ADAPTIVE CONTENT GENERATION USING FACIAL RECOGNITION AND DEEP LEARNING

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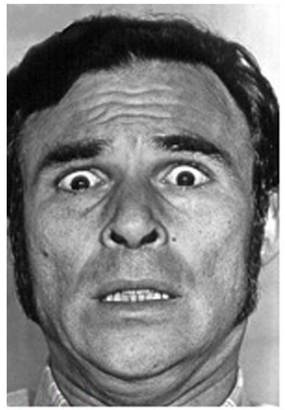
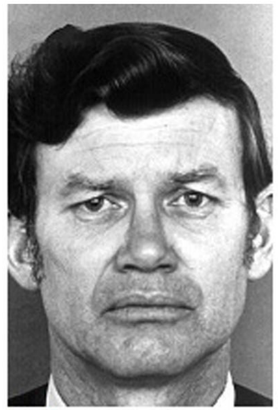
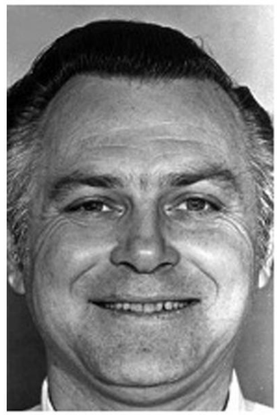
INTRODUCTION

- While the human face can make over 10,000 expressions, there are only six universal emotions.


Fearful


Angry


Sad

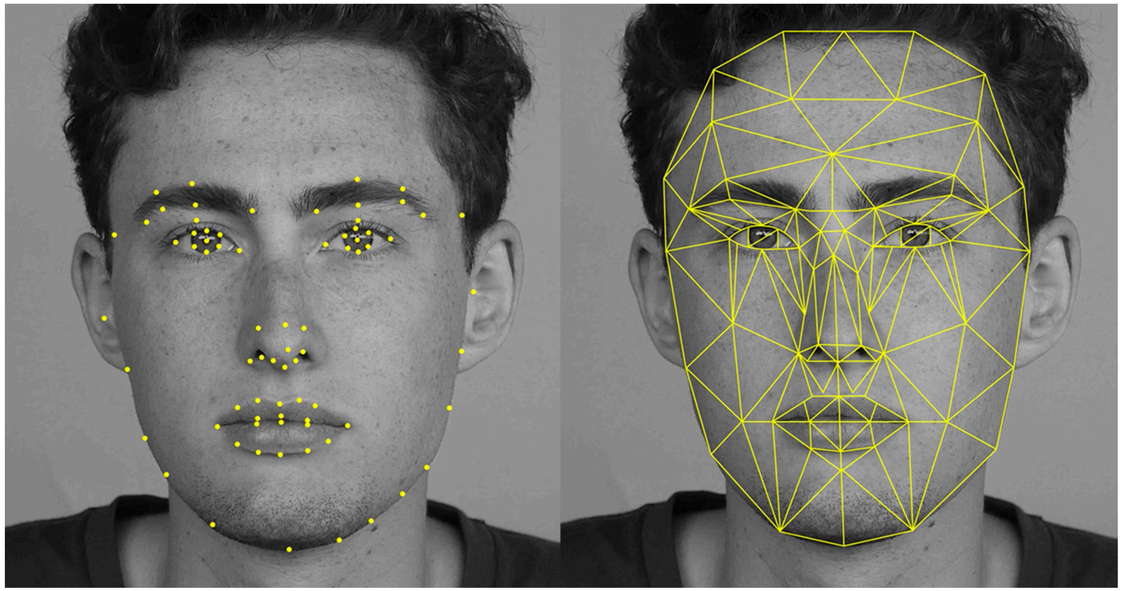

Happy


Disgusted


Surprised

OBJECTIVE

- Our goal is to develop a neural network to recognise facial expressions and classify them into one of seven emotions - happy, sad, disgusted, surprised, angry, fearful and neutral.
- By identifying these emotions, we will then generate content in the style of a news feed.

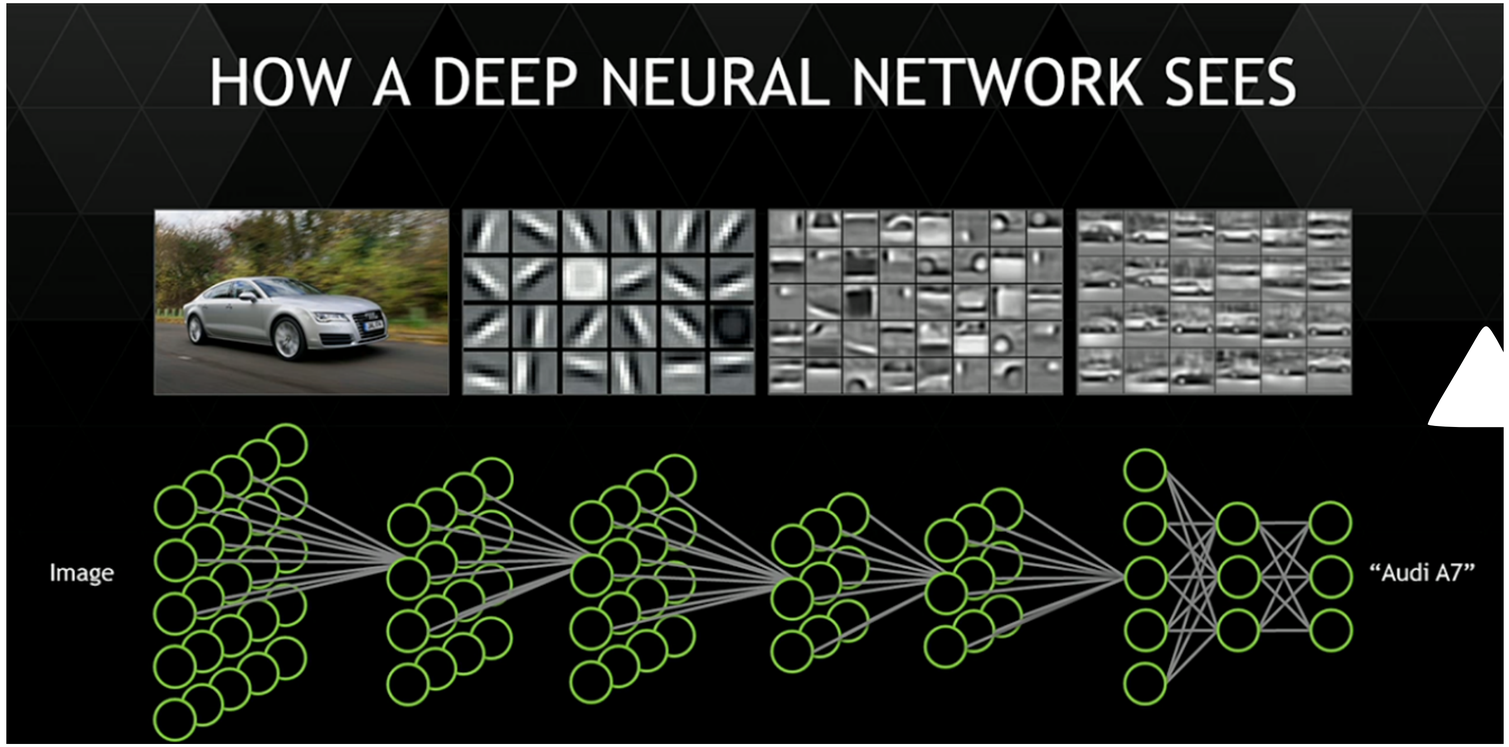


CHALLENGES

- Class Imbalance Problem
- Moreover, a feedforward network generally predicts the same emotion all the time.
- Another issue is that images have to be well illuminated. Low light / highly exposed images produce poor results - primarily due to a low res camera.

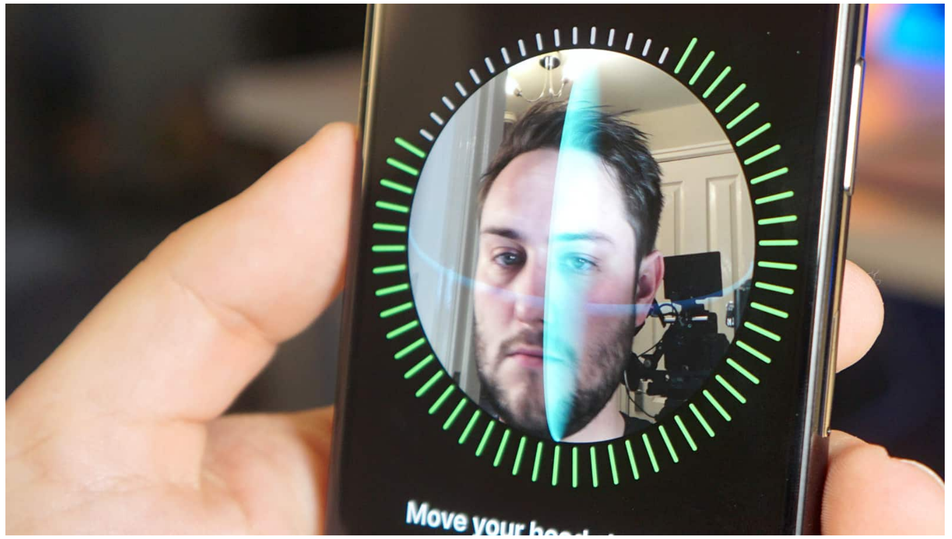
ADDRESSING THE CHALLENGES

- We have used a deep neural network - a Convolutional Neural Network which is capable of overcoming this problem by spatial locality - detecting edges and extracting certain features.
- Plus, our model uses *Haar Cascades* to detect faces. A pre-trained cascade of classifiers that can detect faces. This addresses most low light issues.

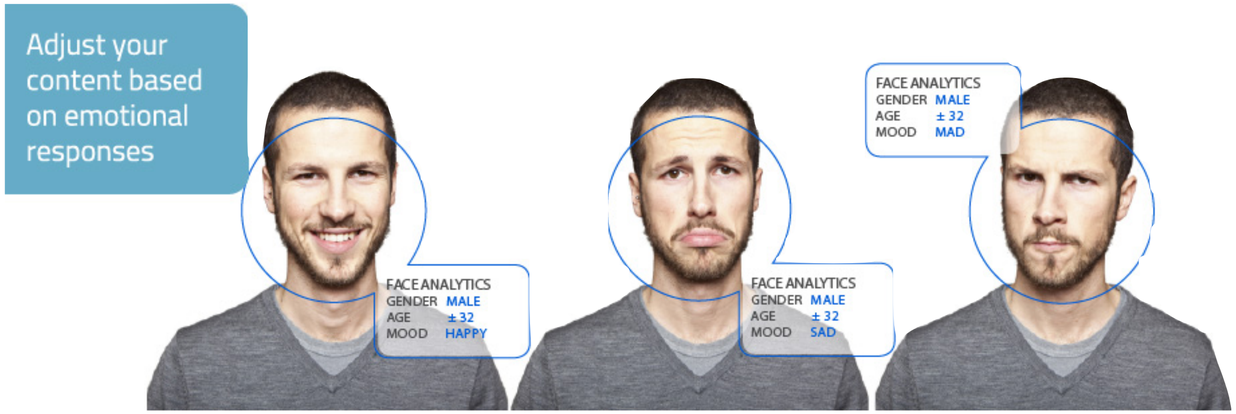


PRACTICAL APPLICATIONS

Surveillance



Security

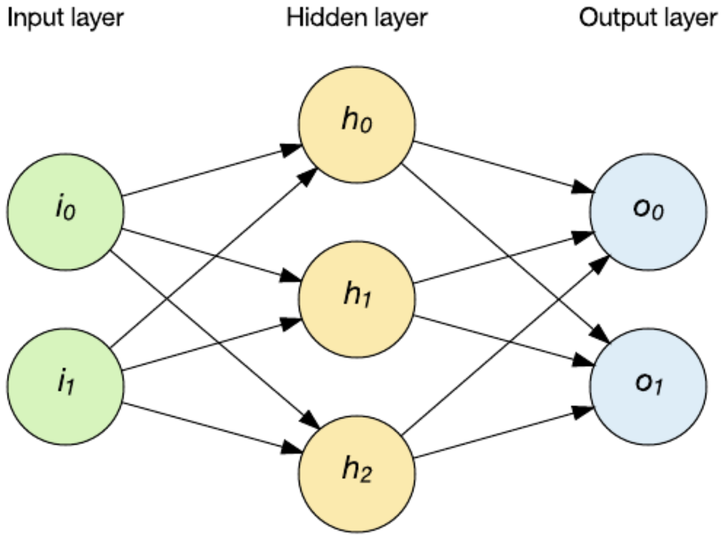


Identification of Psychological illness

COMPARING NEURAL NETWORKS

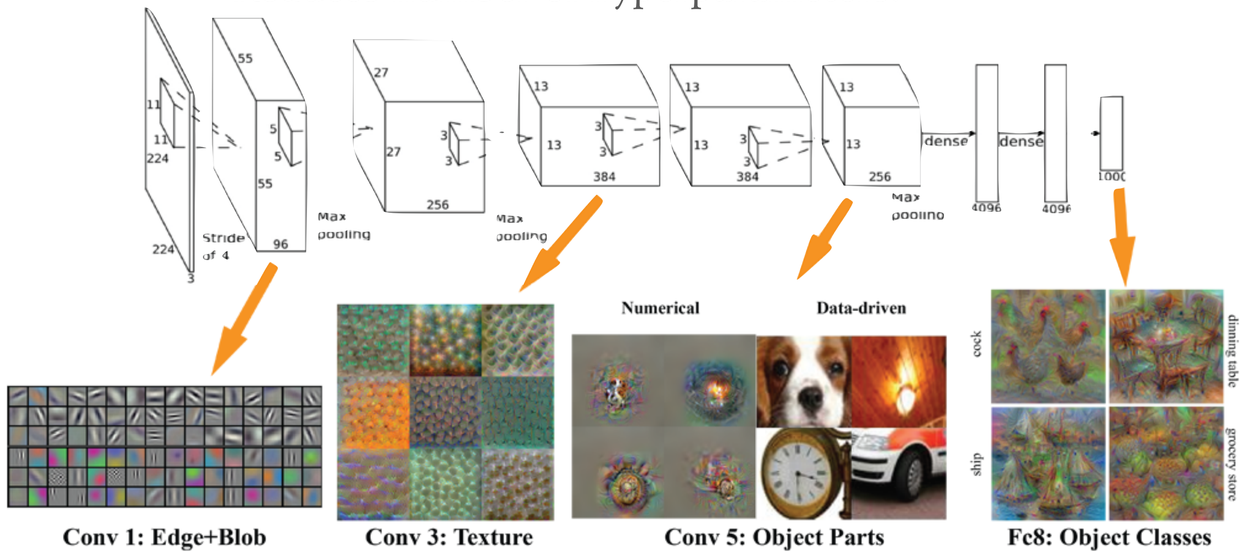
Feed Forward Neural Network

- The simplest kind of neural network is a *single-layer perceptron* network, which consists of a single layer of output nodes; the inputs are fed directly to the outputs via a series of weights.
- In this way it can be considered the simplest kind of feed-forward network.

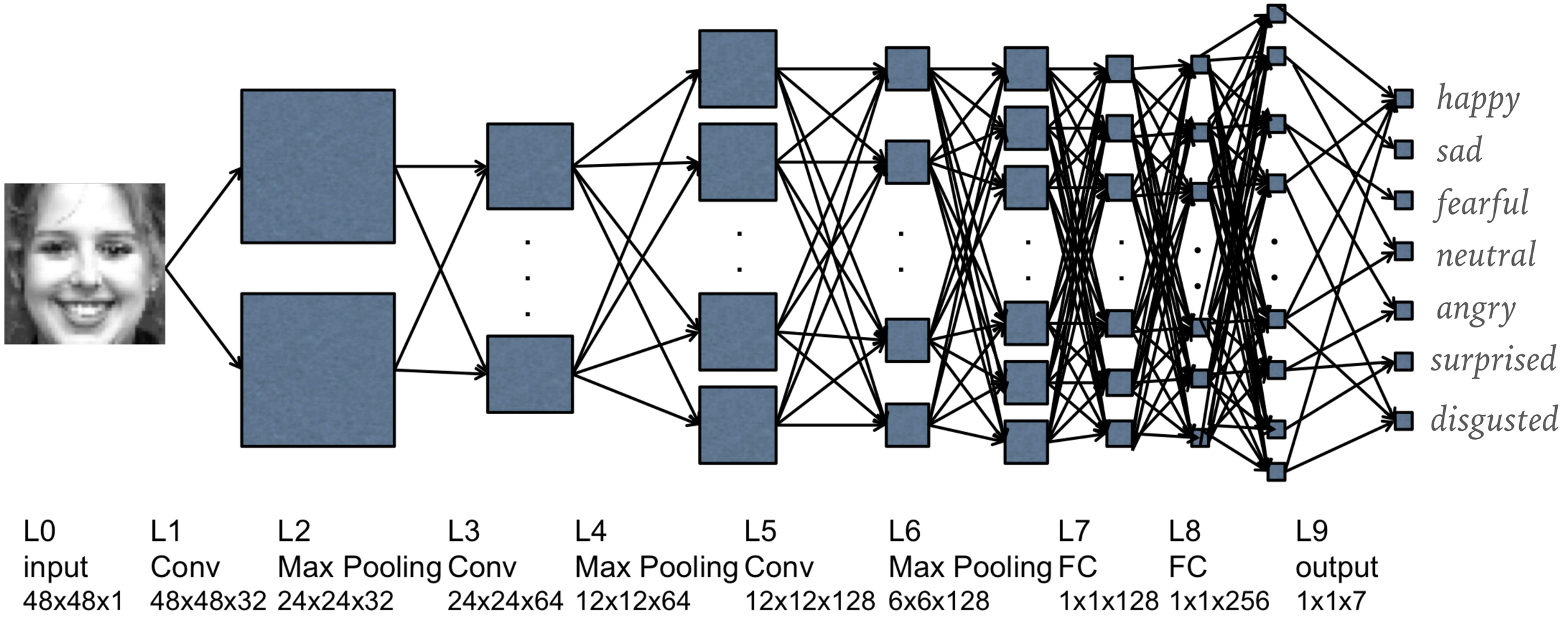


Convolutional Neural Network

- They are deep feed forward neural networks that consist of input and output layers, along with hidden layers consisting of convolutional layers, pooling layers and normalisation layers.
- Better suited for processing image data as it takes advantage of spatial locality in images.
- Reduces number of hyperparameters.

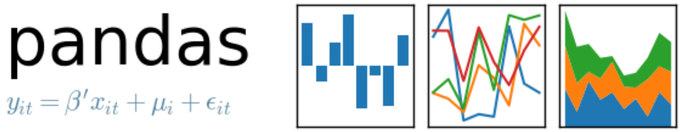


PROPOSED ARCHITECTURE



TECH STACK

- Backend - Preprocessing the dataset and developing the neural network:



- Dataset used: https://www.kaggle.com/c/challenges-in-representation-learning-facial-expression-recognition-challenge

PREPROCESSING THE DATA

- The initial dataset was split into two sections - a string of 2304 numbers indicating pixel values for the image and a number from 1-7 indicating the emotion.
- We converted the string of numbers into a 48x48 matrix to feed into the neural network.

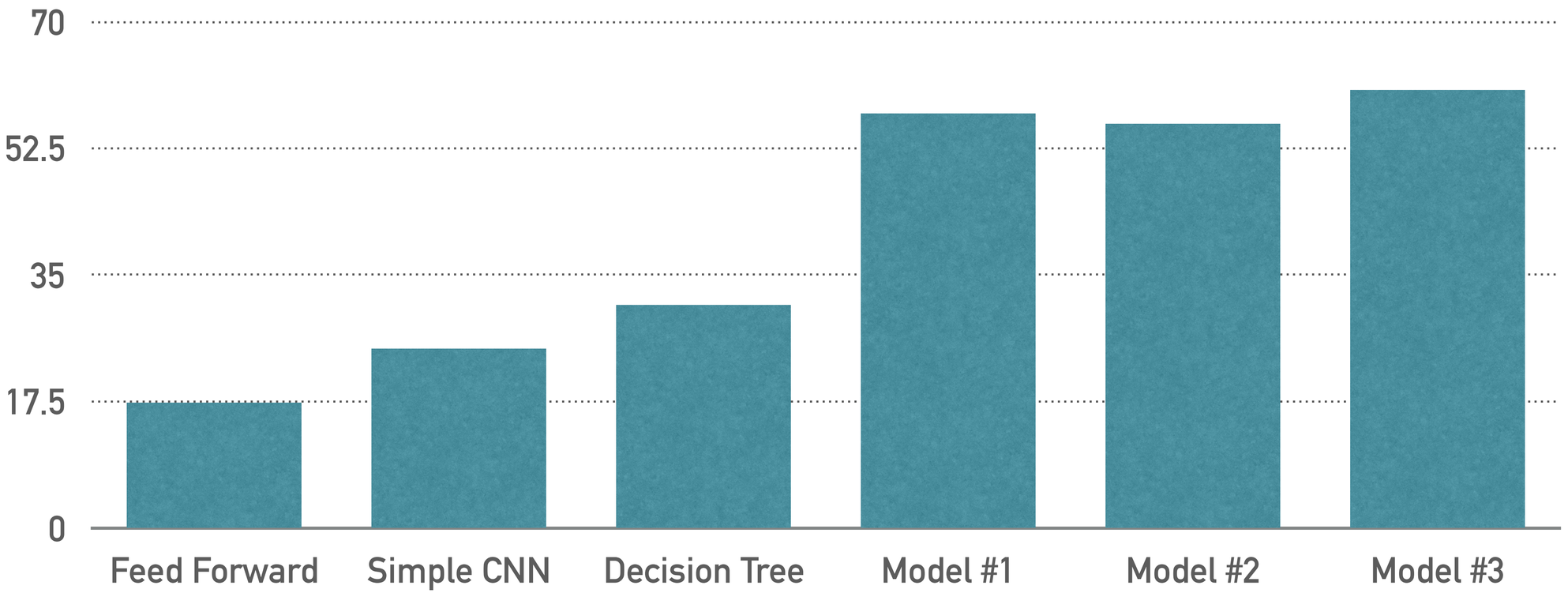
emotion	pixels
0	70 80 82 72 58 58 60 63 54 58 60 48 89 115 121...
0	151 150 147 155 148 133 111 140 170 174 182 15...
2	231 212 156 164 174 138 161 173 182 200 106 38...
4	24 32 36 30 32 23 19 20 30 41 21 22 32 34 21 1...
6	4 0 0 0 0 0 0 0 0 0 0 0 3 15 23 28 48 50 58 84...

```
array([[ 70.,  80.,  82., ...,  52.,  43.,  41.],
       [ 65.,  61.,  58., ...,  56.,  52.,  44.],
       [ 50.,  43.,  54., ...,  49.,  56.,  47.],
       ...,
       [ 91.,  65.,  42., ...,  72.,  56.,  43.],
       [ 77.,  82.,  79., ..., 105.,  70.,  46.],
       [ 77.,  72.,  84., ..., 106., 109.,  82.]])
```

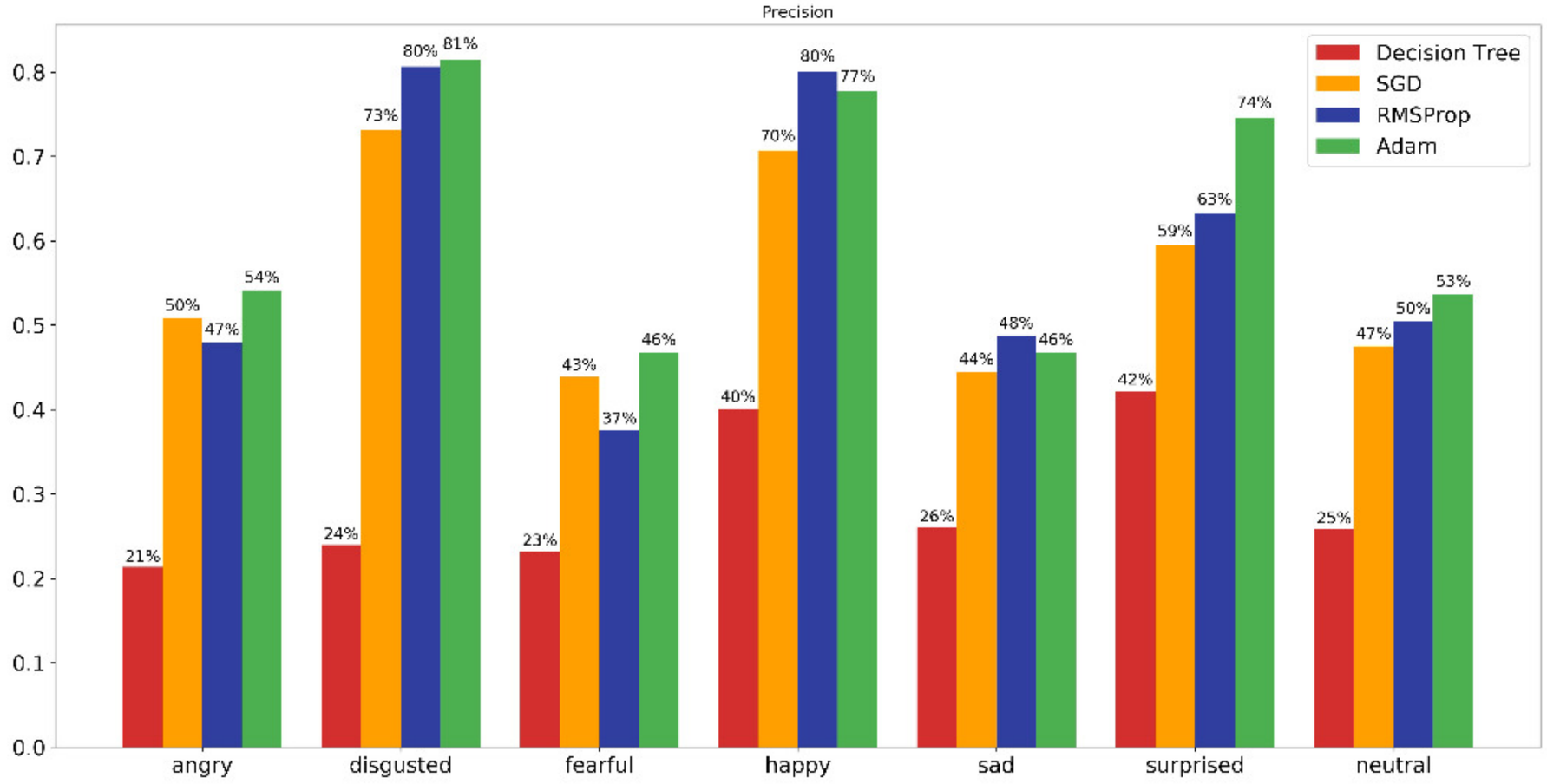
APPROACHES

Model	Batch Size	Optimizer	Epochs	Accuracy
Feed Forward	128	RMSProp	10	17.386
Simple CNN	128	RMSProp	10	24.728
Decision Tree	40	-	-	30.843
Model #1	96	RMSProp	100	57.397
Model #2	64	SGD	10	55.900
Model #3	128	Adam	20	60.587

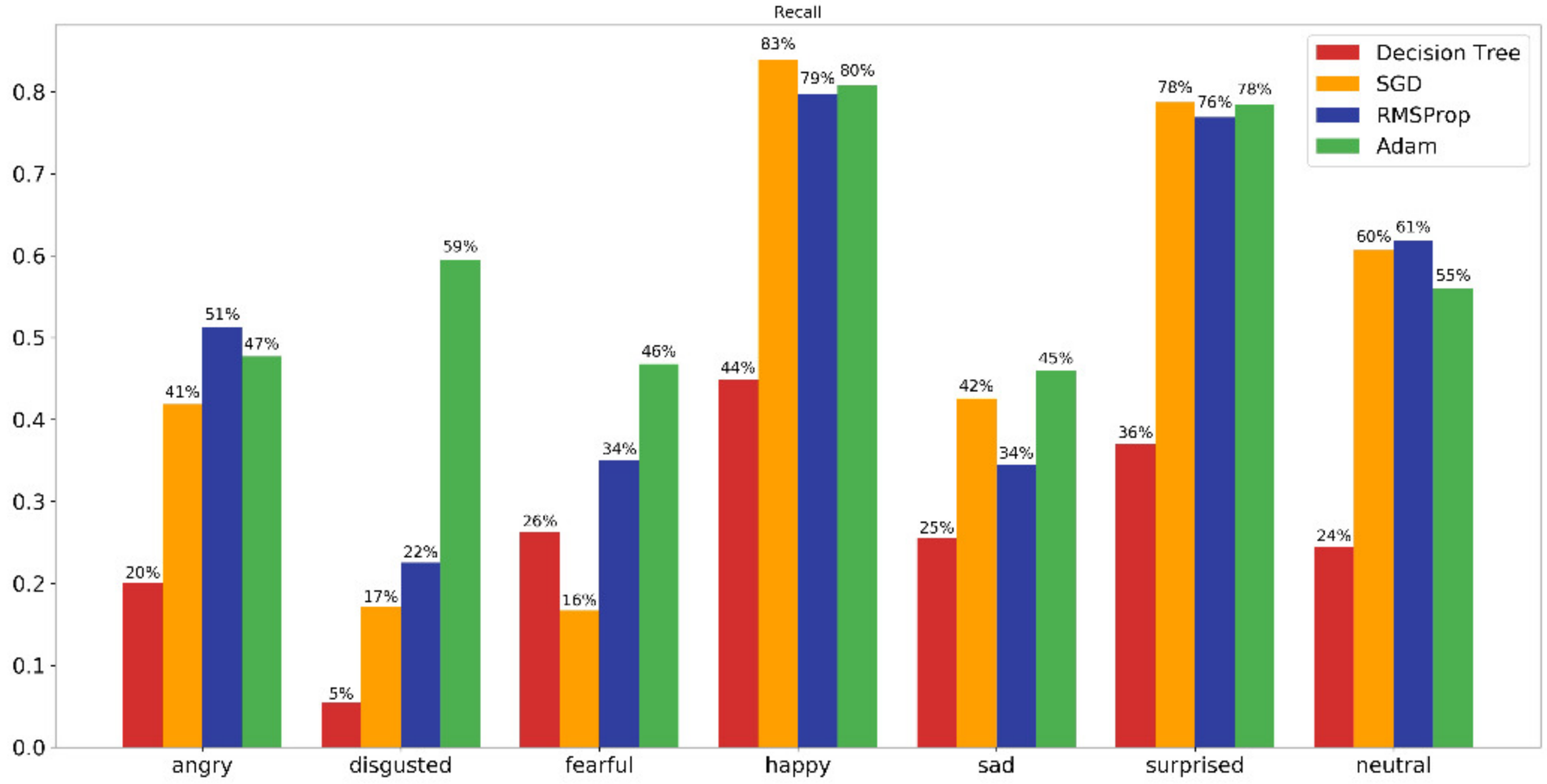
APPROACHES - ACCURACY



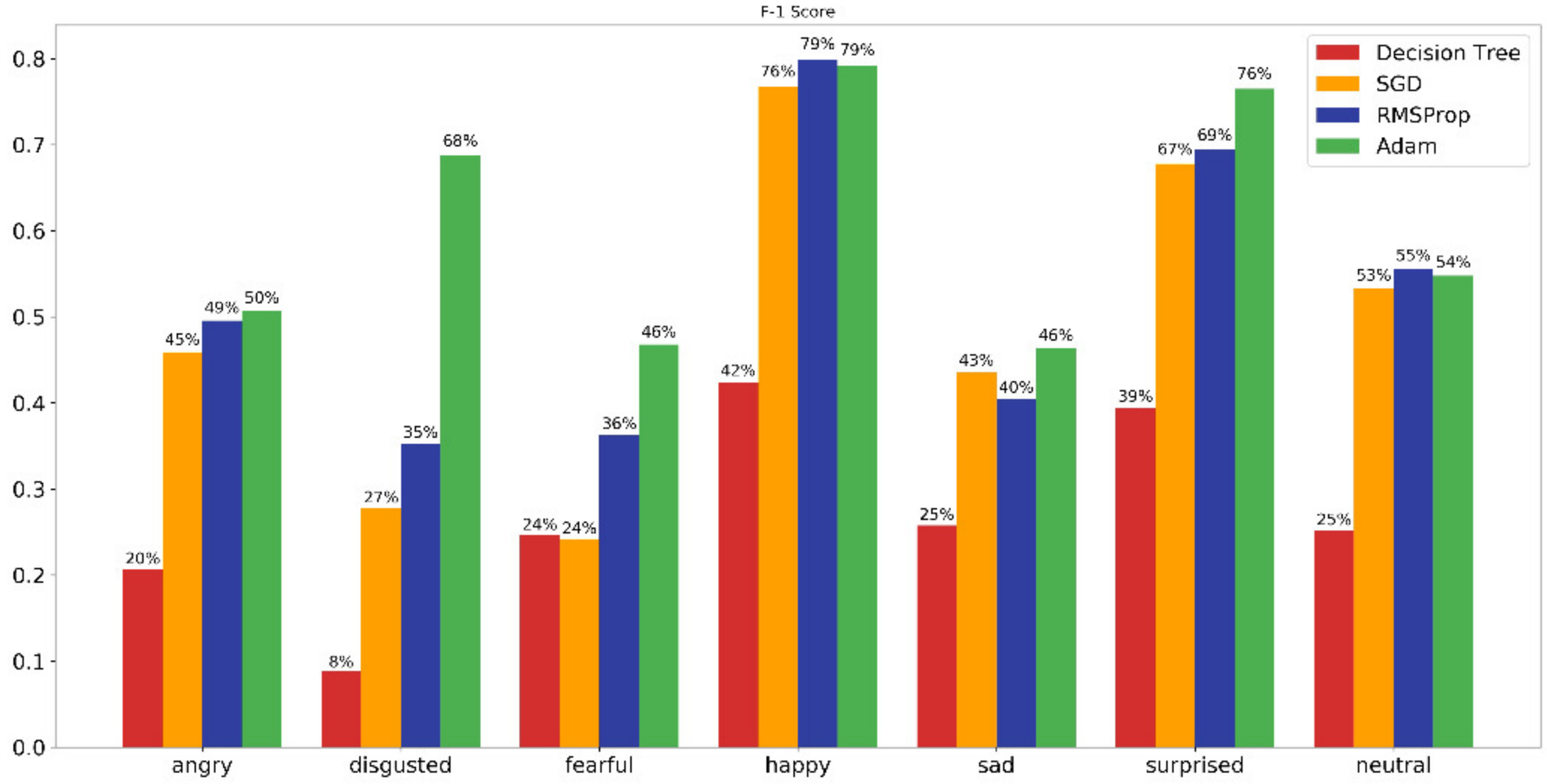
COMPARISON OF APPROACHES – PRECISION



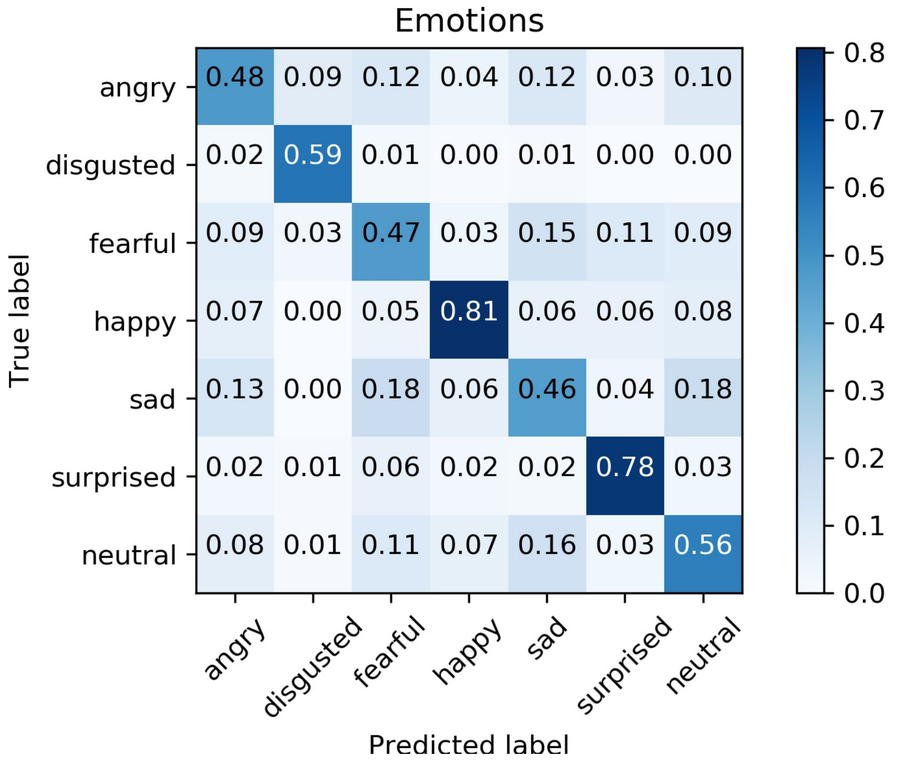
COMPARISON OF APPROACHES – RECALL



COMPARISON OF APPROACHES – F SCORE



CONFUSION MATRIX



Optimizer: Adam

- *Adam optimiser gave the highest overall accuracy.*
- *It does drastically better for faces showing disgust and fearful - almost 30%*

COMPARISON WITH OTHER SYSTEMS

- Similar systems that made use of emotion analysis did so on static images and not on real-time video streams.

- Some such models made use of using basic machine learning techniques such as Support Vector machine and Linear Discriminant Analysis, in combination with regular neural networks.

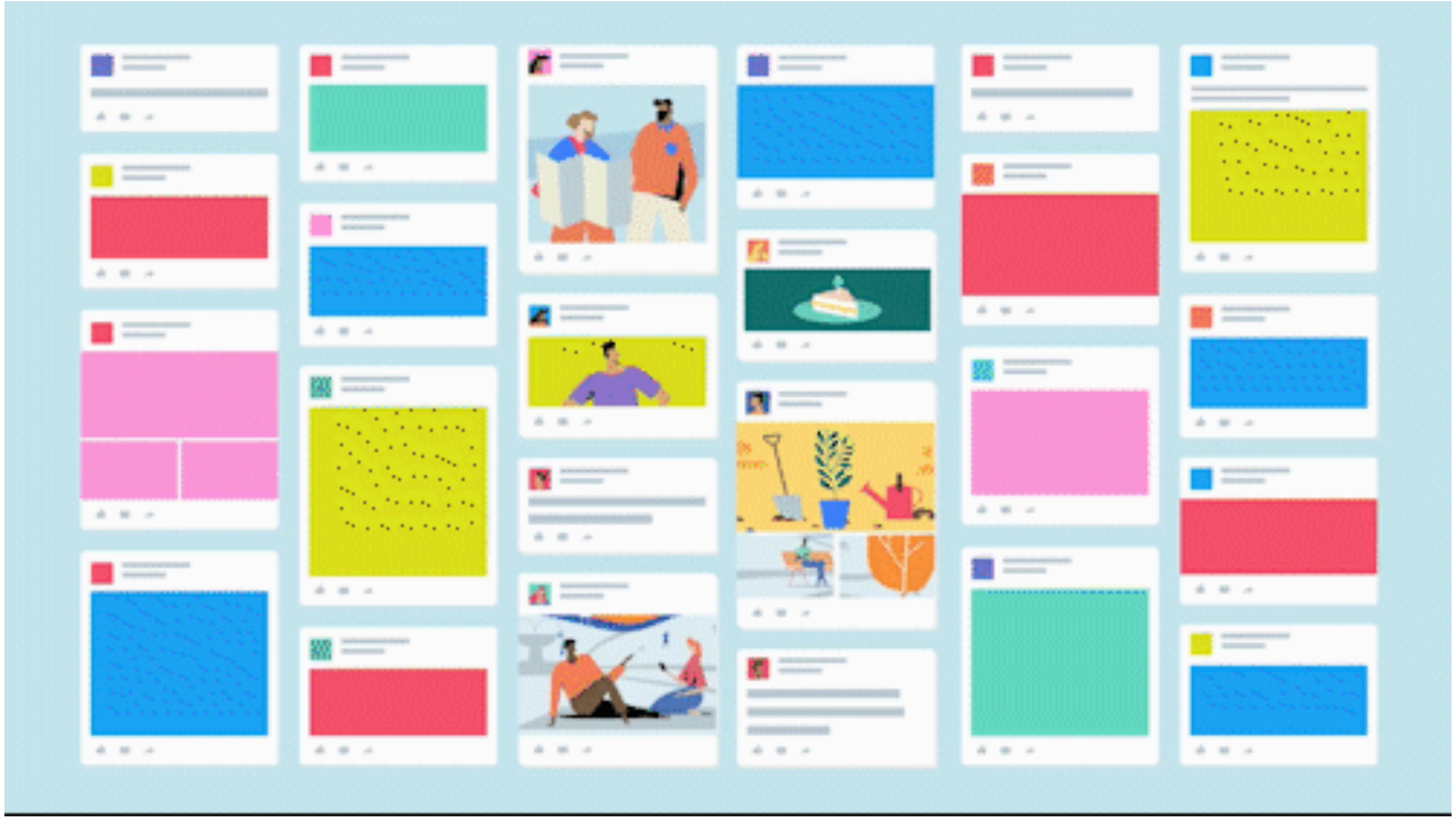
- A disadvantage of these systems is that they take a long time to train and their predictions are not instantaneous as required by a real-time system.

- These systems take a long time to train because of the complexity of the data and the network, itself.

- Owing to the low computational requirements and faster training and prediction time, our model can be further developed for mobile use.

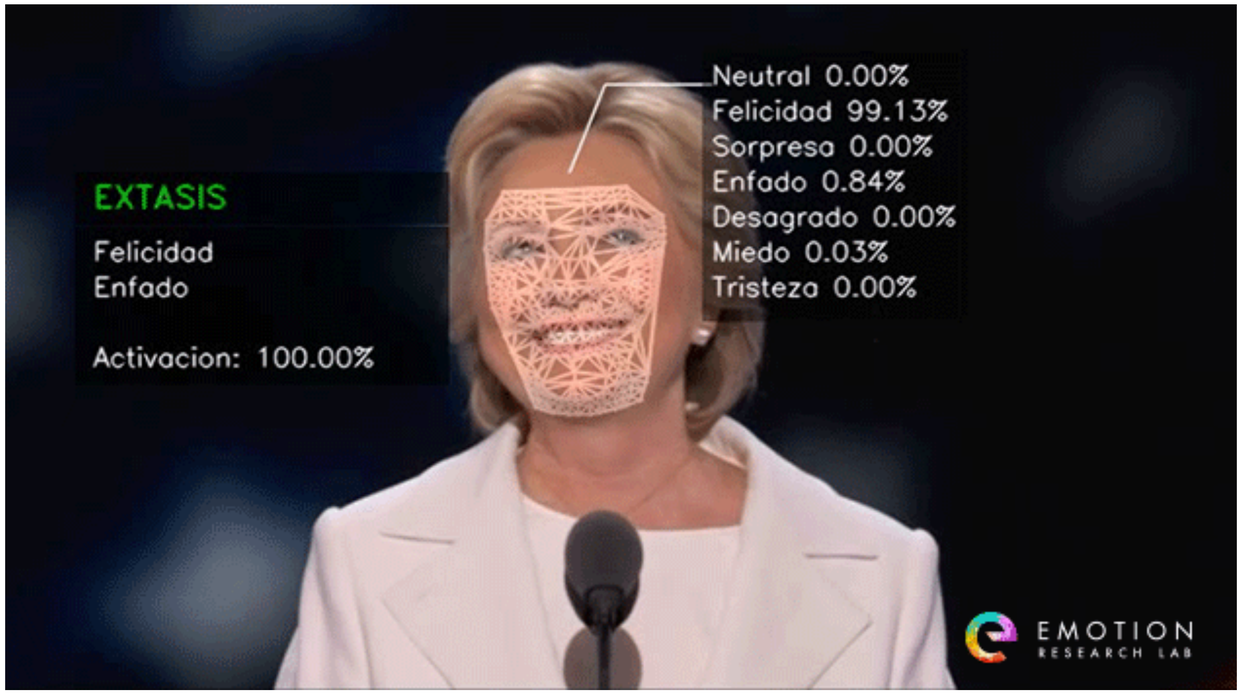
FUTURE WORK

- We plan to create a dynamic feed similar to social media sites and generate content based on the user's emotions.



CONCLUSION

- Thus we conclude that a real-time system in which emotions can be detected is feasible and generating content based on these emotions is a viable proposal.
- Furthermore, the established average accuracy of 60% is competent considering the complex nature of a human face and the real-time constraints.



REFERENCES

- [1] Albert Mehrabian. Silent Messages, University of California Los Angeles, 1971.
- [2] P. Ekman and W. V. Friesen. Emotional facial action coding system. Unpublished manuscript, University of California at San Francisco, 1983.
- [3] Yaniv Taigman, Ming Yang, Marc'Aurelio Ranzato, Lior Wolf. DeepFace: Closing the Gap to Human-Level Performance in Face Verification. The IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2014.
- [4] Thai Hoang Le. Applying artificial neural networks for face recognition. Advances in Artificial Neural Systems, 2011:15, 2011.
- [5] Ruiz-Garcia A., Elshaw M., Altahhan A., Palade V. (2016) Deep Learning for Emotion Recognition in Faces. In: Villa A., Masulli P., Pons Rivero A. (eds) Artificial Neural Networks and Machine Learning – ICANN 2016. ICANN 2016.
- [6] Hiranmayi Ranganathan, Shayok Chakraborty, Sethuraman Panchanathan, "Transfer of multimodal emotion features in deep belief networks", Signals Systems and Computers 2016 50th Asilomar Conference, 2016