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Facial Emotion Recognition

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FACIAL EMOTION RECOGNITION

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***Abstract*— The technique of determining an individual's emotional state is done via the Facial Expression Recognition system. This system compares the taken image with a trained dataset stored in the database before displaying the image's emotional state.**

With the use of transfer learning and the trained database, the suggested method's recognition performance will be assessed. When it comes to image preparation, deep learning-based emotion recognition performs better than conventional techniques. The FER-2013 dataset, which consists of face photos of various men and women with expressions like anger, neutral, disgust, fear, happiness, sadness, and surprise, is used to test our suggested approach. In order to identify the essential seven human emotions—anger, disgust, fear, happiness, sorrow, and surprise—we used a variety of deep learning techniques in this study.

I. INTRODUCTION

The goal of the fascinating topic of face emotion recognition is to identify and categorize human emotions from facial expressions. Humans may typically express their intentions and feelings through nonverbal cues including gestures, facial expressions, and unconscious languages. This technique, which allows people to interact nonverbally, can be incredibly helpful. This technology uses a range of machine learning approaches to identify and categorize emotions from facial expressions. Given that facial expressions can convey a person's mood or mental state, their significance can be measured. When engaging in social interactions, emotions are exhibited. It might be difficult to learn how to interpret them, therefore technology is utilized to help.

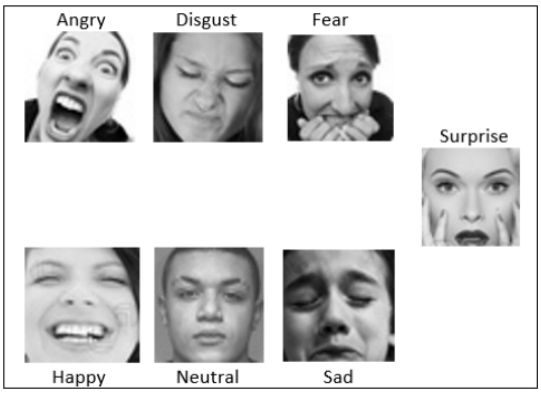

Fig. 1. Emotions

A. *PROBLEM STATEMENT*

Six fundamental expressions are the focus of the majority of facial expression recognition research and systems. Humans are skilled at interpreting this kind of emotional cues from others; in fact, kids as young as 14 months old are already able to distinguish between happy and sad feelings. Can machines, however, access emotional states more accurately than humans? In response to the inquiry, we developed a deep learning neural network that enables computers to infer our emotional states. Stated differently, we provide them with eyes to view what we see.

B. *SCOPE OF THE PROJECT*

Road safety can be achieved with the usage of FER technology. Thus, observe the driver's facial expressions and sound the alarm if you suspect they are feeling under the weather. Selfie shots on smartphones can be automatically taken using the solution codes for the facial emotion recognition project. A lovely smile is required to be directed at the camera; else, the gadget will take the picture on its own without human input. Another application of facial emotion recognition in the workplace.With the use of this technology, they are able to examine the feelings expressed by their clients in their service reviews.

C. *Aim and Objectives*

1.To create a system for recognizing face expressions.

2. To test machine learning algorithms in the domain of computer vision.

3. To identify feelings, enabling intelligent communication between humans and computers.

II. LITERATURE REVIEW

[1] The study provides a fantastic source of theoretical and applied knowledge for facial expression-based emotion recognition. Additionally, the reasons why emotion identification is necessary are illustrated by looking at things like facial expressions. Facial expressions are crucial for identifying persons and for recognizing emotions. They are also employed in nonverbal communication. Next only to vocal tone in everyday emotional communication, they are highly significant. They also serve as a feeling-indicator, enabling a man to communicate his emotions. People are able to identify someone's emotional condition right away. Consequently, face expression data is frequently utilized in automatic emotion recognition systems. The article presents the findings of a facial expression-based identification of seven different emotional states: neutral, joy, sadness, surprise, wrath, fear, and disgust. Six subjects' registered facial expressions were described by coefficients, which were then employed as characteristics. The features for the three-dimensional face model have been computed. MLP neural network and k-NN classifier were used to classify the features.

[2] The study examines deep neural networks and their application to the identification of facial emotions. In several optical recognition missions involving Facial Expression Recognition (FER), which is a crucial procedure in next-generation Human-Machine Interaction (HMI) for clinical treatment and behavioral description, Deep Neural Networks (DNNs) perform better than standard models. The author pointed out that current FER techniques lack sufficient practicality for real-time applications and have low accuracy. A Hybrid Convolution-Recurrent Neural Network technique for FER in images is presented in this paper. Convolution layers and Recurrent Neural Networks (RNNs) make up the suggested network architecture. Together, these two models extract relationships from facial images, and the RNN allows for the consideration of temporal dependencies in the images during classification. Comparing the proposed hybrid model to state-of-the-art techniques, promising experimental results are found. The model is evaluated using two available datasets. The importance of ER techniques and the current state of emotion recognition throughout the life cycle were briefly discussed by the author.

[3] Deep learning-based facial emotion identification is the topic of this paper. This paper aims to investigate current advances in deep learning-based automatic facial emotion recognition (FER). The most recent findings in this field were made available to us by the paper's presentation of recent FER research. We have discussed many CNN and CNN-LSTM architectures that have lately been put forth by various scholars. We

made it quite evident in this work that scholars have been very interested in FER using deep learning in recent years. The automated FER task involves several stages, including data processing, the suggested model design, and emotion recognition at the end. The authors also described how automatic emotion recognition based on facial expression has been presented and used in a number of fields, including safety, health, and human-machine interfaces. They also mentioned how automatic emotion recognition is a significant and expansive field of study that focuses on artificial intelligence (AI) and psychological human emotion recognition.

[4] Image processing is a technique for digitally transforming and manipulating images. This is done to improve the image or to draw out important details. Nonverbal communication takes the form of facial expressions. There are eight common facial expressions: disdain, disgust, fear, rage, sadness, happiness, and surprise. Therefore, it is crucial to recognize these feelings on the face. One way to describe a facial expression is as the movement of muscles beneath the skin. Nonverbal communication takes the form of facial expressions. A person's face has the ability to express a wide range of emotions without using words. In contrast to many nonverbal communication methods that are not universally known, these facial expressions are universally understood by all types of individuals. The technique known as "machine learning" aids in our investigation of the models and algorithms that a computer system can employ to carry out a particular task without the need for outside guidance. Without the influence of outside variables on task performance, machine learning algorithms create mathematical models based on sample data, or "training data," which can be used to forecast or make choices. The technology that recognizes locations, logos, people, items, buildings, and other things in photos is known as image recognition.

[5] The research's authors talked about the study's current successes, analysis, and remaining difficulties. which are Deep Learning Methods and Conventional Machine Learning. They said that nonverbal communication plays a big part in daily interactions and accounts for between 55 and 93 percent of all conversation. In surveillance films, expression analysis, gesture recognition, computer games, smart homes, depression treatment, patient monitoring, anxiety, lying detection, psychoanalysis, paralinguistic communication, operator tiredness detection, and robotics, facial emotion analysis is effectively employed. They give a thorough review of FER in this publication.This paper explained the practical applications of facial emotion identification. In the fields of investigation, security, surveillance, and medicine, FER is quite beneficial. Additionally, it helps identify human attention-related traits including behavior, mental health, personality, propensity for crime, lying, etc. Facial expression recognition is a skill that most people possess, regardless of their gender, nationality, culture, or ethnicity. However, automating the recognition and categorization of facial emotions is a difficult issue. A few fundamental emotions, including fear, aggression, upset, and pleasure, are used by the scientific community. Writers employed various methods such as Analyzing performance through quantitative comparison is a crucial method for comparing the outcomes of experiments. Also included are benchmark comparisons using datasets that are openly accessible. The correctness of the reported system is assessed using two distinct methods: cross-dataset and subject-independent. First, each dataset is divided into two sections using a task that is independent of the subjects: verification and instruction

III. PROJECT FLOW AND METHODOLOGY

A. *Planning*

The following are the steps we used to construct this project:

1. Examining the issue statement.
2. Compiling the specifications for the requirements.
3. Examining whether the project is feasible.
4. Consulting the journals for information on earlier studies in this area.
5. Selecting the algorithm development methodology.
6. Examining the numerous benefits and drawbacks.
7. Launching the project's development
8. Installing ANACONDA-type software.

9. Creating an algorithm.
10. Algorithm analysis using a guide.
11. Coding in Python using the created algorithm

B. *Data flow diagram*

A data flow diagram (DFD) models the process characteristics of an information system by providing a graphical depiction of the ”flow” of data through the system. A DFD is frequently used as a first stage to quickly sketch out the system's general layout before delving into further depth. A DFD illustrates the types of data that will enter and exit the system, how the data moves through the system, and where it is kept. It doesn't display details regarding the timing of processes or if they will run concurrently or sequentially. One tool used in the top-down approach to systems design is DFD.

Level 0 DFD It provides a fundamental synopsis of the entire system or process under study.

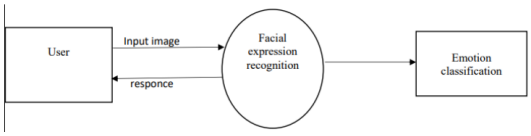

Fig. 2. DFD Level 0

The Context Level Diagram's component parts are broken down into greater detail in DFD Level 1. As you deconstruct the high-level process of the Context Diagram into its subprocesses, you will draw attention to the primary tasks performed by the system.

C. *Algorithm*

- **Step 1:** Assembling a picture data collection. (In this instance, the FER2013 database is being used. It contains 35887 grayscale, 48 by 48 pixel, pre-cropped pictures of faces that have been classified into one of the following seven emotion classes: anger, disgust, fear, happiness, sorrow, surprise, and neutral.
- **Step 2:** Defining the list of classes in our training dataset; training the data through the creation of a data directory
- **Step 3:** The BGR photos are transformed to RGB images.

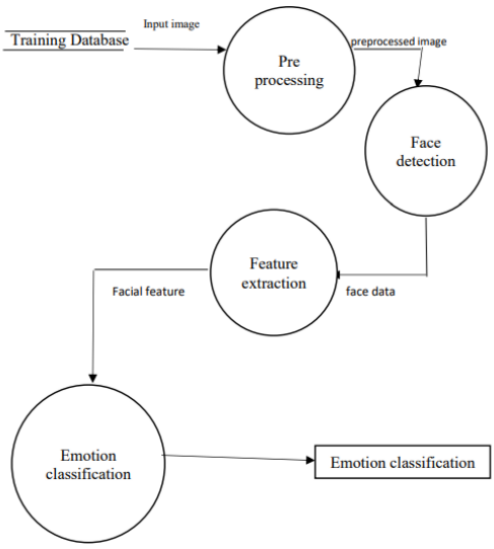

Fig. 3. DFD Level 1

- **Step 4:** Resizing photos from 48 by 48 to 224 by 224 pixels. Reading every image and turning it to an array, then changing the dimensions to four
- **Step 5:** Data normalization
- **Step 6:** Transfer Learning, a deep learning paradigm for teaching
- **Step 7:** Using stored photos to test the deep learning algorithm
- **Step 8:** By using real-time video to determine the emotion on a face based on the expressions in the input picture

D. *THE LIBRARY AND PACKAGES*

1. **OpenCV (Open Source Computer Vision Library)**: OpenCV is a robust open-source library used for computer vision tasks such as hand detection, segmentation, gesture recognition and emotion recognition. It provides a plethora of functions and algorithms that facilitate the development of gesture control systems.
2. **Numpy**: The term ”Numeric Python” or ”Numerical Python” is abbreviated as NumPy. It is an open-source Python extension module that offers quick precompiled functions for numerical and mathematical operations. Moreover, NumPy enhances Python with strong data

structures for the effective computation of matrices and multi-dimensional arrays. The implementation even aims to work with large arrays and matrices. In addition, the module offers a vast library of sophisticated mathematical operations that may be performed on these arrays and matrices.

3. **TensorFlow**: Google launched TensorFlow, a Python library for efficient numerical computation. It is a foundation library that can be used to build Deep Learning models directly, or it can be used with wrapper libraries that are developed on top of TensorFlow to make the process easier.

4. **Matplotlib**: Matplotlib is a low level Python graph charting toolkit that functions as a tool for visualization. The creator of Matplotlib is John D. Hunter. Matplotlib is available for free and without restriction. The majority of Matplotlib is written in Python; however, for platform compatibility, a small portion is also written in C, Objective-C, and JavaScript. The majority of Matplotlib's utilities are imported under the plt alias and are found in the pyplot submodule.

5. **Keras**: Written in Python, Keras is a high-level neural network API that may be used with TensorFlow, CNTK, or Theano. Its development was centered on making quick experiments possible. Many implementations of widely used neural network building components, including layers, objectives, optimizers, activation functions, and a variety of tools to facilitate working with text and image data, are included in Keras. The source is housed on GitHub, and there are Slack channels and a GitHub problems page for community help. Using the Java Virtual Machine, the web, and smartphones running iOS and Android, users may productize deep models thanks to Keras. Additionally, it permits the utilization of GPU clusters for the distributed training of deep learning models.

*E. **Dataset***

The Kaggle Facial Expression Recognition Challenge from a few years ago provided the dataset that was used to train the model (FER2013). In the training set, there are 28,709 instances. Using 48*48 pixel grayscale photos of faces, each face expression is classified into one of seven categories (0=Angry, 1=Disgust, 2=Fear, 3=Happy, 4=Sad, 5=Surprise, 6=Neutral) according to the emotion displayed.

0: 4593 pictures- Anger
1: 547 pictures- Disgust
2: 5121 pictures- Fear
3: 8989 pictures- Happy
4: 6077 pictures- Sad
5: 4002 pictures- surprise
6: -6198 pictures- Neutral

Fig. 4. FER Dataset sample Emotion figures

*F. **RESULT***

The successful outcome of a Face Emotion Recognition system below picture with happy emotion.

The use of Face Emotion Recognition technology has improved our comprehension of human-computer interaction and created new opportunities for creative applications in a range of sectors. We have proven that FER systems are feasible and have the potential to improve safety protocols and user experiences by utilizing Python's power and deep learning capabilities. FER is positioned to have a big impact on how emotional intelligence and human-machine interaction develop in the future as technology advances.

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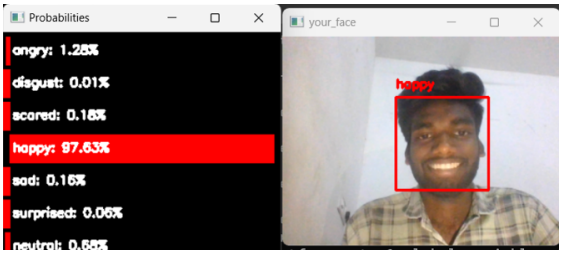

Fig. 5. Result with happy emotion

IV. CONCLUSION AND FUTURE WORK

The technological instrument that aids in evoking human feeling is face emotion recognition. Face Emotion Recognition has numerous applications, such as automatically taking photos on smartphones and setting off alarms in cars, among others. With this project, we aimed to deepen our understanding of Face Emotion Recognition's internal workings and how Python may be used to implement them.

FER technology has advanced significantly, but there are still a number of obstacles and opportunities to be overcome. It is still important to increase the precision and resilience of emotion identification algorithms, especially for a range of demographic groups and lighting scenarios. Concerns about data security and privacy must also be addressed ethically as FER systems grow more commonplace in daily life. In addition, investigating interdisciplinary partnerships with neuroscientists and psychologists can yield insightful knowledge about the emotional experience of humans and result in FER systems that are more sophisticated and context-aware.

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