EMOTION ANALYSIS

Group 3

Emotion Analysis in the domain of sports through neural networks:

To determine how the performance of sports players is affected by emotional morale

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12-11-2024

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We the Team!

NAME	ROLES
Pradyumn Kedar Tendulkar (Team Leader)	Data collection and Model testing
Sathvick Sudarsan	Business Model Aspect + Model building
Shrirang Patil	Model Building + Training
Utkarsh Krishna	Data Cleaning and case study
Aadya Goel	Literature Survey + Presentation
Faiz Shamsudeen Bin Hussain	Research + Business model

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Project Outline

A emotional analysis system that uses advanced facial recognition software, which includes CNN bi-directional LSTM model, to detect the different emotions that the footballers are undergoing through their career. For this we are using the CK+48 5 Emotion Dataset, which we divided into 70 and 30 percent respectively for training and validating the data. We implemented three models, simple CNN, CNN bi-directional LSTM and convolutional LSTM, which gave us 98.22,90.67,95.00 percent accuracies respectively. This software will be given to big sports data companies, which will be used to analyse the patterns and trends of each player's emotions individually, so that the necessary actions can be taken to boost their performance.

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What we are trying to build?

Our facial emotional analysis system utilizes advanced facial recognition software, including a CNN bi-directional LSTM model, to detect and quantify different emotions from facial expressions. This data is then analysed to understand patterns and trends in emotional responses and identify areas for improvement. The use of a CNN bi-directional LSTM model allows our software to analyse both past and future context in order to better understand the relationships between different emotions and improve the accuracy of our analysis.

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Key performance indicators

Emotion Frequency

This could be calculated by counting the number of times a particular emotion is displayed over a specific period of time, such as a game or practice session.

Emotion Intensity

This could be calculated by measuring the intensity of an emotion based on the presence and intensity of certain facial features, such as eyebrows, eyes, nose, and mouth.

Emotion Duration

This could be calculated by measuring the length of time that an emotion is displayed.

Emotion Consistency

This could be calculated by measuring the consistency of emotional expressions over time. For example, a player who consistently displays high levels of frustration or anger may be more likely to struggle with emotional management.

Emotion Correlation

This could be calculated by analysing the relationship between different emotions and other factors, such as performance, team dynamics, or external stressors.

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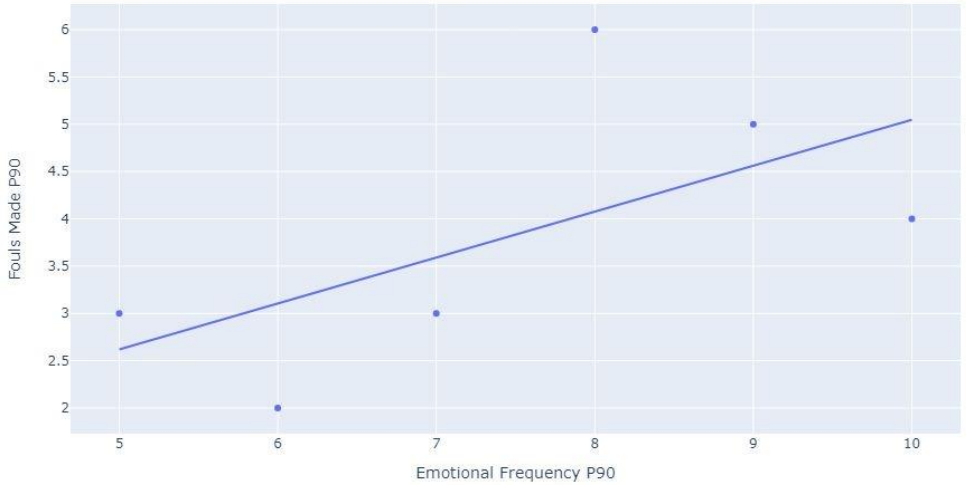
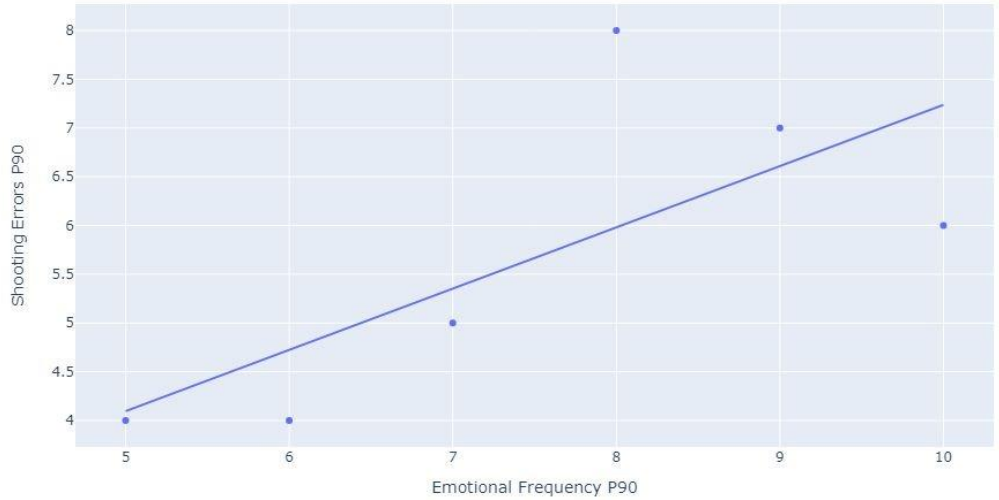
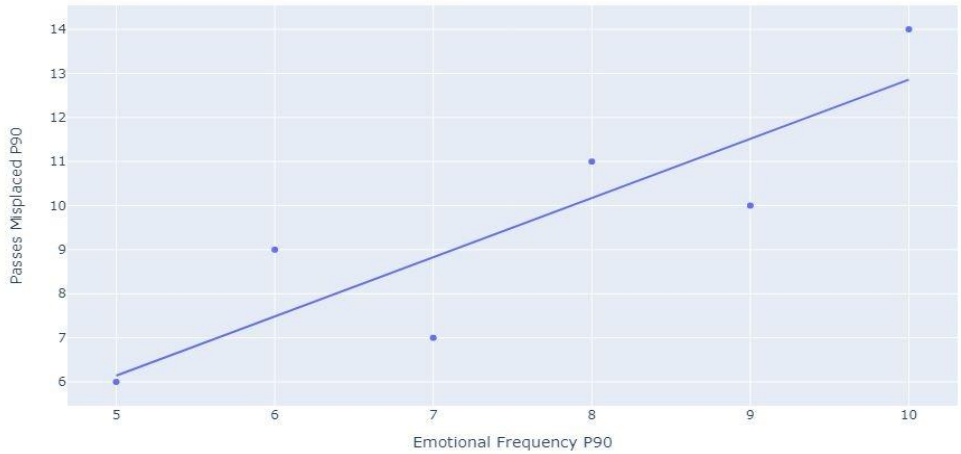
Use case of KPI: Emotional Frequency



R = 0.6 approx.



R = 0.8 approx.



R = 0.7 approx.

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Abstract

Playing sports can be filled with emotions. To perform well in sport, athletes can learn to manage their emotions and cope with stress. In competitions, athletes have to face high levels of pressure, which may trigger a full range of emotions, which will directly affect their performance. However, this is easier said than done. Some emotion regulation and coping strategies might be more useful than others. One of the key challenges is understanding and managing player emotions to improve performance.

Facial emotional analysis systems that are quantified into data can provide valuable insights for coaches and trainers looking to support players emotionally and improve performance.

By understanding and managing player emotions, coaches and trainers can optimize player performance and contribute to the team's success.

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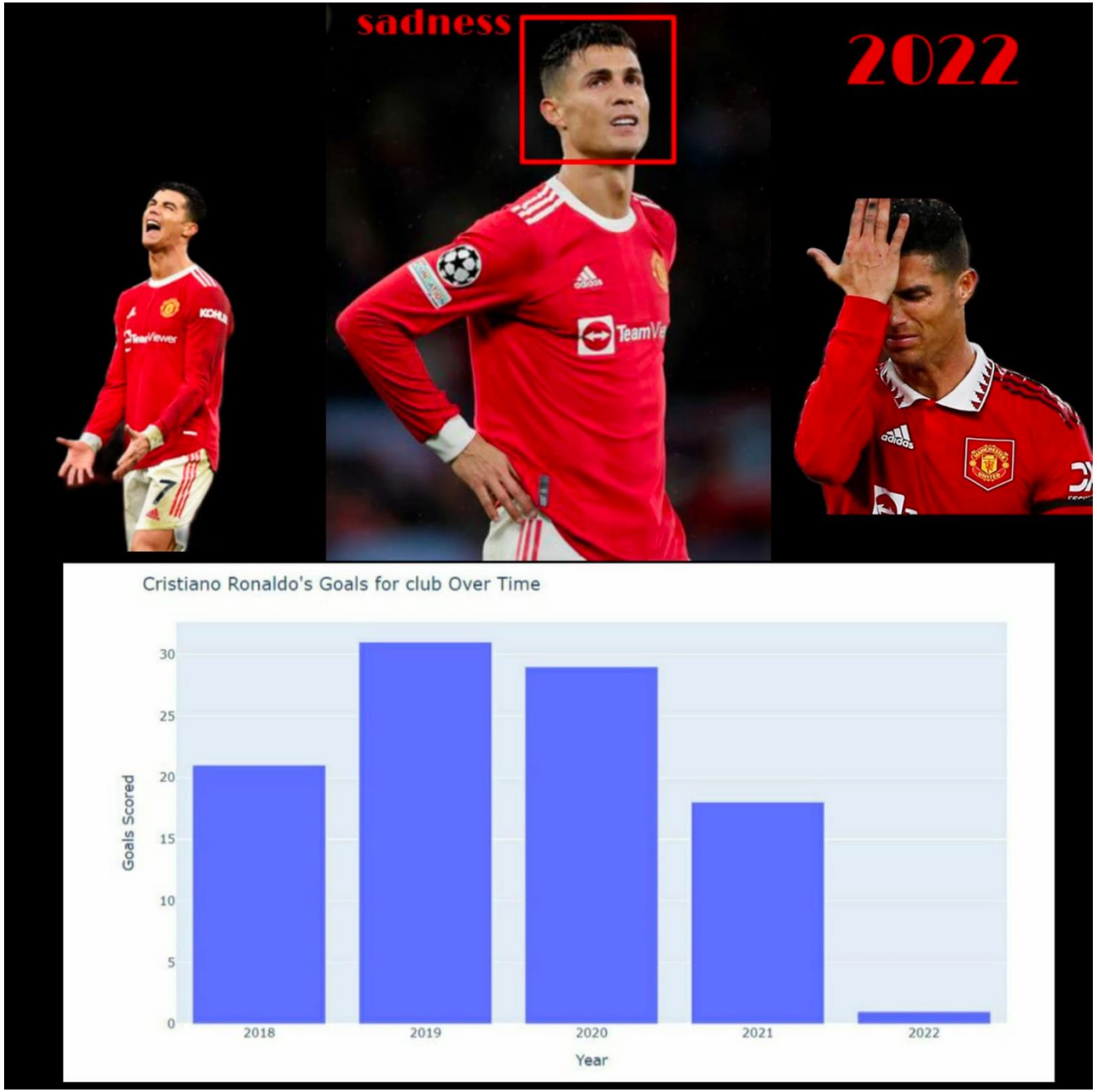
STATS OF CRISTIANO RONALDO



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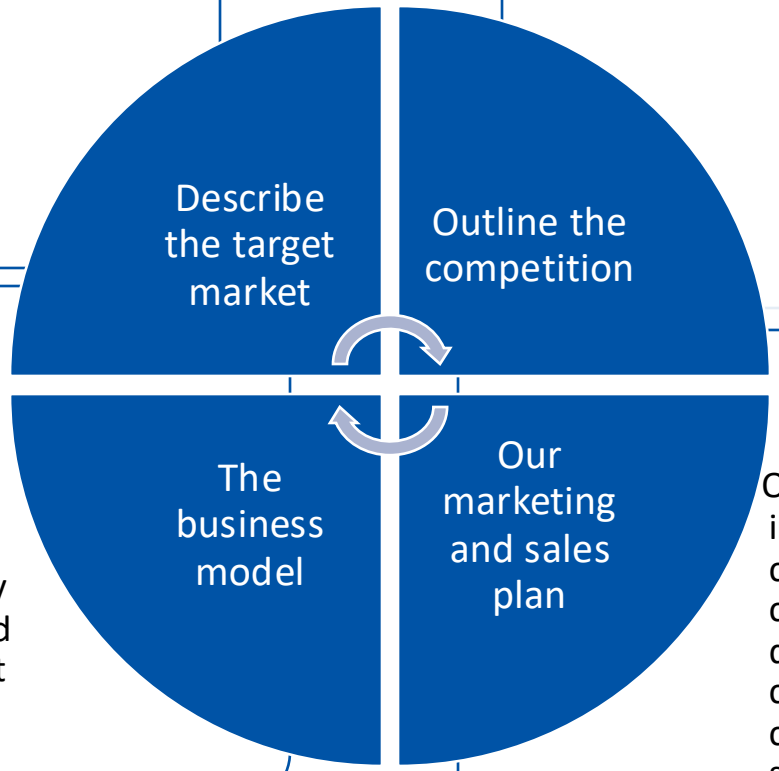
Business Use Case

StatsBomb

wyscout®

Our target market is major data companies in sports such as Statsbomb, Wyscout and others that are looking for innovative ways to understand and improve player performance

There are several companies that offer facial emotional analysis systems, but many of these systems are limited in their capabilities or are not specifically focused on sports. Our system is designed specifically for the sports industry and provides a more comprehensive and accurate analysis of player emotions.



Our business model is based on evaluating players using the emotional key performance indicators we collect to quantify the ability of a sports player and providing this data to our target market.

Our marketing and sales plan will involve targeting major data companies in sports through a combination of online advertising, direct mail campaigns, and sales calls. We will also attend industry conferences and events to showcase our product and build relationships with potential clients.

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Important Use Case

By analysing the facial expressions of players during games, coaches and trainers can identify players who are struggling emotionally. By identifying these players early on, coaches and trainers could provide support and intervene to prevent negative outcomes, such as poor performance or injury.

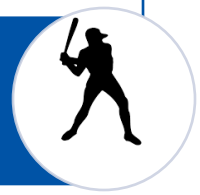
Identifying struggling players

Analysing the facial expressions of players during games gives a better understanding of reactions of players to different situations. This helps in identifying patterns and trends in player emotions, such as which situation tend to generate the most excitement or frustration.

Understanding player reactions to different situations

By analysing the facial expressions of players during games, coaches and trainers could provide feedback to players on how they are responding to different situations. Such as, if a player is consistently showing signs of frustration, the coach can provide guidance on how to better manage those emotions .

Providing feedback to players



Coaches and trainers get a better understanding of how players are interacting with each other and how their emotions are impacting the overall team dynamic. This helps them identify issues that may be affecting team performance and work to address them.

Improving team dynamics

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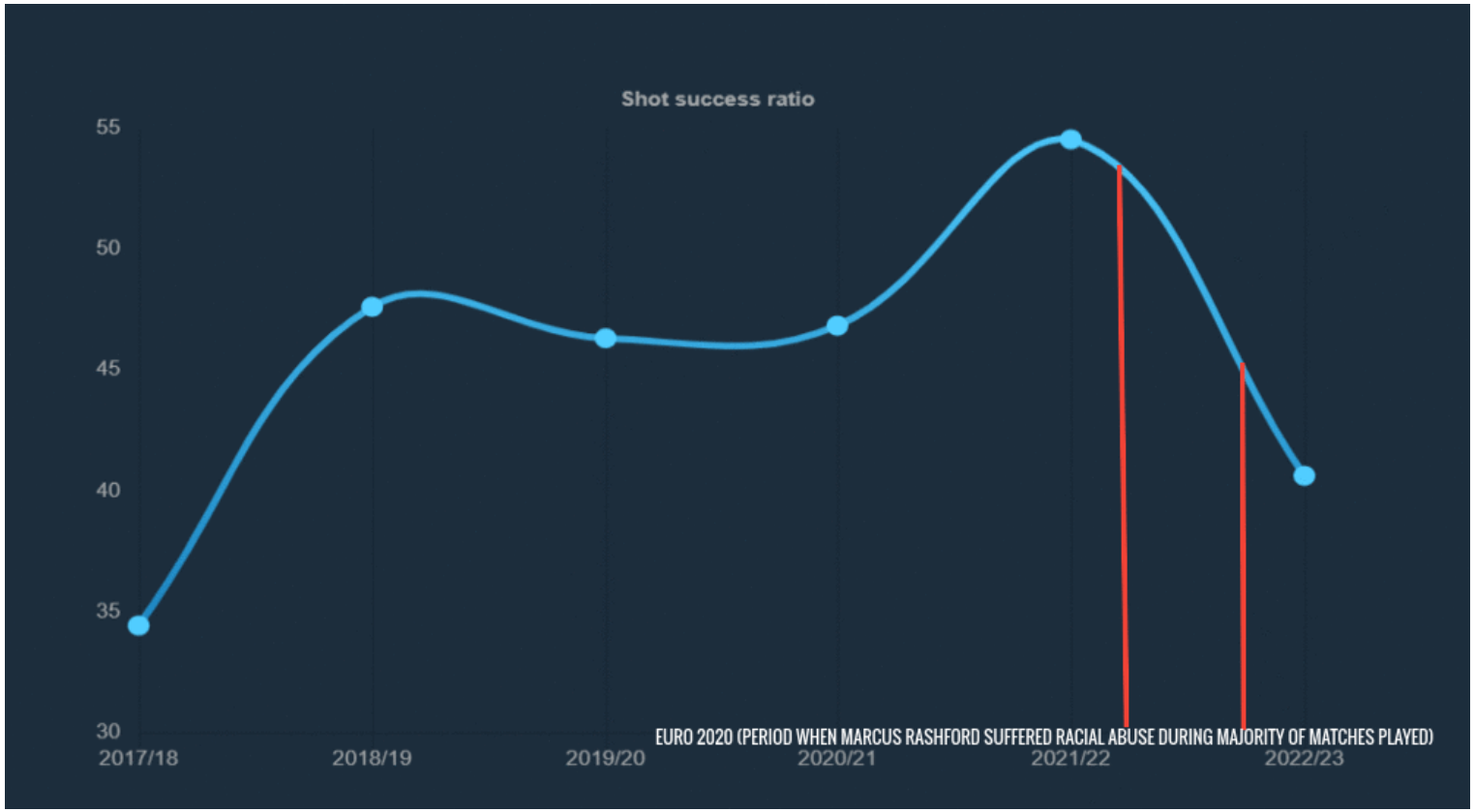
Case Study

Marcus Rashford is a football player who plays for Manchester united at club level and England at country level. During the EURO 2020 Final, Marcus missed one of his penalty kicks, which in part contributed to England losing. Post the tournament, he was subjected to racial abuses, chants and taunts from the crowd in most of his matches on international as well as club level. This led to a decline in his mental health and as a result of his emotional state, his performance declined. The below Graphs show his performance statistics –



SHOT SUCCESS RATIO DURING PERIOD OF EMOTIONAL DISTRESS

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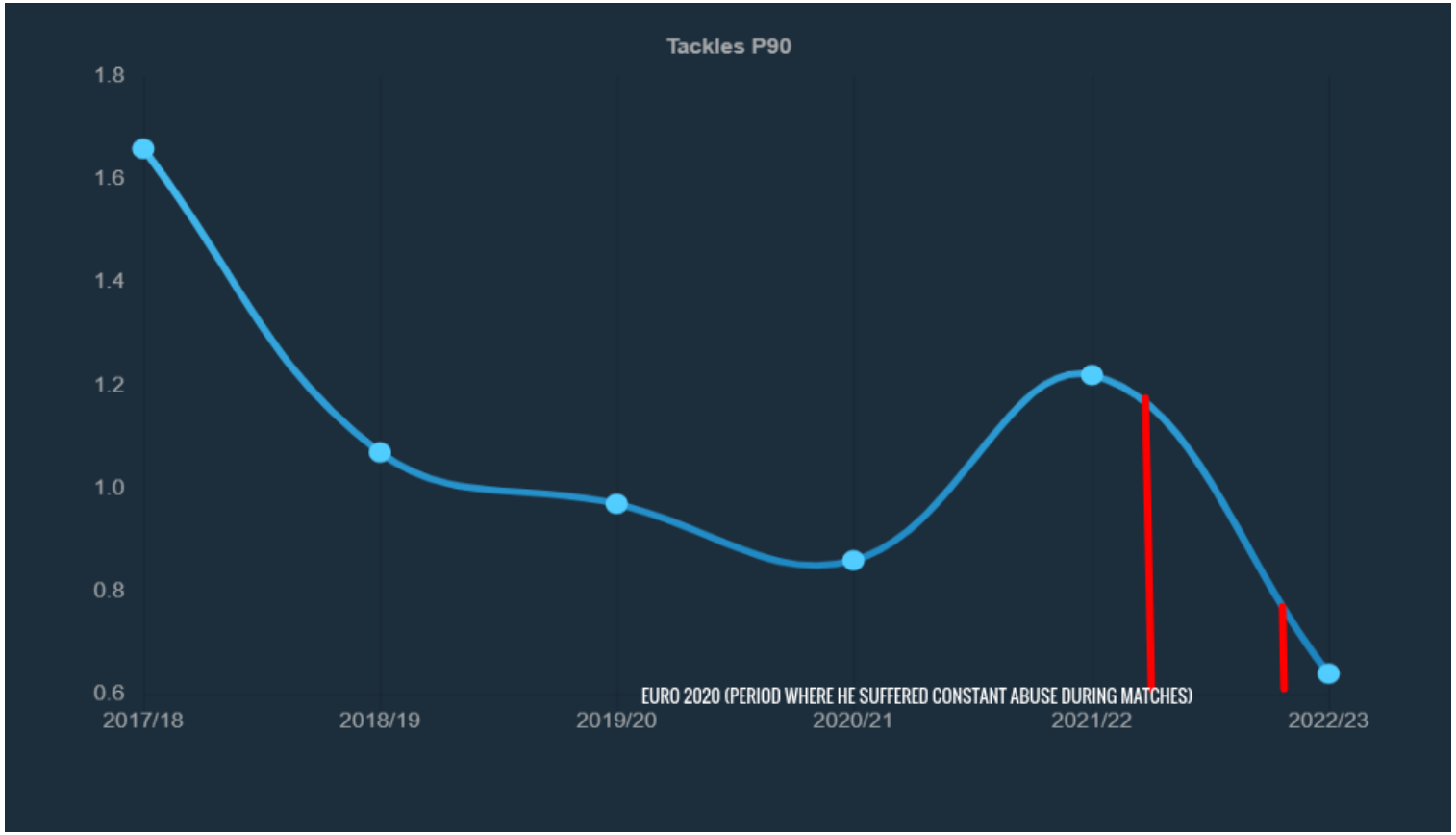
Harry Maguire is another England player, who suffered constant abuse and trolling on social media as well as during matches, which led to a decline in his mental health. Consequently, his performance dipped.



TACKLES COMPLETED DURING PERIOD OF EMOTIONAL DISTRESS

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Concepts Used

CNN: A type of ANN which is used for facial emotion detection and classification.

LSTM: A variety of RNN capable of learning long term dependencies especially in sequence prediction.

Bidirectional LSTM: Every component of input sequence has information from both past and present.

CNN BiLSTM: In this model LSTM layers are concatenated with CNN layers, in which frames are transformed into a sequence of vectors to classify the emotions.

Our Data

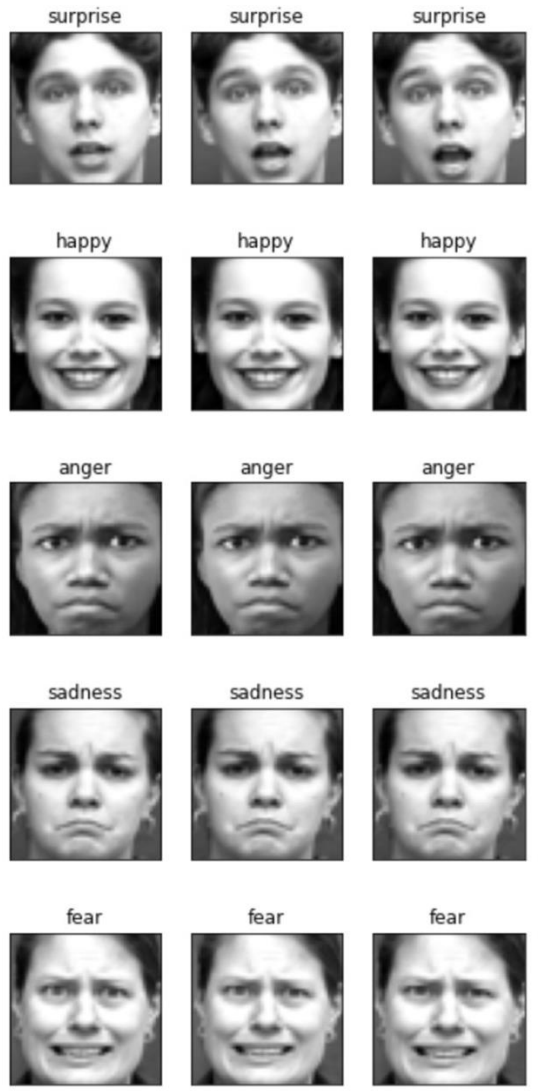
Reliable and Diverse

High Quality

Well annotated

Widely used

The CK+ (Cohn-Kanade+) dataset is a popular dataset for facial emotion recognition tasks.
Overall, the CK+ dataset is a reliable and widely used dataset for facial emotion recognition tasks, and it has several advantages over other datasets in this domain.



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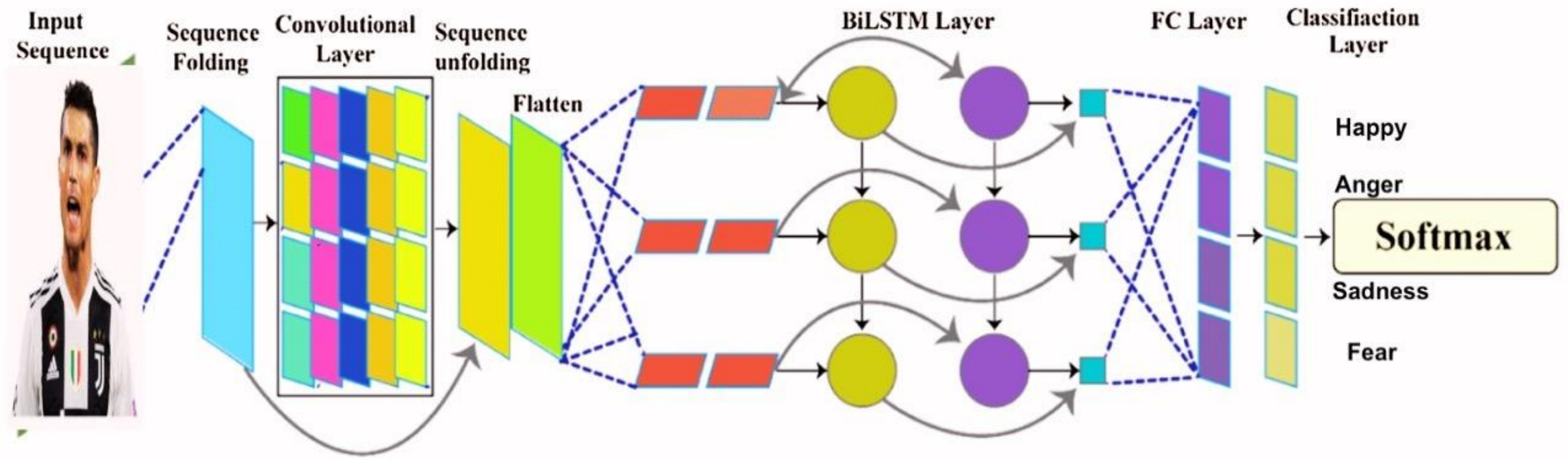
How we Processed Data

Dataset CK+ 48 was collected using various internet sources and Kaggle.
Data refining was done with the help of OpenRefine application.
Data augmentation was done manually for ease of access and to fit the model better.
The training of the ANN is accomplished through a learning process. While in the training process, weights are modified for attaining required results. In the training process, some sample data is processed to the network and weights are modified to attain better approximation of the desired output.

Algorithm Used



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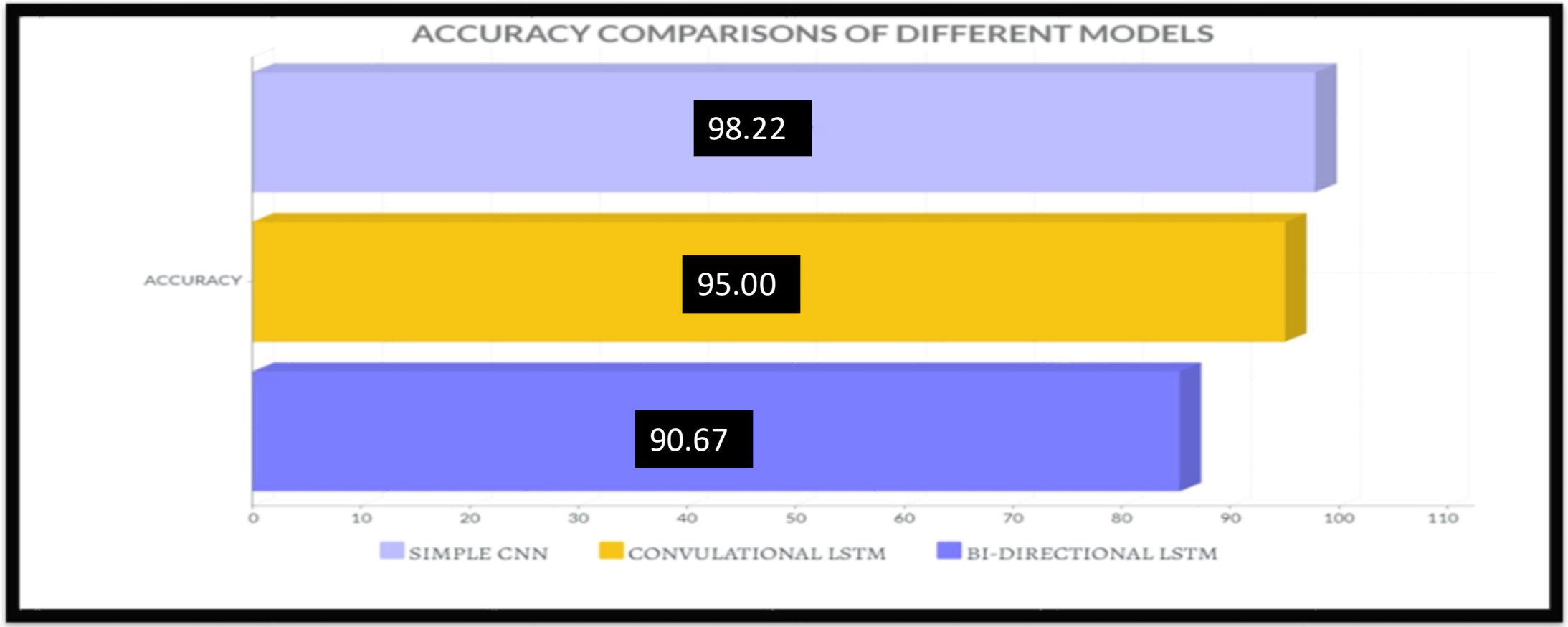
Comparison of Models



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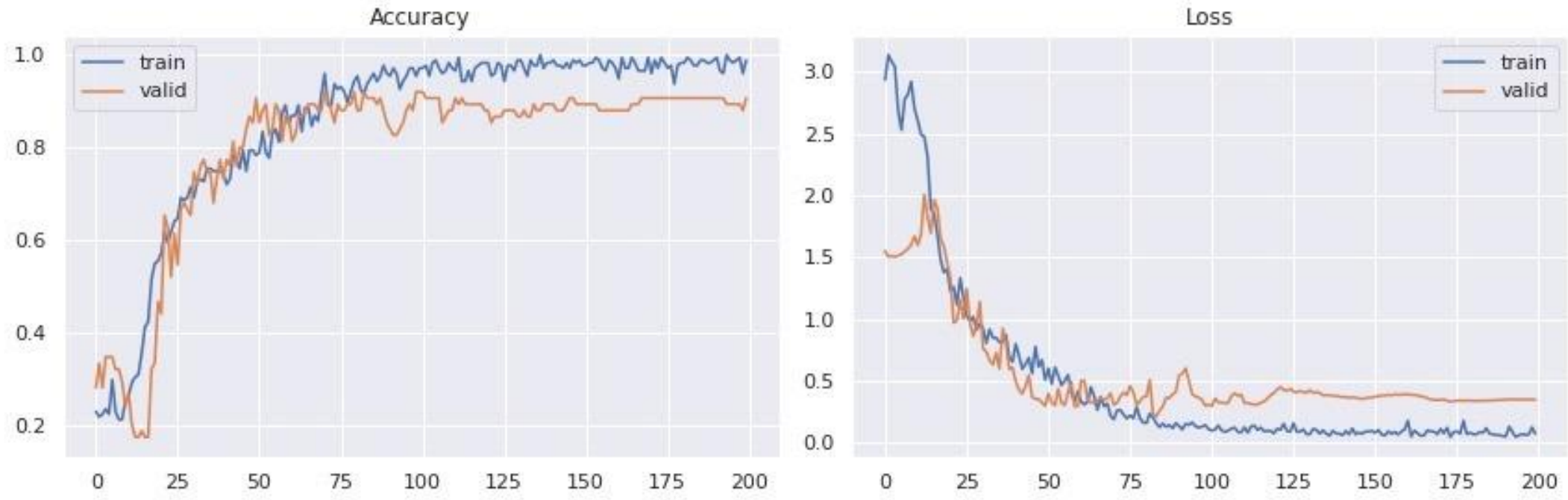
Diagram(s) or Visualization(s)



CNN Bi-directional LSTM – **OPTIMAL CASE**

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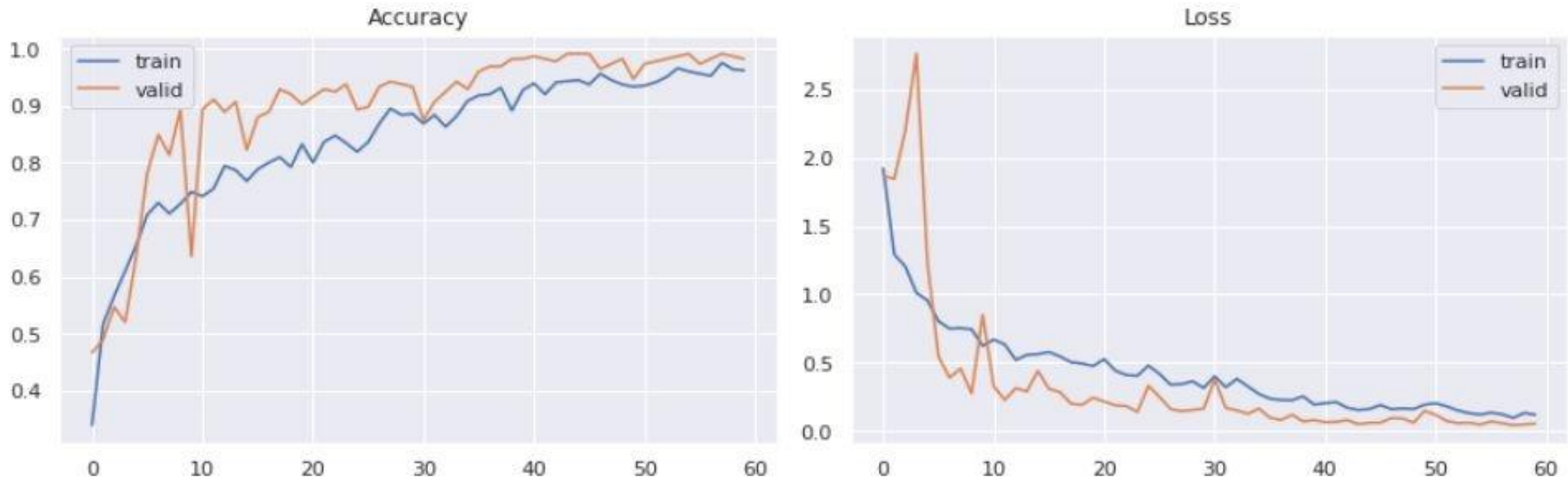
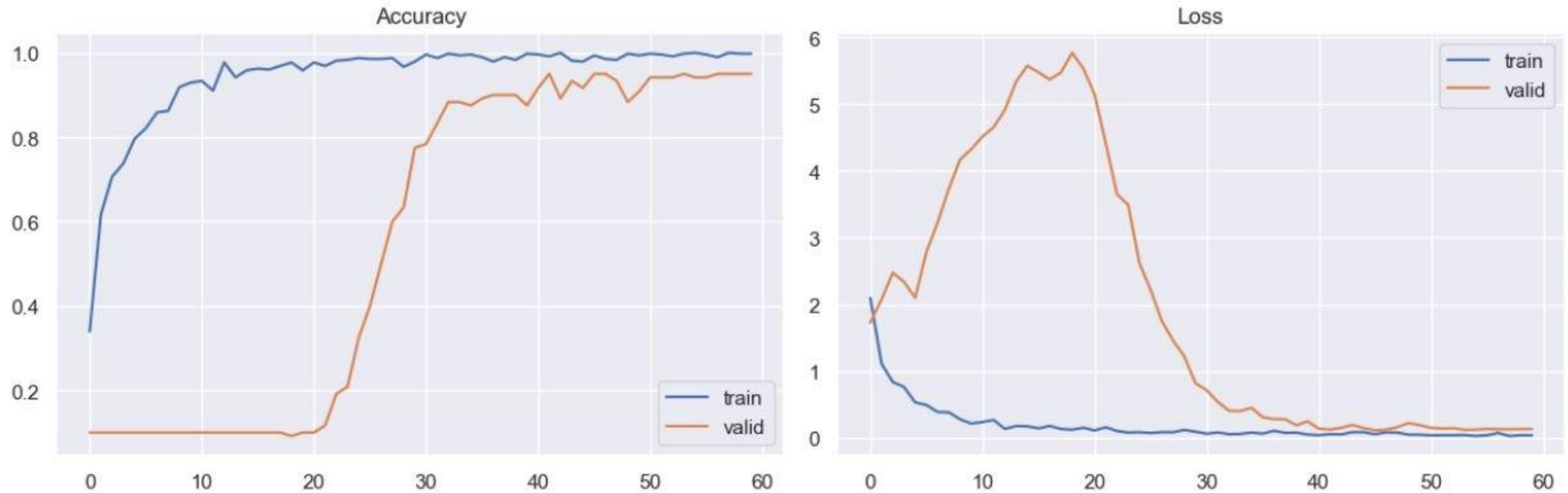

Accuracy
train
valid
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0
10
20
30
40
50
60
Loss
train
valid
2.5
2.0
1.5
1.0
0.5
0.0
0
10
20
30
40
50
60

Simple CNN


Accuracy
1.0
0.8
0.6
0.4
0.2
0
10
20
30
40
50
60
train
valid
Loss
6
5
4
3
2
1
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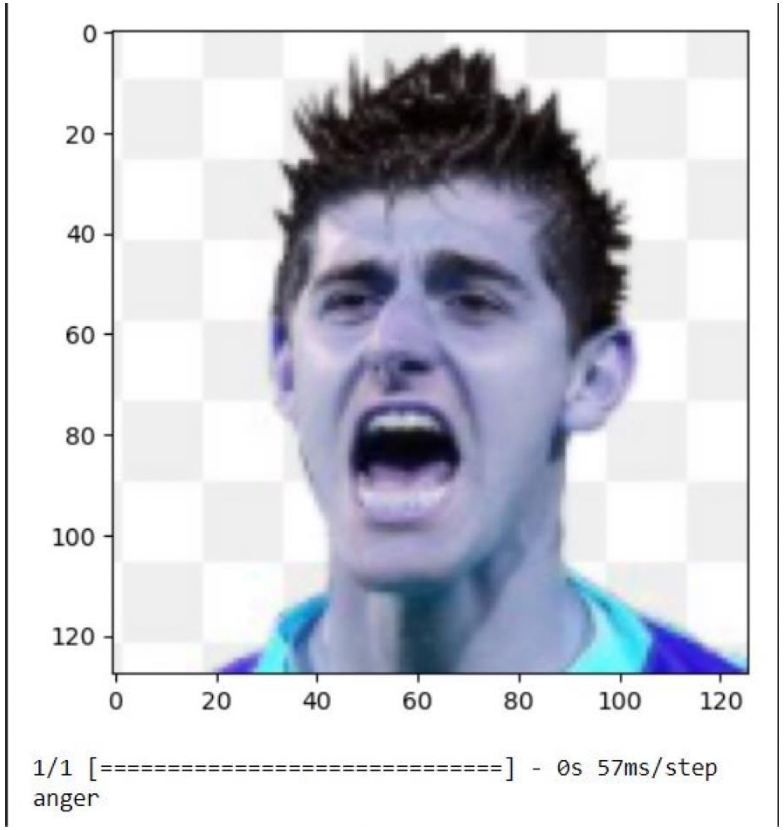
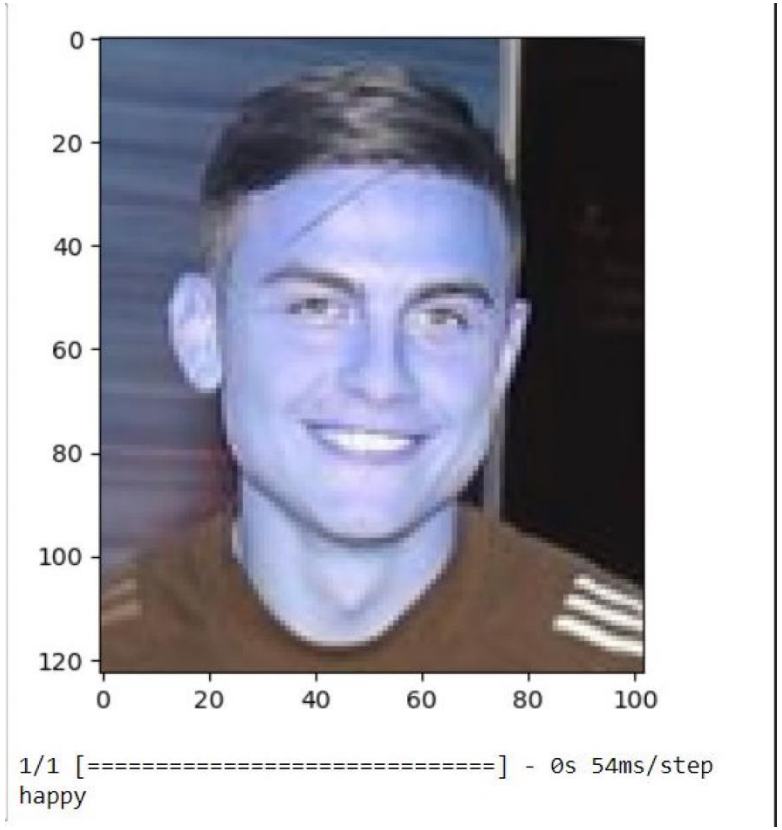
10
20
30
40
50
60
train
valid

ConvLSTM

True v/s Predicted





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Challenges Faced

Good Quality Data	For an accurate emotional recognition, we need a large and high quality annotated data.
Difficulty in classifying emotional states	Emotional states may vary from individual to individual based on factors like age, gender, ethnicity etc. which may make it difficult to classify.
Overfitting	Deep neural networks like CNN are prone to overfitting because of the millions or billions of parameters it encloses..
Limited interpretability	LSTMs are complex models which make it difficult to interpret to identify any potential biases.
Computational complexity	CNN LSTMs are computationally intensive to train and deploy in a timely manner

Literature review

TITLE	AUTHOR	YEAR	DATASET	ABSTRACT	CONCLUSION
Facial expression emotion recognition model integrating philosophy and machine learning theory	Zhenjie Song, School of humanities and Social sciences, Xi'an Jiaotong University, Xi'an, China	2021	The data set used in this article is FER-2013.	This paper is based on machine learning theory and philosophical thinking, aiming at the problem that the features extract CNNs ignore subtle changes in the active areas of facial expressions.	This paper proposes dual-channel expression recognition algorithm based on machine learning theory and emotional philosophy. The Gabor feature of ROI is taken as input and features of this region is extracted using Gabor transform. A channel attention network based on deep separable convolution is proposed to improve the linear bottleneck structure, reduce network complexity, and avoid overfitting.
Facial emotion recognition using deep learning: review and insights	Wafa Mellouka, Wahida Handouzi	2020	In first phase, the proposed model was evaluated in three databases: CK+, JAFFE, BU-3DFE. Later it was tested on large databases like FED-RO, RAF-DB and AffectNet.	Automatic emotion recognition is a field which needs more research and improvement, which can be applied into several areas like health, safety and in human machine interfaces. Researchers are interested in developing techniques to interpret, code facial expressions etc. The purpose of this paper is to make a study on the recent works on automatic facial recognition FER through deep learning models.	This paper presented research on FER, which described different architectures of CNN and CNN-LSTM and presented a different database which contained spontaneous images collected from real world and other sources, in order to achieve an accurate detection. It also shows study that the machines today will be more capable of interpreting emotions.

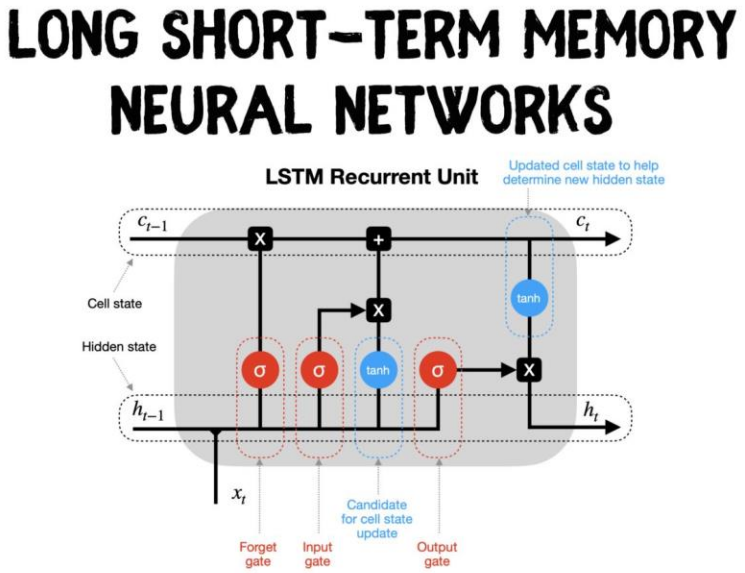
TITLE	AUTHOR	YEAR	DATASET	ABSTRACT	CONCLUSION
Optimal Facial Feature based emotional recognition using deep learning algorithm	Tarun Kumar Arora, Pavan Kumar Chaubey, Manju Shree Raman, Bhupendra Kumar, Yagnam Nagesh. K. Anjani, Hamed M. S. Ahmed,Arshad Hashmi,S. Balamuralitharam & Baru Debtera	2022	The dataset consists of around 32,298 images, each separately labelled. The images are sized in the 48*48 size pixels, thus the FER2013 dataset was used for further analysis.	The primary goal of this article is to use a deep learning algorithm to recognise different sorts of emotions based on facial features. This is done by implementing 7 different types of facial expressions. When compared to the current technique, the feature extraction for our proposed study uses geometric-based approaches, hybrid approaches, holistic approaches, all of which provide accuracy.	This paper proposes a facial feature for emotional recognition using convolutional neural network through deep learning algorithm with proper dimensional space reduction, which gave improved accuracy and the classification methodology. It also showed better outcomes compared to suggested strategy.

Literature Survey: https://docs.google.com/document/d/1vTYGfkk-5mSPxoTThsWmWur_kN8ltR3QAFqyjeXplPs/edit

Our Learning

There are several things that a beginner data scientist could learn from implementing a bi-directional Long Short-Term Memory (LSTM) model for facial emotional recognition and quantifying emotional data to enhance player performance:

- **Pre-processing and cleaning data**
- **Model selection and evaluation**
- **Quantifying and visualizing data**
- **Deep learning best practices**



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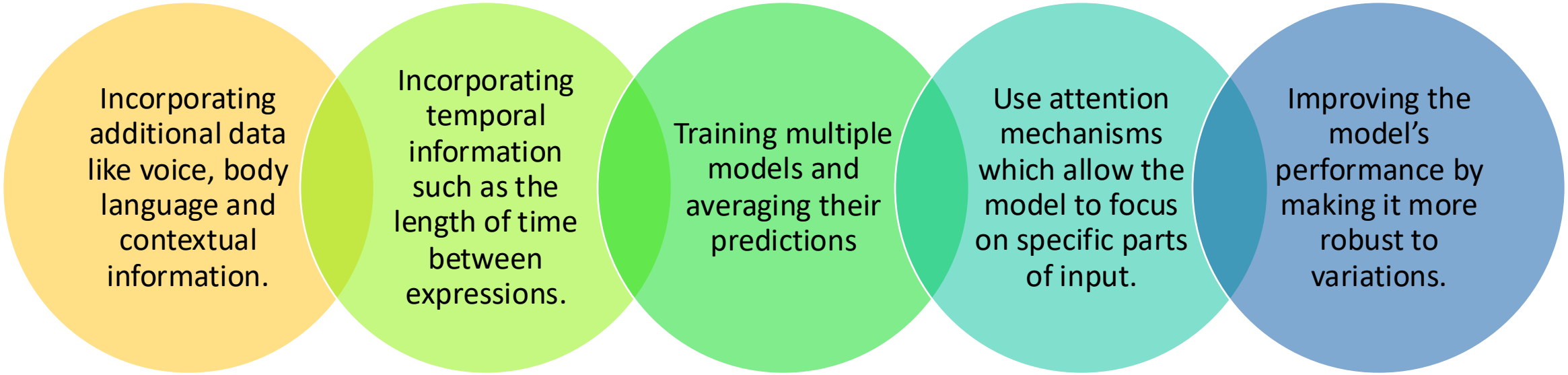
Future Enhancements



Demo

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Thank You