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FACIAL EXPRESSION DETECTION USING DEEP LEARNING

Dr. N. Gopala Krishna[1], Korlapati Jasmitha Lakshmi [2],

Koneti Mohan Vasmi[3], Pallapothu Padmavathi [4],

Mudavatha Sai Ram Naik [5]

[1] Professor, Department of Computer Science and Engineering, Tirumala Engineering College
[2, 3 ,4, 5] Student, Department of Computer Science and Engineering, Tirumala Engineering College

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Abstract - The use of machines to perform different tasks is constantly increasing in society. Providing machines with perception can lead them to perform a great variety of tasks, even very complex ones such as elderly care. Machine requires that machines understand about their environment and interlocutor's intention. Recognizing facial emotions might help in this regard. During the development of this work, deep learning techniques have been used over images displaying the following facial emotions : happiness, sadness, anger, surprise, disgust, and fear.

As results, such method best resolves issues of lighting variations and different orientation of object in the image and thus achieves a higher accuracy.In the field of education online learning plays a vital role.. The fundamental problem facing in the online learning environment is the low engagement of Listener to the Preceptor. The educational institutions and Preceptors are responsible to guarantee best learning environment with maximum engagement in educational activities for online learners.

***Key Words*:** Environment, interlocutor, happiness, sadness, anger, surprise, listener, educational.

1.INTRODUCTION

The primary goal of this research is to design, implement and evaluate a novel facial expression recognition system using various statistical learning techniques. This goal will be realized through the following objectives:

1. System level design: In this stage, we'll be using existing techniques in related areas as building blocks to design our system.

a) A facial expression recognition system usually consists of multiple components, each of which is responsible for one task. We first need to review the literature and decide the overall architecture of our system, *i.e.*, how many modules it has, the responsibility of each of them and how they should cooperate with each other.

b) Implement and test various techniques for each module and find the best combination by comparing their accuracy, speed, and robustness.

2. Algorithm level design: Focus on the classifier which is the core of a recognition system, trying to design new algorithms which hopefully have better performance compared to existing ones.

1.1 MOTIVATION

In today"s networked world the need to maintain security of information or physical property is becoming both increasingly important and increasingly difficult. In countries like Nepal the rate of crimes are increasing day by day. No automatic systems are there that can track person"s activity. If we will be able to track Facial expressions of persons automatically then we can find the criminal easily since facial expressions changes doing different activities.

So we decided to make a Facial Expression Recognition System. We are interested in this project after we went through few papers in this area.. As a result we are highly motivated to develop a system that recognizes facial expression and track one person's activity.

1.2 PROBLEM DEFINITION

Human facial expressions can be easily classified into 7 basic emotions: happy, sad, surprise, fear, anger, disgust, and neutral. Our facial emotions are expressed through activation of specific sets of facial muscles. These sometimes subtle, yet complex, signals in an expression often contain an abundant amount of information about our state of mind. Through facial emotion recognition, we are able to measure the effects that content and services have on the audience/users through an easy and low-cost procedure.

Neural Network

A neural network is a network or circuit of neurons, or in a modern sense, an artificial neural network, composed of artificial neurons or nodes. Thus a neural network is either a biological neural network, made up of real biological neurons, or an artificial neural network, for solving artificial intelligence (AI) problem.

2. LITERATURE REVIEW

As per various literature surveys it is found that for implementing this project four basic steps are required to be performed.

a. Preprocessing
b. Face registration

c. Facial feature extraction
d. Emotion classification

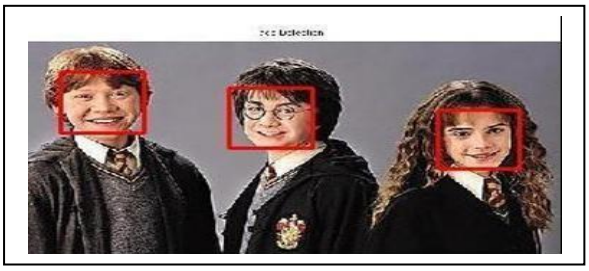
Description about all these processes are given below

1. Preprocessing

Preprocessing is a common name for operations with images at the lowest level of abstraction both input and output are intensity images.

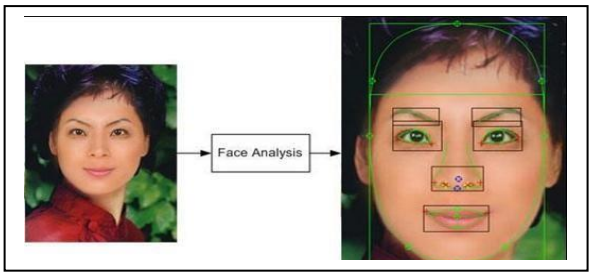
2.Face Registration :

Face Registration is a computer technology being used in a variety of applications that identifies human faces in digital images. In this face registration step, faces are first located in the image using some set of landmark points called "face localization" or "face detection".



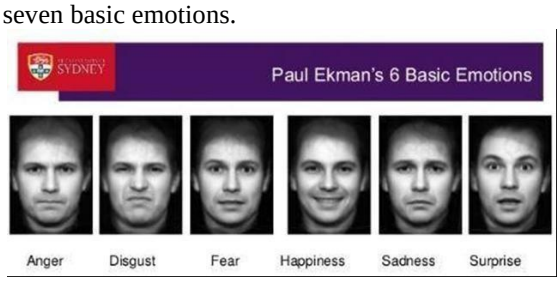
3.Facial Feature Extraction

Facial Features extraction is an important step in face recognition and is defined as the process of locating specific regions, points, landmarks, or curves/contours in a given 2-D image or a 3D range image. In this feature extraction step, a numerical feature vector is generated from the resulting registered image.



4.Emotion Classification

In the third step, of classification, the algorithm attempts to classify the given faces portraying one of the seven basic emotions.



- Sunil Kumar, M K Bhuyan, Biplab Ketan Chakraborty[6] described Extraction of Informative regions of a face or FER The proposed model successfully estimated the importance of facial sub regions.It attained the accuracy of 98.44% MUG ,98,51% on JAFFEE, 97.01% on CK+ datasets.

- Ebenzer Owusu, Justice Kwame , Appati Percy okae[7] described Robust FER system in Higher passes. The proposed model improves FER performance. Also the 2D phase conversions has been established to handle phase invariant FER problems successfully. It attained an accuracy of 98.90% on Bosphorus , 93.50% on BUD3FE, 97.20% on MMI, 98.20% on CK+ datasets.

- Shrey Modi, Muhmmad Hussain Bohara[8] described Facial Expression recognition Using CNN.This technology will provide a great boom to many things such as the robotics field, which will provide emotions to them and then to the blind community. It attained the accuracy of 73.5% on FER dataset.

- Dimas Lima, Bin Li[9] described Facial Expression FER via Res Net-50 The proposed system focuses on FER dataset that achieved good results in multitasking classification.It attained the accuracy of 95.39+/-1.41.

- Michail N et al [4], proposed a wristband model system which has an EEG cap. ENOBIO EOG correction mechanism is used for calibrating data. The user wore the EEG cap and the concentration and attention level while learning is measured. Mohamed El Kerdawy et al [5], uses 14 channel EEG headset to record EEG signals.

3.SYSTEM ANALYSIS

3.1 EXISTED SYSTEM

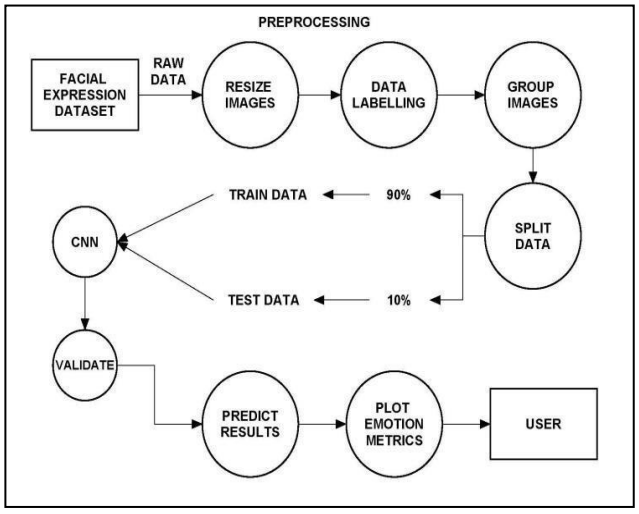
In the existing system, classification is done through simple image processing to classify images only. Existing work includes the application of feature extraction of facial expressions with the combination of neural networks for the recognition of different facial emotions (happy, sad, angry, fear, surprised, neutral, etc..). Humans are capable of producing thousands of facial actions during communication that varies in-complexity, intensity, and meaning.Overview of conventional methods used for expression detection, such as feature extraction followed by classification. The challenges faced by traditional approaches, including limited accuracy and robustness to variations in facial expressions.

3.2 PROPOSED SYSTEM

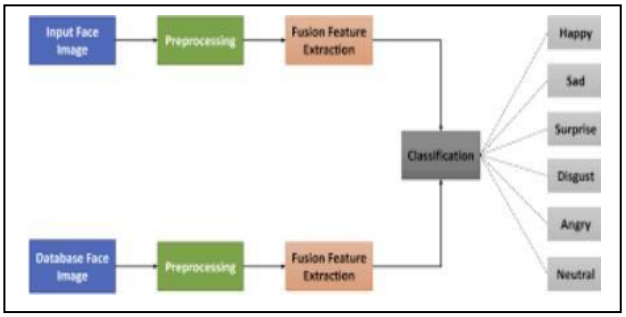
Deep Learning-Based Approach:

1. First Phase is the acquisition phase of face.
2. The second phase images preprocessing and extraction is completed.
3. In the third phase, extracted images of faces are checking to data sets.
4. After this step some algorithmic and statistical part processed based on the images input.

The idea was to build a single consolidated system that is able to effectively recognize the emotions of learners during online form of education with the help of convolutional neural networks and plot emotion metrics based on the results. Below Fig shows the overall system design.



System Architecture



Work Flow

3.3 MODULE DESCRIPTION

1. Data cleaning
2. Virtualization

DATA COLLECTION AND DATA PRE-PROCESSING

Collecting data for training the model is the basic step in the machine learning pipeline.The predictions made by systems can only be as good as the data on which they have been trained. Following are some ofthe problems that can arise in data collection:Inaccurate data. The collected data could be unrelated to the problem statement.Missing data. Sub-data could be missing. That could take the form of empty values in columns or missing images for some class of prediction.

Matplot-lib

Matplotlib is a powerful and widely-used plotting library in Python which enables us to create a variety of static, interactive and publication-quality plots and visualizations. It's extensively used for data visualization tasks and offers a wide range of functionalities to create plots like line plots, scatter plots, bar charts, histograms, 3D plots and much more. Matplotlib library provides flexibility and customization options to tailor our plots according to specific needs.

4. SYSTEM DESIGN

4.1 Data Flow Diagrams

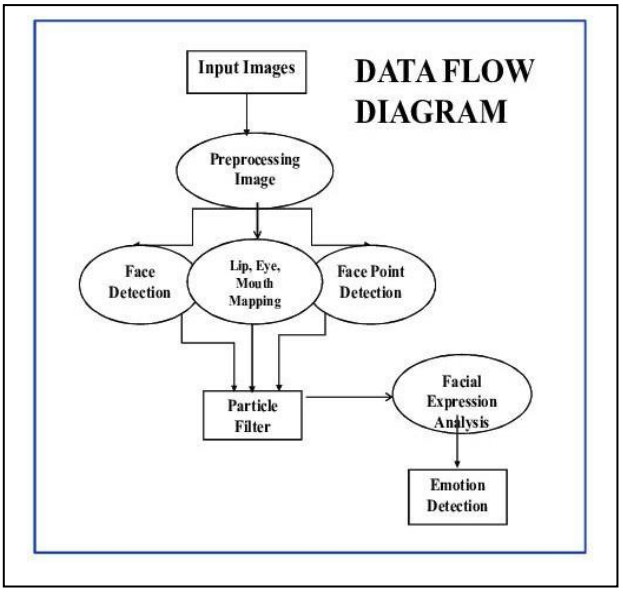


Fig: Data Flow Diagram

5. IMPLEMANTATION

Python

Python is a popular programming language. It was created in 1991 by Guidovan Rossum. It is used for:

1. web development(server-side)
2. software development
3. mathematics
4. system scripting

The most recent major version of Python is Python 3. However, Python 2, althoughnot being updated with anything other than security updates, is still quite popular. It is possible to write Python in an Integrated Development Environment, such as Thonny, Pycharm, Netbeans or Eclipse, Anaconda which are particularly useful when managing larger collections of Python files. Python was designed for its readability. Python uses new lines to complete a command, as opposed to other programming languages which often use semicolons or parentheses. Python relies on indentation, using whitespace, to define scope; such as the scope of loops, functions and classes.

Python Libraries

1. Numpy
2. TensorFlow
3. Pandas
4. Matplotlib

NumPy: is a very popular python library for large multi-dimensional array and matrix processing, with the help of a large collection of high-level mathematical functions. It is very useful for fundamental scientific computations in Machine Learning.

TensorFlow: is a very popular open-source library for high performance numerical computation developed by the Google Brain team in Google. As the name suggests, Tensorflow is a framework that involves defining and running computations involvingtensors.

Pandas is a popular Python library for data analysis. It is not directly related to Machine Learning. As we know that the dataset must be prepared before training. In this case, Pandas comes handy as it was developed specifically for data extraction and preparation.

Matpoltlib is a very popular Python library for data visualization. Like Pandas, it is not directly related to Machine Learning. It particularly comes in handy when a programmer wants to visualize the patterns in the data.

Open CV

Open CV (Open Source Computer Vision Library) is an open source computer vision and learning software library. Open CV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products. Being a BSD-licensed product, Open CV makes it easy for businesses to utilize and modify the code.

Internal Images

The basic idea of integral image is that to calculate the area. So, we do not need to sum up all the pixel values rather than we have to use the corner values and then a simple calculation is to be done. The integral image at location x , y contains the sum of the pixels above and to the left of x , y, inclusive

$$ii(x, y) = \sum_{x' \le x, y' \le y} i(x', y'),$$

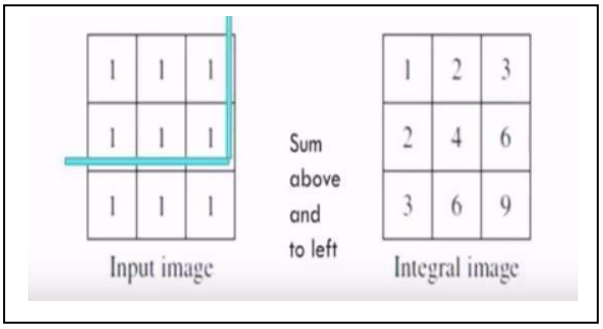
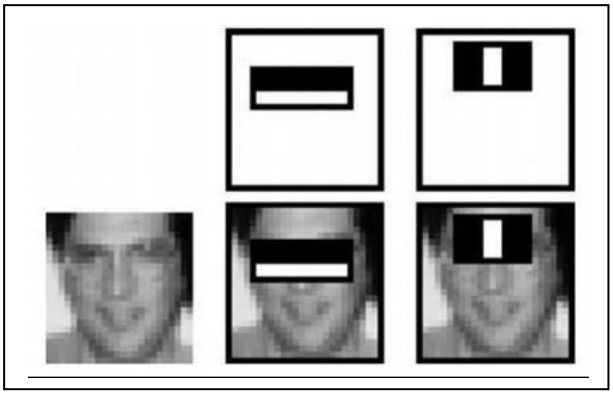


Fig: Integral Images

Adaboost

Adaboost is used to eliminate the redundant feature of Haar. A very small number of these features can be combined to form an effective classifier.



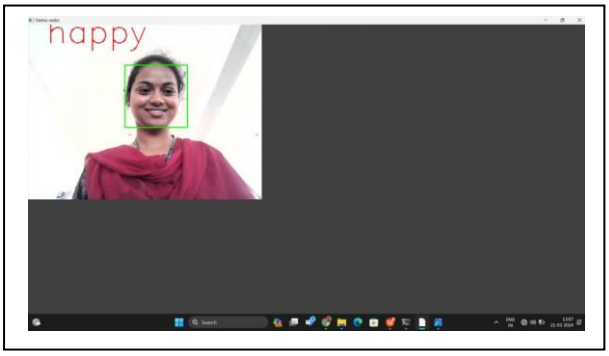
f(x) = a1f1(x) + a2f2(x) + a3f3(x) + a4f4(x) + ….

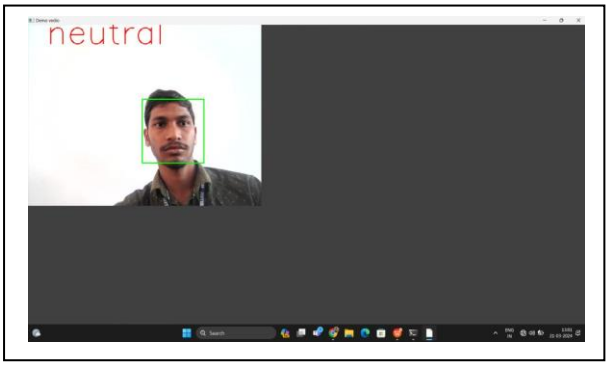
F(x) is strong classifier and f(x) is weak classifier.

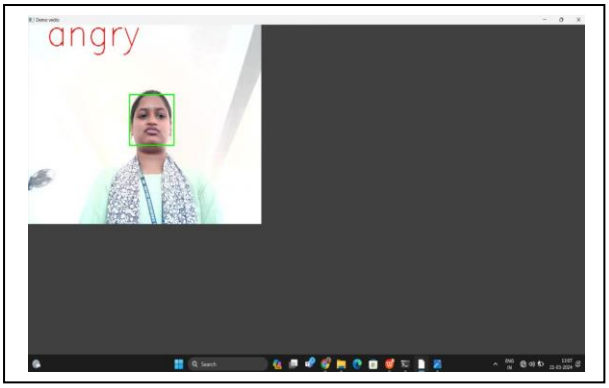
Weak classifier always provide binary value i.e. 0 and 1. If the feature is present the value will be 1, otherwise value will be 0. Generally 2500 classifiers are

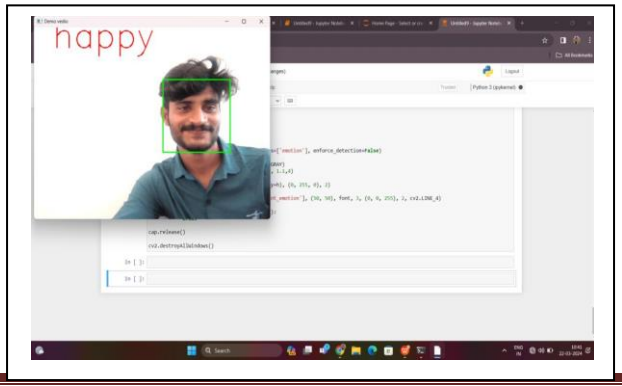
used to make a strong classifier. Here selected features are said to be okay if it perform better than the random guessing i.e. it has to detect more than half of cases.

6. RESULTS









7. SYSTEM TESTING

7.1 TESTING OBJECTIVE

Software testing is a process used to help identify the correctness, completeness and quality ofdeveloped computer software.

Software testing is the process used to measure the quality of developed software. Testing is the process of executing a program with the intent of finding errors. Software testing is often referred to as verification & validation.

STLC (Software Testing Life Cycle):

Testing itself has many phases i.e., is called as STLC. STLC is part of SDLC

1. Test Plan
2. Test Development
3. Test Execution
4. Analyze Result
5. Defect Tracking

TYPES OF TESTING:

- White Box Testing
- BlackBox Testing
- GreyBox Testing

White Box Testing

White box testing as the name suggests gives the internal view of the software. This type oftesting is also known as structural testing or glass box testing as well, as the interest lies in what lies inside the box.

BlackBox Testing

Its also called as behavioral testing. It focuses on the functional requirements of the software.Testing either functional or non functional without reference to the internal structure of the component or system is called black box testing.

GreyBox Testing

Grey box testing is the combination of black box and white box testing.

8. CONCLUSION

In this case, when the model predicts incorrectly, the correct label is often the second most likely emotion.The facial expression recognition system presented in this research work contributes a resilient face recognition model based on the mapping of behavioral characteristics with the physiological biometric characteristics. The physiological characteristics of the human face with relevance to various expressions such as happiness, sadness, fear, anger, surprise and disgust are associated with geometrical structures which restored as base matching

template for the recognition system.The behavioral aspect of this system relates the attitude behind different expressions as property base. The property bases are alienated as exposed and hidden category in genetic algorithmic genes. The gene training set evaluates the expressional uniqueness of individual faces and provide a resilient expressional recognition model in the field of biometric security.

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