Human/Animal Emotion Recognition Using ECG & ML Techniques

EndEvaluation
Group 22

Project Team

Team

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Supervisors

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Problem

Why Emotion Recognition

- Way to communicate beyond words
- Provide emotional intelligence to computing systems.
- Entertainment,marketing, healthcare, e- learning etc…

Why ECG?

- Comfortable wearable device
- Capture from different parts of the body
- High amplitude bio-sensors
- Prospective technique

Emotion Recognition Methods

- Physiological Signals (ECG, EEG)
- Behavioral Expressions (Facial, Speech)
- Computational Methods
- Self Report

Animal Emotion Prediction

- Difficult to define animal emotion
- Communication is easier
- Animal protection

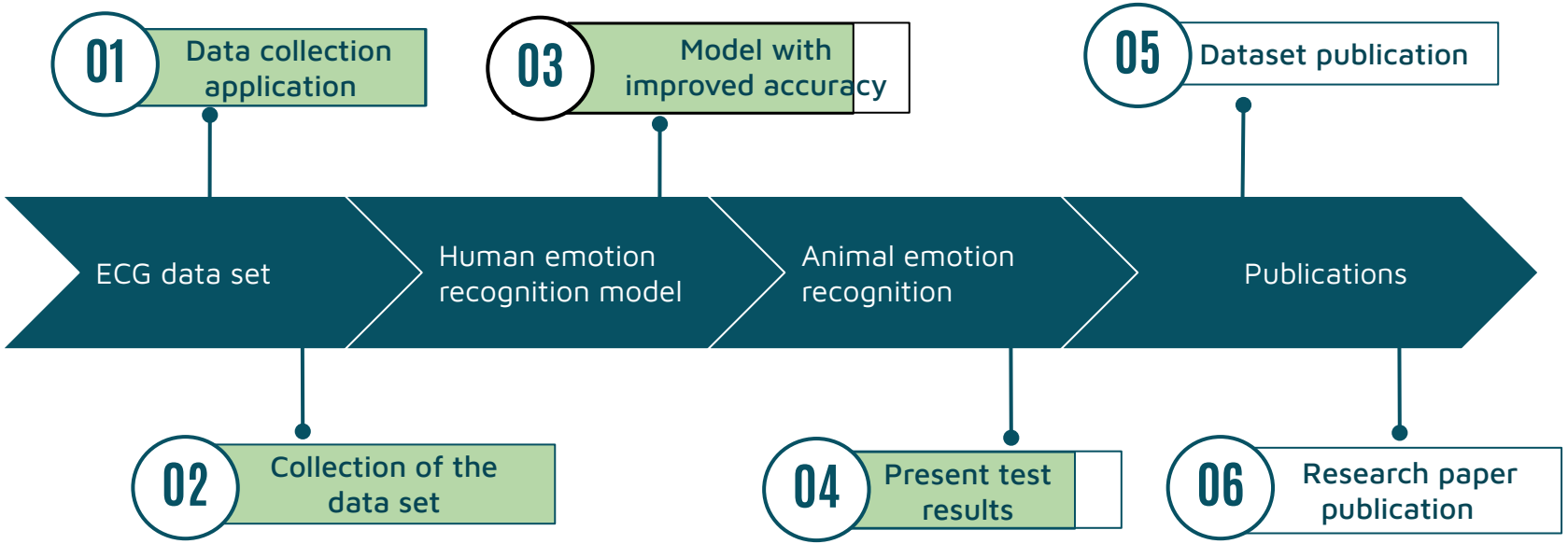
Solution

Collected data and created new dataset

Recognize emotions using Deep Learning

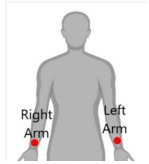
Predict animal emotions using implemented model

Progress


01
Data collection application
03
Model with improved accuracy
05
Dataset publication
ECG data set
Human emotion recognition model
Animal emotion recognition
Publications
02
Collection of the data set
04
Present test results
06
Research paper publication

Methodology

Emotion Elicitation



ECG acquisition

Dataset

Pre-processing

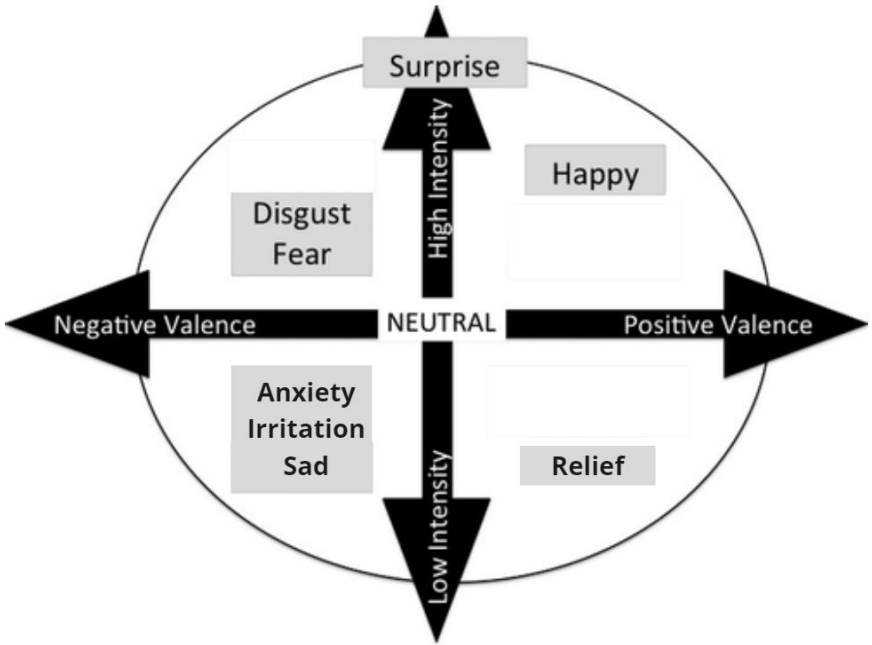
Emotion Classification

Binary Classification

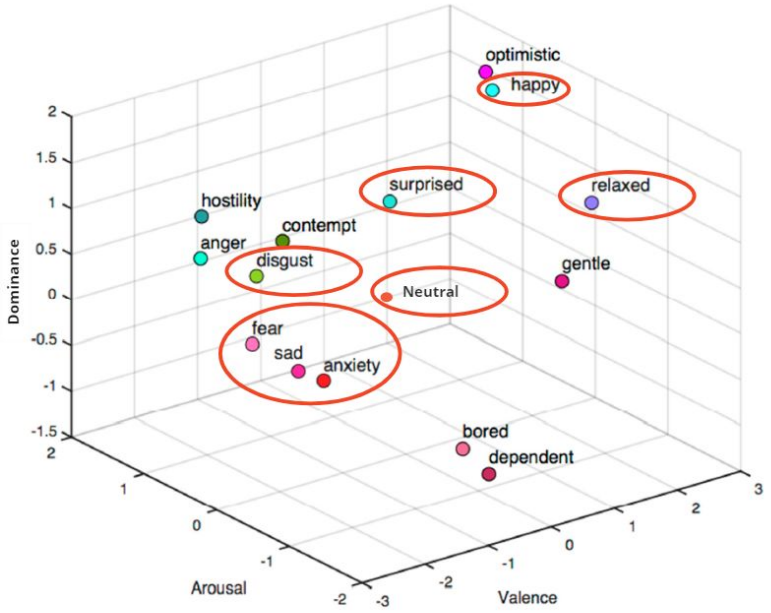
Human Emotions

Animal Emotions

Emotion Selection



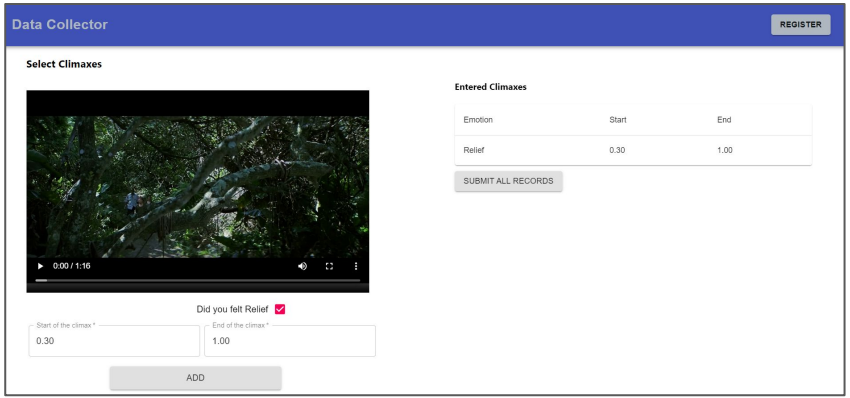
Two-dimensional emotional model



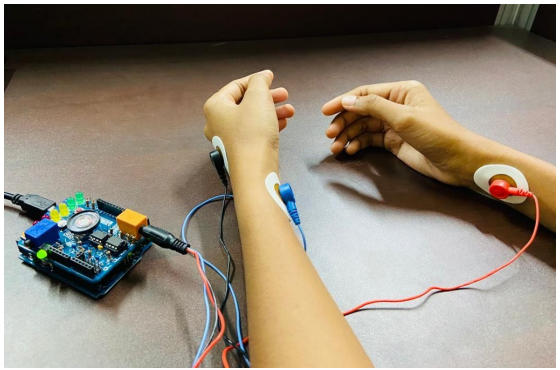
Three-dimensional emotional model

Data Acquisition

Automated Data Collection



ECG Lead Placement



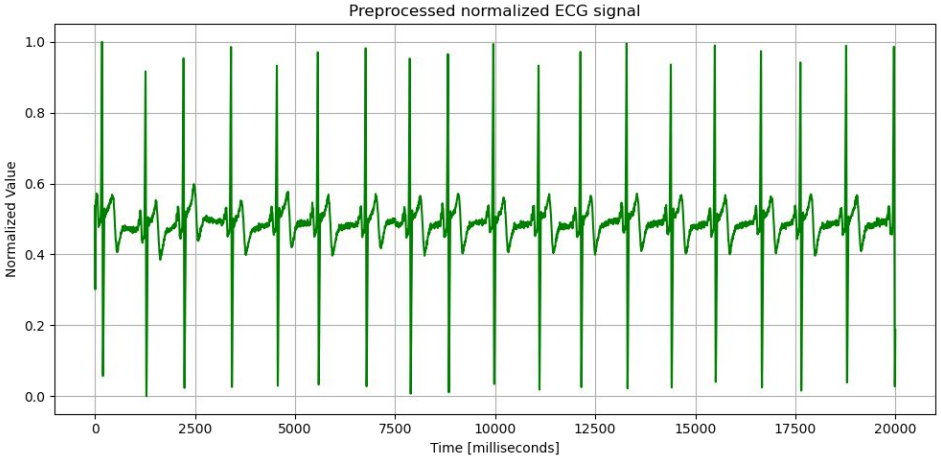
25 Subjects

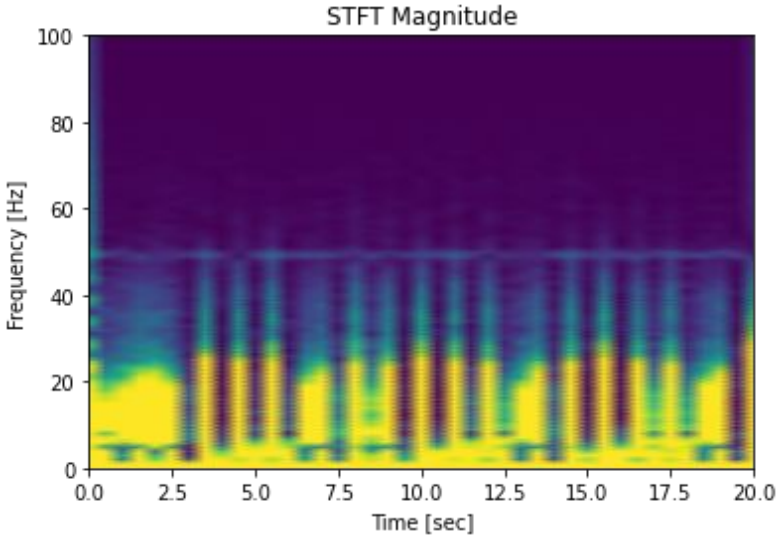
Data Summary

Emotion	Film / Video	Duration	Hits	Misses	Discarded & Not taken
Neutral	A Black Screen	1 min	17	0	8
Happy	Lottery Ticket (2010)	1:29 mins	18	3	4
Relief	Blood Diamond (Journalist)	1:16 mins	13	8	4
Sad	My Sister's keeper(doctor)	1:51 mins	18	2	5
Irritation	The Pursuit of Happiness	1:42 mins	13	7	5
Anxiety	Limitless (apartment)	1:34 mins	13	8	4
Disgust	Slumdog Millionaire (blinded)	1:28 mins	15	3	7
Fear	The Conjuring (2013)	03:19 mins	17	0	8
Surprise	One Day	0:55 mins	21	0	4

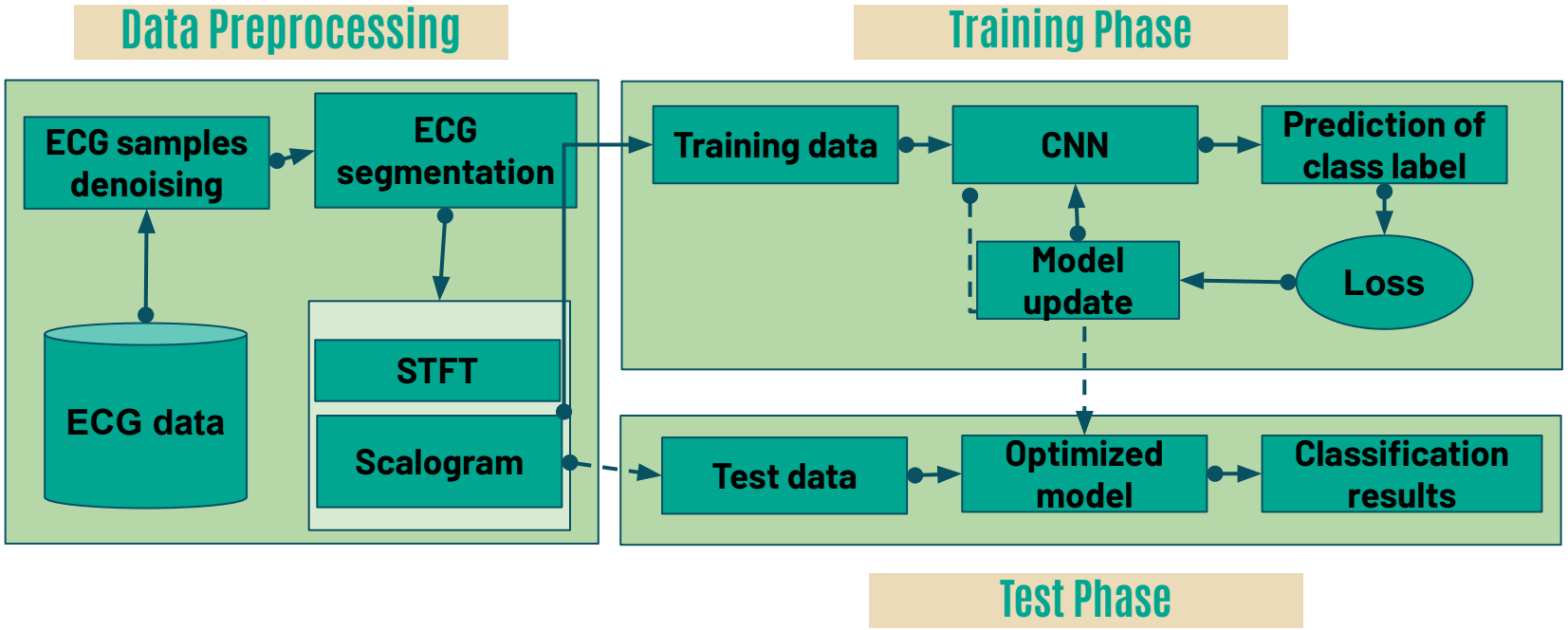
Data Pre-processing

Raw ECG Signal → Filtering → De-Trending → Smoothing → Normalizing → STFT





Emotion classification

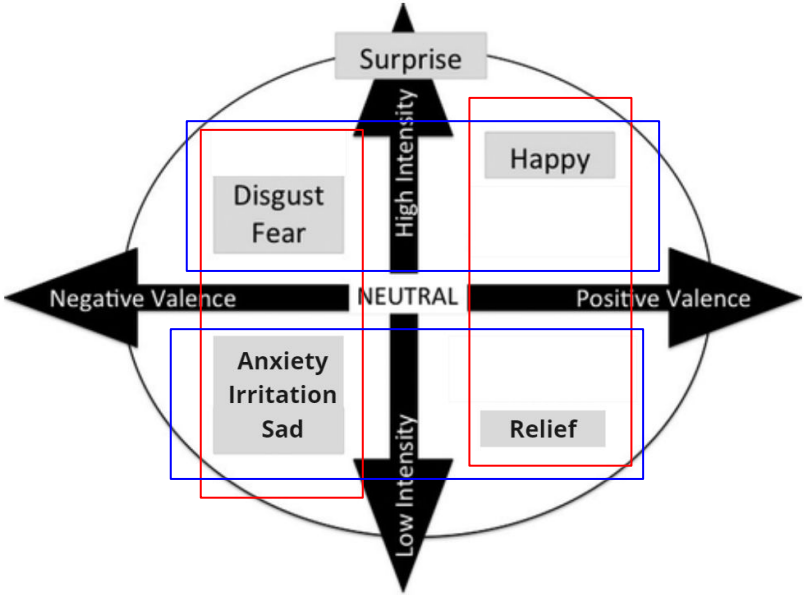


Model Development

Nine emotion Model — 51%

Positive - Negative Model (Valence) — 60%

Active-Passive Model (Arousal) — 64%



Model Summary

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d (Conv2D)             (None, 254, 254, 16)      448

 max_pooling2d (MaxPooling2D  (None, 127, 127, 16)     0
 )

 conv2d_1 (Conv2D)           (None, 125, 125, 32)      4640

 max_pooling2d_1 (MaxPooling  (None, 62, 62, 32)       0
 2D)

 conv2d_2 (Conv2D)           (None, 60, 60, 16)        4624

 max_pooling2d_2 (MaxPooling  (None, 30, 30, 16)       0
 2D)

 flatten (Flatten)           (None, 14400)             0

 dense (Dense)               (None, 256)               3686656

 dense_1 (Dense)             (None, 9)                 2313

=================================================================
Total params: 3,698,681
Trainable params: 3,698,681
Non-trainable params: 0
_________________________________________________________________
```

Nine emotion model summary

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d (Conv2D)             (None, 254, 254, 16)      448

 max_pooling2d (MaxPooling2D  (None, 127, 127, 16)     0
 )

 conv2d_1 (Conv2D)           (None, 125, 125, 32)      4640

 max_pooling2d_1 (MaxPooling  (None, 62, 62, 32)       0
 2D)

 conv2d_2 (Conv2D)           (None, 60, 60, 16)        4624

 max_pooling2d_2 (MaxPooling  (None, 30, 30, 16)       0
 2D)

 flatten (Flatten)           (None, 14400)             0

 dense (Dense)               (None, 256)               3686656

 dense_1 (Dense)             (None, 1)                 257

=================================================================
Total params: 3,696,625
Trainable params: 3,696,625
Non-trainable params: 0
_________________________________________________________________
```

Positive - Negative Model (Valence)

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d (Conv2D)             (None, 254, 254, 16)      448

 max_pooling2d (MaxPooling2D  (None, 127, 127, 16)     0
 )

 conv2d_1 (Conv2D)           (None, 125, 125, 32)      4640

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 dense (Dense)               (None, 256)               3686656

 dense_1 (Dense)             (None, 1)                 257

=================================================================
Total params: 3,696,625
Trainable params: 3,696,625
Non-trainable params: 0
_________________________________________________________________
```

Active-Passive Model (Arousal)

Animal Emotion Data Collection

10 Subjects

Emotion States

Clinical Environment

Positive
Called by their name and petted by owners

Negative
Commanded by owners and when they show unwillingness

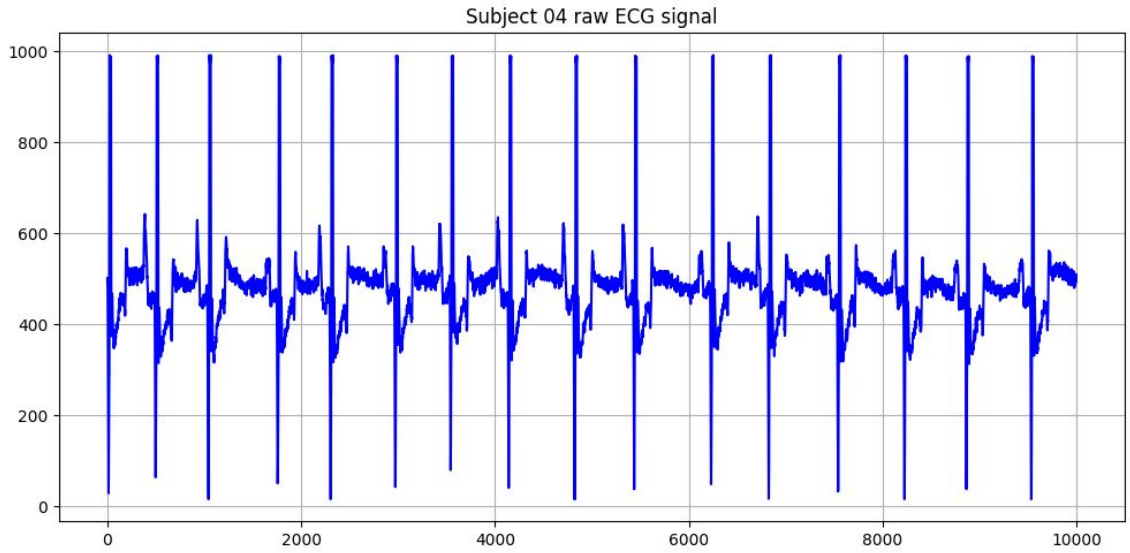
Neutral
After they calm down and get used to the environment

ECGs of Dogs

Same Experimental Setup

Similar ECG

Test Results With Valance Model - 32%

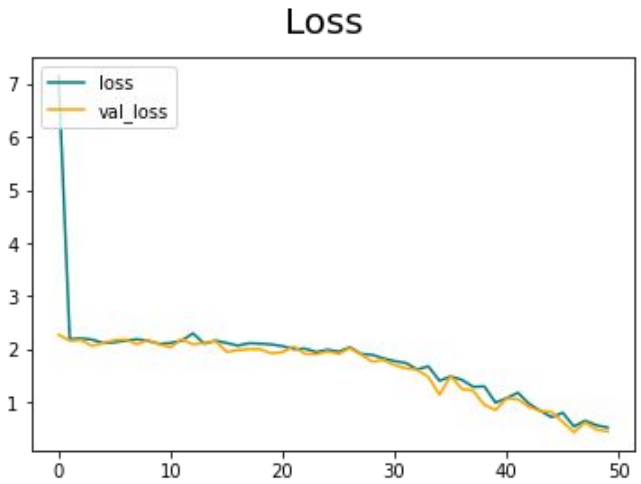


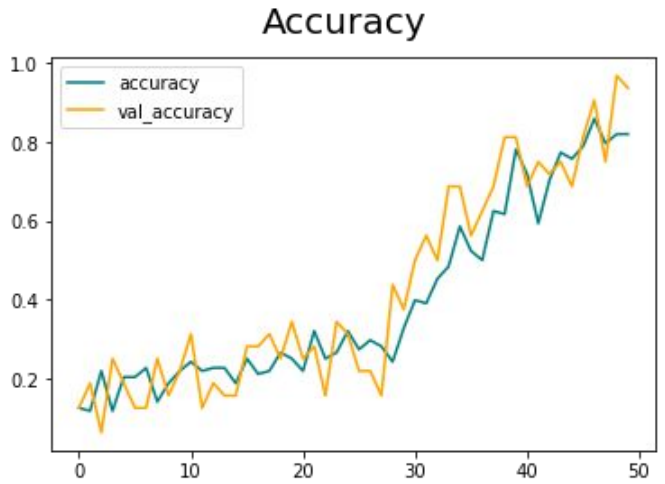
Q & A

Thank You!

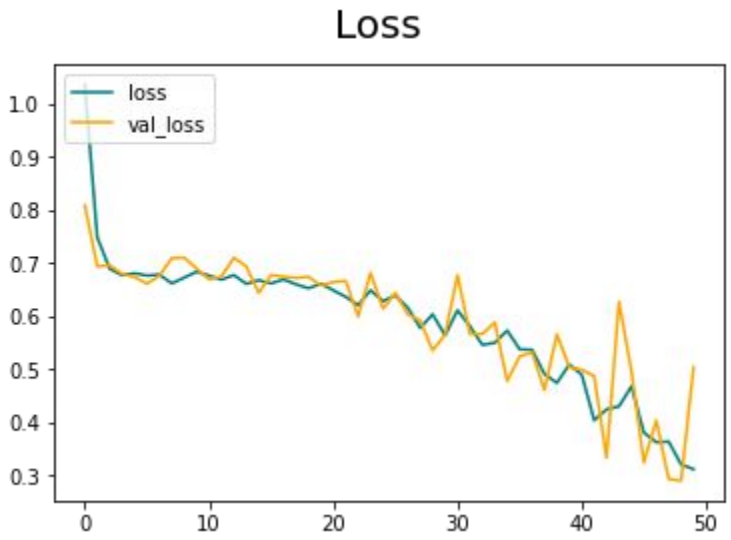
Positive - Negative Model

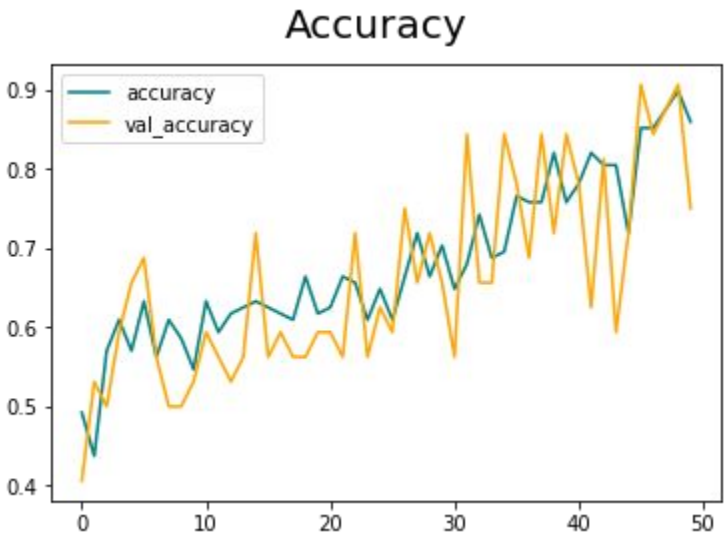
Nine Emotion Model





Active - Passive Model





Summary