IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 4, April 2024

Human Face Emotion Detection and Recognition

Shrikant Boinwad, Chaitanya Waghmare, Pratik Jadhav, Prof. S. A. Koti
Department of Electronics and Telecommunication Engineering
Sinhgad College of Engineering, Savitribai Phule Pune University, Pune, India

Abstract: *This research project aims to develop an efficient and cost-effective system for the real-time detection and recognition of human facial emotions using a Raspberry Pi platform. Emotion recognition from facial expressions is a critical component in human-computer interaction, and it finds applications in various fields, including healthcare, education, and entertainment.*
The proposed system leverages computer vision techniques and deep learning models to detect and classify emotions based on facial features. Raspberry Pi, a low-cost, credit-card-sized computer, serves as the core hardware platform, making the system accessible and affordable for a wide range of applications..

Keywords: Facial Detection, Emotion Classification, Real-time processing, Iser Interaction

I. INTRODUCTION

Numerous industries that demand extra protection or personal data use human face detection and emotion recognition. It might be thought of as a follow-up to face detection in which we could need to establish a protective layer in which the emotion is recognised in addition to the face. Business promotions are another significant area where emotion detection is crucial. The majority of firms rely heavily on the reactions of their clients to all of their offerings.
An artificial intelligence system can determine if a customer loves or dislikes a product or service if it can recognise and record real-time emotions from user photos or videos. As we've seen, the primary motivation for identifying someone is security. It may be predicated on voice recognition, passwords, fingerprint matching, retinal detection, etc. To avoid threats, it can also be crucial to determine the other person's intentions. This can be useful in high-risk locations such as airports, arenas, and large public spaces.

II. HARDWARE AND SOFTWARE REQUIREMENTS

The proposed human face emotion detection and recognition using a deep learning System comprises the following key components:

Hardware:

- Raspberry PI.
- Raspberry Pi Camera Module V2 5MP
- USB Cabel
- Processor: Any Processor above 500 MHz Ram: 8 GB Hard Disk: 4 GB Dedicated Graphics Card
- Input device: Standard Keyboard, Mouse, and Camera. Output device: High-Resolution Monitor.

Software:

- Raspberry Pi OS(Formaly Raspbian)
- Programming language: Python and related libraries.
- Haar cascade
- CNN

III. IMPLEMENTATION AND RESULT

1**. Facial Expression dataset**:
The literature contains a large number of publicly available facial expression datasets. We have employed a facial expression dataset from Kaggle, which consists of grayscale portraits of faces with 48 by 48 pixels. 28,709 instances

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representing seven different emotions make up the training set: joyful, sad, astonished, afraid, furious, disgusted, and neutral.

2**. Image Preprocessing:** The Haar Cascade library was used to extract the photographs' facial circumference. Following detection, these rectangular facial expressions were captured and edited. In addition, the pictures were transformed into grayscale and fed into neural networks. The purpose of this procedure was to prevent superfluous density in the neural networks.

3. Convolutional neural network architecture:
The goal of the suggested CNN architecture is to train the pixel values in the rectangle area that contains the expressions on the face. This happens in three steps, after which the completely connected layers receive it. The three levels of the CNN structure—two convolutional layers with a "real" activation function in each—are made up of facial expression through three fully connected layers with a "real" and softmax activation function, as well as max-pooling layers. Each frame feeds into fully connected layers after convolutional and max-pooling layer operations are complete, and the classifier processes the predicted frames as seven distinct emotional states on the face.

4. Network training
Tensor Flow, a Python backend for Tensor Flow, was used in conjunction with Keras to build the neural networks. Fifty epochs were used to train the model

5. Real-time testing:
Real-time testing was done on the trained model following the training of the suggested CNN architecture. Initially, the computer camera used the Haar Cascade library to identify faces. Subsequently, the model was queried for the classes to which the discovered images belong. The likelihood of which class the facial expression on the webcam screen belonged to was determined by the forecasts.
Using OpenCV, a rectangle boundary is drawn around the identified face, and the emotions are shown on the screen along with an emoticon indication that shows the emotion's percentage confidence..

6. Results and Summary:

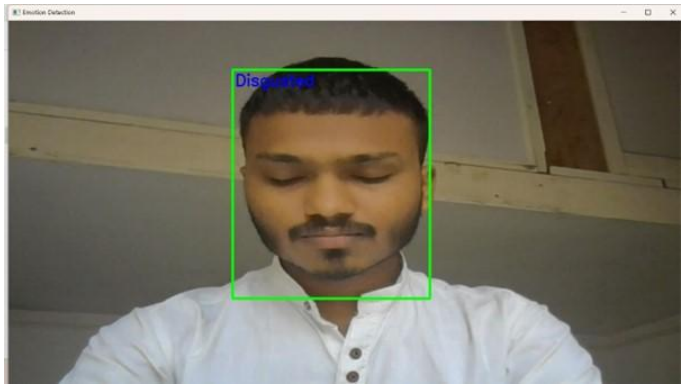

Fig 5.1- Emotion Recognition

Using the seven emotions included in the Kaggle database—happiness, anger, sorrow, disgust, neutral, fear, and surprise—we trained our Convolutional Neural Network model. The photos of the faces that were discovered were reduced to 48 by 48 pixels, turned into grayscale images, and then fed into the CNN model. Our achievement in identifying emotions was a 64% accuracy rate. Emotion Recognition in Figure 5.1 In this paper, we presented a button-based desktop programme that uses a questionnaire that the user must respond to in order to determine whether or not the user is depressed. The user's response is used to determine whether or not they are depressed. Based on internal scores, it was determined whether the individual was experiencing temporary melancholy or depressive symptoms.

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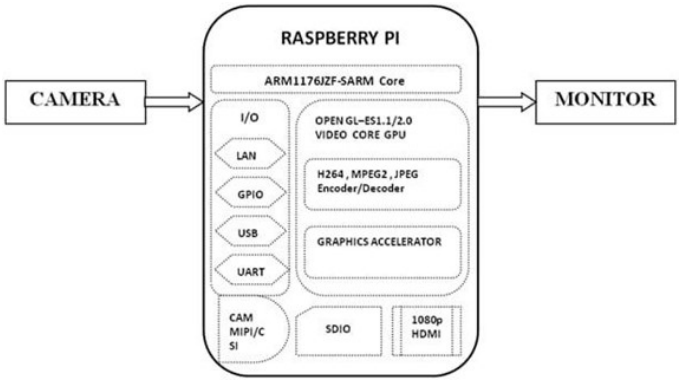
7. Discussion and Future Work:

The project mainly deals with emotion recognition and a depression analyser which is implemented as a desktop application-based chatbot. In the future trends, this desktop application-based chatbot can be implemented as a chatbot using Natural Language Processing.

As of the current working, the desktop application is local. In the future days, this application can be hosted on a website using an internet connection.

The current application is a screening test before consulting a doctor. In the future days, a video consultancy to doctors can be arranged if the user is detected to be depressed.

IV. BLOCK DIAGRAM



V. CONCLUSION

This project on human face emotion detection using a Raspberry Pi has shown the potential of combining cutting-edge technology with real-world applications. By leveraging the power of machine learning and computer vision, we have successfully created a system capable of recognizing and analyzing human emotions based on facial expressions. This project not only demonstrates the versatility of Raspberry Pi but also highlights the importance of emotion detection in various fields, from healthcare to human-computer interaction. As technology continues to advance, the potential for further improvements and broader applications in this area is substantial. Emotion detection using Raspberry Pi is a promising field that can lead to innovative solutions for understanding and improving human well-being.

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