FACE EXPRESSION RECOGNITION WITH DEEP LEARNING

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ABSTRACT

Human emotions are natural expressions that people tend to make naturally, instead of any conscious effort that is accompanied by the reflex of facial muscles. Some of the common emotions are happy, sad, surprised, anger and stable (normal). A human face can make expressions according to the different situations. The project detects and recognizes face expressions which could be used to get feedback from customers or to know if a person needs motivation. The objective of the project is to be an affordable and efficient product. Deep Learning technology is used to make the system in python by using one of its modules called openCV. The camera installed in the system is trained in such way that it focuses on the facial expressions and detects them.

1.INTRODUCTION

- The areas of Deep learning and Digital Image Processing are rapidly developing in the world.
- Many areas of industry have started using the various techniques and applications with deep learning.
- The project is implemented to let us know the emotion of a human.
- Facial expression is one of the most important features of human emotion recognition.
- Images are high-dimensional objects, eg. one person (i.e. one observation) has millions of possible gene combinations.
- Facial features over high-dimensional spaces can be difficult to classify.
- The convolutional networks extracts larger features in a hierarchal set of layers.
- The convolutional network is used in training the model and testing.

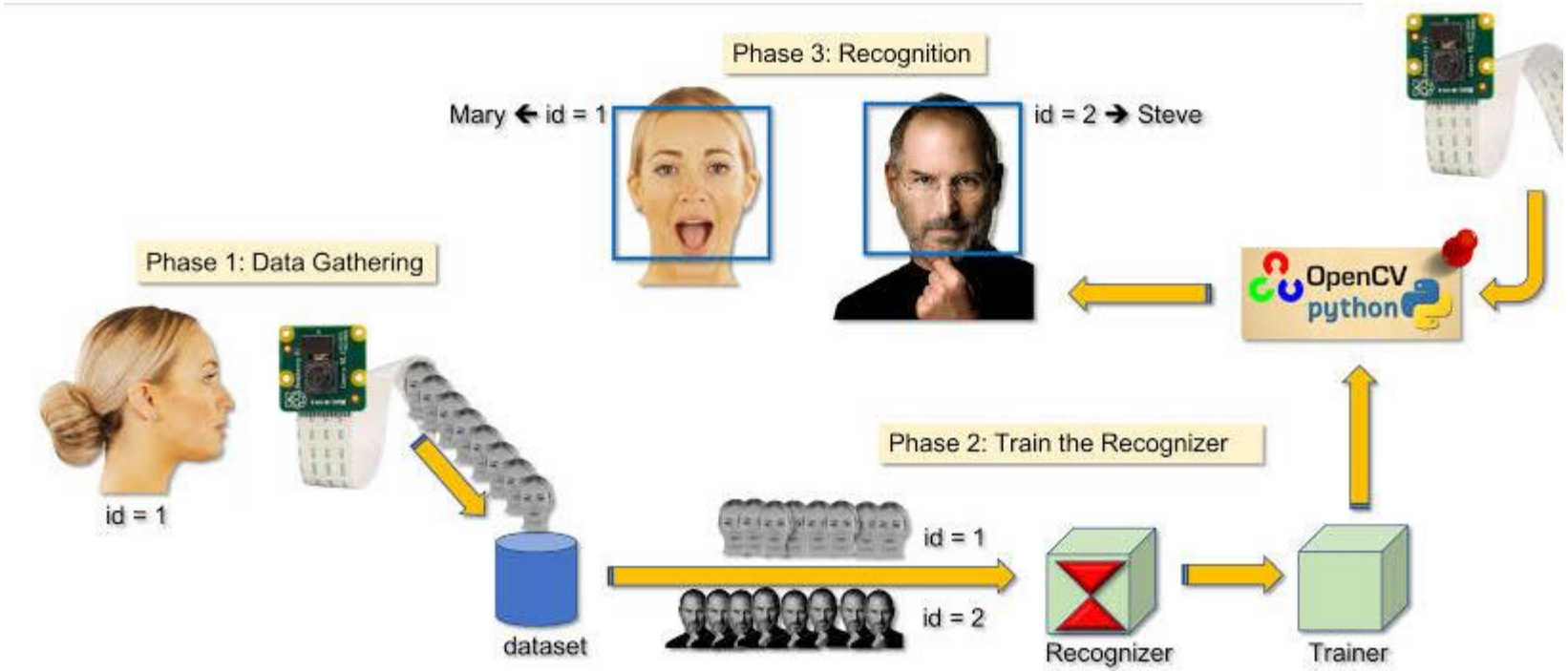


Fig 1.1 Overview of the project

2. LITERATURE SURVEY

Literature survey is the most important step in software development process. Before developing a tool it is necessary to determine the time factor, economy n company strength. Once these things are satisfied, then next steps are to determine which operating system and language can be used for developing the tool. Once the programmers start building the tool the programmers need lot of external support. This support can be obtained from senior programmers, from book or from websites. Before building the system the above consideration are taken into account for developing the proposed system.

1. https://ieeexplore.ieee.org/document/8122667

Nian Zhang, Welezane Karimoune, Lara Thompson, and Hongmei Dang. "A Between-Class Overlapping Coherence-Based Algorithm in KNN Classification",

- The KNN algorithm is used to overcome the class overlapping problem in the class distribution is skewed.
- Being different from the conventional KNN algorithm, it not only finds out the k nearest neighbors of each sample (even the test object itself) in the training dataset, but also the neighbors of the unknown test object.
- Then the validity value of a data point is computed based on the label of the data and the labels of its k nearest neighbors. A classifier is designed to assign the unknown test object to a class membership based on the proposed validity ratings equations.

2.https://scholar.lib.ntnu.edu.tw/en/publications/fast-knn-classification-algorithm-based-on-partial-distance-searc

Wen-Jyi Hwang and Kuo-Wei Wen. “Fast kNN classification algorithm based on partial distance search.”,

- The kNN algorithm is a non-parametric classification technique which has been shown to be effective in statistical pattern recognition applications.
- The technique can achieve a high classification accuracy.
- However, it has a major drawback in that a large amount of design vectors are required in the classifiers resulting in high computational complexity for classification.

3. https://ieeexplore.ieee.org/document/7523134

Bilel Ameur, Sabeur Masmoudi, Amira Guidara Derbel, Ahmed Ben Hamida. "Fusing Gabor and LBP Feature Sets for KNN and SRC-based Face Recognition."

- The face recognition performance can be significantly improved by combining Tensorflow, deep learning extraction, the K Nearest Neighbor and Sparse Representation Classifier (KNNSRC) for classification.
- The best results are obtained in terms of time consumption and recognition rate.
- But the drawback is it's proven that system efficiency depends on the size of the reduced vector obtained by the dimension reduction technique of deep learning.

4.https://arxiv.org/pdf/1808.03457.pdf

Z. Shao, Z. Liu, J. Cai, Y. Wu, and L. Ma, “Facial action unit detection using attention and relation learning,”

- Attention mechanism has recently attracted increasing attentions in the field of facial action unit (AU) detection.
- By finding the region of interest of each AU with the attention mechanism, AU-related local features can be captured.
- Most of the existing attention based AU detection works use prior knowledge to predefine fixed attentions or refine the predefined attentions within a small range, which limits their capacity.

5. https://ieeexplore.ieee.org/document/8090281

Vedat TÜMEN, Omer Faruk SÖYLEMEZ, Burhan ERGEN. "Facial Emotion Recognition on a Dataset Using Convolutional Neural Network."

- Deep learning is a technique that takes place in many computer vision related applications and studies.
- While it is put in the practice mostly on content based image retrieval, there is still room for improvement by employing it in diverse computer vision applications.
- The aim was to build a Convolutional Neural Network (CNN) based Facial Expression Recognition System (FER), in order to automatically classify expressions presented in Facial Expression Recognition (FER2013) database.
- But achieved only 57.1% success rate.

3. LIMITATIONS

The existing system is unable to find out the facial expressions. It’s not supporting the machine learning (ML), artificial intelligence (AI).here only the data is captured but couldn’t produce proper output. The existing system to failed in identifying the facial emotion expression.

Disadvantages

- Sensitive to distance metrics
- No accurate results
- Not possible to find the facial expression.
- Loss of data base.

4.PROBLEM STATEMENT

- Feedback is taken from the customers in different ways like filling the forms, self service technology where customers press the buttons showing the feedback like excellent, average etc.
- One of the best ways of collecting feedback is through face expression recognition
- There are different human emotions, like angry, sad, happy, surprise, neutral and fear.
- A model is trained with dataset such that it will understand the human emotions from different facial expressions provided as input.

5. PROJECT WORK OBJECTIVES

- The goal of the project is to establish a model that can classify basic emotions like Happy, Sad, Surprise, Anger, Neutral and Fear.

- To achieve a better accuracy than the existing systems.

- In addition to this our project also aims to analyze the result of our model in terms of accuracy for each expression.

- In future the model is expected to perform emotions recognition that has more complex variance than the current images.

6. MINIMUM SYSTEM REQUIREMENTS

H/W System Configuration:

- Processor - I3/Intel Processor
- RAM - 4GB (min)
- Hard Disk - 160GB
- Key Board - Standard Windows Keyboard
- Mouse - Two or Three Button Mouse
- Monitor - SVGA

S/W System Configuration:

- Operating System : Windows 10
- Language : Python
- IDE : Pycharm.
- Data sets : FER2013

7. PROPOSED PROJECT WORK

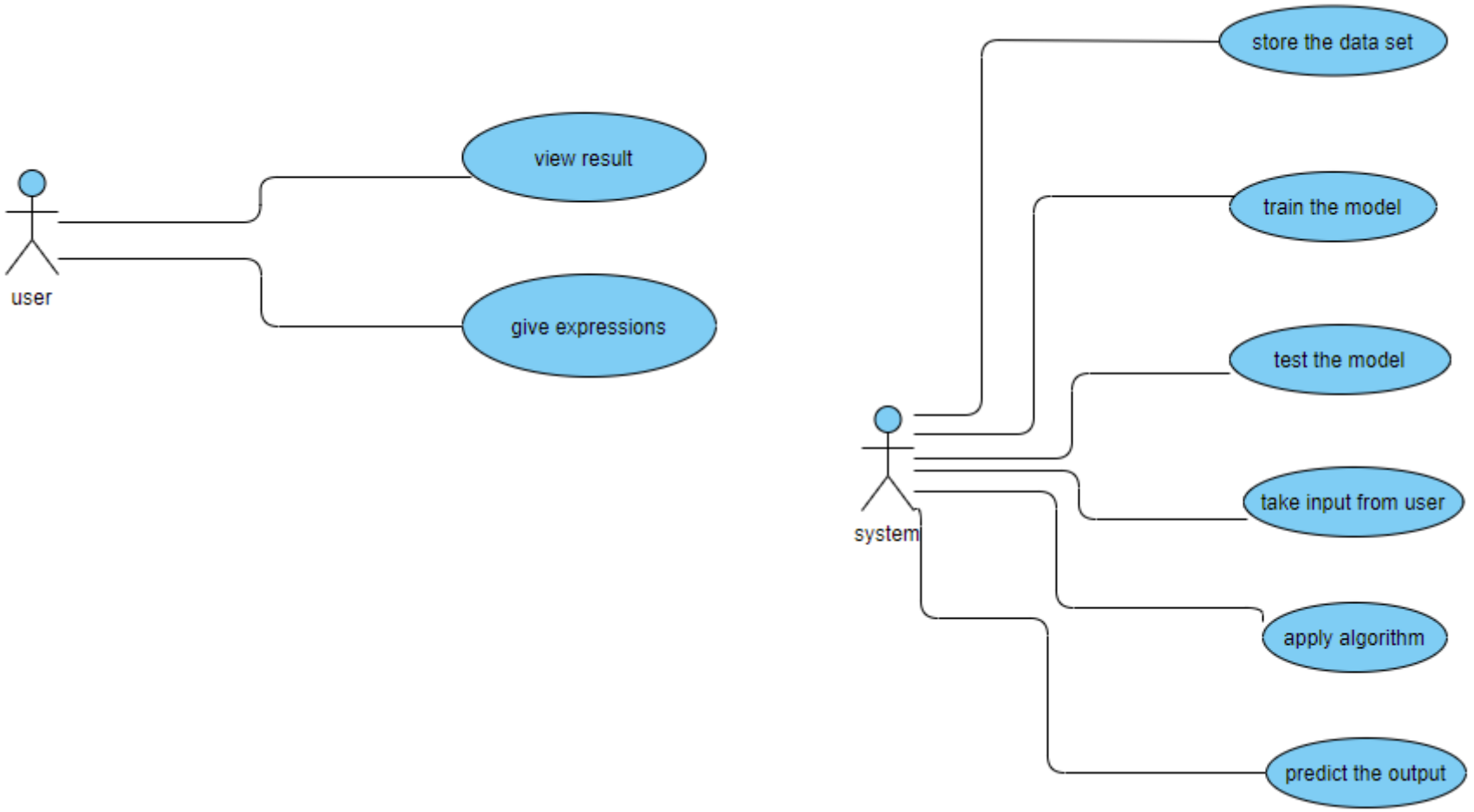
- There is a thought for a better face expression recognition technique which is based on the ROI(region of interest).
- Here the convolution neutral networks (CNN) with deep learning focuses only on those areas which are associated with that particular expression which the human face makes. The given training data, as all the regions of the face are not useful for expression recognition
- It identifies the relationship between the different areas in the face which are helpful in intensifying the accuracy.

Some of the common emotions are Happy, sad, surprised, anger, stable (normal) which a human face can make according to the different situations one may find itself in. This is a proposed method to find the emotions of a person.

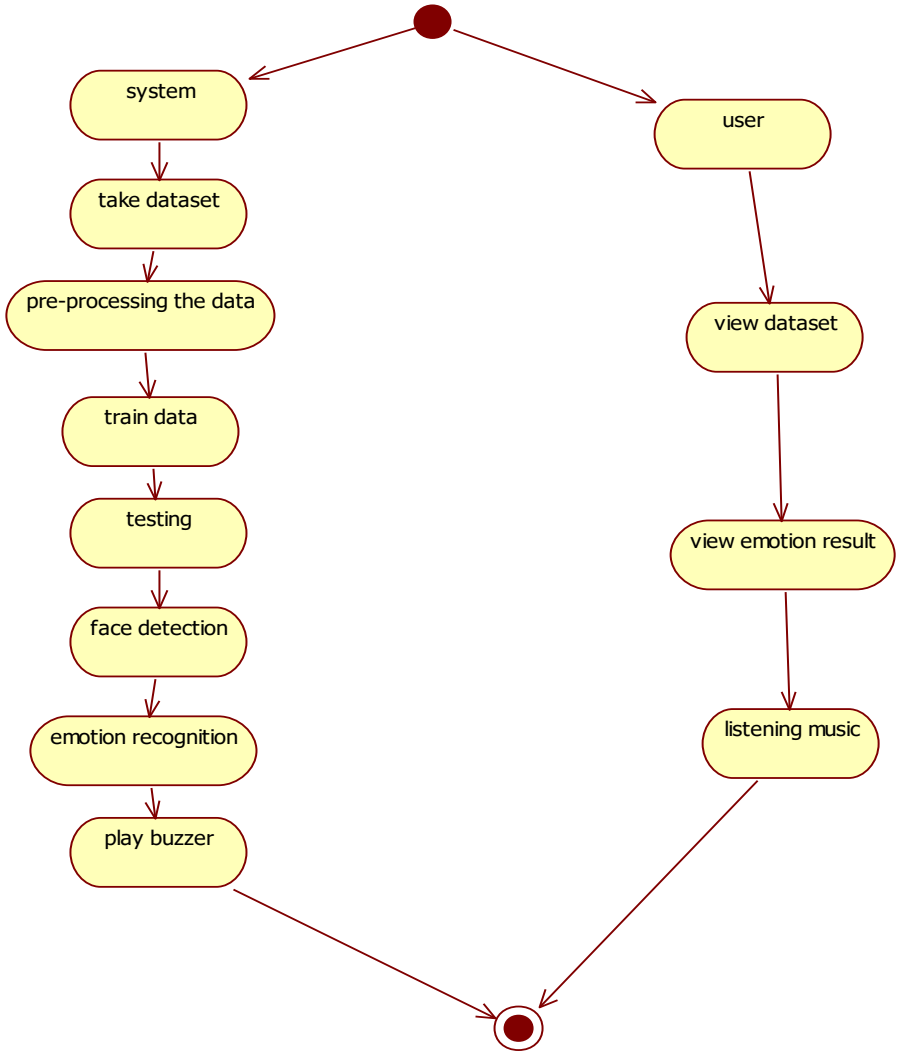
Advantages

- Time saving
- Find the facial expression
- Accurate results

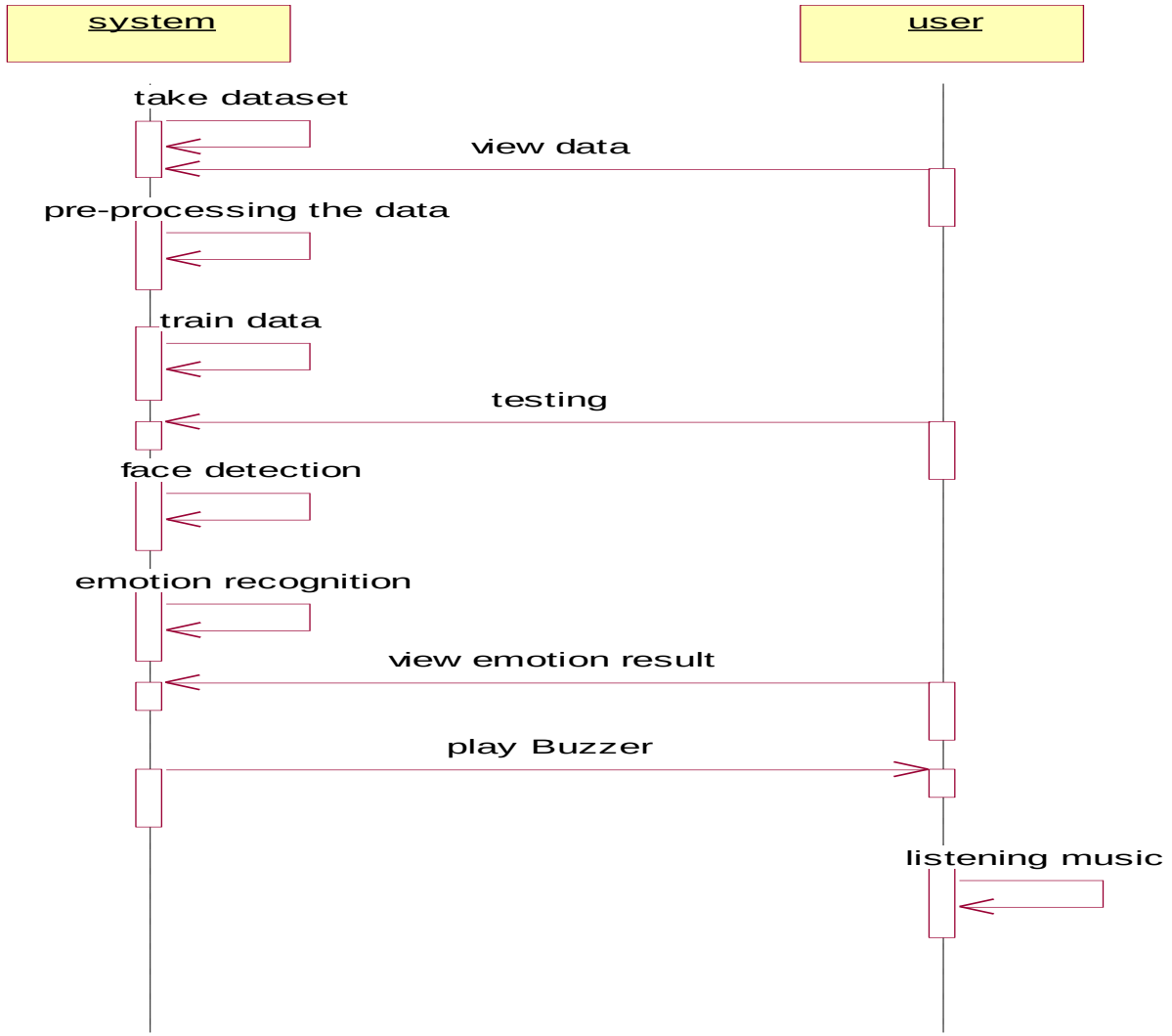
8. SYSTEM DESIGN



8.1 use-case diagram



8.2 activity diagram



8.3 sequence diagram

8.4 class diagram

9. ALGORITHM

What are CNNs?

- Convolutional Neural Networks are made up of neurons that have learn-able weights and biases. Each neuron receives some inputs, performs a dot product and optionally follows it with a non-linearity.
- VGG16 is one of the models of CNN.

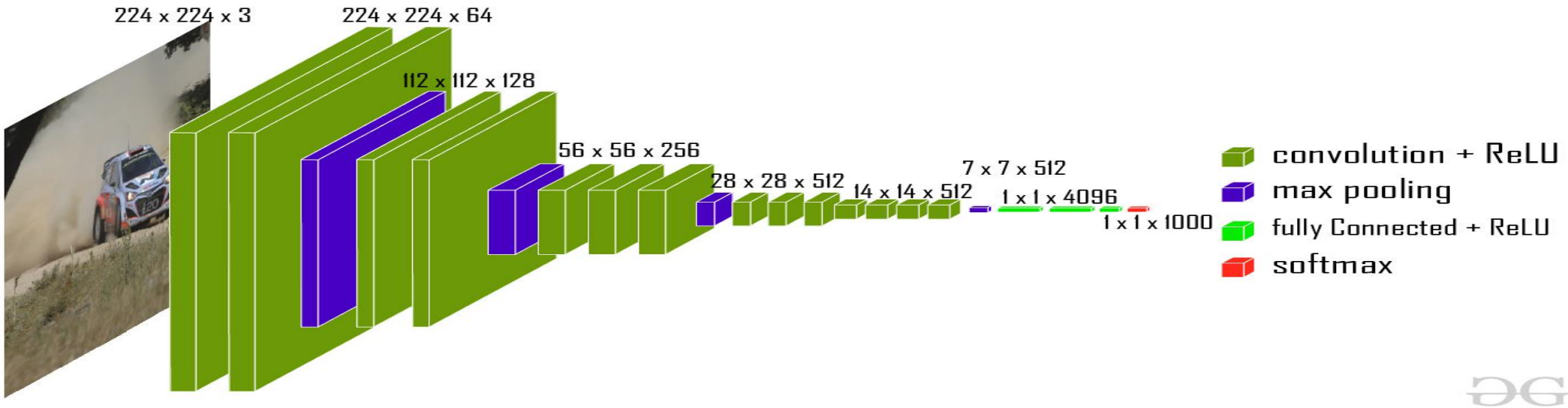


fig 9.1 VGG16 architecture

- Each CNN layer learns filters of increasing complexity.
- The first layers learn basic feature detection filters: edges, corners, etc
- The middle layers learn filters that detect parts of objects. For faces, they might learn to respond to eyes, noses, etc
- The last layers have higher representations: they learn to recognize full objects, in different shapes and positions.

1. Convolutional layers:

The layers where filters are applied to the original image, or to other feature maps in a deep CNN. This is where most of the user-specified parameters are in the network. The most important parameters are the number of kernels and the size of the kernels.

2. Pooling layers:

Pooling layers are similar to convolutional layers, but they perform a specific function such as max pooling, which takes the maximum value in a certain filter region, or average pooling, which takes the average value in a filter region. These are typically used to reduce the dimensionality of the network.

3. Fully Connected layers:

Fully connected layers are placed before the classification output of a CNN and are used to flatten the results before classification.

- The VGG16 architecture has 2 convolutional layers with the activation function ReLu, followed by a pooling layer.
- The number of such convolutional layers can be added based on the dimension of the input image.
- After going through these layers the dimension gets reduced to 2D array
- The output of the above layers will be given as input to the fully connected layer to reduce it to a 1D array.
- This value will be given as input to the last activation function softmax to give the output.
- The pictorial representation of the layers is shown in the figure 9.2

It looks like..

Fig 9.2 Layers of VGG16

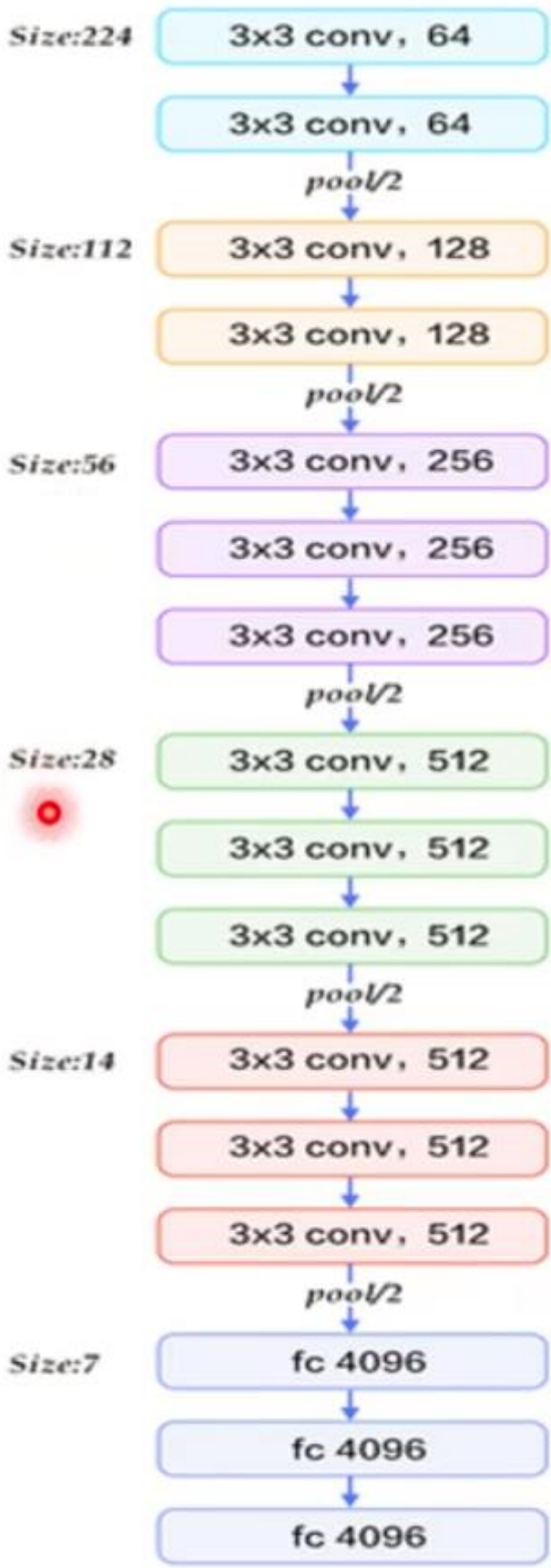


Fig 9.3 Layers of VGG16

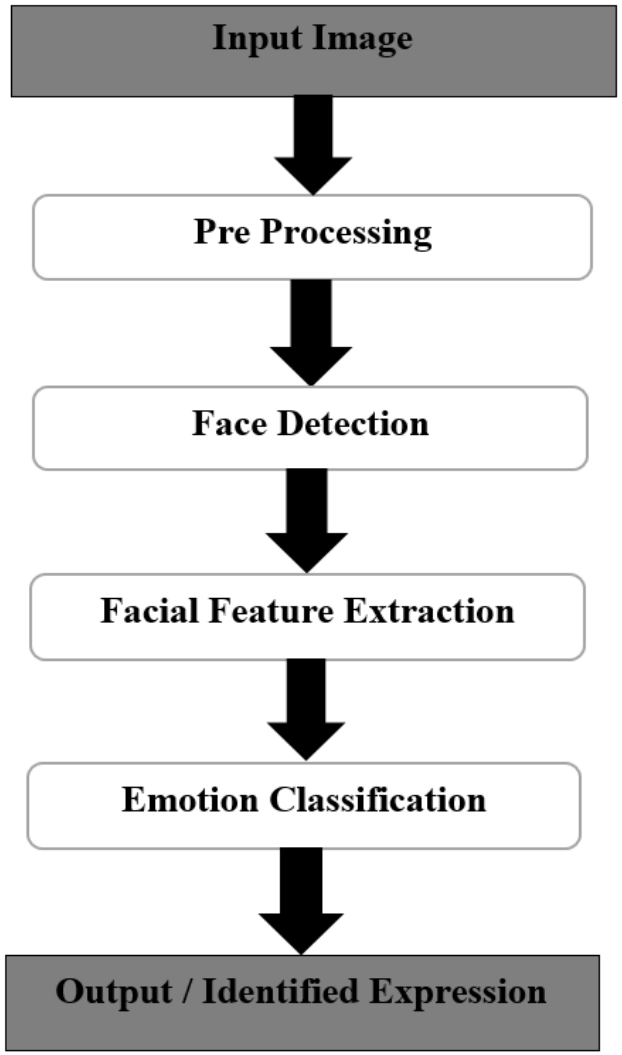


fig. 9.4 Block diagram:

10. RESULTS

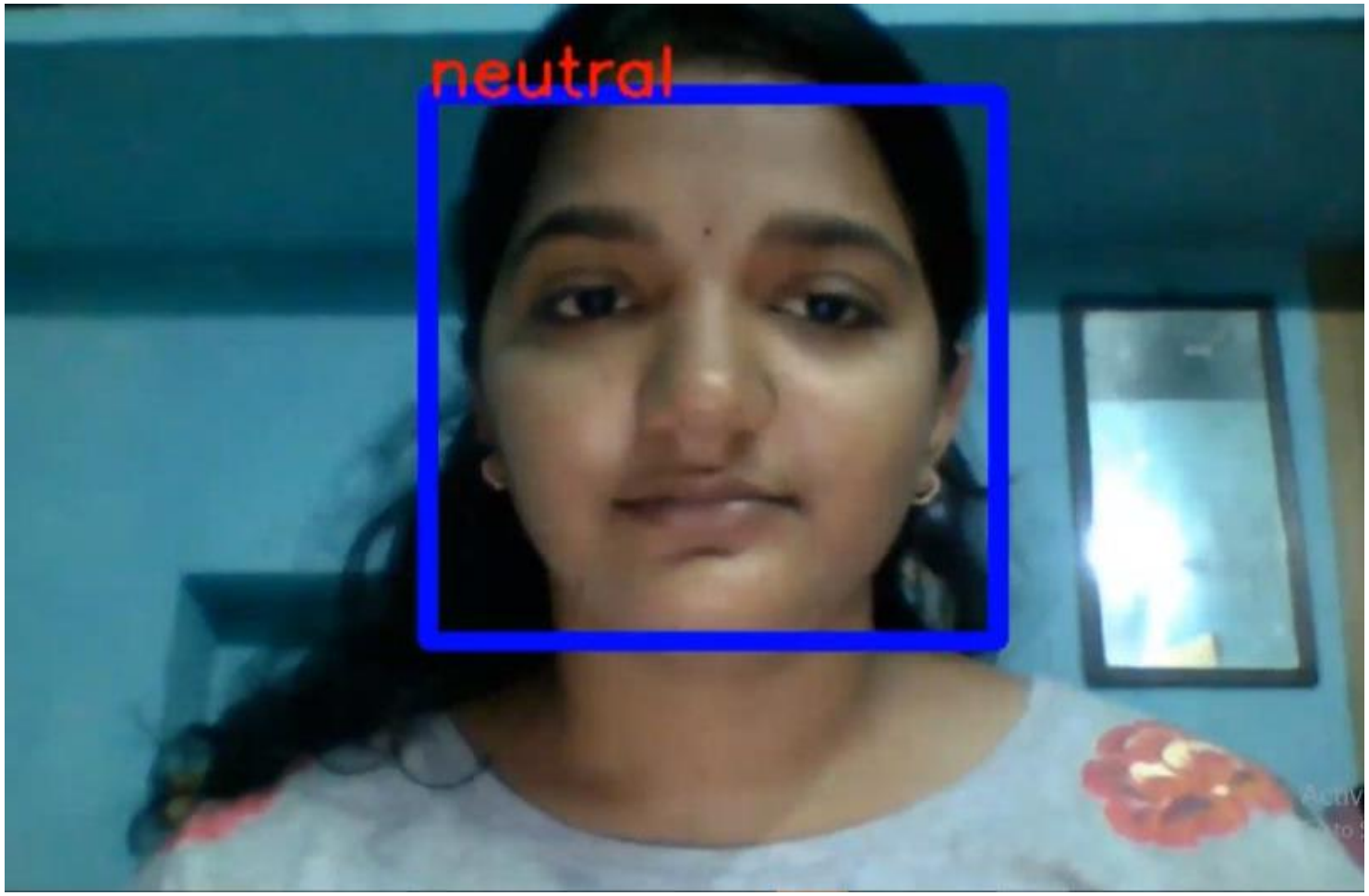


fig 10.1 neutral

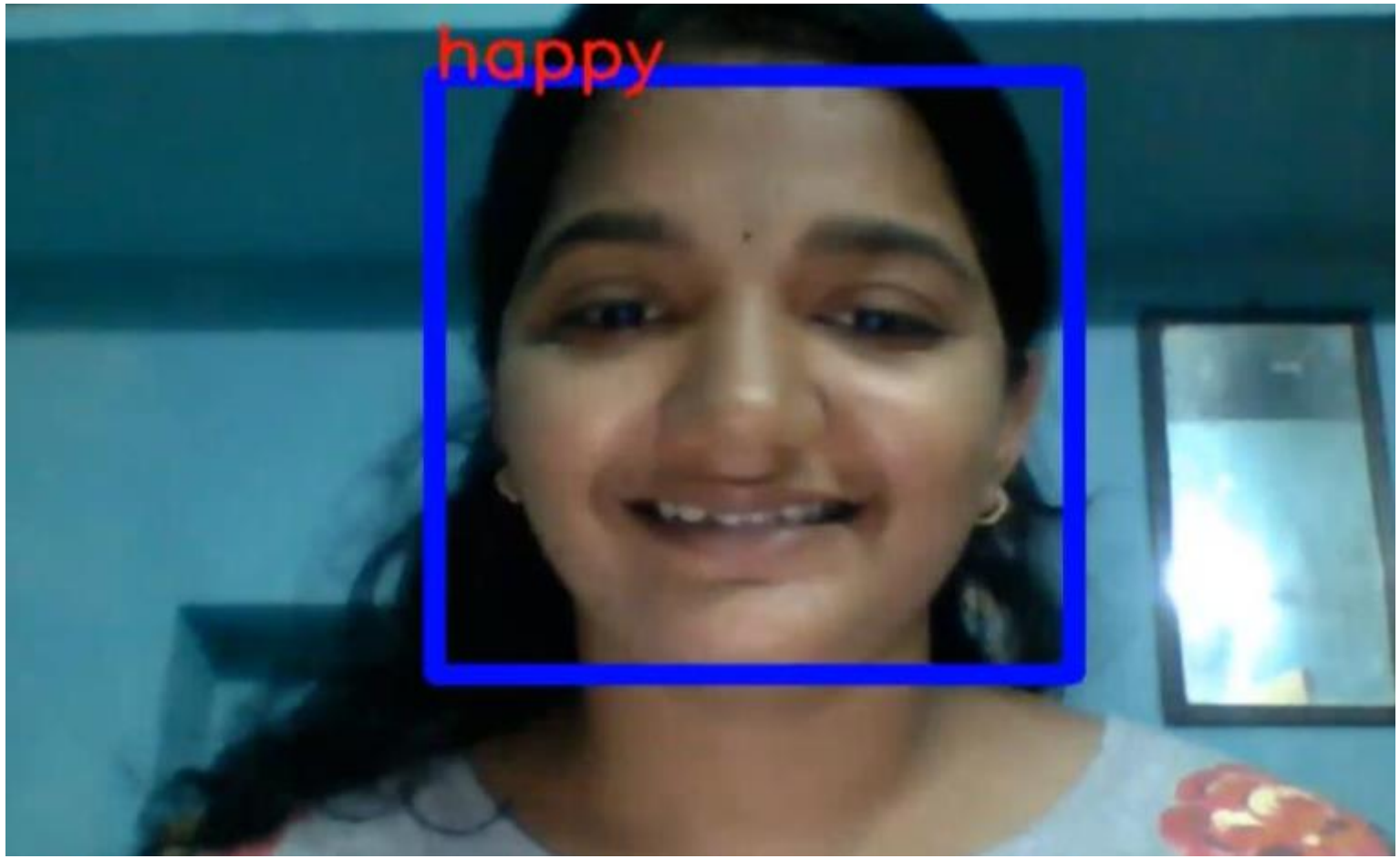


fig 10.2 happy

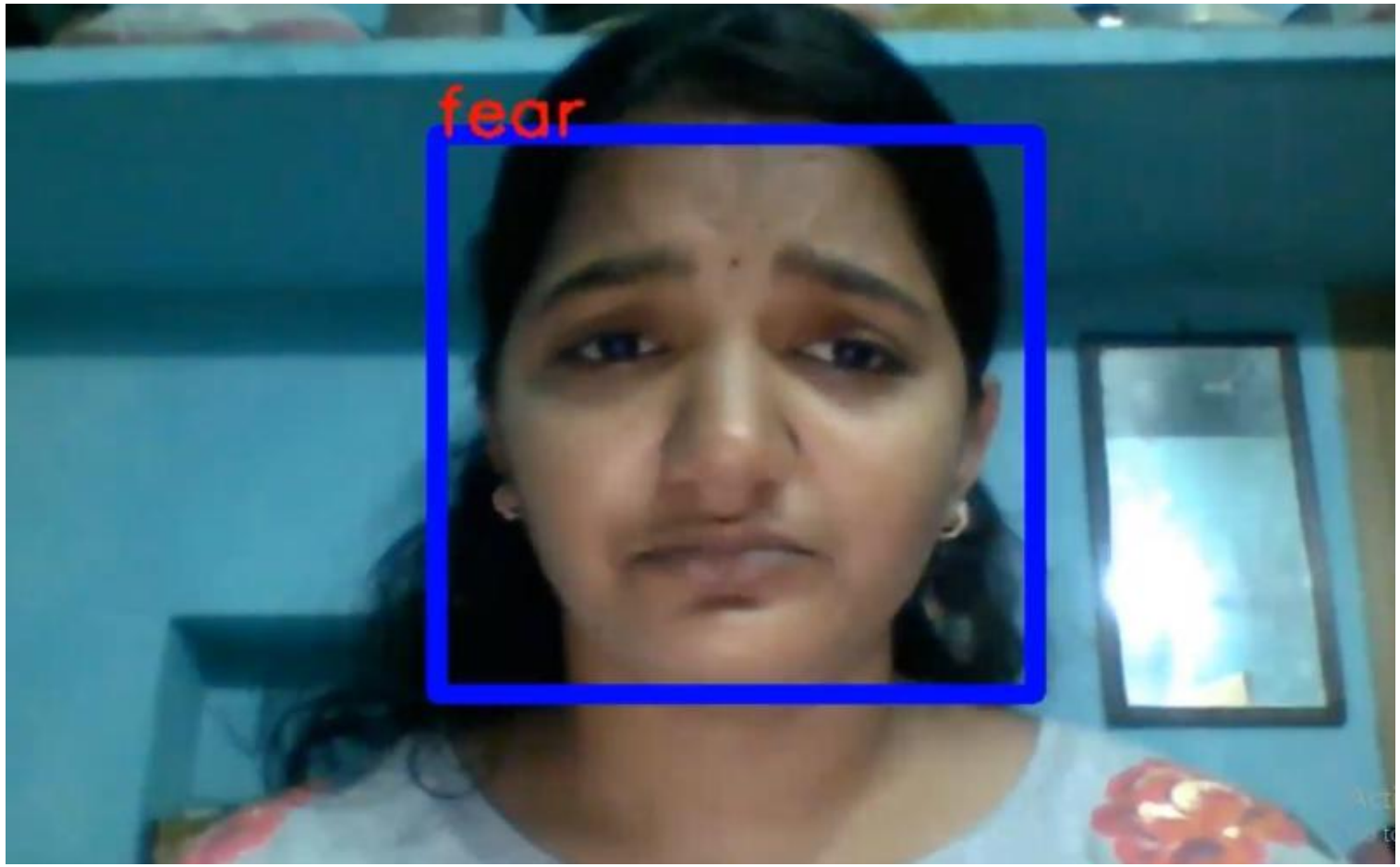


fig 10.3 fear

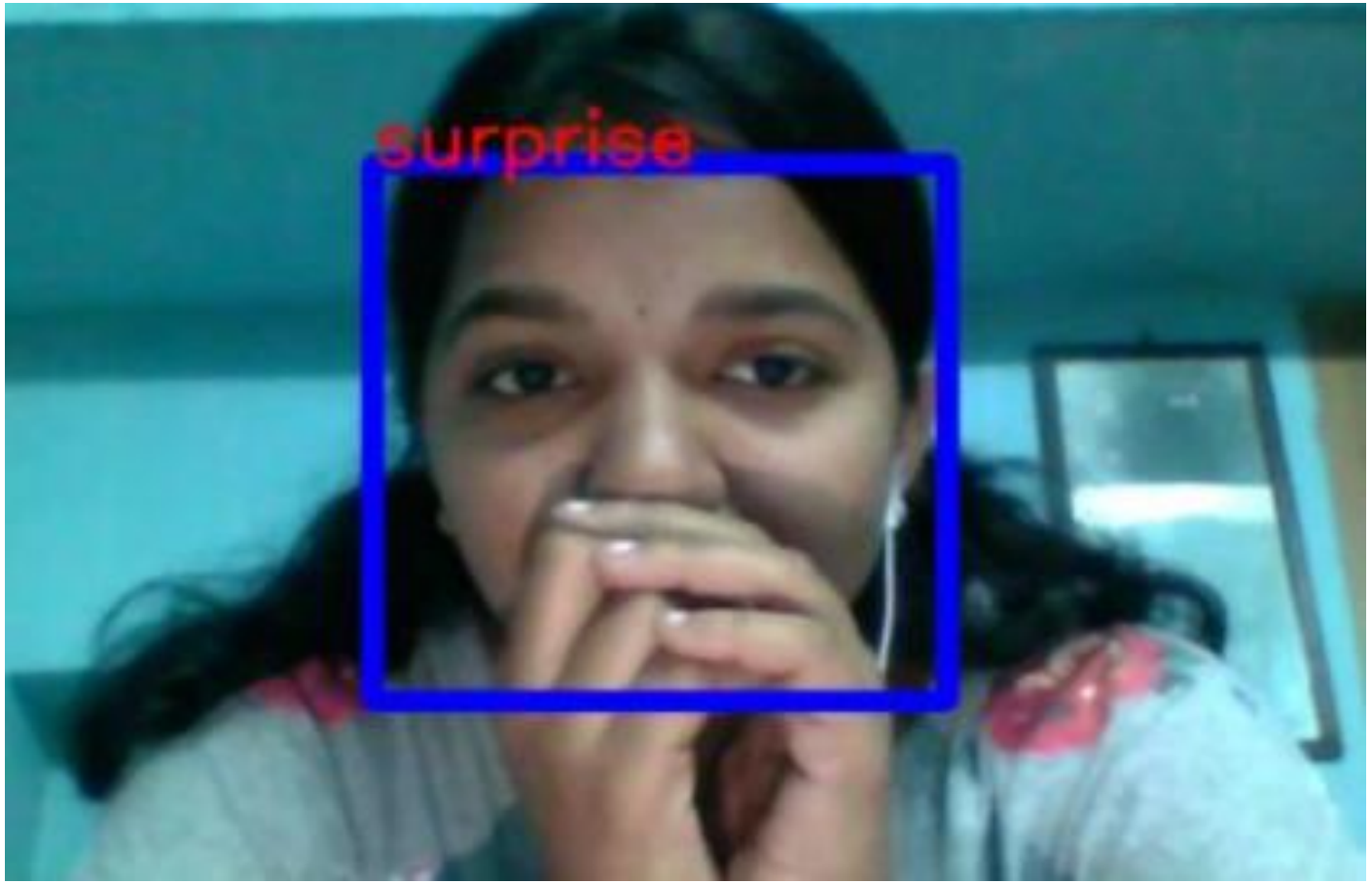


fig 10.4 surprise

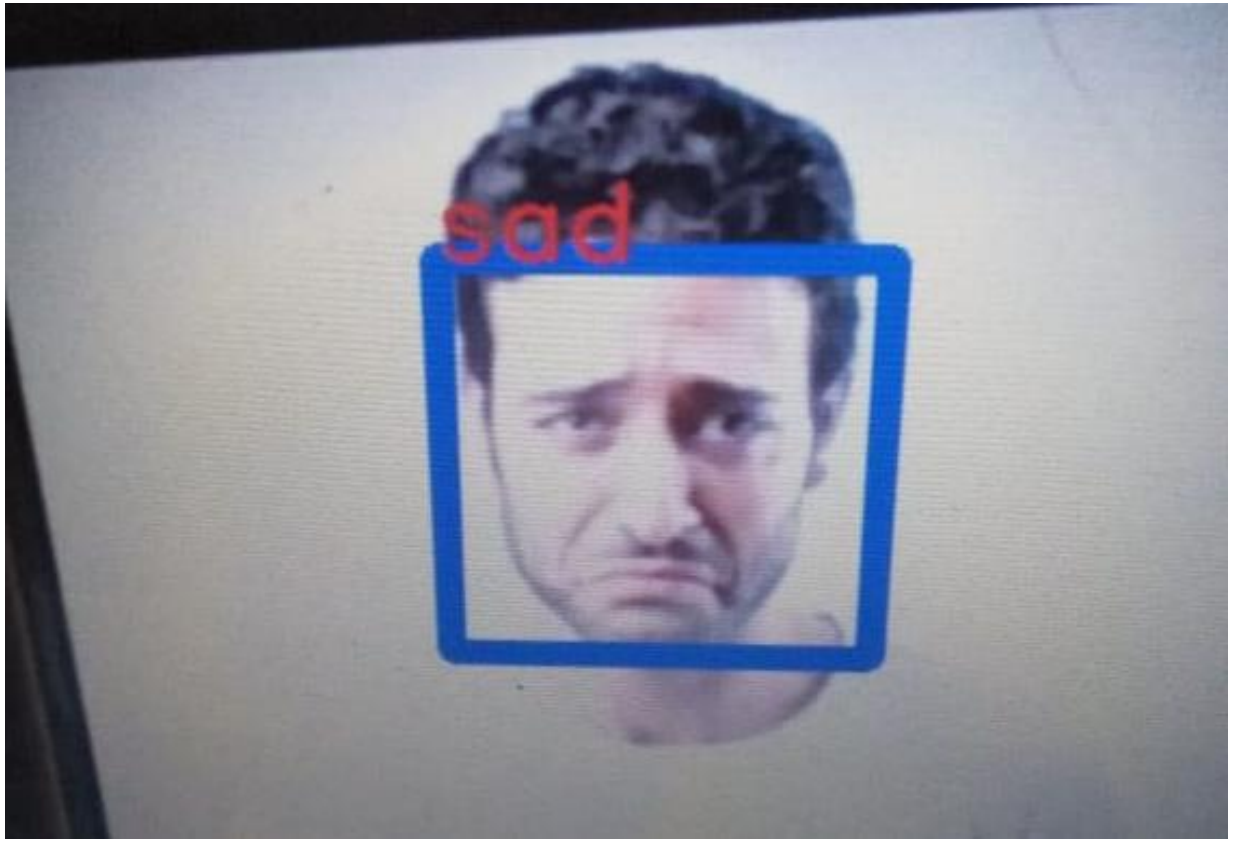


fig 10.5 sad

fig 10.6 angry

CONCLUSION

- The customer feedback can easily be collected through their Face expressions.
- The facial expressions can be accurately determined.
- It can effectively recognize the actual meaning of the expression. The model can also achieve full automation, and its accuracy can reach a high level.
- Even though there are large number of similar images, the model is trained by different layers of CNN and the layer that gives the best accuracy is chosen.

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3. Xiao Sun, Man Lv, Changquin quang. “Improved Facial Expression Recognition Method Based on ROI Deep Convolutional Neutral Network.”. 01 February 2018
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