A Major Project Report

on

Real Time Facial Recognition using Twilio

submitted in partial fulfillment of the requirements for the award of degree of

BACHELOR OF TECHNOLOGY

in

COMPUTER SCIENCE & ENGINEERING

by

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(UGC Autonomous, Accredited by NBA & NAAC)

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CERTIFICATE

This is to certify that the Major Project entitled **"Real Time Facial Recognition using Twilio"**, being submitted by

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In partial fulfillment of the requirements for the award of degree of BACHELOR OF TECHNOLOGY in COMPUTER SCIENCE AND ENGINEERING to B.V.RAJU INSTITUTE OF TECHNOLOGY is a record of bonafide work carried out during a period from May 2021 to July 2021 by them under the guidance of Mrs.L.Pallavi, Assistant Professor, CSE Department.

This is to certify that the above statement made by the students is/are correct to the best of my knowledge.

Ms. Srilakshmi,
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CANDIDATE'S DECLARATION

We hereby certify that the work which is being presented in the project entitled **"Real Time Facial Recognition using Twilio"** in partial fulfillment of the requirements for the award of Degree of Bachelor of Technology and submitted in the Department of Computer Science and Engineering, B. V. Raju Institute of Technology, Narsapur is an authentic record of my own work carried out during a period from May 2020 to July 2021 under the guidance of **Ms.Srilakshmie**, Assistant Professor. The work presented in this project report has not been submitted by us for the award of any other degree of this or any other Institute/University.

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REAL TIME FACIAL RECOGNITION USING TWILIO

Abstract

Face recognition is one of the widely used technologies or systems in which it has the potential to perform tasks such as to have records provided in by the dataset in many areas such as the school and colleges attendance systems, it can also be helpful in catching the thieves or the terrorist, can be helpful in the security of common people and the much needed security areas in the country. Face recognition can be used by the government to verify the voters list, find missing persons, find the population or census, immigration process, also provide security over internet scams protecting Ecommerce and highly used in the medicine and healthcare.

Criminals are widely using Social Media & Social Networks to Commit the Crime and they are being part of cyber space as well, in this regard.

A facial recognition system is a technology capable of identifying or verifying a person from a digital image or a video frame from a video source. There are multiple methods in which facial recognition systems work, but in general, they work by comparing selected facial features from given image with faces within a database

Key Words:

Facial recognition, twilio, database, image processing.

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Chapter 1

INRODUCTION

1.1 Motivation

In recent years, the study of image analysis and its use in facial recognition applications has gained significant attention from the worldwide research community.

Facial recognition is a popular research area in pattern recognition and computer vision due to its wide range of commercial and law enforcement applications, including passports, credit cards, drivers' licenses, biometric authentication, video surveillance, and information security (Zhao et al, 2003; Phillips et al, 1997).

These applications demands user-friendly automatic systems that can secure our assets and protect our privacy without losing our identity.

Although researchers in various fields like psychology, neural sciences and engineering, image processing and computer vision have investigated a number of issues related to personal identification and machines, it is still difficult to design an automatic system for this task.

Although extremely reliable methods of biometric personal identification exists, e.g., fingerprint analysis and retinal or iris scans, these methods have yet to gain acceptance from the general population.

Thus, facial recognition is a very challenging problem and, to date, there is no technique that provides a robust solution to all situations and different applications that facial recognition may encounter.

The applications may be very useful for personal verification and recognition, however, its implementation is always very difficult due to all of the different situations a human face can be found (Pentland et al., 1994; Rizvi et al., 1998).

Because of the said difficulty of the facial recognition task, the number of techniques is large and diverse. In addition, the applications involve a huge number of situations.

As mentioned above, there are numerous applications for facial recognition that can be divided into two groups, those applications that require facial identification and those that require facial verification.

The first group of applications matches a face to one in a database; and the second group, the verification technique tries to verify a human face from a given sample of that face (Zhao et al, 2003; Phillips et al, 1997).

1.2 Problem Definition

In general, facial recognition systems proceed by capturing the face in an image, with the effect of estimating and normalizing for translation, scale and in-plane rotation. Given a normalized image, the features, either global or local, are extracted and compressed in a compact face representation which can then be stored in an image database and compared with face representations/search images derived at later times.

The research on face recognition generally falls into two main categories (Chellappa et al., 1995) i.e:
1. Feature-based approach and
2. Holistic or global approach

Feature-based approaches: Facial recognition based on feature-based approaches relies on the detection and characterization of individual facial features and their geometrical relationships. Such features generally include the eyes, nose, and mouth. The detection of faces and their features prior to performing verification or recognition makes these approaches robust to positional variations of the faces in the input image.

Holistic or global approaches: Facial recognition based on holistic approaches, on the other hand, involves encoding the entire facial image and treating the resulting facial “code” as a point in a high dimensional space. Here, it is assumed that all faces are constrained to particular positions, orientations, and scales.

1.3 Objective of Project

Feature-based approaches were more predominant in early attempts at automating the facial recognition process. Some of the early works involved the use of very simple image processing techniques, which include edge detection, signatures, and so on for detecting faces and their features (Kelly, 1970).

The first attempt at edge map extraction from an input image and then matching it to a large oval template, with possible variations in position and size, was done by Sakai and colleagues (Sakai et al., 1969). The presence of a face was then confirmed by searching for edges at estimated locations of certain features like the eyes and mouth.

An improved edge detector, involving heuristic planning to extract an accurate outline of a person's head from various backgrounds was described by Kelly (1970).

1.4 Limitations of Project

The difficulties and limitations of facial recognition are many. To name a few, human faces are not invariant, i.e., a person's face can change a lot during short periods of time. One problem of facial recognition is the fact that different faces can seem very similar; therefore, a discrimination task is needed. Similarly, when we analyze the same face, at different times many characteristics might have changed (Phillips et al, 1997; Pentland and Choudhury, 2000; Yuille, et al, 1992).

Some of the most important problems are change in illumination, variability in facial expressions, the presence of accessories (glasses, beards, etc.). In addition, the rotation of a face may change many facial characteristics (Yuille et al, 1992; Nefian, 1999).

To address the above problems, we have introduced a digital image processing-based facial recognition and verification system designed and developed on the TMS320C6713 DSP. The main advantage of this system is reduced size, increased speed and reduced cost. First we will highlight the different methodologies and algorithms that can be used for facial recognition applications. Algorithms based on PCA and DCT were developed and verified on a PC-based real-time system. Next, a DSP system prototype is developed and validated in real-time. Analysis is also carried out tocompare the accuracy and performance of both algorithms.

Chapter 2

LITERATURE SURVEY

2.1 Introduction

Feature-based approaches were more predominant in early attempts at automating the facial recognition process. Some of the early works involved the use of very simple image processing techniques, which include edge detection, signatures, and so on for detecting faces and their features (Kelly, 1970). The first attempt at edge map extraction from an input image and then matching it to a large oval template, with possible variations in position and size, was done by Sakai and colleagues (Sakai et al., 1969). The presence of a face was then confirmed by searching for edges at estimated locations of certain features like the eyes and mouth. An improved edge detector, involving heuristic planning to extract an accurate outline of a person's head from various backgrounds was described by Kelly (1970).

More recently, Govindaraju et al. (1990) proposed a technique for identifying a face in a cluttered image, which employed a deformable template similar to ones given by Yuille et al. (1989).

They based their template on the outline of the head and allowed it to deform according to certain spring-based models. This approach, based on the outline of the head and allowing it to deform according to certain spring-based models, performed quite well when tested on a small dataset, but sometimes gave rise to errors (Govindaraju et al, 1990). Other recent approaches have used hierarchical coarse-to-fine searches with template-based matching criteria (Burt, 1989; Craw et al, 1992; Shepherd, 1985).
The next step after a face has been located is computation of its features. Early examples of this involved work on facial profile features (Kanade, 1973; Harmon and Hunt 1977).

2.2 Existing System

In existing system criminal information is stored in file format with outdated images and low quality images. Using this information it is not possible for eye witness to guess the criminal, so there is need to develop a better method for identifying criminals like finger print, DNA…Etc. Among all these methods face detection method is cost effective and more accurate.

2.3 Disadvantages of Existing System

The difficulties and limitations of facial recognition are many. To name a few, human faces are not invariant, i.e., a person's face can change a lot during short periods of time. One problem of facial recognition is the fact that different faces can seem very similar; therefore, a discrimination task is needed. Similarly, when we analyze the same face, at different times many characteristics might have changed (Phillips et al, 1997; Pentland and Choudhury, 2000; Yuille, et al, 1992).

2.4 Proposed System

When image quality is taken into consideration, there is a plethora of factors that influence the system's accuracy.

Most face recognition algorithms are extremely sensitive to lighting conditions, so that if it was trained to recognize a person when they are in a dark room, it probably won't recognize them in a bright room, etc.

This is why it is so important to use a good image pre-processing filters before You will need to tell the classifier where to find the data file you want it to use.

The one we are using called Haarcascade_frontalface_defult.xml

Chapter 3
ANALYSIS

3.1 Introduction

Face recognition has been one of the most interesting and important research fields in the past two decades. The reasons come from the need of automatic recognitions and surveillance systems, the interest in human visual system on face recognition, and the design of human-computer interface, etc. These researches involve knowledge and researchers from disciplines such as neuroscience, psychology, computer vision, pattern recognition, image processing, and machine learning, etc.

A bunch of papers have been published to overcome difference factors (such as illumination, expression, scale, pose, ……) and achieve better recognition rate, while there is still no robust technique against uncontrolled practical cases which may involve kinds of factors simultaneously. In this report, we'll go through general ideas and structures of recognition, important issues and factors of human faces, critical techniques and algorithms, and finally give a comparison and conclusion.

Readers who are interested in face recognition could also refer to published surveys [1-3] and website about face recognition [4]. To be announced, this report only focuses on color-image-based (2D) face recognition, rather than video-based (3D) and thermal-image-based methods.

Before going into details of techniques and algorithms of face recognition, we'd like to make a digression here to talk about pattern recognition. The discipline, pattern recognition, includes all cases of recognition tasks such as speech recognition, object recognition, data analysis, and face recognition, etc. In this section, we won't discuss those specific applications, but introduce the basic structure, general ideas and general concepts behind them.

The general structure of pattern recognition is shown in fig.3. In order to generate a system for recognition, we always need data sets for building categories and compare similarities between the test data and each category. A test data is usually called a "query" in image retrieval literatures, and we will use this term throughout this report.

We can easily notice the symmetric structure. Starting from the data sets side, we first perform dimension reduction2 on the stored raw data. The methods of dimension reduction can be categorized into data-driven methods and domain-knowledge methods, which will be discussed later.

After dimension reduction, each raw data in the data sets is transformed into a set of features, and the classifier is mainly trained on these feature representations. When a query comes in, we perform the same dimension reduction procedure on it and enter its features into the trained classifier. The output of the classifier will be the optimal class (sometimes with the classification accuracy) label or a rejection note (return to classification).

Following the definition of Jain et al. Techniques of pattern recognition can be classified into four categories: Template matching, statistical approaches, syntactic approach, and neural networks. The template matching category builds several templates for each label class and compares these templates with the test pattern to achieve a suitable decision. The statistical approaches is the main category that will be discussed in this report, which extracts knowledge from training data and uses different kinds of machine learning tools for dimension reduction and recognition. Shows the categories of the statistical approach.

The syntactic approach is often called the rule-based pattern recognition, which is built on human knowledge or some physical rules, for example, the word classification and word correction requires the help of grammars. The term, knowledge, is referred to the rule that the recognition system uses to perform certain actions.

Finally, the well-know neural networks is a framework based on the recognition unit called perceptron. With different numbers of perceptrons, layers, and optimization criteria, the neural networks could have several variations and be applied to wide recognition cases.

Dimension reduction is one of the most important steps in pattern recognition and machine learning. It’s difficult to directly use the raw data (ex. face patches) for pattern recognition not only because significant parts of the data haven’t been extracted but also because the extremely high dimensionality of the raw data. Significant parts (for recognition purposes or the parts with more interest) usually occupy just a small portion of the raw data and cannot directly be extracted by simple methods such as cropping and sampling.

For example, a one-channel audio signal usually contains over 10000 samples per second, and there will be over 1800000 samples for a three minute-long song. Directly using the raw signal for music genre recognition is prohibitive and we may seek to extract useful music features such as pitch, tempo, and information of instruments which could better express our auditory perception.

The goal of dimension reduction is to extract useful information and reduce the dimensionality of input data into classifiers in order to decrease the cost of computation and solve the curse of dimensionality problem.

There're two main categories of dimension reduction techniques: domain knowledge approaches and data-driven approaches. The domain-knowledge approaches perform dimension reduction based on knowledge of the specific pattern recognition case. For example, in image processing and audio signal processing, the discrete Fourier transform (DFT) discrete cosine transform (DCT) and discrete wavelet transform are frequently used because of the nature that human visual and auditory perception have higher response at low frequencies than high frequencies. Another significant example is the use of language model in text retrieval which includes the contextual environment of languages.

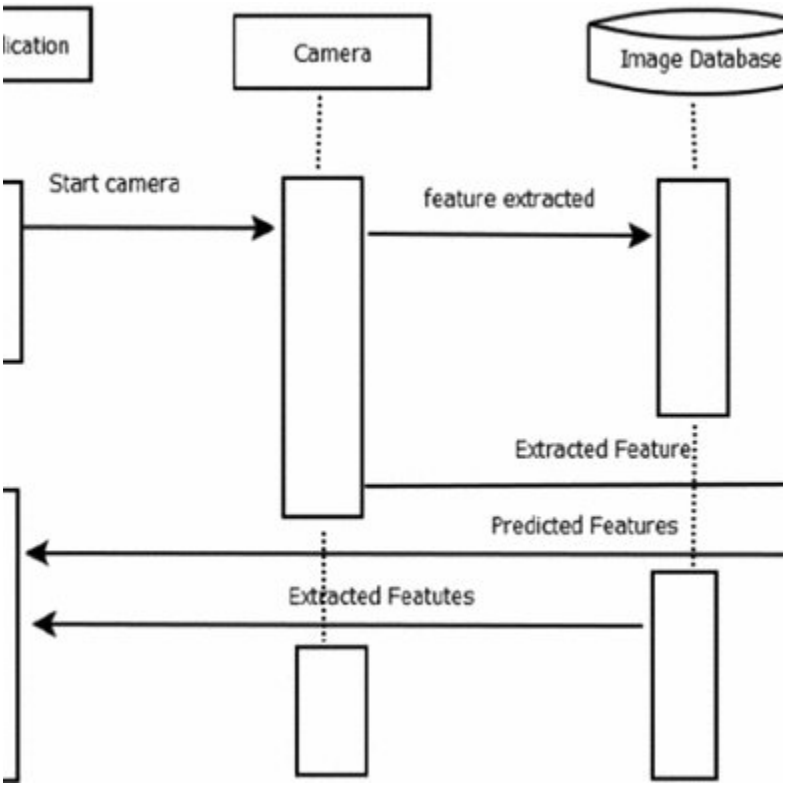
3.2.1 Software Requirements

- Python
- Opencv-4.2.0
- Numpy-1.18
- Haarcascade_frontalface_default.xml

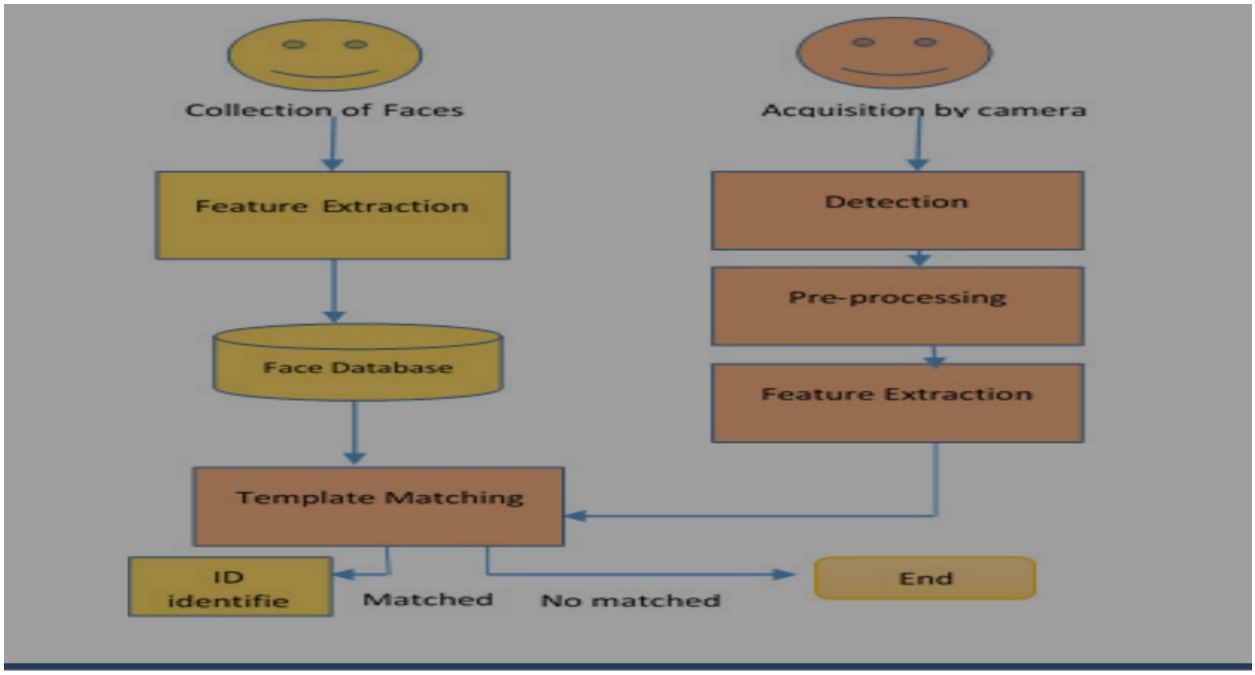
3.2.2 Hardware Requirements

- Processor : i3 Or More.
- Hard Disk : Minimum 50 Gb.
- Display : Led/Led Colour.
- Accessories : Web Cam, Keyboard & Mouse.
- Ram : Minimum 2 Gb.

3.3 content Diagram of Project



3.4 Algorithms and Flowcharts



Chapter 4
DESIGN

4.1 Introduction

The most creative and challenging phase of the life cycle is system design. The term design describes a final system and the process by which it is developed. It refers to the technical specifications that will be applied in implementations of the system.

The importance of software design can be stated in a single word “Quality”. Design provides us with representations of software that can be assessed for quality. Design is the only way where we can accurately translate user requirements into a complete software product or system.

Without design we risk building an unstable system that might fail if small changes are made. It may as well be difficult to test, or could be one who’s quality can’t be tested. So it is an essential phase in the development of a software product. Design is the specification or construction of a technical, computer-based solution for the business requirements identified in a system analysis.

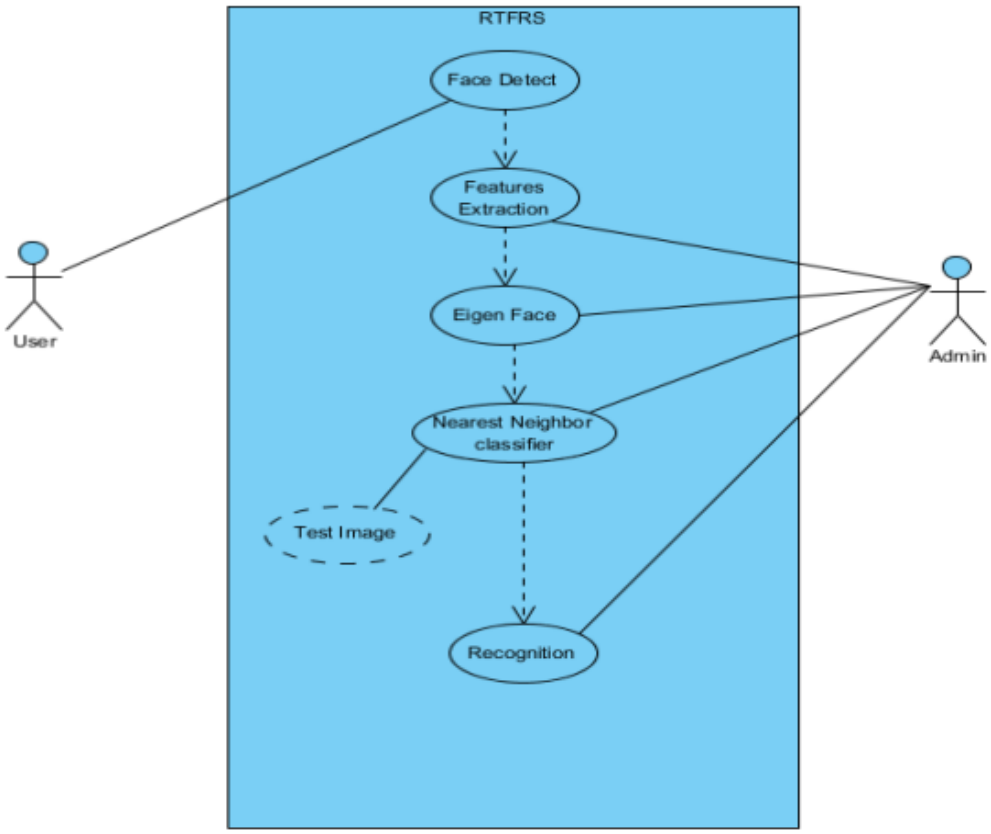
It gives the overall plan or model of a system consisting of all specifications that give the system its form and structure i.e. the structural implementation of the system analysis.

The objective of designing the new system is to provide an automatic timetabling system that will generate a feasible timetable.

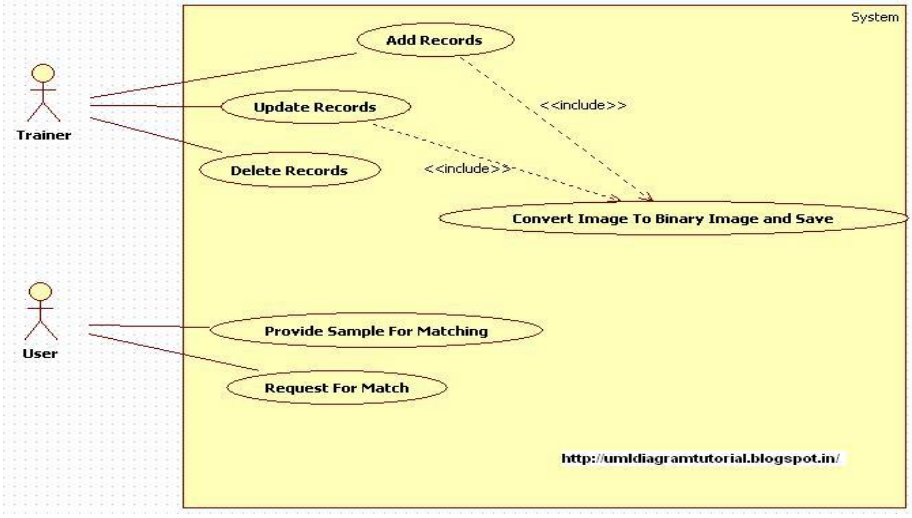
The following factors are put into consideration during the design of new system:
1. A user friendly system.
2. A time effective system.
3. A system that is able to consider all given constraints before producing a feasible output.

4.2 UML Diagram

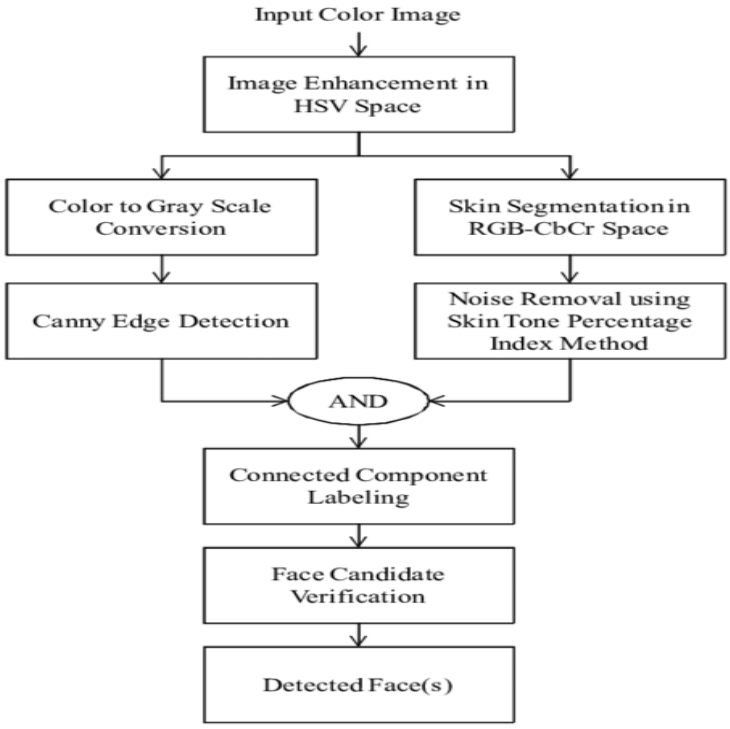
4.2.1 User options



4.2.2 Detection UML diagram



4.2.3 Flowchart



4.3 Module Design and Organisation

Module 1: FACE DETECTION IN IMAGES

Most face detection systems attempt to extract a fraction of the whole face, thereby eliminating most of the background and other areas of an individual's head such as hair that are not necessary for the face recognition task. With static images, this is often done by running a across the image. The face detection system then judges if a face is present inside the window (Brunelli and Poggio, 1993).

Module 2: REAL-TIME FACE DETECTION

Real-time face detection involves detection of a face from a series of frames from a videocapturing device. While the hardware requirements for such a system are far more stringent, from a computer vision stand point, real-time face detection is actually a far simpler process thandetecting a face in a static image. This is because unlike most of our surrounding Department of ECE Page 28 environment, people are continually moving. We walk around, blink, fidget, wave our hands about, etc.

Module 3: FACE DETECTION PROCESS

It is process of identifying different parts of human faces like eyes, nose, mouth, etc… this process can be achieved by using MATLAB codeIn this project the author will attempt to detect faces in still images by using image invariants. To do this it would be useful to study the greyscale intensity distribution of an average human face. The following 'average human face' was constructed from a sample of 30 frontal view human faces, of which 12 were from females and 18 from males. A suitably scaled colormap has been used to highlight grey-scale intensity differences

Chapter 5
IMPLEMENTATION AND RESULT

5.1 Introduction

The system implementation defines the construction, installation, testing and delivery of the proposed system. After thorough analysis and design of the system, the system implementation incorporates all other development phases to produce a functional system.

The developer has to enter the subject name to know which subject has to be allotted and the faculty name to know which faculty is going to deal that particular subject.

He should also enter the number of periods in a week. This tells us how many hours should be allotted to that particular subject in a week. Once all these details are filled, the developer or user should click on either submit button or reset button. The submit button sends the details to the code and prints the output in another tab.

If you click on reset button, the information which was entered till then will be lost and you can enter the correct details again. We click on reset only if the entire details are wrong and we want to erase all the details.

This system is implemented using the minimum hardware requirements like RAM 512MB and above, hard disk used is 20GB or above, processor used is 2.4GHz or above, display is standard output display and data input is keyboard/mouse.

Software requirements deal with defining software resource requirements and prerequisites that need to be installed on a computer to provide optimal functioning of an application. These requirements or prerequisites are generally not included in the software installation package and need to be installed separately before the software is installed.

5.2 Explanation of Key functions

Knowledge-based methods encode human knowledge of what constitutes a typical face. Usually, the rules capture the relationships between facial features. These methods are designed mainly for face localization, which aims to determine the image position of a single face. In this subsection, we introduce two examples based on hierarchical knowledge-based method and vertical / horizontal projection.

Hierarchical knowledge-based method is composed of the multi-resolution hierarchy of images and specific rules defined at each image level [8]. The hierarchy is built by image sub-sampling and an example is shown in fig. 9. The face detection procedure starts from the highest layer in the hierarchy (with the lowest resolution) and extracts possible face candidates based on the general look of faces.

Horizontal / vertical projection method uses the fairly simple image processing technique, the horizontal and vertical projection [9]. Finally, each face candidate is validated by further detection rules such as eyebrow and nostrils. As shown in fig. 10, this method is sensitive to complicated backgrounds and can’t be used on images with multiple faces.

Face Detection Using Color Information In this work, Hsu et al. Proposed to combine several features for face detection. They used color information for skin-color detection to extract candidate face regions. In order to deal with different illumination conditions, they extracted the 5% brightest pixels and used their mean color for lighting compensation. After skin-color detection and skin-region segmentation, they proposed to detect invariant facial features for region verification. Human eyes and mouths are selected as the most significant features of faces and two detection schemes are designed based on chrominance contrast and morphological operations, which are called “eyes map” and “mouth map”. Finally, we form the triangle between two eyes and a mouth and verify it based on (1) luminance variations and average gradient orientations of eye and mouth blobs, (2) geometry and orientation of the triangle, and (3) the presence of a face boundary around the triangle. The regions pass the verification are denoted as faces and the Hough transform are performed to extract the best-fitting ellipse to extract each face.

Code
Dataset Creator

```
import cv2
import numpy as np
import sqlite3
import os
conn = sqlite3.connect('database.db')
if not os.path.exists('./dataset'):
    os.makedirs('./dataset')
c = conn.cursor()
face_cascade = cv2.CascadeClassifier('haarcascade_frontalface_default.xml')
cap = cv2.VideoCapture(0)
uname = input("Enter your name: ")
c.execute('INSERT INTO users (name) VALUES (?)', (uname,))
uid = c.lastrowid
sampleNum = 0
while True:
  ret, img = cap.read()
  gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
  faces = face_cascade.detectMultiScale(gray, 1.3, 5)
  for (x,y,w,h) in faces:
    sampleNum = sampleNum+1
    cv2.imwrite("dataset/User."+str(uid)+"."+str(sampleNum)+".jpg",gray[y:y+h,x:x+w])
    cv2.rectangle(img, (x,y), (x+w, y+h), (255,0,0), 2)
    cv2.waitKey(100)
  cv2.imshow('img',img)
  cv2.waitKey(1);
  if sampleNum > 50:
    break
cap.release()
conn.commit()
conn.close()
cv2.destroyAllWindows()
```

Data Training

```
import os
import cv2
import numpy as np
from PIL import Image
recognizer = cv2.face.LBPHFaceRecognizer_create()
#recognizer = cv2.createLBPHFaceRecognizer()
path = 'dataset'
if not os.path.exists('./recognizer'):
    os.makedirs('./recognizer')
def getImagesWithID(path):
  imagePaths = [os.path.join(path,f) for f in os.listdir(path)]
  faces = []
  IDs = []
  for imagePath in imagePaths:
    faceImg = Image.open(imagePath).convert('L')
    faceNp = np.array(faceImg,'uint8')
    ID = int(os.path.split(imagePath)[-1].split('.')[1])
    faces.append(faceNp)
    IDs.append(ID)
    cv2.imshow("training",faceNp)
    cv2.waitKey(10)
  return np.array(IDs), faces
Ids, faces = getImagesWithID(path)
recognizer.train(faces,Ids)
recognizer.save('recognizer/trainingData.yml')
cv2.destroyAllWindows()
```

Code for facial Detector

```
import cv2
import numpy as np
import sqlite3
import os
from twilio.rest import Client
index = 0
def SMS(name):
  account_sid="ACd506f1f0c3b5009fec4603e85c13aba9"
  auth_token="77464d09990a7a5175b089c23d502052"
  client=Client(account_sid, auth_token)
```

```
 message = client.messages \
            .create(
            body=name+" is recognized at hyderabad ",
            from_='+15098225628',
            to='+918919724433'
            )
  print(message.sid)

conn = sqlite3.connect('database.db')
c = conn.cursor()
fname = "recognizer/trainingData.yml"
if not os.path.isfile(fname):
  print("Please train the data first")
  exit(0)
face_cascade = cv2.CascadeClassifier('haarcascade_frontalface_default.xml')
cap = cv2.VideoCapture(0)
recognizer = cv2.face.LBPHFaceRecognizer_create()
recognizer.read(fname)
while True:
  ret, img = cap.read()
  gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
  faces = face_cascade.detectMultiScale(gray, 1.3, 5)
    if conf < 50:
      if(index==0):
        SMS(name)
        index+=1
      #cv2.putText(img, name, (x+2,y+h-5), cv2.FONT_HERSHEY_SIMPLEX, 1,
(150,255,0),2)
    else:
      #cv2.putText(img, 'No Match', (x+2,y+h-5), cv2.FONT_HERSHEY_SIMPLEX, 1,
(0,0,255),2)
      print("no match")
  cv2.imshow('Face Recognizer',img)

  k = cv2.waitKey(30) & 0xff
  if k == 27:
    break
cap.release()
cv2.destroyAllWindows()
```

5.3 Method of Implementation

After you have carefully planned your project, you will be ready to start the project implementation phase, the third phase of the project management life cycle.

The implementation phase involves putting the project plan into action. The implementation phase is where you and your project team actually do the project work to produce the deliverables. The word “deliverable” means anything your project delivers.

The deliverables for your project include all of the products or services that you and your team are performing for the client, customer, or sponsor, including all the project management documents that you put together.

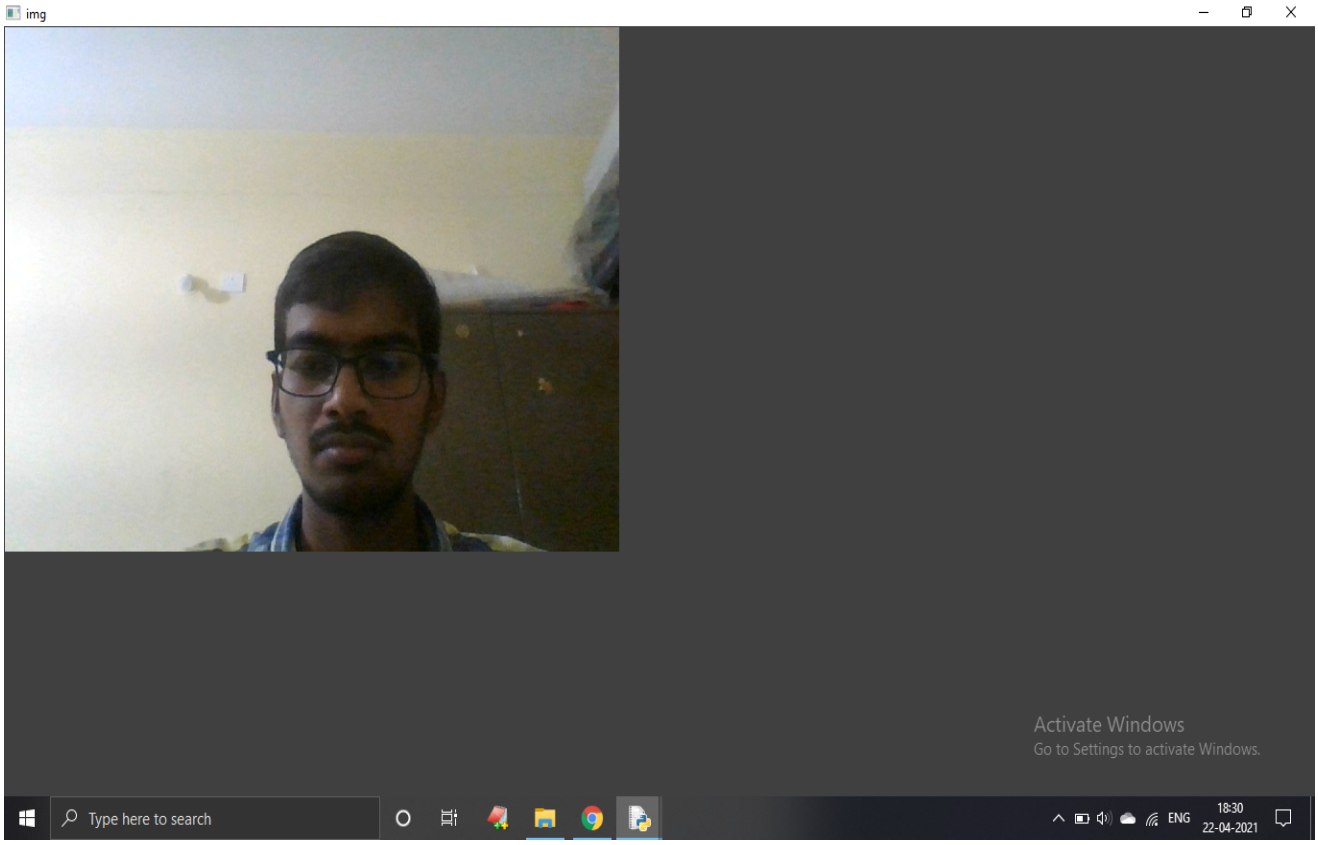
The steps undertaken to build each deliverable will vary depending on the type of project you are undertaking, and cannot therefore be described here in any real detail. For instance engineering and telecommunications projects will focus on using equipment, resources, and materials to construct each project deliverable, whereas computer software projects may require the development and implementation of software code routines to produce each project deliverable.

The activities required to build each deliverable will be clearly specified within the project requirements document and project plan.

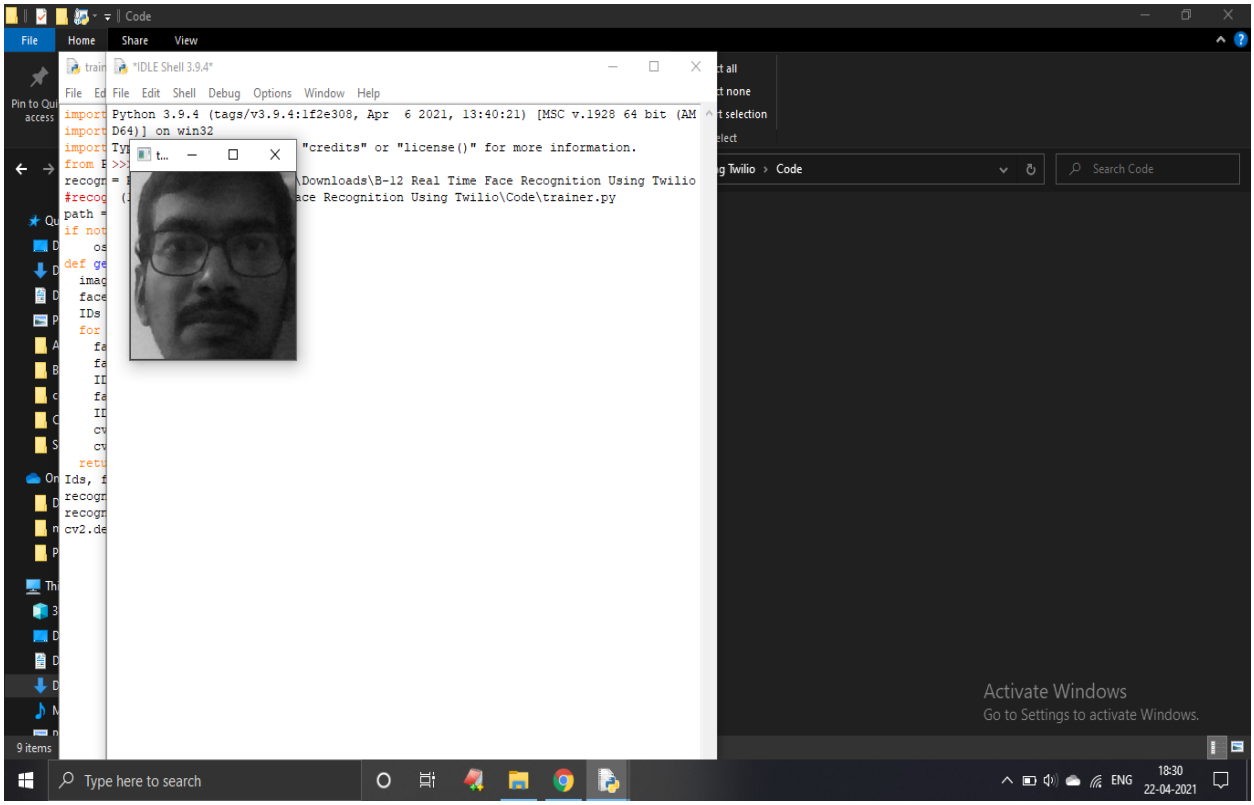
Most often, changes are identified by looking at performance and quality control data. Routine performance and quality control measurements should be evaluated on a regular basis throughout the implementation phase. Gathering reports on those measurements will help you determine where the problem is and recommend changes to fix it.

5.3.1 output Screens

Dataset creation

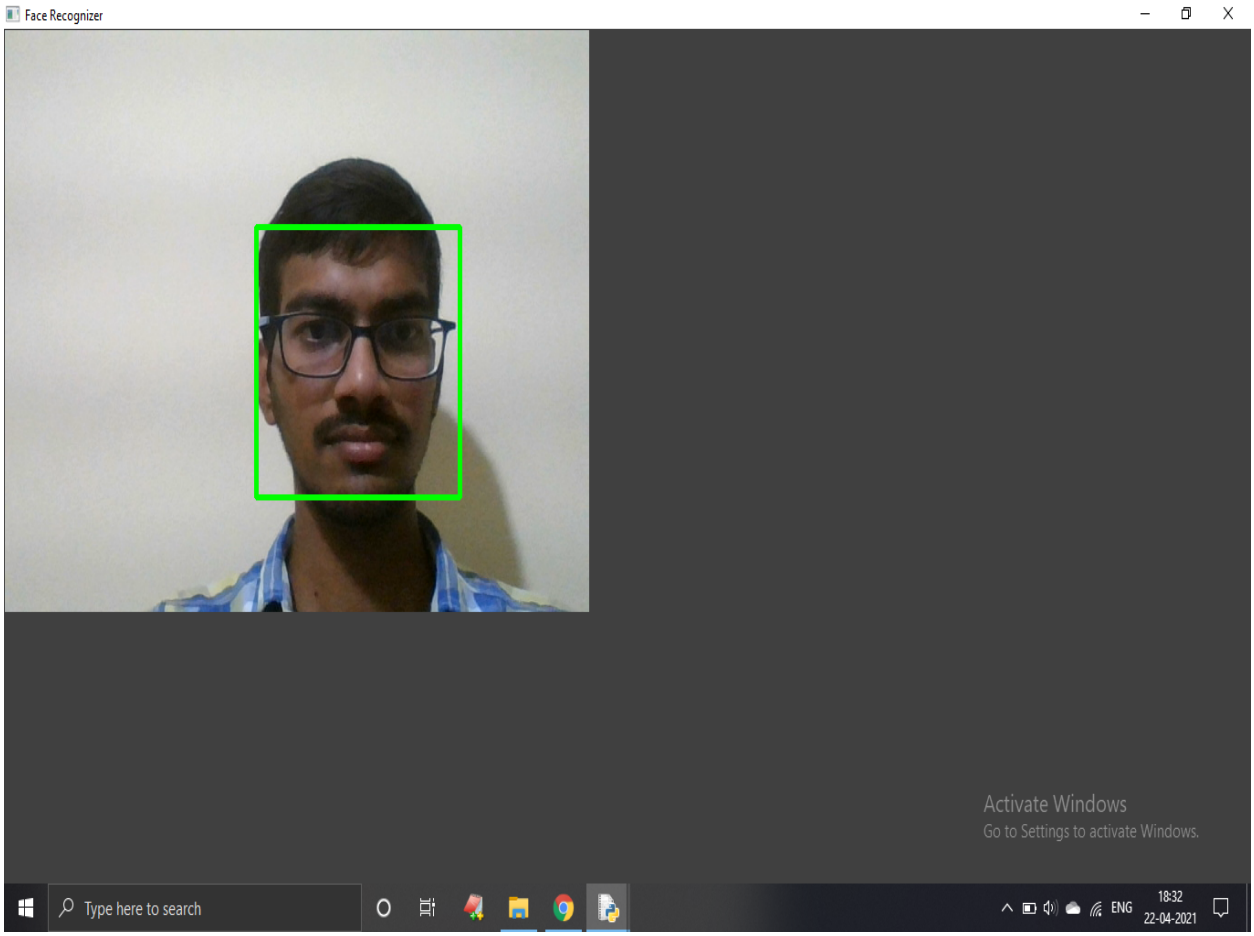


Data Training

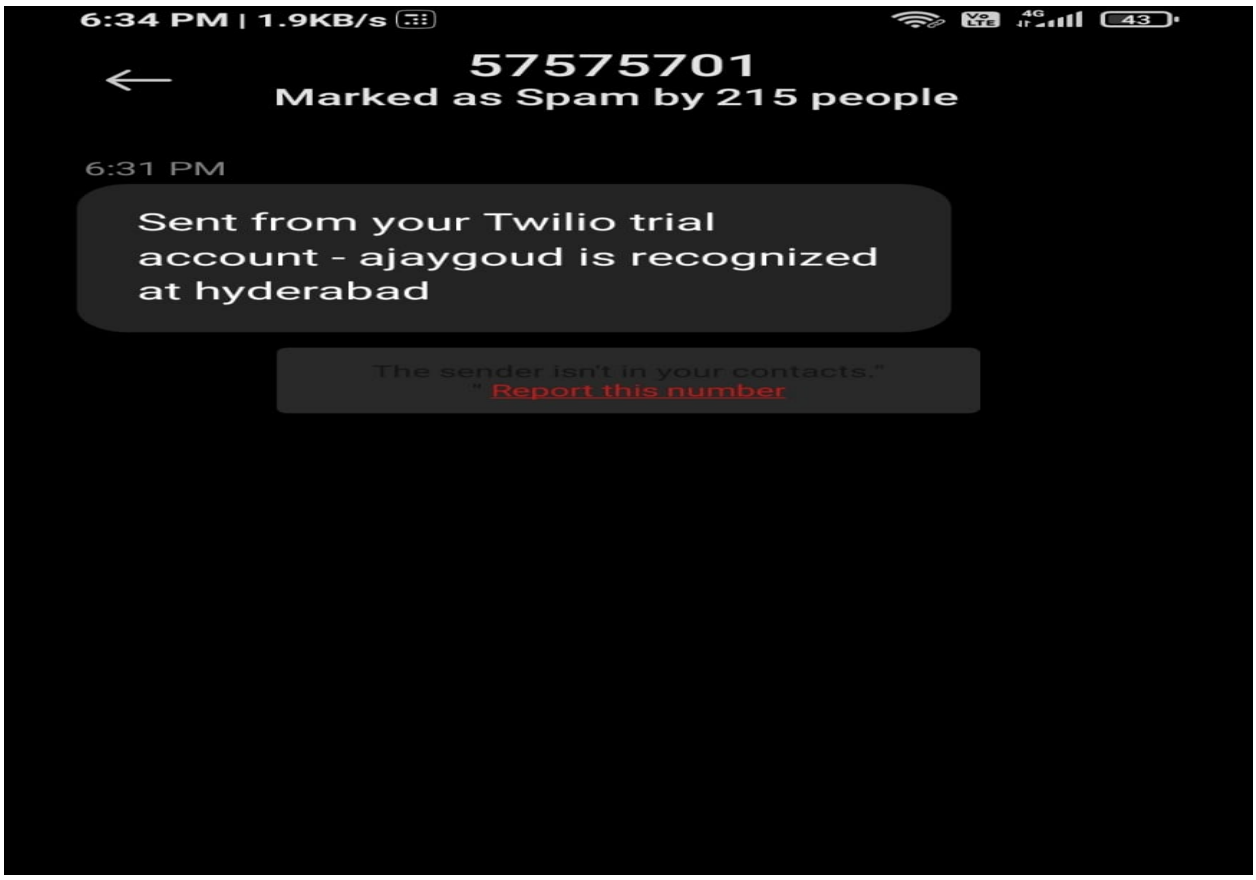


Training set

Data Detection



SMS received when recognized



5.3.2 Result Analysis

The experimental results obtained from the proposed algorithms are highlighted in this section.

Experiments are carried out using MATLAB simulations, a PC-based real-time system and DSP based Prototype system. Finally, the proposed system is validated in real-time by taking a simple case study of automatically opening and closing of the doors.

PCA Analysis

The training set, the database image considered and the eigen faces generated with calculated eigen values that are not zero is given respectively.

The reconstructed image is compared with the mean image of database images. The mathematical tool used for this purpose is the minimum Euclidean distance.

By training the database images we define a threshold value. If the minimum Euclidean distance of input image is within the given threshold, it's a known face or present in the database. If the minimum Euclidean distance of input image is greater than the threshold value, it's an unknown face or not in the database

DCT Analysis

Similar analysis as mentioned above is done in MATLAB using the DCT technique. For this analysis, a database of images of size 512x512 is created.

For each image in the database its DCT coefficients are generated in MATLAB. Out of the generated 2080 DCT coefficients, only a maximum of 32 coefficients were collected.

Next the image to be tested against the database, known as the search image, is obtained. Next, the DCT coefficients of input image are obtained as for the database images.

The coefficients of each image in the database are compared with the coefficients of search image.

For comparison, the autocorrelation comparison method is used. The match occurs when the autocorrelation value is maximum.

PC-Based System

The above results demonstrated in MATLAB are again repeated by implementing a PC-based system using a webcam to capture images in real time.

Both PCA and DCT analysis are carried out in real-time using database images and test images. Excellent matches were obtained in this real-time PC-based system. The experiment is repeated by changing the search images. Exact classification of the images was obtained using both PCA and DCT algorithms.

Chapter 6
TESTING AND VALIDATION

6.1 Introduction

A test plan is a procedure used to schematically analyze and find the shortcomings or mistakes, if any, in a technical system or product. Through experimental runs of the unit, this process is used to make sure that the unit can function to full capacity, both effectively and efficiently, once it is in full operation.

Therefore, the test plan clearly states how the unit or the unit or system will be tested, what aspects of it will be tested, who will perform the tests, where and for how long the testing will occur and the overall effectiveness of such testing.

Software Testing is performed for each and every possible test case in our entire project for checking the expected validations and correctness of flow of control from one page to another as requirement of user.

Software Testing, depending on the testing method employed, can be implemented at any time in the development process, however the most test effort is employed after the requirements have been defined and coding process has been complete.

Testing can never completely identify all the defects within software. Instead, it furnishes a criticism or comparison that compares the state and behavior of the product against oracles²principles or mechanisms by which someone might recognize a problem.

These oracles may include (but are not limited to) specifications, contracts, comparable. Products, past versions of the same product, inferences about intended or expected purpose, user or customer expectations, relevant standards, applicable laws, or other criteria.

6.2 Design of test cases and scenarios

- Validate Registration option-To verify that registration is done properly or not.
- Validate login page-To verify that login id and password is correct.
- Validate recipe details-To verify that option is entered or not.
- Validate submit button for each form- To verify that option is working Correctly when opened.
- Validate training set item list detail-To verify that various form are working correct.
- Validate detector option-To verify that option is working correctly.
- Validate SMS option-To verify that option sending SMS or not.

6.3 Validation

As a result of the large data input a Real Time Facial Recognition application is supposed to handle, a linear method or algorithm cannot be employed to handle such validation and generation, hence the usage of a heuristic method.

The heuristic method to be used in this study is the genetic algorithm. The genetic algorithm is one that seeks to find the most optimal solutions where the search space is great and conventional methods is inefficient.; it works on a basis of the Darwinian evolution theory.

The business layer is vital in that it validates the input conditions before calling a method from the data layer. This ensures the data input is correct before proceeding, and can often ensure that the outputs are correct as well. This validation of input is called business rules, meaning the rules that the business layer uses to make “judgments” about the data. However, business rules don’t only apply to data validation; these rules apply to any calculations or any other action that takes place in the business layer. Normally, it’s best to put as much logic as possible in the business layer, which makes this logic reusable across applications.

Chapter 7
CONCLUSION AND FUTURE WORK

Conclusion

The computational models, which were implemented in this project, were chosen after extensive research, and the successful testing results confirm that the choices made by the researcher were reliable.The system with manual face detection and automatic face recognition did not have a recognition accuracy over 90%, due to the limited number of eigen faces that were used for the PCA transform. This system was tested under very robust conditions in this experimental study and it is envisaged that real-world performance will be far more accurate. The fully automated frontal view face detection system displayed virtually perfect accuracy and in the researcher's opinion further work need not be conducted in this area

The fully automated face detection and recognition system was not robust enough to achieve a high recognition accuracy. The only reason for this was the face recognition subsystem did not display even a slight degree of invariance to scale, rotation or shift errors of the segmented face image. This was one of the system requirements identified in section 2.3. However, if some sort of further processing, such as an eye detection technique, was implemented to further normalise the segmented face image, performance will increase to levels comparable to the manual face detection and recognition system. Implementing an eye detection technique would be a minor extension to the implemented system and would not require a great deal of additional research.

All other implemented systems displayed commendable results and reflect well on the deformable template and Principal Component Analysis strategies. The most suitable real-world applications for face detection and recognition systems are for mugshot matching and surveillance. There are better techniques such as iris or retina recognition and face recognition using the thermal spectrum for user access and user verification applications since these need a very high degree of accuracy. The real-time automated pose invariant face detection and recognition system proposed in chapter seven would be ideal for crowd surveillance applications. If such a system were widely implemented its potential for locating and tracking suspects for law enforcement agencies is immense.

Future Work

While there are several risks with facial recognition, it also offers numerous solutions for future and upcoming technologies. Currently the internet of things (IoT) technology is booming as well as the way to connect domestic or urban devices to the Internet to make them “smart”.

In my future work I want to integrate facial recognition into the IoT, various simplifications of life will be available. For example, the door of an apartment could recognize the resident and open automatically. A more common example is the simple activation of the smartphone by facial recognition via its front camera. Similarly, this technology can help us to find lost relatives when visiting an unknown city. A program will search for correspondence to the person’s profile photo in a predefined database by uploading a photo to a website. Finally, facial recognition can increase security by identifying criminals, assuming that this technology’s accuracy rate is nearly 100%.

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