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Digital Image Processing Mini Project report on

"FACIAL EMOTION RECOGNITION"

Submitted in partial fulfillment of the requirement for the award of Degree of

BACHELOR OF ENGINEERING
IN
ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

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Certificate

Certified that the Digital Image Processing Laboratory with Mini Project entitled **FACIAL EMOTION RECOGNITION** is a bonafide work carried out by **Akula Vidyullatha(1AY20AI005), Bhoomi Kaushik (1AY20AI012) and Shaik Mohammad Junaid(1AY20AI037)** of Sixth semester in partial fulfillment for the award of degree of **Bachelor of Engineering in Artificial Intelligence & Machine Learning** of the **Visvesvaraya Technological University**, **Belagavi**, during the year **2022-2023.** It is certified that all corrections/ suggestions indicated for internal assessments have been incorporated in the Report deposited in the departmental library. The Mini Project report has been approved as it satisfies the academic requirements in respect of Mini Project work prescribed for the **Bachelor of Engineering Degree**.

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Name of the examiners **Signature with date**

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ABSTRACT

The objective of our project is to detect pedestrians in images and video sequences as it is an essential and significant task in any intelligent Video surveillance system, Driving assistance system, Image and video retrieval. Detection system has received tremendous attention in the vision community but has numerous challenges and complexities. Since the detection systems are critical to the success of next generation automotive vision systems, it must be easily configurable by new environment. We present a work on detection system that can be trained to detect the pedestrians in the real time version of the system. The images of pedestrians are obtained and it is determined whether each pedestrian candidate is suitable or not on the basis of average value and height of the respective pedestrian candidate as appeared on the image and performs selection processing for eliminating unsuitable candidates.

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CHAPTER 1

INTRODUCTION

1.1 DEFINITION:

- Real-time facial emotion recognition involves capturing and analyzing facial expressions as they occur, typically using a video feed from a camera or webcam.
- The technology uses algorithms to identify and classify specific facial features such as the mouth, eyes, and eyebrows.
- It applies machine learning models to interpret the emotional state of the individual based on the patterns of these features.
- It is important for developers and users to consider the potential implications of this technology and ensure that it is used in a responsible and ethical manner.
- It can also be used in fields such as education, psychology, and marketing to better understand human behavior and improve communication strategies.

CHAPTER 2

PROBLEM DEFINITION

2.1. DEFINITION:

- It is a challenging problem that involves detecting and interpreting emotions from facial expressions in real-time.
- The goal of this problem is to develop a system that can accurately and quickly recognize emotions from live video streams or images, and respond appropriately to the user.
- This problem is important in a variety of applications, including human-computer interaction, social robotics, and mental health assessment
- The inability to accurately recognize and understand patients' emotional states in healthcare settings can have significant consequences.
- It can lead to misdiagnosis, inadequate treatment plans, and limited emotional support for patients. Additionally, it can affect patient satisfaction, engagement, and overall healthcare outcomes.
- In healthcare, real-time processing is crucial to provide timely and effective interventions. FER systems must process and analyze facial expressions in real-time to support clinical decision-making. Achieving low-latency and high-speed processing for real-time applications can be technically demanding and resource-intensive.

CHAPTER 3

LITERATURE SURVEY

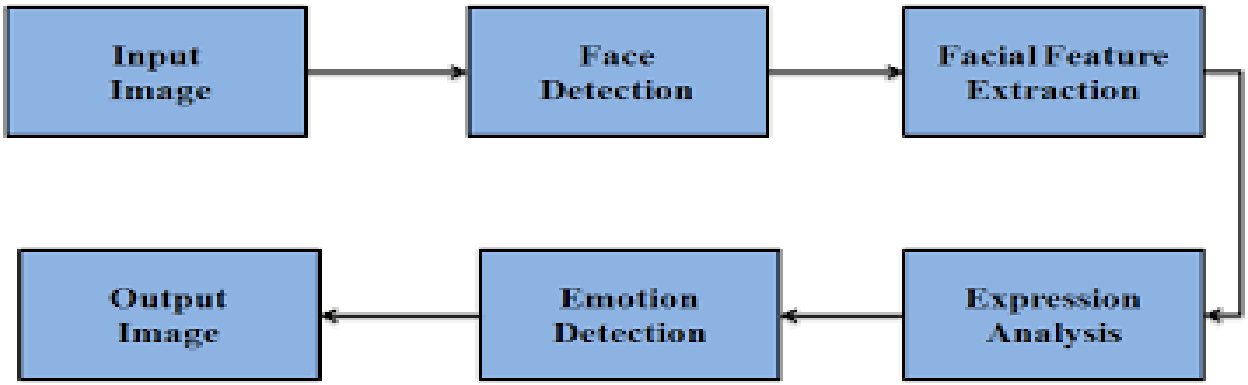
3.1. LITERATURE REVIEW

- **Reference paper 1**: Facial expressions can vary significantly among individuals due to factors such as personality, cultural background, and personal expression styles. FER models may not fully account for these individual differences, leading to reduced accuracy
- **Reference paper 2:** FER models often perform well under controlled lab conditions but may face challenges when deployed in real-world healthcare settings. Factors such as variations in lighting, image quality, camera angles, patient positioning, and noise can impact the accuracy.
- **Reference paper 3:** It is challenging to find the similarity of the same emotion state between different person since they may express the same emotion state in various ways. As an example, the expression may varies in different situations such as the individual's mood, their skin color, age, and environment surrounds.

S.N	PAPER TITTLE & PUBLICATION DETAILS	NAME OF THE AUTHORS	TECHNICAL IDEAS / ALGORITHMS USED IN THE PAPER & ADVANTAGES	SHORTFALLS/DISADVANTAGES & SOLUTION PROVIDED BY THE PROPOSED SYSTEM
1	Human Emotions Reader by Medium of Digital Image Processing.	B. Manoatl-Netzahual, L. Flores-Pulido, M. d. R. Ochoa-Montiel and	Emotion reader by medium of digital image processing	• This can lead to incorrect or biased interpretations of emotions. • It works by capturing a live or recorded video feed or image of a person's face,

		M. Labastida-Roldan		recognizing the facial features and expressions
2	Emotion Detection Algorithm Using Frontal Face Image	Kim, Moon-Hwan, Young-Hoon Joo, and Jin-Bae Park	Emotion Detection Algorithm	• Many emotion detection algorithms are only able to detect a limited range of emotions, such as happiness, anger, sadness, fear, and surprise. • It is used to recognise a person's distinctive facial traits and connect them to a specific identity
3	Digital Twin Model: A Real-Time Emotion Recognition System for Personalized Healthcare	B. Subramanian, J. Kim, M. Maray and A. Paul	ER system with a digital twin setup	• The use of personal data for emotion recognition can raise privacy concerns • ER system with a digital twin setup, allowing the predicted outcome to be analysed and tested prior to providing the best possible personal healthcare treatment before it leads to any life-threatening disease.

3.2 PROPOSED SOLUTION



- The proposed solution approach involves the development of advanced facial emotion recognition algorithms and systems that can accurately analyze facial expressions in healthcare settings.
- These systems should leverage machine learning, computer vision, and data analytics techniques to accurately analyze and interpret facial expressions.
- The FER is composed of three major steps :

1. face and facial component detection

2. feature extraction

3. expression classification.

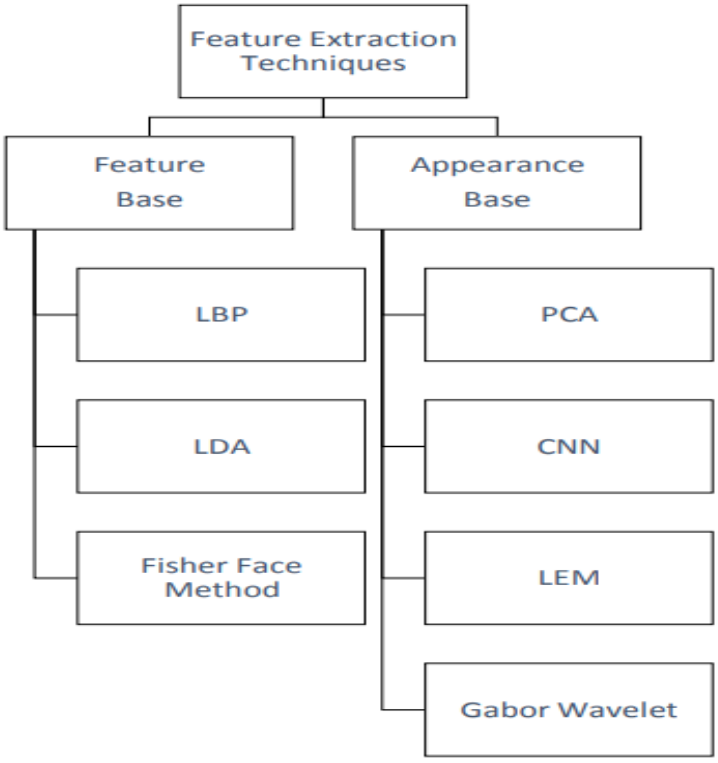
Figure 1. Facial Emotion Classification Stages.

Face Detection :

- **First stage**, which is a preprocessing stage, an image of a face is detected and facial components of the face will be detected from the region. The facial components can be an eyes, brows, nose, and mouth.
- Face detection is a pre-processing phase to recognize facial expressions of human. An image is segmented into two parts which have faces and other non-face regions.

Feature Extraction:

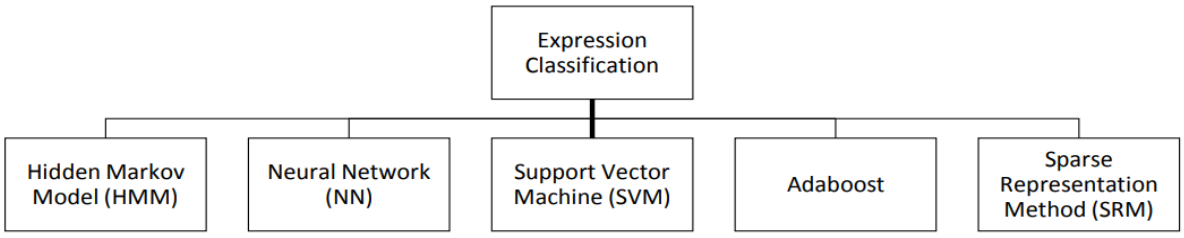
- Feature extraction converts a pixel data of the face region into a higher-level representation of shape, colour , texture, and spatial configuration of the face or its components.
- Feature extraction will reduce the dimension of the input space while keeping the important information.



Expression Classification :

- This stage is performed by a classifier. There are various classifications methods used to extract expressions.
- Methods such as :-

    1. Hidden Markov Model (HMM)
    2. Neural Network (NN)
    3. Support Vector Machine (SVM)
    4. Bayesian Network (BN)
    5. Sparse Representation Method (SRM)



CHAPTER 4

REQUIREMENTS SPECIFICATION

Requirements specification is a specification of software requirements and hardware requirements required to do the project.

4.1 HARDWARE REQUIREMENTS SPECIFICATION

Hardware Requirements are the hardware resources that are need to do the project work. These resources are a computer resource provides functions and services to do the project. Hardware resources required for our project are shown below.

- Processor : Intel Core i5 or above
- RAM : >=8GB
- Hard disk : Minimum 10 GB

4.2 SOFTWARE REQUIREMENTS SPECIFICATION

Software Requirements are the software resources that are need to do the project work. These resources are installed on a computer in order to provide functions, services, hardware accessing capabilities to do the project.

In our project we used the following software resources.

4.3 FUNCTIONAL REQUIREMENTS:

Functional requirements specify a function that system or a system component must be able to perform. It can be documented in various ways.

- The system should be able to gather the data from the camera. The system should be able to collect input feed from the camera of the mobile.
- The system should be able to process the data. The images obtained from the dataset or the inbuilt phone memory or clicked by the farmers in real time is processed by the system.
- The system should be able to detect the correct disease be it Late Blight or Early Blight.
- Use of Automated System, no manual work needed. This project helps the farmer in reducing their manual task as our rich and comprehensive dataset involves more than 1500 images, No heavy Hardware Requirements

- High Accuracy Level. Our system aims to provide high level of Accuracy and certainly better than human eye, such that farmer can judge and take action beforehand appropriately.

- High Speed/Getting results quickly. We applied CNN in deep learning as this model will suitably be the fastest to give results with high level of accuracy.

4.4 NON-FUNCTIONAL REQUIREMENTS:

- Realibilty: Database updating should follow transaction processing to avoid data inconsistency.
- Availabilty: The project will be deployed on a public shared server so it will be available all the time and will be accessible anywhere of the world using internet.
- Security: We have implemented a lot of security mechanism to avoid to hack the system by outer world.
- Maintainabilty: It is very easy to maintain the system. The system has been developed on php so anyone who has the knowledge of php, can easily maintain the system.
- Portability: Yes this system is portable and we can switch the servers very easily.
- Browser Compatibilty: The project being web based required compatibility with at least the popular web browsers. Microsoft windows XP and above, Linux and Macintosh being the current popular operating system and Microsoft Internet Explorer, Mozilla Firefox, Opera, Safari and Google Chrome being the currently popular web browsers.

CHAPTER 5

SYSTEM DESIGN

5.1 DATA FLOW DIAGRAM

5.2 USE CASE DIAGRAM

5.3 CLASS DIAGRAM

5.4 MODULE DESCRIPTION

CHAPTER 6

IMPLEMENTATION

6.1 TOOLS AND TECHNOLOGIES USED

JUPYTER: Jupyter is an open-source web application that allows users to create and shared documents containing live code, visualizations, and narrative text. It provides an interactive computing environment where users can write and execute code in different programming languages, including Python, R, and Julia

OPEN CV: OpenCV (Open Source Computer Vision Library) is an open source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the 22 commercial products. Being a BSD-licensed product, OpenCV makes it easy for businesses to utilize and modify the code. The library has more than 2500 optimized algorithms, which includes a comprehensive set of both classic and state-of-the-art computer vision and machine learning algorithms. These algorithms can be used to detect and recognize faces, identify objects, classify human actions in videos, track camera movements, track moving objects, extract 3D models of objects, produce 3D point clouds from stereo cameras, stitch images together to produce a high resolution image of an entire scene, find similar images from an image database, remove red eyes from images taken using flash, follow eye movements, recognize scenery and establish markers to overlay it with augmented reality, etc. It has C++, C, Python, Java and MATLAB interfaces and supports Windows, Linux, Android and Mac OS.

6.2 ALGORITHMS / METHODOLOGIES USED

HAAR CASCADE ALGORITHM: The Haar Cascade algorithm is a machine learning-based object detection technique used to identify and locate objects within images or video streams. The algorithm uses Haar-like features, which are rectangular filters that are applied to the input image at different scales and positions. These features can capture patterns of light and dark regions in the image. During detection, the algorithm applies the cascade of classifiers to the input image. At each stage, it quickly rejects regions that are unlikely to contain the object based on the weak classifier's responses, focusing only on potential positive regions for further evaluation.

GRAY SCALE CONVERSION:It is an image conversion technique in digital photography. It eliminates every form of colour information and only leaves different shades of gray; the brightest being white and the darkest of it being black.

CHAPTER 7

SYSTEM TESTING

System testing was done by giving different training and testing datasets. This test was done to evaluate whether the system was predicting accurate result or not. During the phase of the development of the system our system was tested time and again. The series of testing conducted are as follows:

4.2.1. Unit Testing : In unit testing, we designed the whole system in modularized pattern and each module was tested. Till we get the accurate output from the individual module we worked on the same module.

4.2.2. Integration Testing: After constructing individual modules all the modules were merged and a complete system was made. Then the system was tested whether the prediction given by training dataset to testing set was correct or not. We tried to meet the accuracy as higher as much as we can get. After spending a couple of days in integration testing the average accuracy of our system was 91%.

4.2.2.1. Alpha testing: Alpha testing is the first stage of software engineering which is considered as a simulated or actual operational testing done by the individual member of the project. Alpha testing is conducted by the project developers, in context of our project.

4.2.2.2. Beta Testing: Beta testing comes continuously after alpha testing which is considered as a form of external user acceptance testing. The beta version of the program is developed to and provided to limited audience. This is the final test process in the case of this project. In this system the beta-testing is done by our colleagues and the project supervisor.

CHAPTER 8

CONCLUSION AND FUTURE SCOPE

8.1 CONCLUSION:

- It is a rapidly advancing field with numerous applications in various domains such as healthcare, security, entertainment, and marketing.
- In marketing, real-time emotion recognition can be used to analyze the emotional responses of consumers to products and advertisements.
- In conclusion, facial emotion recognition in real-time has the potential to revolutionize various industries, but it is important to ensure that the use of such systems is ethical and respects individual privacy.
- Facial Emotion Recognition (FER) holds great potential in healthcare settings.
- Several limitations and challenges need to be addressed for successful implementation.
- Despite these challenges, ongoing research, advancements in machine learning techniques we can gradually overcoming these limitations
- FER in healthcare can enable healthcare providers to improve diagnostic accuracy, personalize treatment plans, and provide timely emotional support. It has the potential to enhance patient satisfaction, engagement, and overall healthcare outcomes

8.2 FUTURE SCOPE:

Face expression recognition systems have improved a lot over the past decade. The focus has definitely shifted from posed expression recognition to spontaneous expression recognition. Promising results can be obtained under face registration errors, fast processing time, and high correct recognition rate (CRR) and significant performance improvements can be obtained in our system. System is fully automatic and has the capability to work with images feed. It is able to recognize spontaneous expressions. Our system can be used in Digital Cameras wherein the image can be captured only when the person smiles. In security systems which can identify a person, in any form of expression he presents himself. Rooms in homes can set the lights, television to a person's taste when they enter the room. Doctors can use the system to understand the intensity of pain or illness of a deaf patient. Our system can be used to detect and track a user's state of mind, and in mini-marts, shopping center to view the feedback of the customers to enhance the business etc.

APPENDICES

A. SAMPLE CODE

```
import cv2 ### pip install opencv-python ## pip install opencv-contrib-python fullpackage from deepface import DeepFace ## pip install deepface

from deepface import DeepFace

faceCascade = cv2.CascadeClassifier(cv2.data.haarcascades + 'haarcascade_frontalface_default.xml')

cap= cv2.VideoCapture(0)

# Check if the webcam is opened correctly

if not cap.isOpened():
    cap= cv2.VideoCapture(0)

if not cap.isOpened():

    raise IOError("Cannot open webcam")

while True:

    ret,frame  = cap.read()

    result = DeepFace.analyze(frame, actions=['emotion'], enforce_detection=False)

    gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY) #print (faceCascade.empty()) faces faceCascade.detectMultiScale(gray,1.1,4)
    faces = faceCascade.detectMultiScale(gray,1.1,4)
    #Draw a rectangle around the faces

    for(x, y, w, h) in faces:
        cv2.rectangle(frame,(x,y),(x+w,y+h),(0,255,0),2)
    font = cv2.FONT_HERSHEY_SIMPLEX
```

```
FF.
GG.    cv2.putText(frame,
HH.            result[0]["dominant_emotion"].upper(),
II.            (100,100),
JJ.            font, 3,
KK.            (0,0,255),
LL.            2,
MM.                        cv2.LINE_4)
NN.    cv2.imshow('Original video',frame)
OO.    if cv2.waitKey(2) & 0XFF ==ord('q'):
PP.        break
QQ.cap.release()
RR. cv2.destroyAllWindows()
```

SS. SNAPSHOTS

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