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A Novel Face Detection and Recognition System Using Machine Learning Approaches

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Abstract: ***An image or video that was acquired with a digital camera can be used to detect, track, identify, or authenticate human faces using a computer program called face recognition. Recognition and Detection the Outpost system is made to provide resources for home security and investigators who need to explore the immediate surroundings using video data. The device can identify biometric faces in real - time footage through analysis and can provide real - time surveillance in inclement weather. "Face Detection," a type of biometric technology, is the automatic recognition of faces by computer systems when they are presented with a face. It is a characteristic that is frequently utilized in biometrics, digital photography, and social tagging. Face detection and recognition have received more research interest in recent years. Biometrics research is often focused on face detection and image or video recognition. Real - time face recognition is a fascinating field with a continually escalating challenge. Framework for application authentication using face recognition. The PCA (Principal Component Analysis) facial recognition algorithm is suggested here. A statistical technique that falls within the general category of factor analysis is called the key component analysis (PCA). The PCA's goal is to lower the size of the feature space needed to describe the data efficiently from its current high quantity of storage. For facial recognition by the PCA, a wide 1 - D pixel vector constructed from a 2 - D face image in compact primary space function elements is intended.***

Keywords: Face detection, face Recognition, Image Processing, Machine learning, Biometric

1. Introduction

Face recognition is a task that humans automatically and realistically accomplish every day. Although it seems like a fairly simple operation to us, it has turned out to be a complicated task for a computer due to the numerous factors that might reduce the accuracy of the approaches, such as illumination variation, low resolution, occlusion, and others. Face recognition is basically the work of identifying a person based on their facial appearance, and it has become much more sophisticated over the past two decades, largely due to the new techniques created and the excellent quality of computer science. The most recent videos and cameras have gained a lot of popularity. Keep in mind that face recognition differs from face detection.

Face recognition:

- The challenge of determining if a previously observed object is a known or unknown face, and in more sophisticated circumstances, determining exactly whose face it is, is known as face recognition.
- 1On the other hand, face recognition determines if a "face" belongs to a known or unknown person by validating the input face against a database of faces.

Face Detection:

- Ability to distinguish an object from the background.
- Face Detection for identifying an object as a "face and locate it in the input image".

In our research work, we classify the faces by machine learning model of the system. Here, we use the real time algorithm CNN to classify the faces based on face data set in our database.

1.1 Artificial Intelligence

Artificial intelligence (AI) is the capacity for thought and learning in a computer programme or other system. Additionally, it is an area of study that aims to "smarten up" computers. As machines' capabilities increase, mental capabilities that were earlier considered to require intelligence are no longer included. The study of artificial intelligence (AI) focuses on building intelligent devices that behave and act like people [1]. Artificially intelligent computers are built for a variety of tasks, including face recognition, learning, planning, and decision - making. Artificial intelligence is the application of computer science programming to replicate human thought and behavior by analyzing data and the environment, resolving or foreseeing issues, and learning or self - teaching to adapt to a variety of activities.

1.2 Machine Learning

A developing technology called machine learning makes it possible for computers to learn autonomously from historical data. Machine learning uses a variety of techniques to create mathematical models and make predictions based on previous information or data. Currently, it is utilised for many different things, including recommender systems, email filtering, Facebook auto - tagging, image identification, and speech recognition [2]. According to some, machine learning is a branch of artificial

intelligence that focuses primarily on creating algorithms that enable a computer to independently learn from data and previous experiences. Arthur Samuel coined the phrase "machine learning" in 1959. In a nutshell, we may say that it is: “Machine learning enables a machine to automatically learn from data, improve performance from experiences, and predict things without being explicitly programmed”. When a machine learning system receives new data, it forecasts the outcome using the prediction models it has built using prior data. The amount of data used determines how well the output is anticipated, as a larger data set makes it easier to create a model that predicts the outcome more precisely. Imagine that we have a complex problem that requires some predictions. Instead of creating code for it, we can simply input the data to generic algorithms, and the machine would develop the logic according to the data and forecast the output. Our perspective on the issue has altered as a result of machine learning. The machine learning algorithm's operation is explained in the block diagram below Figure 1 shows Machine learning model.

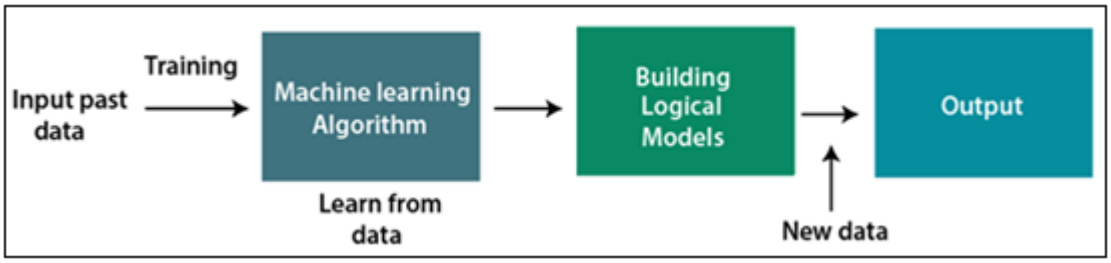

Figure 1: Machine learning Model

1.2.1Features of Machine Learning:

- Machine learning makes use of data to find different patterns in a dataset.
- It can automatically improve by learning from previous data.
- It wasa data - driven technology.
- Data mining and machine learning are very similar since both processes work with vast amounts of data.

1.2.1.1Classification of Machine Learning

Machine learning is classified into 3 types:

1) Supervised learning
2) Unsupervised learning
3) Reinforcement learning

1.3 Deep Learning

As artificial neural networks will mimic the human brain, deep learning is also a type of mimic of the human brain. Deep learning is a subfield of machine learning that is entirely based on neural networks. We don't have to explicitly programme everything in deep learning. Deep learning is not a brand - new idea. It has been in existence for a while. It's popular now because we have access to more data and computing capacity than we did in the past. Deep learning and machine learning emerged as a result of the exponential rise in processing power over the past 20 years [3]. This is an image of a single neuron, and there are around 100 billion of them in the human brain. Each neuron is connected to thousands of its neighbours. How do we simulate these neurons on a computer is the question at hand. So, we build a synthetic network of nodes and neurons, known as an artificial neural network. There are some neurons for input values, some for output values, and maybe a large number of interconnected neurons in between in the hidden layer.

Architectures:

Deep Neural Network:

A particular level of complexity has been achieved in the neural network (having multiple hidden layers in between input and output layers). They have the ability to process and model non - linear relationships.

Deep Belief Network (DBN):

a) Using the Contrastive Divergence technique, learn a layer of features from units that are visible.
b) Consider previously trained features' activations as observable units before learning new features.
c) When the learning for the final hidden layer is accomplished, the entire DBN is trained.

Recurrent (perform same task for every element of a sequence) Neural Network: both parallel and sequential processing is possible. as the human brain does (large feedback network of connected neurons). They can recall crucial details from the feedback they got, which helps them to be more exact.

1.4 Convolutional Neural Network (CNN):

Artificial neural networks do incredibly well in machine learning. Artificial neural networks are used to classify a variety of things, including words, audio, and images. Different types of neural networks are employed for various tasks [4]. For example, we use recurrent neural networks—more specifically, an LSTM—to predict the order of words, while we use convolutional neural networks to classify images. We will create the fundamental building blocks for CNN in this blog.

Let's first review the basic concepts of neural networks before delving into the Convolution Neural Network. There are three different sorts of layers in a typical neural network:

Input Layers: It is the layer where we input data into our model. The entire number of characteristics in our data is equal to the number of neurons in this layer.

Hidden Layer: The hidden layer is then fed the input from the input layer. Depending on our model and the volume of the data, there may be numerous hidden levels. The number of neurons in each hidden layer might vary, but they are

typically more than the number of features. The network is made nonlinear by computing the output from each layer by matrix multiplying the output of the layer before it by the learnable weights of that layer, adding the learnable biases, and then computing the activation function.

Output Layer: The output of each class is then converted into a probability score for each class using a logistic function, such as sigmoid or SoftMax, using the data from the hidden layer as input.

The model is then given the data, and each layer's output is then obtained. We then calculate the error using an error function, some examples of which are cross entropy, square loss error, etc. This stage is known as feed forward. After that, we calculate the derivatives and back propagate into the model. Back propagation is the process that is utilised to reduce loss in general. Convolution Neural networks that share their parameters are known as covnets. Think of having an image. It can be visualised as a cuboid with three dimensions: length, width, and height. Figure 2 shows the neural network architecture.

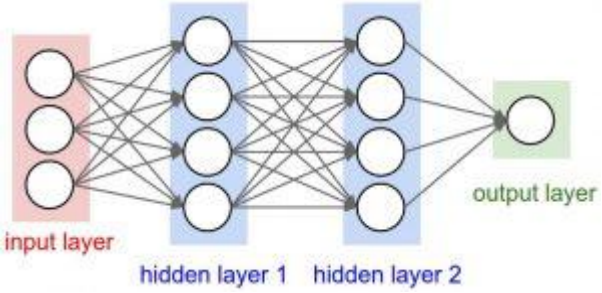

Figure 2: Neural networks architecture

Let's now discuss some of the math that goes into the convolution process as a whole. A group of filters that can be learned make up convolution layers (patch in the above image). Each filter has a small width, a small height, and a depth that is equal to the input volume. For instance, suppose we need to perform convolution on a 34x34x3 - pixel image. Possible filter size is axax3, where 'a' can be 3, 5, 7, or another tiny number compared to the size of the image. In the forward pass, each filter is slid across the entire input volume step by step (each step is referred to as a stride), and the dot product between the weights of the filters and the patch from the input volume is computed. Each filter will produce a 2 - D output, which we will stick together to produce an output volume with a depth equal to the number of filters. All the filters will be learned by the network.

Types of Layers:

Input Layer: The 32 by 32 by 3 - inch raw image input is stored in this layer.

Convolution Layer: The output volume is calculated by this layer by computing the dot product between each filter and the picture patch. If we apply a total of 12 filters to this layer, the resulting volume will have the dimensions 32 x 32 x 12.

Activation Function Layer: The output of the convolution layer will be subjected to an element - wise activation function in this layer. The following activation functions are frequently used: Tanh, Leaky RELU, RELU: max (0, x), Sigmoid: 1/ (1+e - x), etc. Since the volume is unchanged, the output volume will have the following dimensions: 32 by 32 by 12.

Pool Layer: This layer is periodically added to the covnets, and its primary purpose is to decrease the volume, which speeds up computation, saves memory, and also guards against overfitting. Max pooling and average pooling are two popular varieties of pooling layers. The resulting volume will have dimensions of 16x16x12 if we utilise a maximum pool with 2 x 2 filters and stride 2.

Fully - Connected Layer: This layer of the regular neural network computes the class scores using the input from the layer above and returns a 1 - D array with a size equal to the number of classes.

Dense Layer: The dense layer is the typical layer of a neural network with many connections. It is the most typical and often utilised layer. Dense layer performs the operation below on the input and then returns the result. Dense layers add an intriguing nonlinearity trait, making it possible for them to mimic any mathematical function. They are still constrained, though, in that we always obtain the same output vector for the same input vector. They are unable to recognise temporal repetition or generate various results from the same input. Each neuron in a layer receives input from every neuron in the layer below it, making them highly linked. In other words, all of the neurons in a layer are coupled to those in the layer above it, making the dense layer a completely connected layer.

2. Literature Review

[1] Author Name: Akanksha, Jashanpreet Kaur, Harjeet Singh et al [2018]

Title: Face detection and Recognition: A review

Description: Face detection and recognition have surpassed other biometric identification techniques in popularity in recent years. Method of using a person's face for facial recognition characteristics of biometric systems. Face recognition the two main roles of the system are verification and identification. Face identification refers to a 1: N comparison challenge. Compare a facial image to each template in a face database. Face recognition is something we do, and it's really. Almost immediately, a challenging visual challenge, and our own. The power of recognition is much greater than that of any computer can possibly be. We can identify a familiar person. scaling variations (closeness or distance of a face), varying upbringing has no bearing on our capacity to face recognition, and we

Face detection is the core issue with face recognition. Face detection is further divided into the following categories: real - time face detection using pictures. We will in this project try to use image analysis to find faces in still pictures invariants. To do this, it would be beneficial to examine the grey scale intensity distribution of a typical human face. The phrase "average human face was built from a selection of

human faces. A colour map that appropriately proportioned used to draw attention to variations in grayscale intensity. The universally consistent grey - scale differences. The sample faces are clearly visible. The eyes and brows area appears to always have low - intensity (dark) grey levels, whereas the nose, forehead, and cheeks always have brilliant levels.

Face recognition
It includes extracting a collection of geometrical characteristics from the image of the face we desire to depict, including the width and length of the nose, the position of the mouth, the shape of the chin, etc. Next, the matching between this collection of features and the characteristics of well - known people. a useful metric, such You can utilise Euclidean distance. to locate the ideal fit. Despite the fact that the face viewed closely. Its general geometrical arrangement can be obtained for face identification The primary drawback of the method is that automated facial geometrical extraction

[2] Author Name: Faizan Ahmad, Aaima Najam and Zeeshan Ahmed et al [2006]

Title: Image - based Face Detection and Recognition:

Description:
Face Detection
While Support Vector Machine (SVM) classifier is utilised with Haar and Local Binary Pattern (LBP) features, AdaBoost classifier uses Features for the Histogram of Oriented Gradients (HOG) evaluation of face detection. The evaluation of Haar - like properties makes use of a fresh visual representation that yields a substantial number of AdaBoost is a boosting technique that is used in the improved classifiers' degenerative tree should be reduced for strong and quick interferences Utilizing merely straightforward rectangular Haarlike characteristics, a multitude of benefits such as ad - hoc domain knowledge are suggested Additionally to being faster than pixel - based systems, equal to suggestive of Haar basis functions Readings of the intensity difference can be calculated relatively easily. Implementation As the subject walks ahead in dataset, the shadows generate fluctuation that results in little changes to the subject's head turn, tilt, and slant. Variations in head size, some expression variations, and translation in relation to the subject's face's position and the image's illuminationas it does, the lighting on faces noticeably shifts. In dataset, a collection of faces with a detailed background Variations in head size; slight changes to head turn, tilt, tilt, expression, slight displacement of the face, and substantial light change caused by object moment in synthetic illumination The face collection with plain faces in dataset background; small head size variation; substantial change in head turn, tilt, and significant change in expression; little change in the face.

[3] Author Name: Shivam Singh, S. Graceline Jasmine et al [2019]

Title: face recognition system

Description: In applications like security systems, credit and debit card verification, and monitoring on identifying illegal public locations, human faces always play a significant part. the essential The system's objectives are to create a facial recognition that might be copied in order to eventually outwit people's capacity to recognise faces. The human face fronts are of great relevance to this system. There are many different facial recognition algorithms, and each one has a certain strength. Many times, if we are familiar with a face, we can instantly recognise it when we look at it. This is normalability should be justified wherever feasible and put to use in practical situations. There are numerous face detection systems available at the moment. algorithms. A local face recognition system is the first. that use machine learning. Viola and Jones built a framework out of all these techniques that has a high detection rate and is also quick. detection of Viola - Jonesalgorithm is very quick and reliable. . detection process employs Integral Image andAdaBoost is a more refined learning method. To date, noticed that this algorithm produces superior outcomes in a range of lighting situations. Pre - processing is the procedure of removing the facial features. The retrieved facial picture is specified at this pre - processing stage, and it is transformed to 100x100. Equalization of the histogramis the most popular Histogram Normalization method. technique. This enhances the image's contrast since itgoes beyond the image's sharpness, enhancing it evenmore constrained and explicit.

[4] Author Name: Assyakirin M H, Shafriza Nisha B, Haniza et al. [2021]

Title: Face Recognition and Identification using Deep Learning Approach

Description: Computer vision includes face recognition. It isBased on image of a person's face, face recognition is used in biometric methods to identify them. Biological characteristics can be used to identify a person. Human eyes can quickly identify people by gazing at them, but their attention span is limited thathas a maximum. Consequently, a computerised technique for doing facial recognition is developed. Face identificationThe operations automatically identifying, verifying, a person from either photo are included in. or a movie. Despite substantial study on facial recognition, there are still difficulties. to resolve a number of concerns, including:

[5] Author Name: Arun Alvappillai, Peter Neal Barrina et al [2016]

Title: Face Recognition using Machine Learning

Description: The Viola - Jones algorithm is frequently used for facial detection because of its high detection rate and quick processing time. Four steps feature selection, feature evaluation, feature learning to build a classifier, and cascading classifiers can be used to summarise the algorithm. In many different configurations, simple characteristics, primarily rectangular features, are used as an inspiration for the Haar basis functions. A two - rectangle feature represents the difference between the sum of the pixels in two adjacent regions of the same size and shape.

This concept can be developed to the four - and three - rectangle features. These rectangular attributes can be quickly computed using an alternate. It is necessary to have an integral picture representation of the input image. equal to the total number of pixels in A, 2, A and B, C, and D, respectively; 3 was the total no of pixels in A; and 4 is the total number of pixels in A, B, C, and D. Knowing this demonstrates how to calculate the total of pixels in D. simply equals (4+1) - (2+3). We can streamline the process by averaging just a subset of the original image's pixels. a component of the algorithm. The algorithm's learning phase for face detection utilises Adaboost, which essentially makes use of a linear combination. Using faulty categorization methods to produce.

3. Problem Statement

Following is a general formulation of the facial recognition issue: Use a database of saved faces to recognize or confirm one or more people in a situation from still or moving photos. Additionally, recent considerable improvements in multimedia processing have advanced the uses of facial recognition technologies. Face objects, among the varied components of multimedia, are particularly significant. For instance, a database programme that allows you to look for faces or a certain face object is highly helpful [5]. Another illustration is a security system that can track human objects automatically and report their IDs.

Although people are accustomed to tracking and recognising facial objects, developing such a system is still an active research area. The most promising face recognition methods of the several that have been presented use image - based techniques.

4. Development Process

4.1 Requirement Analysis

Requirements are a feature of a system or description of something that the system is capable of doing in order to fulfil the system's purpose. It provides the appropriate mechanism for understanding what the customer wants, analysing the needs assessing feasibility, negotiating a reasonable solution, specifying the solution unambiguously, validating the specification and managing the requirements as they are translated into an operational system.

4.1.1. Python

Python is a dynamic, high level, free open source and interpreted programming language. It supports object - oriented programming as well as procedural oriented programming. In Python, we don't need to declare the type of variable because it is a dynamically typed language.

For example, x=10. Here, x can be anything such as String, int, etc.

Python is an interpreted, object - oriented programming language similar to PERL, that has gained popularity because of its clear syntax and readability. Python is said to be relatively easy to learn and portable, meaning its statements can be interpreted in a number of operating systems, including UNIX - based systems, Mac OS, MS - DOS, OS/2, and various versions of Microsoft Windows 98. Python was created by Guido van Rossum, a former resident of the Netherlands, whose favourite comedy group at the time was Monty Python's Flying Circus. The source code is freely available and open for modification and reuse. Python has a significant number of users.

Features in Python

There are many features in Python, some of which are discussed below

- Easy to code
- Free and Open Source
- Object - Oriented Language
- GUI Programming Support
- High - Level Language
- Extensible feature
- Python is Portable language
- Python is Integrated language
- Interpreted Language

4.2 PYCHARM

PyCharm is a cross - platform application that works with Linux, macOS, and Windows operating systems. The top Python IDEs are PyCharm, which supports Python 2 (2.7) and Python 3 (3.5 and higher) versions.

PyCharm includes a wide range of modules, packages, and tools to speed up Python programming while also significantly reducing the amount of work necessary to do it. Additionally, PyCharm can be modified to meet specific preferences and development needs. It originally became available to the general public in February of 2010. PyCharm has the following features in addition to code analysis:

- A graphical debugger
- An integrated unit tester
- Integration support for version control systems (VCSs)
- Support for data science with Anaconda

This IDE was developed by Pycharm primarily for Python programming and to run on different operating systems, including Windows, Linux, and macOS. The IDE includes version control options, a debugger, testing tools, and tools for code analysis. It also helps programmers create Python plugins with the aid of the many available APIs. The IDE enables us to work directly with a number of databases without integrating them with other programmes. Despite being specifically made for Python, this IDE also allows for the creation of HTML, CSS, and Javascript files. It also has a stunning user interface that can be altered using plugins to suit the demands.

In terms of data projects, machine learning has grown in importance. In our data - driven world, the capacity to learn from previous calculations in order to produce trustworthy, repeatable decisions and results is becoming an essential procedure [6]. And as this area develops, it's more crucial than ever for developers to be aware of which platforms can support machine learning projects. Machine learning programmes may be built on PyCharm platforms with ease.

Tensor Flow and PyTorch, two of Python's most potent machine learning libraries, can be used with PyCharm. Therefore, whichever option you choose will give you a complete toolkit for taking on Python machine learning tasks.

When you check into Jupyter Notebooks, you'll see that machine learning experts love it a lot and frequently cite it in more recent research articles. Programmers may create a computational narrative that includes code, data analysis, hypothesis, and conjecture using Jupyter Notebook, which is fantastic. Even though machine learning projects are frequently filled with a lot of information and are challenging to understand, these computational narratives can substantially promote analytical knowledge when the document is shared. The IDE provided by PyCharm, on the other hand, is perfectly suited for handling even the most complicated deep learning applications. If you need to create an ML project using PyCharm, all you need to do is install the appropriate Python packages. The difference essentially depends on the kind of task you're doing.

The default installation of Anaconda2 includes Python 2.7 and Anaconda3 includes Python 3.7. However, it is possible to create new environments that include any version of Python packaged with conda.

4.3 Resource Requirements:

Below table 1 describes the software requirements.

Table 1: Software requirements

Operating System	Windows 7or later
Simulation Tool	Pycharm
Documentation	Ms – Office

Below table 2 describes the hardware requirements.

Table 2: Hardware requirements

CPU type	Intel Pentium
Ram size	4GB
Hard disk capacity	80 GB
Keyboard type	Internet keyboard
Monitor type	15 Inch colour monitor
CD - drive type	52xmax

4.4 System Architecture

The below figure 3 shows the system architecture which describes the data collection, data pre - processing, Machine learning CNN model and finally the developed model uses for classification and prediction.

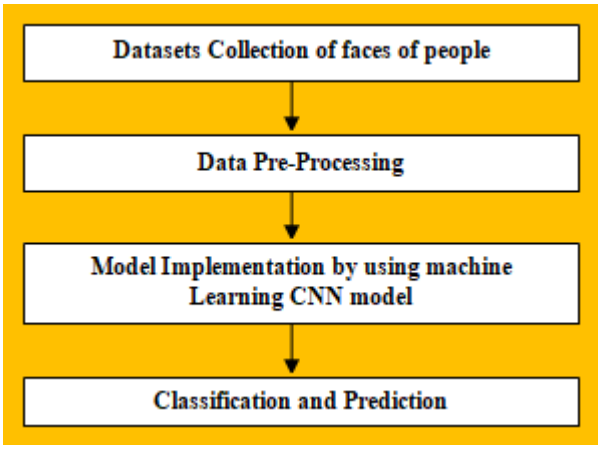

Figure 3: System architecture

4.5 Proposed System

In our proposed method, this project demonstrated to recognize faces by using machine learning as well as the image processing techniques of the system. This study proposed designing and developing an automated real - time faces identification system of authenticated people using open cv, LPBH, Haar cascade technique. The system is composed of a computer vision system that is used for training and testing a LPBH model of the system. We have developed an end - to - end computer vision system with a convolutional neural network (CNN) model in Sequential method to identify faces in dataset when given an image of the system. The proposed system showed a promising direction toward real - time face identification system.

4.5.1Advantages

- Better performance
- Efficiency
- Accurate

System Modules:

- Datasets collection
- Data Preprocessing
- Model Implementation
- Classification
- Performance Metrics

Datasets Collection: A dataset is a collection of data for a machine learning method. An image dataset includes digital images curated for testing, training, and evaluating the performance of machine learning and artificial intelligence (AI) algorithms, commonly computer vision algorithms. Here, the data are collected in the open source website of GIT hub website [7]. A Collection of data is called datasets. Let us consider, face databases consists of 30 categories of the system. Here, an input data can be obtained in the image format to classify the faces based on user selecting process of the system.

Data Preprocessing: The aim of pre - processing is an improvement of the image data that suppresses unwilling distortions or enhances some image features important for further processing, although geometric transformations of images (e. g. rotation, scaling, translation) are classified

among pre - processing methods of the system. There are several techniques used to preprocess image data. Examples include; image resizing, converting images to grayscale, and image augmentation. Data preprocessing is essential before its actual use [8]. Data preprocessing is the concept of changing the raw data into a clean data set. The dataset is preprocessed in order to check missing values, noisy data, and other inconsistencies before executing it to the algorithm.

Model Implementation: An image model object stores information about an image such as class, type, display range, width, height, minimum intensity value and maximum intensity value. Convolutional Neural Networks (CNNs) CNN's, also known as ConvNets, consist of multiple layers and are mainly used for image processing of the system. Tensor Flow compiles many different algorithms and models together, enabling the user to implement deep neural networks for use in tasks like image recognition/classification and natural language processing. Here, we can use the Convolution neural network model to implement of our project to classify the medicinal plants based on deep learning model of the system.

Classification: CNN is a type of deep learning model for processing data that has a grid pattern, such as images, which is inspired by the organization of animal visual cortex and designed to automatically and adaptively learn spatial hierarchies of features, from low - to high - level patterns. Here, we can use both the training and testing the model by using Convolution neural network to classify the plants based on medicinal of the system. Deep learning uses neural networks to learn useful representations of features directly from data [9]. A CNN can be instantiated as a Sequential model because each layer has exactly one input and output and is stacked together to form the entire network. Sequential image classification is the task of classifying a sequence of images [10].

Performance Metrics: Finally, the performance metrics are measured in terms of accuracy part of the system. The graph is shown the train and test accuracy plotting of the system.

5. System Study

5.1 Feasibility Study

The feasibility of the project is analyzed in this phase and business proposal is put forth N with a very general plan for the project and some cost estimates. During system analysis the feasibility study of the proposed system is to be carried out. This is to ensure that the proposed system is not a burden to the company. For feasibility analysis, some understanding of the major requirements for the system is essential. Three key considerations involved in the feasibility analysis are

a) Economic Feasibility
b) Technical Feasibility
c) Social Feasibility

5.1.1. Economic Feasibility

This study is carried out to check the economic impact that the system will have on the organization. The amount of fund that the company can pour into the research and development of the system is limited. The expenditures must be justified. Thus, the developed system as well within the budget and this was achieved because most of the technologies used are freely available. Only the customized products had to be purchased.

5.1.2. Technical Feasibility

This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Any system developed must not have a high demand on the available technical resources. This will lead to high demands on the available technical resources. This will lead to high demands being placed on the client. The developed system must have a model requirement, as only minimal or null changes are required for implementing this system.

5.1.3. Social Feasibility

The aspect of study is to check the level of acceptance of the system by the user. Thisincludes the process of training the user to use the system efficiently. The user must not feelthreatened by the system, instead must accept it as a necessity

6. Implementation

Development:

The below figures 4 and 5 shows the sample development process.

```
import cv2
face_cascade = cv2.CascadeClassifier(cv2.data.haarcascades + 'haarcascade_frontalface_default.xml')
eye_cascade = cv2.CascadeClassifier(cv2.data.haarcascades + 'haarcascade_eye.xml')
smile_cascade = cv2.CascadeClassifier(cv2.data.haarcascades + 'haarcascade_smile.xml')
# faces = face_cascade.detectMultiScale(gray,1.3, 5)
def detect(gray, frame):
    faces = face_cascade.detectMultiScale(gray, 1.3, 5)
    for (x, y, w, h) in faces:
        cv2.rectangle(frame, (x, y), ((x + w), (y + h)), (255, 0, 0), 2)
        roi_gray = gray[y:y + h, x:x + w]
        roi_color = frame[y:y + h, x:x + w]
        smiles = smile_cascade.detectMultiScale(roi_gray, 1.8, 5)

        for (sx, sy, sw, sh) in smiles:
            cv2.rectangle(roi_color, (sx, sy), ((sx + sw), (sy + sh)), (0, 0, 255), 2)
    return frame


video_capture = cv2.VideoCapture(0)
while video_capture.isOpened():
    # Captures video_capture frame by frame
    _, frame = video_capture.read()
```

Figure 4: Sample code 1

```
    # To capture image in monochrome
    gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)

    # calls the detect() function
    canvas = detect(gray, frame)

    # Displays the result on camera feed
    cv2.imshow('Video', canvas)

    # The control breaks once q key is pressed
    if cv2.waitKey(1) & 0xff == ord('q'):
        break

# Release the capture once all the processing is done.
video_capture.release()
cv2.destroyAllWindows()
```

Figure 5: Sample code 2

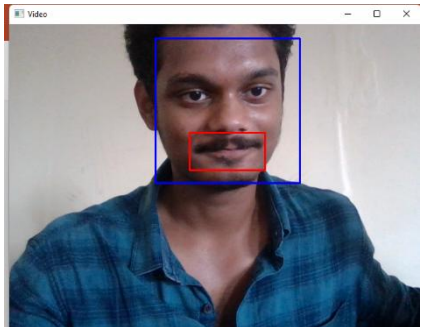

Figure 6: Face detection

The below Figure 7 shows the face detection and recognition process by using machine learning algorithms

7. Result Analysis

Figure 6 shows the working process and how the candidate face will be recognized.

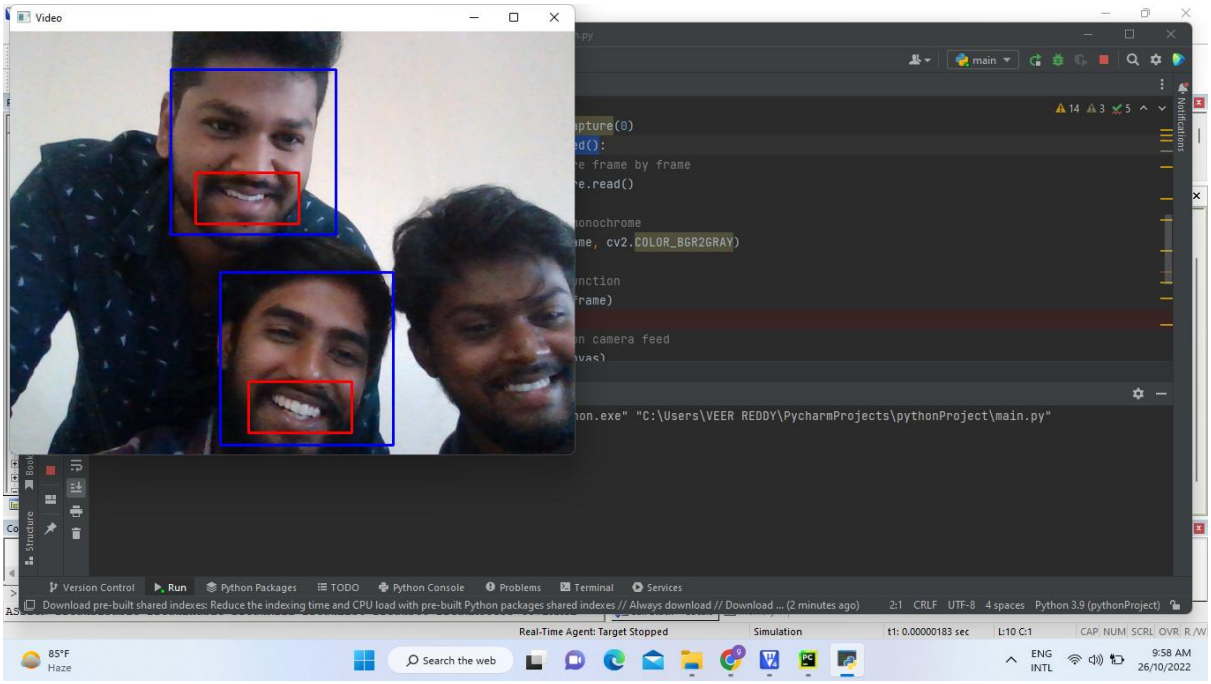

Figure 7: Face detection and recognition process.

8. Conclusion

a) We have proposed a relatively simple and accurate real time smile detection system that can easily run on a common personal computer and a webcam.
b) Our program just needs an image resolution of 320 by 240 pixels and minimum face size of 80 by 80 pixels. We have an intuition that the feature around the mouth right corner and left corner would have optical flow vectors pointing up and outward. The feature which has the most significant flow vector is right on the corner. Meanwhile, we can support a small head rotation and user's moving toward and backward from camera.
c) In the future, we would try to update our mouth pattern such that we can support larger head rotation and face size scaling.
d) In order to prevent the frauds of ATM in India, it is recommended to prepare the database of all ATM customers with the banks in India & deployment of high resolution camera and face recognition software at all ATMs. So, whenever user will enter in ATM his photograph will be taken to permit the access after it is being matched with stored photo from the database.
e) Duplicate voter is being reported in India. To prevent this, a database of all voters, of course, of all constituencies, is recommended to be prepared. Then at the time of voting the resolution camera and face recognition equipped of voting site will accept a subject face 100% and generates the recognition for voting if match is found.
f) Passport and visa verification can also be done using face recognition technology as explained above.

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The assessment of the proposed study is carried out considered, data available on request.

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Authors declare they do not have any conflict of interest.

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Authors declare that they follow all ethics and approve the same in this research**.**

Consent to participate:
Authors declare that we have no issues and consent to participate.

Consent for publication:
Authors declare that we have no issues and consent to publication.

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