International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 08 | Aug 2021 www.irjet.net p-ISSN: 2395-0072

Human Facial Emotion Recognition with Pulse Detection using CNN

Chandan S[1], Dr. N Asha[2]

[1]PG Student, Dept of MCA, The National Institute of Engineering, Mysuru, Karnataka, India
[2]Associate Professor & Head, Dept of MCA, The National Institute of Engineering, Mysuru, Karnataka, India

---

Abstract - *In this paper, we propose and implement a system which is capable of recognizing human facial emotions and also the pulse rate using webcam in real time. During this Covid-19 pandemic there was a huge demand for devices like Oximeter to detect the Pulse Rate and Oxygen levels. Our aim is to develop a Simple, Contactless system which can detect the Pulse Rate and also Facial Emotions using a webcam. The system is also capable of producing ECG Graph plots which can be helpful in further analysis. By this proposed system we can easily detect and avoid the heart related diseases like Heart Attack etc. The facial emotion recognition is done by implementing general Convolutional Neural Network framework and a model trained with FER2013 Dataset. The pulse rate is detected using Eulerian Video Magnification Technique.*

Key Words: Covid-19, CNN, ROI, ECG, FER, Eulerian Video Magnification, ROI, Fourier Transform.

1. INTRODUCTION

Human facial emotion recognition with Pulse detection is an important method that has varying applications such as security systems, medical systems, entertainment. Due to this it has drawn the attention of many researchers. A face recognition concept is one of the biometric information processing systems compared to other biometrics i.e., eye iris recognition and fingerprint recognition of humans. Recently, it became popular as marketing tool and a commercial application.

In everyday life, human interact with the surroundings with facial expressions, so the facial expression exhibits multiple human emotions and the feelings. Hence it is also an important aspect to know one's emotion and also the heart rate can be detected using this system by a simple webcam. Nowadays, the facial expression finds its application in various platforms such as robotics etc. The facial expression that exhibits due to interaction to other people contains important information. many researches have been done in the past years to recognize human facial expression.

Since the beginning of Covid-19 pandemic, Social distancing is one of the main techniques to avoid the infection. In these times the hospitals use Oximeter and other alternatives to detect the Pulse rate and Oxygen levels of the patients. Our aim is to develop a system which should help the individuals can able to check the pulse rate by just using the webcam.

2. TECHNICAL APPROACH

1.1 Emotion Recognition

The facial emotions are recognized by building a general Convolution Neural Network architecture and make use of computer vision technique to detect the face from the webcam and to extract the features for emotion classification. Further we train the model using FER2013 dataset which contains multiple grayscale images for seven different emotions.

The proposed system (Fig 1) includes two models which will be evaluated based on their test accuracy and number of parameters. Both models should give high accuracy. By reducing no. of parameters, we can avoid few problems like slow performances and can provide better generalization [1].

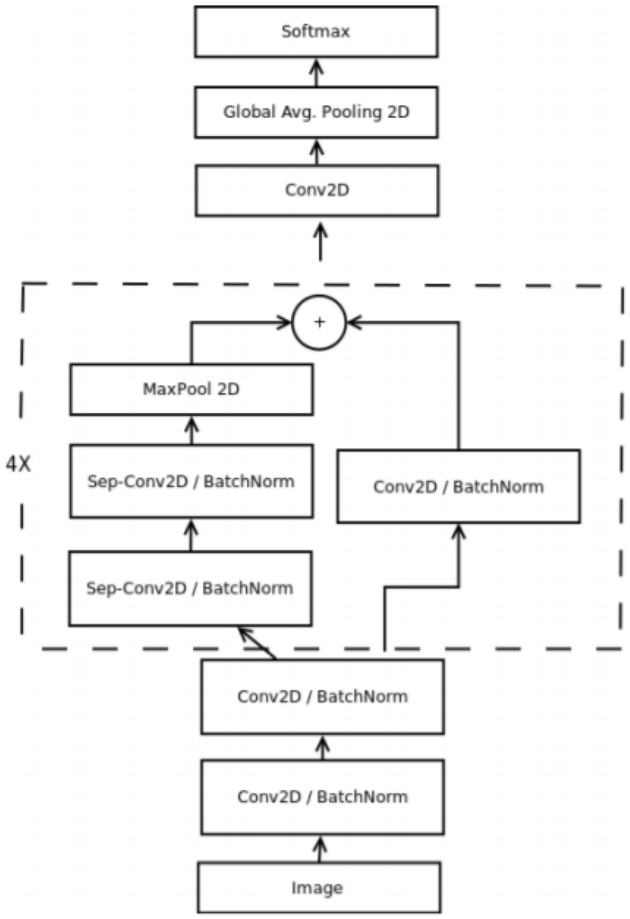

Fig-1 Proposed model for Real Time Classification [1]

The emotion recognition system is implemented by collecting the FER2013 dataset which includes images for different emotions like happy, sad, surprise, angry.

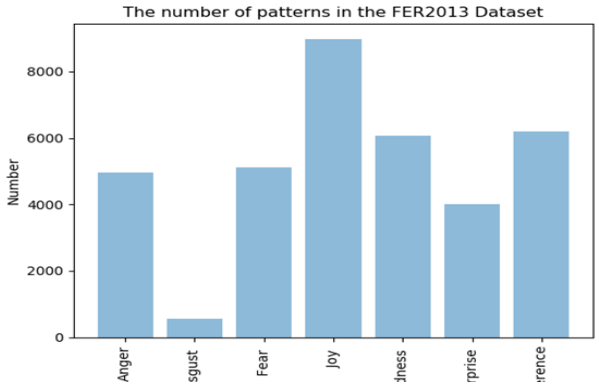

Fig-2 Patterns in FER2013 Dataset

The proposed model is trained with TensorFlow using FER2013 Dataset. The dataset is trained over multiple iterations to achieve maximum accuracy and minimize the losses. The Patterns of the FER2013 Dataset is shown in the Fig 2.

The trained model will be saved in hdf5 file format and used for Emotion Classification. The face detection is done by using capturing the webcam feed and using haar cascade xml file and then the features are extracted to compare with the trained model to classify the emotion.

1.2 Pulse Rate Detection

The Pulse Rate can be determined by make use of existing face detection module to select ROI and further extracting the RGB pixels by Eulerian Video Magnification Technique. The blood flow can be easily identified by Green channel alone and this helps in calculating the Pulse Rate. The color-based Approach is shown in the Fig 3.

The face is detected in the webcam feed using OpenCV by Haar-Cascade detection and then captures the Region of Interest (ROI) by drawing a rectangular around the ROI. The forehead region is one of the best places to choose as a ROI because we can easily track the blood flow by examining the Green pixels alone.

The pixels are captured at ROI which changes the color as the blood circulates. Based on Eulerian Video Magnification Technique, the Blue and Red channels are ignored and only green channel is considered to amplify the variations and calculate the pulse rate by analyzing the frequencies of green channels by Fourier Transform [2].

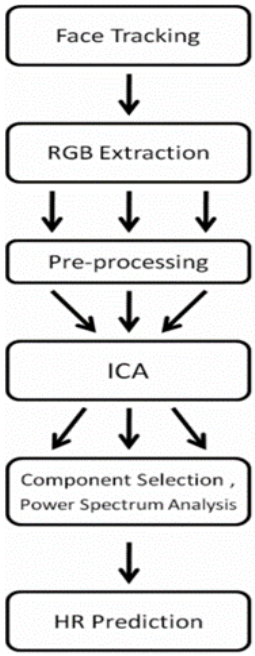

Fig-3 Color-based approach for Pulse rate Estimation [2].

3. Overall Architecture

The overall architecture shows the complete system architecture by combining the Emotion Recognition system and Pulse Rate Detection. This architecture will help user to understand the complete system flow. Fig 4 represents the Overall architecture for Human Facial Emotion Recognition with Pulse Detection.

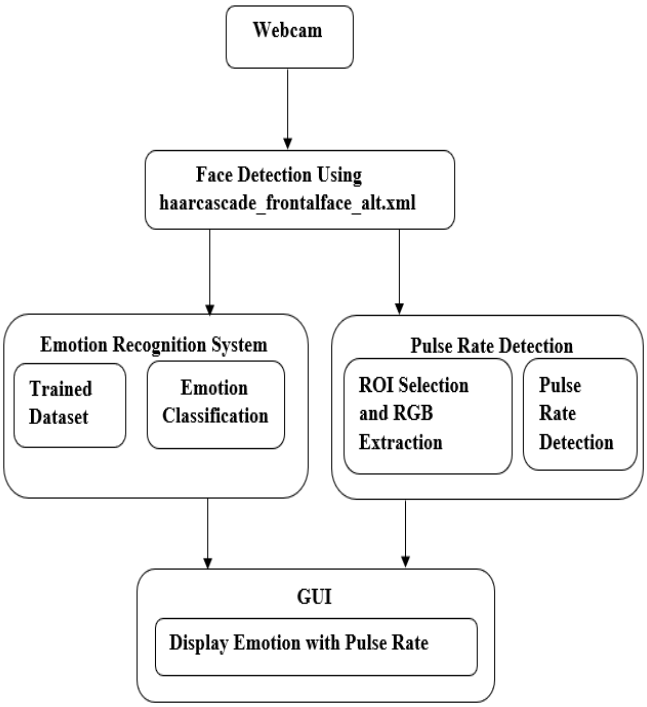

Fig-4 Overall Architecture

3.1 Results

The proposed model for Emotion recognition achieved 71% of the accuracy compared to the second-best methods presented in [5] achieved an accuracy of 66% using an ensemble of CNNs. The result of Pulse rate mainly depends on various factors like quality of the webcam and also the noise in the image, background of the webcam etc. The results of the system are checked in different environments like light area and dark area with different webcams and the pulse rate is also compared with different alterative devices like Oximeter and found that the proposed system has the error correction of +5 or -5 bpm. The details of result analysis are given in the Table-1.

Table -1: Accuracy results

Conditions	Emotion Recognition	Pulse rate Detection
Indoor vs Outdoor	Works well in both conditions	High accuracy in good lighting
Subjects from different ages	Expected results for all ages	Expected results for all ages
Webcam Resolution	Works well for all resolutions	Good accuracy in high resolution webcam (Logitech C920)
Stable vs Moving subject	Does not affect the results	Very sensitive to motion and works well for stable subject

4. CONCLUSION

In this proposed system, the human emotion and heart rate can be recognized in real time using a webcam. The user just needs a webcam to capture a live feed and the system will detect the face and starts to display the emotions recognized in real time and also it helps user to know the pulse rate.

During this covid-19 pandemic, we saw many people got severe health issues and also every patient required the artificial oxygen to maintain the oxygen levels and they all used these devices like oximeter to detect the heart rate and SpO2 levels. This system will help every user to check the heart rate without any interaction and this application can be simply installed in any laptop to start utilizing its functionalities. As of now the proposed system will only be able to recognize a single face in the webcam and the support for multiple face detections will be added in the future work.

REFERENCES

[1] Arriaga, O., Valdenegro-Toro, M., and Plöger, P., "Real-time Convolutional Neural Networks for Emotion and Gender Classification", arXiv e-prints, 2017.J. U. Duncombe, "Infrared navigation—Part I: An assessment of feasibility," *IEEE Trans. Electron Devices*, vol. ED-11, no. 1, pp. 34–39, Jan. 1959.

[2] S. A. Alhammad, "Face Detection for Pulse Rate Measurement," 2018 1st International Conference on Computer Applications & Information Security (ICCAIS), 2018, pp. 1-5, doi: 10.1109/CAIS.2018.8442034.D. B. Payne and J. R. Stern, "Wavelength-switched pas- sively coupled single-mode optical network," in Proc. IOOC-ECOC, 1985,

[3] M. Lewandowska, J. Rumiński, T. Kocejko and J. Nowak, "Measuring pulse rate with a webcam — A non-contact method for evaluating cardiac activity," 2011 Federated Conference on Computer Science and Information Systems (FedCSIS), 2011, pp. 405-410.

[4] Ming-Zher Poh, Daniel J. McDuff, and Rosalind W. Picard, "Non-contact, automated cardiac pulse measurements using video imaging and blind source separation.," Opt. Express 18, 10762-10774 (2010)

[5] Goodfellow I.J. et al. (2013) Challenges in Representation Learning: A Report on Three Machine Learning Contests. In: Lee M., Hirose A., Hou ZG., Kil R.M. (eds) Neural Information Processing. ICONIP 2013. Lecture Notes in Computer Science, vol 8228. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-42051-1_16