010768	0.0010768	0.0010768
17	1.4143	1.3434	1.3733	0.29125	0.65565	0.35822	0.19969	1.6217	1.5563	1.6255	0.0010644	0.0010644	0.0010644
18	1.4107	1.3329	1.3636	0.2412	0.59163	0.36008	0.19783	1.5761	2.0495	1.6343	0.001052	0.001052	0.001052
19	1.4129	1.2978	1.3448	0.32582	0.68511	0.40616	0.1879	1.763	1.5101	1.7708	0.0010396	0.0010396	0.0010396
20	1.4398	1.2778	1.381	0.31964	0.73684	0.44985	0.25596	1.6244	1.4829	1.634	0.0010273	0.0010273	0.0010273

Fig 5.2.1: Model Training

After completing 100 Epochs result. But In this fig showing the 1st 20 Epoch for training the Model and Results.

- **Curves**

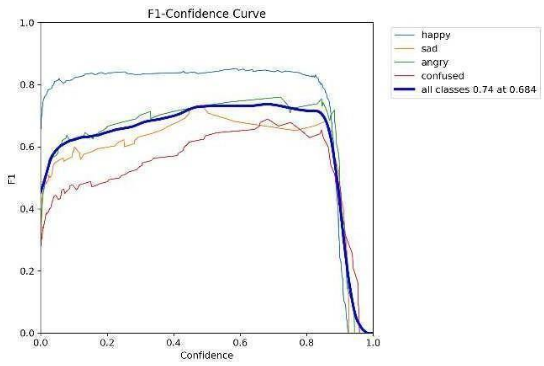

Fig 5.2.2: F1 Curve

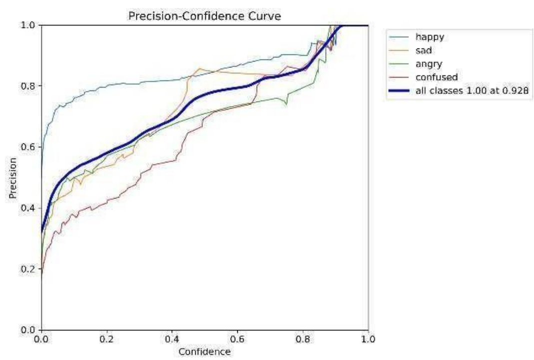

Fig 5.2.3: Precision Curve

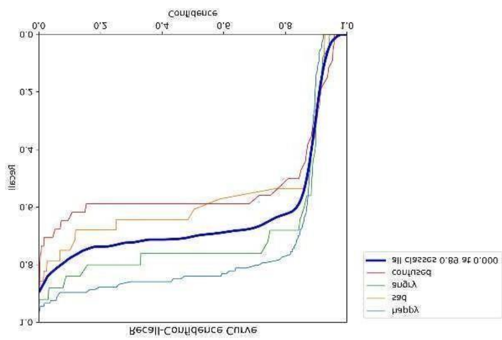

Fig 5.2.4: Recall Curve

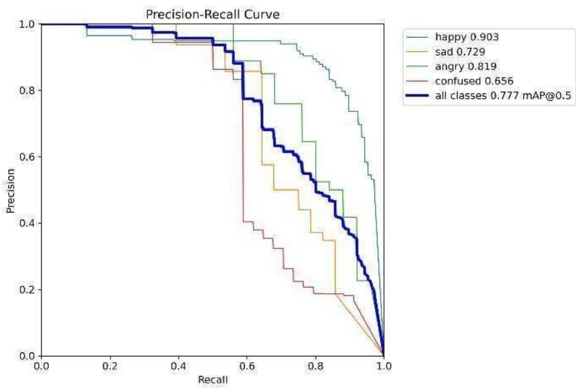

Fig 5.2.5: Precision-Recall Curve

By balancing precision and recall, the F1 score represents a model's performance over a range of thresholds. Recall and Accuracy Through curve visualization, these variables are plotted against various classification thresholds, offering insights into the trade-offs a model makes in terms of performance between identifying genuine positives and reducing false positives.

- **Confusion Matrix**

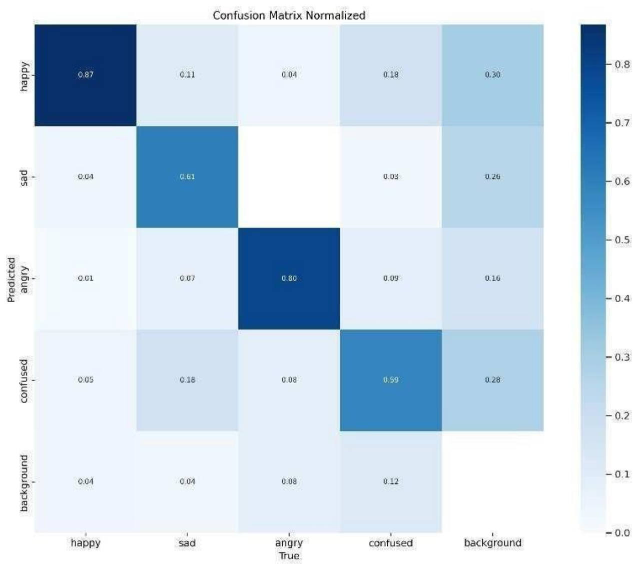

Fig 5.2.6: Confusion Matrix for YOLOv8

A Confusion Matrix for YOLOv8 provides a comprehensive evaluation of the model's classification performance across numerous emotion categories by providing true positives, true negatives, false positives, and false negatives.

- **Result Map**

Class	Images	Instances	Box(P	R	mAP50	mAP50-95): 100% 2/2 [00:01<00:00, 1.92it/s]
all	41	193	0.824	0.678	0.777	0.627
happy	41	106	0.887	0.811	0.903	0.704
sad	41	28	0.838	0.554	0.729	0.637
angry	41	25	0.751	0.76	0.819	0.605
confused	41	34	0.822	0.588	0.656	0.561

Fig 5.2.7: Result Mapping for YOLOv8

- **Result Graph**

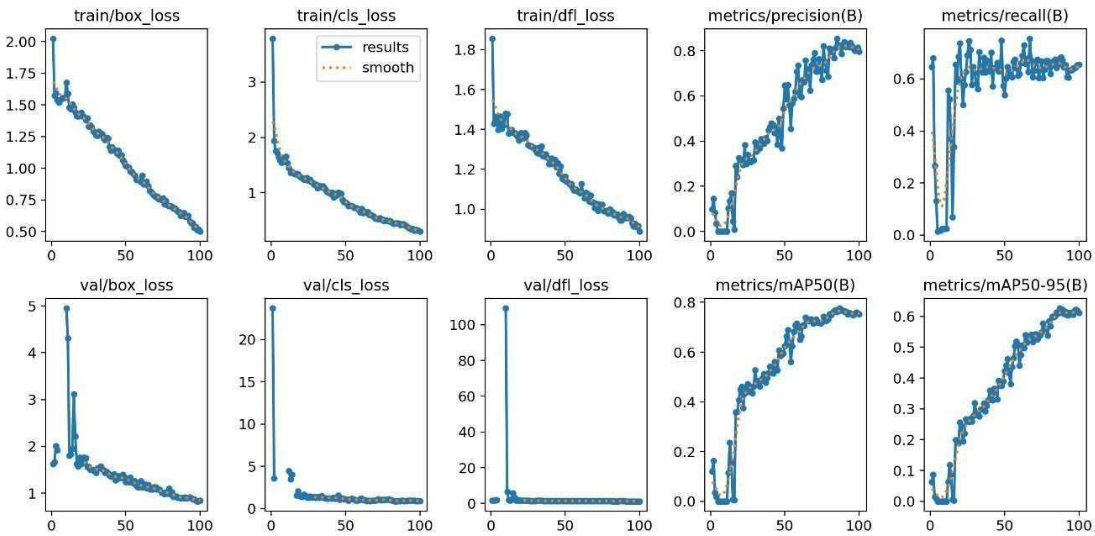

Fig 5.2.8: Result Graph for YOLOv8

Our model operates with an accuracy of up to 77%, as demonstrated by the mapping YOLO v8 create result graph.

5.3 Performance Analysis

Fig 5.3.1: Batch Annotation

Fig 5.3.2: Batch Prediction

Our model operates with an accuracy of up to 77%, as demonstrated by the mapping YOLO v8 create result graph.

5.4 Summary

The higher Mean Average Precision (mAP: 77%) ratings of YOLOv8 demonstrate how accurate it is in detecting emotions. In addition to its remarkable accuracy, YOLOv8's computational efficiency makes processing faster, which is perfect for real-time object detection. It provides accurate human face detecting activities with its improved algorithmic advancements and YOLOv8 efficiency.

CHAPTER 6

Impact on Society, Environment, and Sustainability

6.1 Impact on Life

Deep CNN research on sentiment analysis from face photos has the potential to improve user experience, increase human-computer interaction, and support mental health monitoring. It provides insights into client sentiments for improved services and successful campaigns in business and marketing. Real-time feedback and adaptive learning are beneficial to education. Healthcare professionals can keep an eye on patients' emotional health and treatment outcomes. Better content filtering and customized suggestions are added to social media and online platforms. While accessibility tools help those with communication problems, security systems are capable of identifying anomalous conduct. Immersion experiences and customized material are offered by the entertainment sector. All things considered, this technology improves the effectiveness and empathy of relationships across many domains.

6.2 Impact on Society

In Real-time mental health monitoring is possible with the integration of facial sentiment analysis into a range of platforms and gadgets. This might provide important information on people's emotional wellbeing and reveal warning indications of mental health problems like anxiety or depression.

Analysis of Customer Feedback: Companies can utilize facial sentiment analysis to determine how customers feel about certain goods, services, or commercials. This data could be used to enhance overall happiness, personalize marketing campaigns, and improve client experiences.

Education and Training: Facial sentiment analysis can be employed by educational establishments and corporate training initiatives to evaluate students' comprehension and engagement levels. Teachers might modify their teaching strategies to better meet the needs of specific students or staff members by observing the facial expressions made by participants during lectures or training sessions.

Human-Computer Interaction: Personalized and responsive interactions could improve user experiences through the integration of face sentiment analysis into HCI systems. Software programs, for instance, might adapt their replies according to the user's emotional state, resulting in more intuitive and sympathetic interactions.

Social Robotics: Sentiment analysis from facial photos could be used in social robotics to help robots better understand and behave like people. In a variety of settings, including healthcare, education, and entertainment, this might enable more organic and meaningful interactions between people and robots.

The ethical implications of using facial sentiment analysis algorithms must be carefully considered. This is especially true with relation to privacy, permission, and potential biases. The development of moral standards and laws to guarantee the ethical and just application of this technology can be aided by research in this field.

Overall, by enabling a more nuanced understanding and utilization of human emotions through facial sentiment analysis, your research has the potential to benefit a wide range of fields, from healthcare and education to customer service and human- computer interaction.

6.3 Impact on Environment

Energy Consumption: Significant computational power is needed for training deep learning models like YOLOv8, which is often supplied by cloud services or high- performance computing (HPC) equipment. This computationally demanding process uses a significant amount of energy, which, if derived from non-renewable sources, increases carbon emissions.

Data Center Operations: Data centers, which use a lot of electricity to operate computers and cool themselves, are usually involved in the processing and storing of the massive datasets required to train deep learning models. Data centers' effects on the environment include garbage production, water and energy consumption.

Electronic garbage: As a result of the rapid evolution of technology, hardware upgrades and replacements occur often, leading to the generation of electronic garbage, or e-waste. Although the focus of your research is software development, as companies upgrade their hardware infrastructure to handle computationally intensive workloads, the deployment of deep learning systems may indirectly add to the generation of e-waste.

Carbon Footprint: The carbon footprint related to your study includes indirect emissions from equipment transportation, data center facility management, and hardware component production in addition to direct energy consumption. Both environmental deterioration and climate change are exacerbated by these emissions.

You may think about using the following tactics to lessen the negative effects your research will have on the environment:

Energy-Efficient Computing: To minimize energy usage during training and inference procedures, optimize software implementations, hardware architectures, and algorithms.

Renewable Energy: To lessen the carbon footprint of computer operations, use renewable energy sources like solar, wind, or hydroelectric power.

Cloud Resource Management: Reduce energy waste and boost productivity in cloud environments by optimizing task scheduling and resource utilization.

Encourage programs aimed at recycling electronic components, prolonging the life of hardware, and using energy-efficient hardware designs in order to cut down on energy use and e-waste.

Through the application of these techniques and the dissemination of knowledge on the environmental consequences of deep learning research, you may contribute to reducing the environmental impact of facial image sentiment analysis and advancing sustainable methods in the advancement of artificial intelligence.

6.4 Ethical Aspects

Privacy is an issue when analyzing facial photos without express consent because they include sensitive personal information. Making sure that people's rights to privacy are upheld during the data collecting, storage, and analysis process is crucial. Informed consent from participants and the use of strong data anonymization techniques can assist reduce privacy threats.

Fairness and Bias: Age, gender, and ethnicity are only a few examples of the biases that might affect sentiment analysis and facial recognition systems. Algorithms that are biased can result in unjust treatment and support existing social injustices. To make sure that your model's predictions are equitable and fair, it is essential to assess and reduce bias. This entails applying methods for bias detection and correction in addition to utilizing representative and varied datasets.

Getting Informed Consent: It's crucial to have the consent of the people whose faces are used to train or test the model. In order to do this, it must be made clear to them how their data will be used, as well as any possible dangers or benefits, and their rights with regard to privacy and data usage. Additionally, participants must to have the flexibility to revoke their consent at any moment from researchers.

Data Security: Unauthorized access, misuse, and exploitation of facial image datasets is a serious risk that must be avoided. Strong security measures, such as encryption, access controls, and recurring security audits, should be put in place by researchers to protect the data's confidentiality and integrity.

Social Implications: Emotion analysis of facial photos can have a big social impact by influencing how decisions are made in a lot of different areas, such law enforcement, healthcare, and employment. The possible societal repercussions of implementing such technology, including its implications on people's autonomy, dignity, and well-being, must be carefully considered.

Regulatory Compliance: Make sure that the gathering, processing, and storing of face image data complies with all applicable laws and rules, such as the Health Insurance Portability and Accountability Act (HIPAA) in the US and the General Data Protection Regulation (GDPR) in Europe. Legal ramifications and harm to one's reputation may arise from breaking these rules.

Researchers, ethicists, legislators, and other stakeholders must work together to address these ethical issues through a multidisciplinary method. You may ensure that the advantages of facial sentiment analysis technology are maximized while reducing potential damages to individuals and society by supporting responsible use of the technology and incorporating ethical standards into your research processes.

6.5 Sustainability Plan

Sustainability Reduce the amount of energy used during training and inference procedures by optimizing your hardware infrastructure, software implementations, and algorithms. Investigate ways to increase computing efficiency without compromising accuracy by using parallelization, quantization, and model compression.

Reducing carbon emissions and mitigating environmental effect can be achieved by powering your computing infrastructure with renewable energy sources like hydroelectric power, solar power, or wind power. Engage in on-site renewable energy generation or form partnerships with cloud service companies that supply renewable energy solutions.

Protect sensitive data by using strong encryption, access controls, and anonymization strategies throughout your research. Data privacy and security should be your top priority. Participants should provide their informed consent, and compliance with applicable privacy laws like GDPR and HIPAA should be ensured.

Detection and Mitigation of Biases: Keep an eye out for any biases and concerns with fairness in your model, especially with regard to sensitive attributes such as gender and ethnicity. To guarantee just and equitable results, employ representative and diversified datasets, apply bias detection techniques, and create plans for bias prevention.

Training and Ethical Guidelines: To encourage responsible behavior and increase understanding of ethical issues, give the researchers working on your project materials and training. For the ethical gathering, use, and distribution of data, create internal policies and procedures. Then, periodically evaluate and update them to take into account new legal requirements and best practices.

Engagement with the Community: Seek input, resolve issues, and promote cooperation from a range of stakeholders, including those in academia, business, government, and civil society. Engage in outreach programs, public forums, and seminars to garner feedback on prospective sustainability projects and to draw attention to the societal consequences of your study.

6.6 Summary

Researchers, ethicists, legislators, and other stakeholders must work together to address these ethical issues through a multidisciplinary method. You may ensure that the advantages of facial sentiment analysis technology are maximized while reducing potential damages to individuals and society by supporting responsible use of the technology and incorporating ethical standards into your research processes.

CHAPTER 7

Conclusion and Future Work

7.1 Conclusion

In conclusion, our research on YOLOv8-assisted facial image sentiment analysis has produced insightful findings and encouraging outcomes. We were able to identify and categorize emotions from facial expressions with a noteworthy accuracy rate of 77% by utilizing the YOLOv8 architecture's resilience and efficiency. This proves that deep learning techniques are effective for practical sentiment analysis applications. Additionally, our findings highlight how crucial it is to address ethical issues in facial sentiment analysis, such as data privacy protection, bias prevention, and transparency. We guarantee the ethical and fair use of this technology, defending people's rights and welfare, by placing a high priority on ethical behavior. We also acknowledge that sentiment analysis from facial photos has extensive societal ramifications, including education, human-computer interaction, social robots, education monitoring, and customer feedback analysis. Lastly, our sustainability strategy provides tactics to reduce our research's negative environmental effects, advance moral behavior, and guarantee its continued applicability and accessibility. Our goals are to promote sustainable research procedures, maintain ethical integrity, and improve the area of sentiment analysis through these initiatives.

7.2 Further Suggested Work

The work on sentiment analysis from facial photos with YOLOv8 provides a number of new directions for investigation and study:

Fine-Grained Emotion Recognition: Future research may concentrate on more nuanced emotion recognition, which would include delicate changes and combinations of emotions, whereas our work concentrated on fundamental emotion classification (e.g., happy, sad, angry, confused). Creating models with the ability to recognize nuanced emotional states and comprehend emotions unique to a given situation may be necessary for this.

The accuracy and comprehensiveness of emotion detection systems could be improved by combining face sentiment analysis with other modalities like audio, text, and physiological inputs, or multimodal sentiment analysis. To gain deeper insights into human emotions and behavior, multimodal sentiment analysis methodologies should be investigated.

Examining the ways in which cultural variances impact facial expressions and emotional interpretations could enhance the sentiment analysis models' inclusivity and generalizability. Facial sentiment analysis may become more applicable in a variety of situations by carrying out cross-cultural research and creating models that take cultural sensitivity into account.

Research following People's Emotions Over Time: These research may offer important new information about emotional dynamics, resilience, and the course of mental health. Tailor-made interventions and support networks may be informed by examining changes in facial expressions over time and connecting them to experiences and events in life.

A deeper comprehension of the moral, legal, and societal ramifications of facial sentiment analysis technologies is required through additional research. This involves looking into things like algorithmic bias, privacy concerns, possible abuse, and the effects society has on people as individuals and as communities.

Usability, acceptability, and efficacy of face sentiment analysis systems can all be increased by incorporating user preferences and feedback into system design and development. This approach is known as user-centric design. It is possible to make sure that these systems satisfy the requirements and expectations of various user groups by carrying out user research and participatory design sessions.

Robustness and Generalization: In order to deploy facial sentiment analysis models in the actual world, methodologies to enhance their robustness and generalization capacities must be investigated. To improve the performance and dependability of the model in a variety of settings, this entails tackling issues including data scarcity, domain adaptation, and adversarial attacks.

By carrying out additional research in these areas, scientists can improve the face sentiment analysis systems' capacities, precision, and moral rectitude—which will ultimately lead to a wider acceptance and positive social impact.

7.3 Limitation

YOLOv8 presents a number of challenges when it comes to sentiment analysis from facial images. These include the variability of facial expressions due to individual and cultural differences, occlusion issues caused by accessories or facial hair impacting facial feature visibility, the difficulty of accurately differentiating subtle emotional states, fluctuations in lighting conditions affecting facial visibility and requiring adaptable algorithms, the need for algorithms capable of analyzing facial expressions across varied poses and angles captured in images, the difficulty of generalizing across cultural expressions, and the technical challenges.

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Appendix A

Course Outcomes, Complex Engineering Problems (EP) and Complex Engineering Activities (EA) Addressing

Title: SENTIMENT ANALYSIS FROM FASCIAL IMAGE USING YOLO: ENHANCING EMOTION RECOGNITION THROUGH REAL-TIME OBJECT DETECTION

Student ID: 201-15-3328

CO Description for FYDP

CO	CO Descriptions	PO
	Phase -I	
CO1	Integrate recently gained and previously acquired knowledge to identify a **Emotion Recogition Through Real-Time object Detection** problem for the Final Year Design Project (FYDP)	**PO1**
CO2	Analyze different aspects of the goals in designing a solution for this Final Year Design Project	**PO2**
CO3	Explore diverse problem domains through a literature review, delineate the issues, and establish these goals for the Final Year Design Project	**PO4**
CO4	Perform economic evaluation and cost estimation and employ suitable project management procedures throughout the development life cycle of the Final Year Design Project	**N/A**
	Phase -II	
CO5	Design and develop technical solutions and system components or processes that meet specified requirements, ensuring compliance with public health and safety standards, as well as considering cultural, socioeconomic, and environmental factors in this FYDP	**PO3**
CO6	Choose and apply appropriate methodologies, resources, and contemporary engineering and IT technologies to address complex engineering processes, encompassing prediction and modeling, while adhering to relevant constraints in this FYDP	**PO5**

CO7	Analyze societal, health, safety, legal, and cultural considerations, along with associated responsibilities, in the context of professional engineering practice and the resolution of this problem, employing logical reasoning guided by contextual understanding.	**PO6**
CO8	Comprehend and evaluate the enduring sustainability and impact of professional engineering endeavors in addressing intricate engineering challenges within social and environmental frameworks.	**PO7**
CO9	Implement ethical principles and adhere to professional standards and norms in this FYDP	**PO8**
CO10	Capable of operating proficiently both individually and as a team member or leader across diverse teams and interdisciplinary settings in this FYDP.	**PO9**
CO11	Proficiently communicate with the engineering community and broader society regarding complex engineering endeavors, including the ability to comprehend and generate comprehensive reports and design documentation, as well as provide and receive clear instructions throughout this FYDP.	**PO10**
CO12	Acknowledge the importance of self-directed and life-long learning within the evolving landscape of technology, and possess the readiness and capability to engage in lifelong learning endeavors.	**PO12**

Addressing CO (1 to 8), Knowledge Profile (K), Attainment of Complex Engineering Problems (EP):

SN	EP Definition	Attainment	CO	Justification (with Knowledge Profile)	References
1.	**EP1: Depth of Knowledge required**	Yes	CO1, CO2, CO3, CO5, CO6, CO7 &	This project highlights fundamental engineering (K3) concepts by using YOLO Algorithm. The project exhibits expert knowledge (K4)	**Page no:** [1-4,5-8,10] **Section:** [1.1,1.2,2.2, 2.3, 3.1]

			CO8	through the use of sophisticated model, as well as engineering practice and design. It also assures K8 (Research Literature) by using insights from current research to improve face detection with YOLOv.	
				The project addresses **engineering practice & technology (K6)** by YOLOv8.	**Page no:** [14, 17-19] **Section:** [4.1,4.3]
				This project ensures to **K8 (Research Literature)** by synthesizing insights from recent studies to advance real time face detection.	**Page no:** [5-7] **Section:** [2.2]
2.	**EP2: Range of Conflicting Requirements**	Yes	CO2, and CO7	This project addresses **EP-2** by Recognizes hurdles in face detection	**Page no:** [3, 8,35] **Section:** [1.5,2.4,7.3]

				including limitations of traditional methods and complexities of integrating YOLOv8	
3.	**EP3: Depth of analysis required**	Yes	CO2, and CO6	This project addresses **EP-3** by meticulously experimental outcomes, highlighting YOLOv8 and chosen solution for enhancing face detection accuracy.	**Page no:** [20-26] **Section:** [5.1-5.4]
4.	**EP4: Familiarity of Issues**	Yes	CO8	This project's interdisciplinary approach extends beyond computer science and engineering, Interdisciplinary approach **EP-4**.	**Page no:** [5-7,9] **Section:** [2.2,2.5]
5.	**EP5: Extends of application codes**	Yes	CO5	Applied on methodology	Page No: [10-11] Section: [3.2]

6.	**EP6: Extends of stakeholders involved and conflicting requirements**	Yes	CO8	We have collected data from self collected.	**Page No:** [14-17] **Section:** [4.2]
7.	**EP7: Interdependence**	Yes	CO5	This project's comprehensive Integrates various components across data collection, analysis, and methodology ensuring a holistic solution which ensures **EP-7**.	**Page no:** [10-13] **Section:** [3.2-3.4]

Addressing CO11 with Complex Engineering Activities (EA) [Some or all of the following]:

SN	EA Definition	Attainment	CO	Justification	References
1.	**EA1: Range of resources**	Yes	CO11	My project utilizes diverse resources such as high-performance computing infrastructure,	**Page no:** [10-12,,14-17] **Section:** [3.2,3.3,4.2]

				GPUs, deep learning frameworks, datasets , and ethical considerations to ensure systematic research and contribute to real time face detection with YOLOv8.	
2.	**EA2: Level of interaction**	No		N/A	N/A
3.	**EA3: Innovation**	No		N/A	N/A
4.	**EA4: Consequences for society and the environment**	Yes		This project contributes to society by improving knowledge through real time face detection while promoting environmental sustainability.	**Page no:** [27-32] **Section:** [6.1-6.4]

5.	**EA-5: Familiarity**	Yes		This project Expands existing research by examining face detection using YOLOv8 offering new insights.	**Page no:** [5-8] **Section:** [2.2, 2.3]

Addressing CO (4, 9, 10, and 12):

SN	COs	Attainment	Justification	References
1	CO4	Yes	In order to CO4, this project combines efficient project management with financial control. Careful planning, resource distribution, and budget estimation are guaranteed to provide the best possible resource utilization throughout the duration of the study project.	**Page no:** [4, 12-13] **Section:** [1.6, 3.5]
2	CO9	Yes	The project demonstrates adherence to ethical principles by prioritizing client privacy, obtaining informed consent, and transparently documenting the research process, ensuring responsible knowledge dissemination and societal well-being through the ethical application of advanced real estate technologies that comply with **CO9**.	**Page no:** [30-32] **Section:** [6.3,6.4]
3	CO10	No	N/A	N/A

4	CO12	Yes	The project's dedication to continuous learning **(CO12)** and adaptation within the dynamic technological landscape is reflected in its comprehensive data collection, rigorous statistical analysis, methodology development, and thorough experimental results and analysis, showcasing a commitment to staying updated and refining techniques to address modern challenges.	**Page no:** [10-13,21-26] **Section:** [3.1-3.5, 5.2, 5.3, 5.4]

Sentimental Analysis From Fascial Image Using YOLO: Enhancing Emotion Recognition Through Real-Time Object Detection

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