International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 03 | March - 2024 SJIF Rating: 8.176 ISSN: 2582-3930

Facial Emotional Recognition using Raspberry Pi

Rutuja Machale[1], Apeksha Kharat[2], Sayali Bhosale[3], Mr. R.S.Piske[4]
Department of Electronics and Telecommunication, VPKBIET Baramati
[1]machalerutuja@gmail.com
[2]apekshakharat2002@gmail.com
[3]Sayaliblosale919@gmail.com

Abstract – This facial emotion recognition project utilizes a Raspberry Pi for real-time analysis of facial expressions. Using a camera module, the system captures facial images, and a pre-trained deep learning model processes the data to classify emotions such as happiness, sadness, anger, etc. The Raspberry Pi's GPIO pins are employed to trigger specific actions or display emotion labels. This compact and efficient system demonstrates the integration of edge computing and machine learning for emotion analysis in a portable setup.

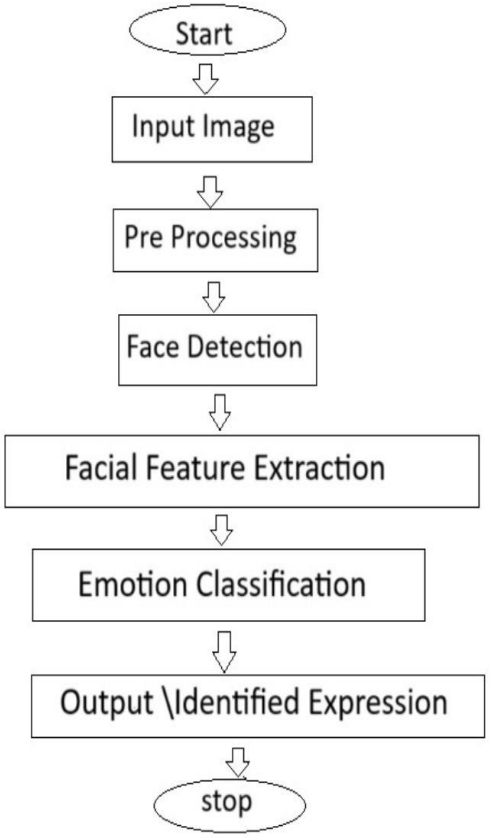
Keywords- **:** Face, Expression, Raspberry Pi, Recognition, Feature Extraction.

1. INTRODUCTION

The Facial Emotion Recognition (FER) project utilizing Raspberry Pi is a comprehensive undertaking that combines the capabilities of this single-board computer with computer vision and machine learning techniques. The project's objective is to create a system capable of real-time detection and classification of facial expressions, thereby enabling the recognition of emotions such as happiness, sadness, and anger. The hardware setup involves connecting a camera module to the Raspberry Pi, serving as the primary data source for facial analysis. Software installation encompasses libraries like OpenCV for image processing and TensorFlow or PyTorch for deep learning. Facial detection algorithms are implemented to locate and isolate faces within captured images or video feeds. The machine learning model is trained on a dataset of annotated facial expressions, teaching it to recognize patterns associated with different emotions. Real-time processing algorithms ensure efficient and timely analysis, and the system classifies each detected face into predefined emotion categories. Optionally, a user interface can be created for displaying the recognized emotions. The project undergoes rigorous testing and calibration with diverse facial expressions to validate its accuracy before deployment for practical applications in human-computer interaction, robotics, or sentiment analysis. Future enhancements may include additional features like voice recognition or an expanded range of emotion categories for a more comprehensive system. This project showcases how Raspberry Pi, with its compact form factor, can be harnessed for sophisticated real-time applications in emotion analysis.

The Facial Emotion Recognition (FER) project implemented on the Raspberry Pi involves a multifaceted approach to enable real-time emotion analysis through facial expressions. The Raspberry Pi serves as the project's core processing unit, orchestrating the integration of various components. A critical hardware component is the camera module connected to the Raspberry Pi, capturing live video feed or images for subsequent analysis. The software stack includes essential libraries such as OpenCV for robust image processing and machine learning frameworks like TensorFlow or PyTorch. Facial detection algorithms are pivotal, enabling the system to accurately identify and isolate faces within the input stream. The machine learning model is a key player, trained on datasets annotated with diverse facial expressions to understand and classify emotions. Real-time processing algorithms ensure that the system operates efficiently, providing timely feedback. These projects typically involve training a machine learning model to detect and classify human emotions based on facial expressions captured through a camera connected to the Raspberry Pi. The process involves preprocessing the facial images, extracting relevant features, and training the model using techniques like convolutional neural networks (CNNs). Once trained, the model can accurately recognize emotions such as happiness, sadness, anger, and surprise in real-time.

Flowchart of Methodology



2. Literature Survey

1. **Mrs. Madhuram.M (2018)** highlighted the significance of face detection and recognition in biometrics research. They emphasized how this technology, particularly when integrated into real-time surveillance systems, doesn't require the cooperation of individuals being monitored. The team designed a system using IP cameras and an image set algorithm, developed with OpenCV and Python programming. This system comprises three main components: detection, training, and recognition modules. Overall, their work underscores the practical applications and value of face recognition technology in various fields.

2. **Dr. Shaik Asif Hussain (2019)** introduced deep learning algorithms for facial recognition to accurately identify and detect faces. The goal of facial recognition is to authenticate and recognize facial features in real-time using haar cascade detection. Their work is divided into three phases: face detection, feature analysis using a convolutional neural network model, and emotion classification. They used OpenCV library, datasets, and Python programming for computer vision techniques. They conducted experiments with multiple students to identify emotions and physiological changes. The results showed high accuracy in face analysis, proving the effectiveness of automatic face detection and recognition.

3. **Nithya Roopa. S (2019)** suggested that recognizing facial expressions is becoming increasingly important, and there's a growing demand for it. While there are existing methods using machine learning and artificial intelligence to identify expressions, this study focuses on using deep learning and image classification techniques for this task. The researchers used a model called Inception Net along with datasets like Kaggle's Facial Expression Recognition Challenge and Karolinska Directed Emotional Faces to train the expression recognition model.

4. **Malyala Divya (2019)** introduced the concept of using image processing and artificial intelligence to automatically recognize emotions on live faces. This is a tough job for computers because they have to understand emotions like humans do. Detecting faces is crucial for recognizing emotions accurately. Emotions like happiness, sadness, disgust, anger, neutrality, fear, and surprise are the main ones focused on. Along with facial expressions, things like speech, eye contact, voice frequency, and heartbeat are also considered. Nowadays, face recognition technology is very effective and used for security reasons in many real-time applications. Emotions can be detected either by analyzing still images or by observing live recordings. To detect emotions, features like eyes, nose, and mouth are identified from the

face. The convolutional neural network (CNN) algorithm is commonly used, which involves steps like max-pooling for extracting important features and flattening the data for analysis.

5. **K. F. Azizan Illiana, (2020)** identifying facial expressions using a CNN model that effectively captures facial features. By directly analyzing pixel values from training images, the model can accurately detect emotions, especially when the background is removed. Recognizing emotions is vital for better human communication and interaction, and in the future, this technology could enhance feedback between humans and robots. Emotion detection mainly focuses on facial features like eyes, eyebrows, and mouth movements. The experiments considered various environments, including controlled settings, real-time scenarios, and diverse images. Recent advancements, especially in recognizing profiles, can have practical applications in areas like patient monitoring in hospitals or security surveillance. Additionally, this concept of recognizing facial emotions could expand to include emotions detected from speech or body movements, benefiting various industries.

3. Application:

Tourism Industry:
In the tourism industries tourist can be allowed to take advantage of many adventurous things depending on theirmood .If the tourism related business employee are not in a good mood they may spoil the entire day of the tourist

Companies:
Working environment can be judged by implementing this module along with the biometric module, if it seems that the employees are not happy or neutral then they can be monitored for the rest of the day.

Corporate Offices:
The behaviour of the staff members with clients can be monitored with the help of this module.

4. Conclusion:

In the fields of computer vision, deep learning, and embedded systems, the Raspberry Pi project of facial expression recognition is a major advancement. We have effectively illustrated the usefulness and adaptability of real-time emotion recognition in resource constrained settings with this project. The Raspberry Pi has shown to be a capable platform for this task when combined with a well chosen deep learning model and a well-designed database. Our project has demonstrated real-time emotion recognition's technological viability as well as its promise for a range of uses, from improving human-computer interaction to solving important issues like driving safety and educational technology. The system's capacity to recognize and react to human emotions creates opportunities for creative and compassionate. To sum up, the facial expression recognition project powered by Raspberry Pi has demonstrated the potential of edge computing and contemporary AI. It emphasizes how crucial user consent, ethics, and openness are to the creation of these kinds of technologies. This technology has the potential to significantly improve our daily lives and foster more responsive and empathic human-computer interactions with additional study, development, and ethical application

4. References:

1. Mrs. Madhuram.M, B. Prithvi Kumar, Lakshman Sridhar, Nishanth Prem, Venkatesh Prasad, "Face Detection and Recognition Using OpenCV", International Research Journal of Engineering and Technology (IRJET), Volume: 05 Issue: 10, Oct 2018.

2. Dr. Shaik Asif Hussain, Ahlam Salim Abdallah Al Balushi, "A Real Time Face Emotion Classification and Recognition using Deep Learning Model", ICE4CT 2019 Journal of Physics: Conference Series 1432 (2020) 012087.

3. Nithya Roopa. S, "Emotion Recognition from Facial Expression using Deep Learning", International Journal of Engineering and Advanced Technology, August 2019.

4. Malyala Divya, R Obula Konda Reddy, C Raghavendra, "Effective Facial Emotion Recognition using Convolutional Neural Network Algorithm", International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-8 Issue-4, November 2019.

5. K. F. Azizan Illiana, "Facial Emotion Recognition: A Brief Review," in International Conference on Sustainable Engineering, Technology and Management 2018 (ICSETM-2018), 2020.