1.SMART SECURITY SYSTEM USING IMAGE RECOGNITION

1.1 INTRODUCTION

Real time face recognition is part of the field of biometrics. Biometrics is the ability for a computer to recognize a human through a unique physical trait. Face recognition provides the capability for the computer to recognize a human by facial characteristics. Today, biometrics is one of the fastest growing fields in advanced technology. Predictions indicate a biometrics explosion in the next century, to authenticate identities and avoid an unauthorized access to networks, database and facilities.

A facial recognition device is a device that takes an image or a video of a human face and compares it to other image faces in a database. The structure, shape and proportions of the faces are compared during the face recognition steps. In addition, distance between the eyes, nose, mouth and jaw, upper outlines of the eye sockets, the sides of the mouth, location of the nose and eyes, and the area surrounding the check bones are also compared.

When using a facial recognition program, several pictures of the person must be taken at different angles and with different facial expressions. At time of verification and identification the subject stands in front of the camera for a few seconds, and then the image is compared to those that have been previously recorded.

Facial recognition is widely used because of its benefits. The advantages of facial recognition are that it is not intrusive, can be done from a faraway distance even without the person being aware that he/she is being scanned. Such thing is needed in banks or government offices for example, and this is what makes facial recognition systems better than other biometric techniques in that they can be used for surveillance purposes like searching for wanted criminals, suspected terrorists, or missing children.

Face recognition devices are most beneficial to use for facial authentication than for identification purposes, because it is easy to alter someone’s face, and because the person can disguise using a mask. Environment is also a consideration as well as subject motion and focus on the camera. Facial recognition, when used in combination with another biometric method, can improve verification and identification results dramatically.

1.2 OBJECTIVE OF RESEARCH

Safety has, for a long time, been one big thing everyone is concerned about. Security breach of private locations has become a threat that everyone intends to eliminate. The traditional security systems trigger alarms when they detect a security breach. However, the usage of image processing coupled with deep learning using convolutional neural networks for image identification and classification helps in identifying a breach in an enhanced fashion thereby increasing security furthermore to a great extent. This is due to its capability to extract complex features from the images using accurate and advanced face and body detection algorithms.

The rate at which machine learning, especially deep learning, is transitioning is very high. The use of such technology in taking the existing systems and models to the next level would be a great step towards advancements in every field of science and technology. The same goes with computer vision. These two coupled and brought together to be used in the field of security results in achieving a lot more than what is imagined to be possible and this paper aims to do the same.

1.3 PROBLEM STATEMENT

Identification:

Given a stored database of faces, identify an unknown input face through facial recognition technique.

Verification:

Given a stored database of faces, confirm or reject the claimed identify of the input face through facial recognition techniques.

1.4 INDUSTRY PROFILE:

The Facial Recognition Market is typically used in biometric security systems. The colossal increase in security threats and breaches in various fields is inducing demand for a systematic technology for identification purpose. The vital application of facial recognition systems in military and defence sector owning to the proliferating terrorist activities and increasing crime rate and incorporation of facial recognition systems in various government and private organisations for security purposes are some of the major factors driving the global facial recognition market.

The advancement in technology is facilitating the incorporation of facial recognition systems in various personal devices such as computers, laptops, and smart phones in-order to maintain the user privacy and data security. The rise in adoption of digital door lock systems which use facial recognition technology along with other biometrics such as fingerprint and retina scanning is positively impacting the expansion of the global Facial Recognition Market.

2. REVIEW OF LITERATURE:

Although face recognition systems are known for decades. There are many active research work on the topic. The subject can be divided into two parts:

1. Detection

2. Recognition

Face detection is the first step for face recognition system. Output of the detection can be location of face region as a whole, and location of face region with facial features. Detection methods in the literature are difficult to classify strictly, because most of the algorithms are combination of methods for detecting faces to increase the accuracy. Mainly, detection can be classified into two groups as Knowledge-Based Methods and Image Based Methods.

Knowledge-Based methods use information about Facial Features, Skin-colour or Template Matching. Facial Features are used to find eyes, mouth, nose or other facial features to detect the human faces. Skin colour is different from other colours and unique, and its characteristics do not change with respect to change with respect to changes in pose and occlusion.

Skin colour is modelled in each colour spaces like RGB, YCBCR, HSV, YUV, and in statistical models. Face has a unique pattern to differentiate from other objects and hence a unique pattern to differentiate from other objects and hence a template can be generated to scan and detect faces. Facial features are important information for human faces and standard images can be generated using these information.

3. DATA COLLECTION:

Security is provided using image recognition technique as images are captured by video capture and then dataset is created by taking two classes and we seperate the dataset into training-set and test-set as majority is taken in training set. Here we use Convolution Neural Network by taking image and predict the accuracy of that particular image if image is not found then it results in image not found.

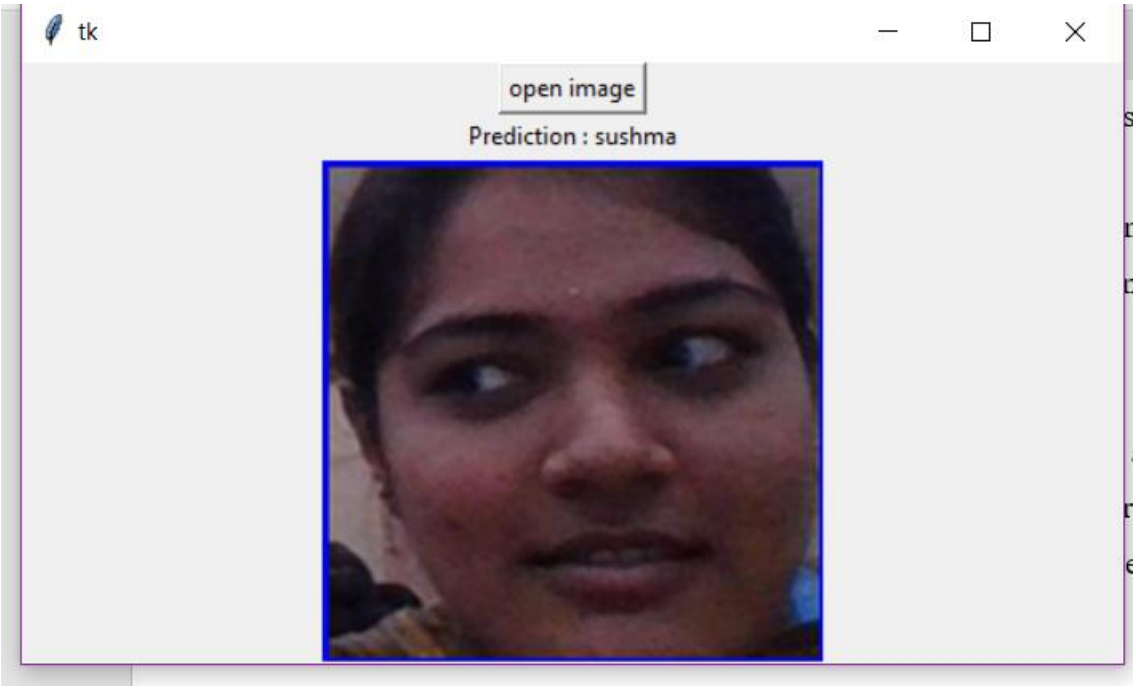
A convolution neural network consists of an input and an output layer as well as multiple hidden layers. The hidden layers of a CNN(Convolution Neural Networks) typically consists of convolution layers, RELU layer i.e, activation function, pooling layers, fully connected layers and normalization layers.

4. METHODOLOGY:

4.1 EXPLORATORY DATA ANALYSIS

Security is provided using image recognition technique as images are captured by video capture and then dataset is created by taking two classes and we seperate the dataset into training-set and test-set as majority is taken in training set. Here we use Convolution Neural Network by taking image and predict the accuracy of that particular image if image is not found then it results in image not found.

4.1.1. Figures and table



4.2 STATISTICAL TECHNIQUES AND VISUALIZATION

NumPy:

NumPy stands for ‘Numerical Python’ or ‘Numeric Python’. It is an open source module of Python which provides fast mathematical computation on arrays and matrices. Since, arrays and matrices are an essential part of the Machine Learning ecosystem, NumPy along with Machine Learning modules like Scikit-learn, Pandas, Matplotlib, TensorFlow, etc. complete the Python Machine Learning Ecosystem.

NumPy provides the essential multi-dimensional array-oriented computing functionalities designed for high-level mathematical functions and scientific computation. NumPy can be imported into the notebook using

NumPy's main object is the homogeneous multidimensional array. It is a table with same type elements, i.e, integers or string or characters (homogeneous), usually integers. In NumPy, dimensions are called axes. The number of axes is called the rank.

There are several ways to create an array in NumPy like np.array, np.zeroes, np.ones, etc. Each of them provides some flexibility.

Keras:

Keras is a high-level neural networks API, capable of running on top of Tensorflow, Theneo and CNTK. It enables fast experimentation through a high level, user-friendly, modular and extensible API. Keras can also be run on both CPU and GPU. Keras was developed and is maintained by Francois Chollet and is part of the Tensorflow core, which makes it Tensorflows preferred high-level API. Keras can be installed using pip or conda.

Keras provides seven different datasets, which can be loaded in using Keras directly. These include image datasets as well as a house price and a movie review datasets.To feed the images to a convolutional neural network we transform the dataframe to four dimensions. This can be done using numpys reshape method. We will also transform the data into floats and normalize it.

The easiest way of creating a model in Keras is by using the sequential API. The problem with the sequential API is that it doesn't allow models to have multiple inputs or outputs, which are needed for some problems. Nevertheless, the sequential API is a perfect choice for most problems.

Keras has a method called ImageDataGenerator which can be used for augmenting images. This ImageDataGenerator will create new images that have been rotated, zoomed in or out, and shifted in width and height.

Now that we defined and compiled our model it's ready for training. To train a model we would normally use the fit method but because we are using a data generator we will use fit generator and pass it our generator, X data, y data as well as the number of epochs and the batch size.

We will also pass it a validation set so we can monitor the loss and accuracy on both sets as well as steps per epoch which is required when using a generator and is just set to the length of the training set divided by the batch size.

We can visualize our training and testing accuracy and loss for each epoch so we can get intuition about the performance of our model. The accuracy and loss over epochs are saved in the history variable we got whilst training and we will use Matplotlib to visualize this data.

4.3 DATA MODELING AND VISUALIZATION

Step 1—Collecting the Dataset

In order to train our machine, we need a huge amount of data so that our model can learn from them by identifying out certain relations and common features related to the objects.

Fortunately many such datasets are available on internet. Here we take persons dataset which consist of 40 images to 90 of each. This will help in training as well testing our classifier.

Step 2—Importing Libraries and Splitting the Dataset

To use the powers of the libraries, we first need to import them. After importing the libraries, we need to split our data into two parts- taining_set and test_set. In our case, the dataset is already split into two parts. The training set has 90 images each of person1 and person2 while the test set has 40 images of each.

Step 3—Building the CNN

This is most important step for our network. It consists of three parts -

1. Convolution
2. Polling
3. Flattening

The primary purpose of Convolution is to extract features from the input image. Convolution preserves the spatial relationship between pixels by learning image features using small squares of input data.

Since every image can be considered as a matrix of pixel values. Consider a 5 x 5 image whose pixel values are only 0 and 1 (note that for a grayscale image, pixel values range from 0 to 255, the green matrix below is a special case where pixel values are only 0 and 1).

Then, the Convolution of the 5 x 5 image and the 3 x 3 matrix can be computed. The obtained matrix is also known as the feature map. An additional operation called RELU is used after every Convolution operation. The next step is of pooling.

Pooling (also called subsampling or down sampling) reduces the dimensionality of each feature map but retains the most important information. In case of Max Pooling, we define a spatial neighbourhood (for example, a 2×2 window) and take the largest element from the rectified feature map within that window. Instead of taking the largest element we could also take the average (Average Pooling) or sum of all elements in that window.

After pooling comes flattening. Here the matrix is converted into a linear array so that to input it into the nodes of our neural network.

Step 4—Full Connection

Full connection is connecting our convolutional network to a neural network and then compiling our network. Here we have made 2 layer neural network with a sigmoid function as an activation function for the last layer as we need to find the probability of the object being a person1 or a person2.

Step 5—Data Augmentation

While training your data, you need a lot of data to train upon. Suppose we have a limited number of images for our network. What to do now??

You don’t need to hunt for novel new images that can be added to your dataset. Why? Because, neural networks aren’t smart to begin with .For instance, a poorly trained neural network would think that these three tennis balls shown are distinct, unique images.

So, to get more data, we just need to make minor alterations to our existing dataset. Minor changes such as flips or translations or rotations. Our neural network would think these are distinct images anyway.

Data augmentation is a way we can reduce overfitting on models, where we increase the amount of training data using information only in our training data. The field of data augmentation is not new, and in fact, various data augmentation techniques have been applied to specific problems.

Step 6—Training our Network

So, we completed all the steps of construction and it’s time to train our model. If you are training with a good video card with enough RAM this will be done in less than an hour. If you are training with a normal CPU, it might take a lot longer. With increasing number of epochs, the accuracy will increase.

Step 7—Testing

Now let’s test a random image. And, yes our network correctly predicted the image of the person1.Though it is not 100% accurate but it will give correct predictions most of the times. Try adding more convolutional and pooling layers, play with the number of nodes and epochs, and you might get high accuracy result. You can even try it with your own image and see what it predicts. Whether you look close to a person1 or a person2.

5. FINDINGS AND SOLUTION:

In this project we provide the security and prediction values are obtained and accuracy. We find that accuracy will be high by running more epochs as epoch is period of time in history or person's life. Therefore, more the epochs then more the accuracy.

6. CONCLUSION:

So, we created a simple Image Recognition Classifier. The same concept can applied to a diverse range of objects with a lot of training data and appropriate network. You can change the dataset with the images of your friends and relatives and work upon the network to make a Face Recognition Classifier.