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FACE DISCERNMENT SYSTEM USING MACHINE LEARNING

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ABSTRACT

The goal of a security system is to detect intrusion, or unauthorized entry into a facility or home. Every home's security has become a top priority. The constant fear of leaving children or elders has grown immensely these days. Imagine a situation from childhood when you were alone at home and the doorbell rings suddenly. Or imagine your grandparents living alone with no security. As a result, home security and surveillance systems are becoming increasingly important in today's computerised home

In threatening situations like these, a FACE DISCERNMENT device is just the thing we need. When a person comes near the door, the system captures the face of the person and welcomes him/her with the name if the person's details are already stored in a database. Hence children /elderly people staying in the home can recognize the person who came by just listening to the voice and can open the door confidently / understand their family members have come.

If a new person comes near the door, the system can't recognize the face of the person and reads out the voice like a stranger has come. It alerts the people inside not to open the door without verifying the person. Further the image of the stranger will also be stored in the database that can be verified by the elders later to know who has come. This security system is a useful addition to today's home where safety is an important issue. Vision based security systems have the advantage of being easy to set up, easy to use and inexpensive

CHAPTER 1

INTRODUCTION

As the number of nuclear families in metro cities grows, home security in the absence of home owners has become a significant concern. Due to an increase in thefts, it is critical that house owners remain aware of people that visit their home while they are away.

The goal of "FACE DISCERNMENT SYSYTEM" is to create a smart home security system. It keeps track of who comes inside the residence. If the face of the person is known then, the device will greet the person entering the room with a welcoming message, along with his/her name. Whereas, if it's an unknown person it will inform that an unknown person is outside. This function is very useful in situations such as robbery. Maximum security can be maintained at home, but also at other important places like hospitals, banks, etc.

There are countless uses, starting from home security cameras, to public security. This technology is also implemented in our phones. It works efficiently to automate airport check-ins. Unlike homes, there are other placdes where confidential files are maintained. Very few personnel are authorized. In such scenarios where security is the top priority, this device is the best choice

Most of the biometric systems, with all their legitimate applications in an expanding socirty, have a bothersome drawback . except for human voice recognition , these methods require the user to remember a password, to enter a PIN code, to carry a badge or in general, require a human action in the course of identification or authentication. In addition, the above mentioned means (keys, badges, passwords, PIN codes) are prone to being lost or forgotten, while fingerprints and retina scans suffer from low user acceptance.

Hence, we need popular methods of authentication that find mass appeal. This brings us to identification and authentication using “Face Recognition systems”. Face recognition systems have the advantage of being non-intrusive

Chapter -2

LITERATURE REVIEW

LITERATURE SURVEY (Paper-1)

Author Name and Title : A.S. Tolba, Face Recognition

Year in which the Paper was Published: 2018

Technologies used: Combined classifiers, face recognition, graph matching , Neural networks

Adoption Ideas: Identification and Authentication using Face recognition systems

LITERATURE SURVEY (Paper-2)

Author name and Title: Mamata S. Kalas, Real time Face detection and tracking using Open CV.

Year in which paper was published: May-2014

Technologies used: Adaboost, Open CV

Adoption Ideas: Implementation of algorithm to easily determine face locations such as nose,mouthetc.., based on correlation values

LITERATURE SURVEY (Paper-3)

Author Name and Title: W.Zhao , R.Chellapa and A.Rosenfeld Face recognition

Year in which the Paper was Published: 2016

Technologies Used: Biometrics , smart Cards , Law Enforcement and Surveillance

Adoption Ideas: systematic empirical evaluations of Face Recognition and multiple views of 2-D intensity Data

LITERATURE SURVEY (Paper-4)

Author Name and Title: K.V. Mahendra prashanth , M.S. Raghu Subspace Based Face Recognition

Year in which the Paper was Published: 2020

Technologies Used: Principal Component Analysis(PCA) , Databases , Classifiers

Adoption Ideas: Research underwent on linear face recognition

CHAPTER – 3

WORKFLOW METHODOLOGY

3.1 workflow

Here in this project, a person approaching, and the family members are considered to be the external entities. First of all, the Scan Face is a process which scans the face and thus encodes it with unique values, so that it can be uniquely identified thereafter. Then the Compare Vector Values Process makes use of the 'Dataset', which basically is a data store. It processes and produces a result in the form of both text, as well as audio. Furthermore, the process Store Details then stores all these information regarding the outputs in a Separate Data Store (a text file in this case), called as Final Records, which holds all the data regarding who has come, at what time and on which date and it also notes down the name of the person, if known, or else it noeytes down , the name as a simple 'unknown' if in case it encounters an unfamiliar person. .

In the end, this data store can be viewed by entity Family Member so that they' can then verify and validate regarding who the system has actually encountered.

3.2 Methodology

3.2.1 Machine Learning

One of the most effective approach in Artificial Intelligence is Machine Leaming. Artificial intelligence (Al) is a technique for a machine to understand human behavior. Machine learning is a method for achieving Al by using algorithms that have been taught with data. Machine Leaming has become an important aspect of our lives during the last decade .. With the rising availability of data, there is a reason to expect that Machine Learning will become an increasingly more important component of technological innovation.

3 ·2·2 Types of Machine Learning

Machine learning algorithms can be trained in a variety of ways, each with its own set of benefits and limitations. To evaluate the benefits and disadvantages of each sort of machine learning, we must first consider the type of data they consume. There are two types of data in machine learning: labeled data and unlabeled data.

Labeled data has both the input and output parameter in a machine-readable manner, however labeling the data takes a lot of human effort to begin with. Only one or none of the parameters are machine-readable in unlabeled data. This eliminates the need for human labor, but it demands more efficient models ..

There are some sorts of machine learning algorithms that are utilized in very specific use-cases, but today there are three basic ways.

Supervised Learning

The first type of machine learning is supervised learning. This machine learning algorithm is trained on test training in this case. Regardless of the fact that precise labelling of data is essential for this method to work, supervised learning can be highly effective when implemented under the right situations.

This ML algorithm is given a training dataset to work with in supervised learning. This training dataset is a subset of the larger dataset, and it serves to provide the algorithm with a general understanding of the problem, solution, and data points to be handled. The training dataset shares many of the similar properties as the final

dataset and provides the algorithm with labelled data.

The programme then establishes a cause-and-effect relationship between the variables in the dataset to find relationships between the parameters given. By the end of the training, the machine understands and distinguishes data as labeled or unlabelled dataset

This solution is eventually studied for usage with the final dataset, from w 1c it learns in the same way as it learned from the training dataset. This means that supervised machine learning algorithms will improve even after they have been implemented, In this way the supervised learning works.

UNSUPERVISED LEARNING

The ability to deal with unlabeled data is a benefit of unsupervised machine learning. This means that no human labour is necessary to make the dataset machinereadable, allowing the programme to work on much larger datasets.

The labels in supervised learning allow the algorithm to determine the exact nature of any link between two data points. Unsupervised learning, on the other hand, lacks labels to deal with, leading in the formation of hidden structures. The programme perceives relationships between data points in an abstract approach, with no human input required.

Unsupervised learning algorithms' versatility is due to the formation of these hidden structures. Unsupervised learning algorithms can adapt to the data by dynamically modifying hidden structures insteiid of a predetennined and fixed problem statement. Compared to supervised learning techniques, this allows for more post-deployment development.

REINFORCEMENT LEARNING

Reinforcement Leaming is directly inspired by how people learn from data in their daily lives. It includes a trial-and-error algorithm that improves upon itself and learns from different scenarios. Positive outcomes are rewarded or 'reinforced,' while negative outcomes are discouraged or ‘punished’.

Reinforcement learning works by placing the algorithm in a work environment with an interpreter and a reward system, based on the psychology idea of 5 I Page conditioning. The output result of each iteration of the algorithm is presented to th e interpreter, who determines whether the outcome is beneficial or not.

In the event that the programme finds the proper solution, the interpreter reinforces it by applauding the algorithm. If the result is not favorable, the algorithm is encouraged to repeat the process until it finds a better approach. In the vast majority of circumstances, the reward system is directly proportional to the effectiveness of the outcome.

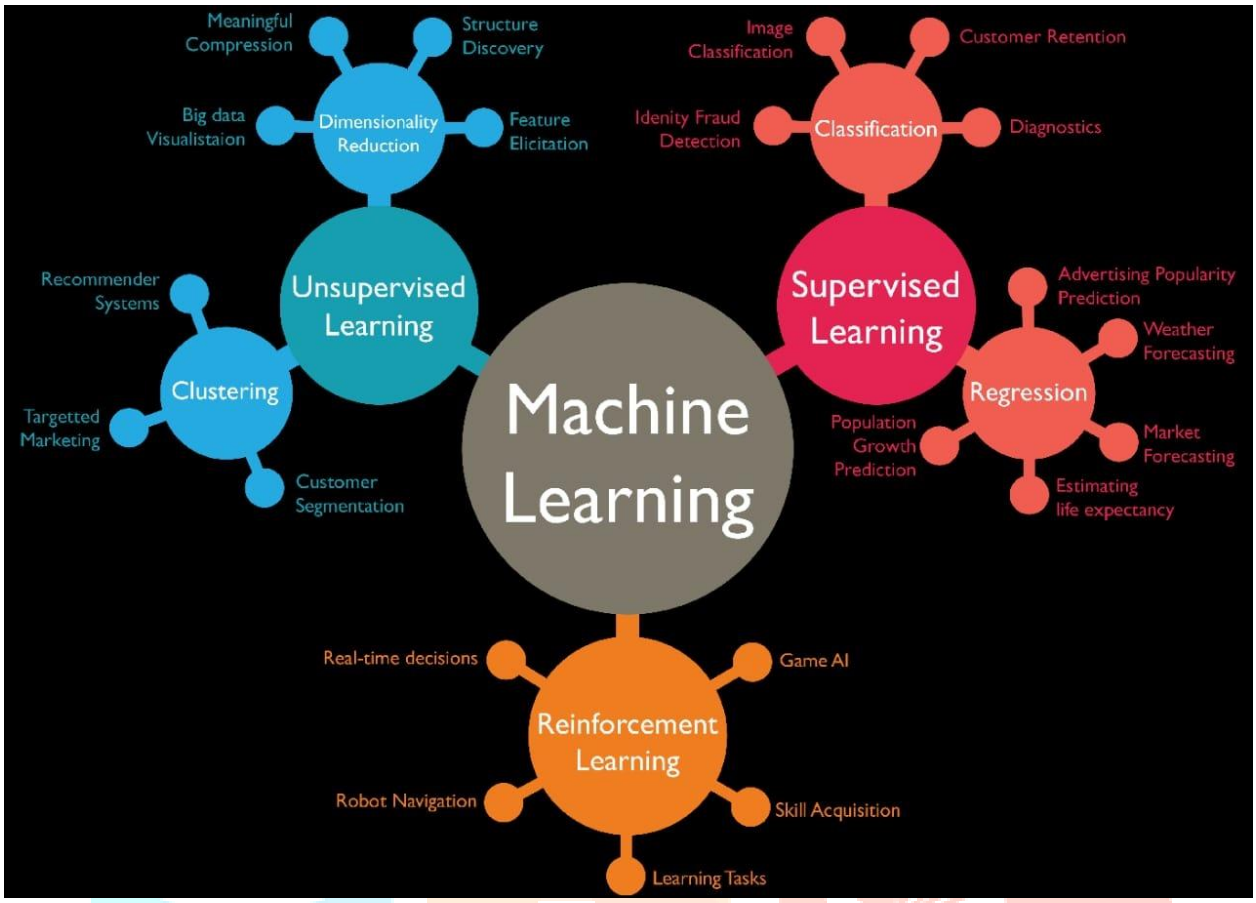
The solution is not an absolute value in typical reinforcement learning use-cases, such as finding the shortest route between two points on a map. Instead, it is assigned an efficiency score, which is expressed as a percentage number. The higher this percentage number is, the more the algorithm gets rewarded. As a result, the computer is programmed to provide the optimal solution for the best potential result.

3.2.3 Dataset

Dataset for the face recognition needs a set of images of a person stored in a file with file name as name of the person.

All the image files of persons together form a folder which is a train data for the supervised machine learning KNN classifier.

The dataset required for the process is a labeled dataset.



Chapter -4 EXISTING SYSTEMS AND PROPOSED SYSYTEMS

4.1 EXISTING SYSTEM

The existing algorithms which were used for the recognition of faces are now stated below. Note that, every time, not all of these were directly implemented in the simultaneous scanning and detection of faces through the cameras.

1.principle Component Analysis (PCA) :

PCA is a method for simplifying the issue of choosing an eigenvalue and related eigenvector representation in order to provide a consistent representation. This can be performed by lowering the representation's dimension space in order to enable quick and reliable Object recognition. PCA also keeps the original information in the data. In the Eigen face-based approach, the PCA foundation is applied.

a. Eigen Face Based Algorithm: The Eigen Face Based Algorithm is the most widely used method for face detection. Eigen face is noted for its ease of use, reduced pose sensitivity, and enhanced performance when working with small databases or training sets. This approach relies on the presence of eyes, nose, and mouth on a face, as well as the relative distances between these objects, are used in this method .In the facial domain, this unique trait is referred to as Eigen faces. Principle Component Analysis (PCA) is a mathematical method that may be used to retrieve this face characteristic. By merging the Eigen faces, any original picture from the training set may be rebuilt using PCA In general, the Eigen face's relative distance is used to classify a face as a face.

2. Linear Discriminant Analysis (LDA):

The Linear Discriminant of Fisher isanother name for LOA (FLO). The FLO method is used to decrease the dimension space. The FLO approach makes use of within-class information to reduce variance while enhancing class separation

a.Fisherface-Based Algorithm:

The Fisherface technique is one of the most widely used methods for extracting characteristics from face images. This method seeks to find a projection path that separates images from different classes as much as feasible.

To accommodate the illumination fluctuation, the Fisher face approach is an improvement of the eigen face algorithm. In a situation when the lighting environment varies, the Fisher face algorithm outperforms eigen face, according to reports. In addition, for each face, this, method needs multiple training pictures. As a result it can't be used in facial recognition software where just one sample image per individual is provided for training.

3. Skin Color - Based Algorithm:

The most visible and essential characteristic of a person's face is their skin color. The intensity of the skin color, not the chromatic characteristics, distinguishes human skin colors from those of other ethinic groups. A skin color-based processing technique is one of the face feature methods. This categorization is based on the color component, which is represented by a Gaussian probability density model. This approach uses color space for the skin region as the categorization for an input picture. Threshold is used to conceal the skin's surface. Finally, to extract the face from the input image, a bounding box is constructed. The skin color processing technique is both quicker and more orientation invariant than previous face feature processing methods.However, others argue that the skin colour technique is time intensive since it scans the target image linearly, which requires a huge amount of scanning space. As a result, it has been suggested that a unique approach based on sub-windows scanning rather than traditional linear scanning would be preferable. This technique scans the image sparsely based on the 'face color density' by determining the horizontal as well as the vertical intervals.

a. RGB (Red-Green-Blue): To detect the pixels of an image's skin colour, a nonnalized colour histogram in RGB colour space is utilised, and it can be adjusted for differences in intensity by dividing by brightness. This identifies and locates the person's face. This colour space is not suited for color-based detection algorithms when compared to YCbCr or HIS. According to a survey, RGB has a tendency to mix chrominance and luminance data, has a high correlation across channels, and has significant perceptual non-uniformity. RGB's unfavorability is exacerbated by these factors.

b.YCbCr (Luminance - Chrominance): This colour space is well-suited to a diverse spectrum of human races. If the chrominance component is used, this approach can be employed. It will eliminate as much brightness as possible by selecting the Cb-Cr plane from the YCbCr colour space. A pixel is considered a skin tone if the values [Cr, Cb] are inside the criterion.

c.HSI (Hue-Saturation-Intensity): HSI appears to be the most effective technique for skin colour. To identify a skin region from the background, an HSI colour predicate might be employed. The HSI colour system categorises skin colour in the same way as the YCbCr colour space, but the responsible values are hue (H) and saturation (S) (S). Unfortunately, when parts of the backdrop, such as arms, legs, and other objects, have the same colour value as the face, all of these techniques fail.

4. wavelength based algorithm

In a wavelet-based technique, each face picture is represented by a subset of band filtered images that include wavelet coefficients. The wavelet transform has a good chance of delivering a reliable multi-scale method analysis of an image. Wavelets are also extremely adaptable, as they have several bases from which it can choose the best one for any given application. The Gabor wavelet method is the most commonly used wavelet approach, notably in picture texture analysis.

a. Gabor Wavelet Method: The Gabor wavelet transfonn makes use of spatial frequency structures as well as an orientation relation. This technique is a sort of Fourier transform that uses a Gaussian modulated sinusoidal wave. The Gabor wavelet method detects short lines and tenninating lines, short lines, and
sudden curvature changes As a result, these curves tend to correspond to the most prominent parts of the human face, such as the mouth, nose, brow, jaw line, cheekbone, and others. As a result of such keen detection, the Gabor Wavelet Method is very well known in the field of face as well as feature detection

5. Artificial Neural Networks Based Algorithm:
Artificial Neural Networks (ANNs) are commonly uttilized in the recognition process. Once a face has been detected ANNs, will be used to compute the weight of visual information in order to identify and recognise the individual An artificial neural network (ANN) mimics the biological neuron system in the human brain. A neuron receives a signal from the previous layer and sends it to all neurons on the following layer. Before being disseminated to the next layer, the signal has been multiplied by a different multi weight value and the weighted input has been combined. Back propagation neural networks, feed forward neural networks, and Radial Basis Function networks are all types of neural networks.

4.2 Proposed Methodology

4.2.1 Face Recognition

Unlike the machine learning problem like credit card fraud detection, generating new data based on the existing data and telling if an image consists of a certain object. All these problems can be solved by choosing one machine learning algorithm, feeding the data and getting the result. Rather face recognition is a series of steps that involves:

1 . First, look at a picture and find all the faces in it

2.Second, focus on each face and be able to understand that even if a face is turned in a weird direction or in bad lighting, it is still the same person

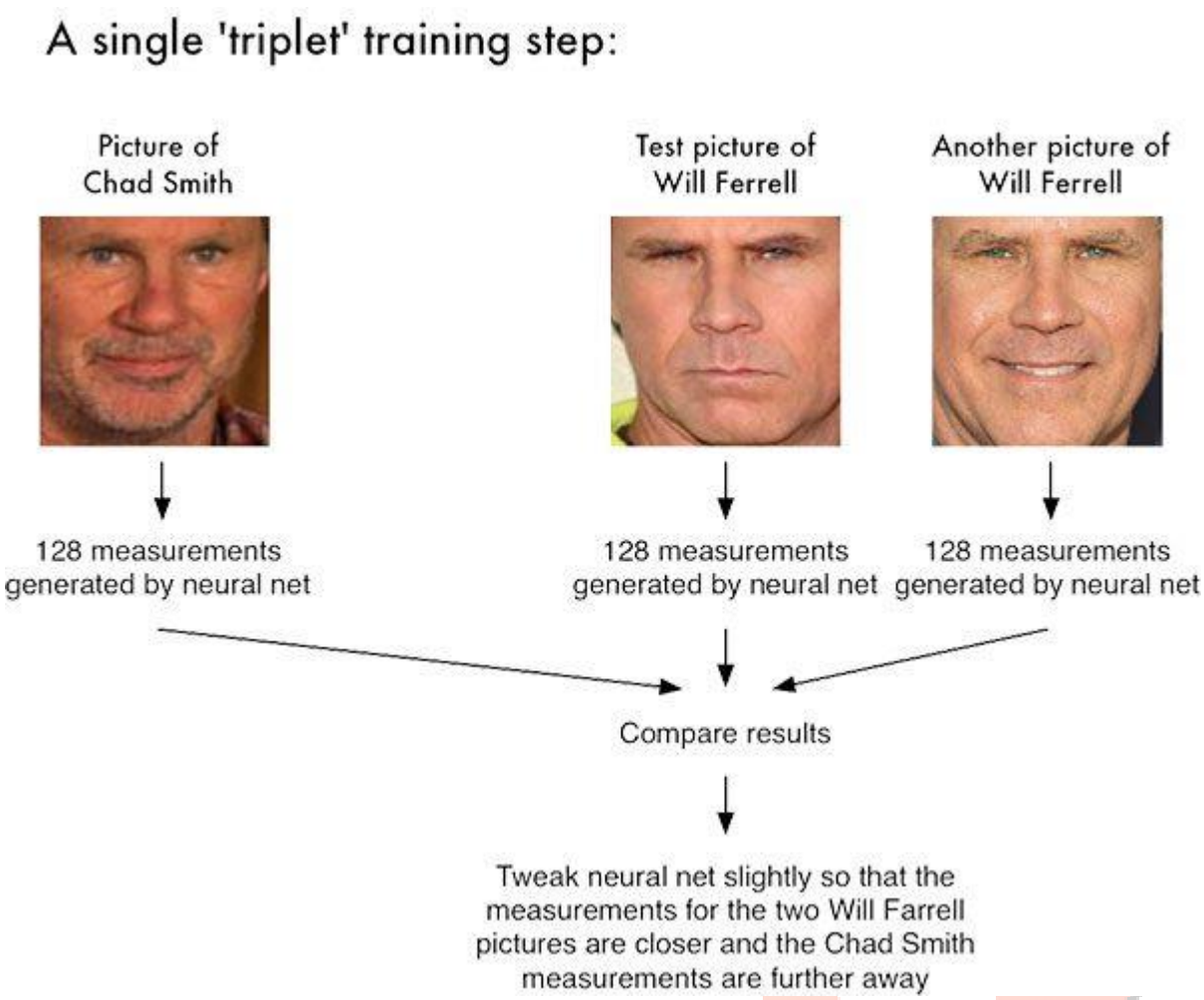
3.Third, be able to pick out unique features of the face that you can use to tell it apart from other people- like how big the eyes are, how long the face is, etc

4.Finally, compare the unique features of that face to all the people you already know to determine the person's name

4.2.2 Face Encoding

It is a face for us. But, for our algorithm, it is only an array of RGB values that matches a pattern that has learnt from the data samples we provided to it.

For the face recognition, the algorithm notes certain important measurements on the face, like the color and size and slant of eyes, the gap between eyebrows, etc. All these put together define the face encoding, the information obtained out of the image, that is used to identify the particular face. To get a feel of what is read from the face, let us have a look at the encodings that we read.



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4.2.3 Pycharm IDE:

PyCharm is a dedicated Python Integrated Development Environment (IDE) providing a wide range of essential tools for Python developers, tightly integrated to create a convenient environment for productive Python, web, and data science development.

PyCharm offers great framework-specific support too for modern web development frameworks such as Django, Flask, Google App Engine, Pyramid, and web2py.

Our project has been carried out by using python, and PyCharm so that it would become much more easier to install and use libraries, and also use datasets for the comparison.

Pycharm has built-in support for many different frameworks, It includes Django, HTML, CSS and Javascript, which are the highlights of using pycharm. Overall, Pycharm is the best proprietary python editor unless we prefer completely FOSS software , there is no reason not to use it. One of the most distinct advantages of Pycharm over other environments is that it gives us access to pull and push the code up to the branches of GIT repository. And the user interface is very easy to use. Another feature that makes it stand out in the crowd is the provision of a terminal with which we can execute bash/cmd commands depending on the OS we use. Thus, pycharm by jet brains is clearly built to suite the needs any kind of a programmer who intend to do some hardcore programming in python.

4.2.4Training & Code

During the training process, along with the input the KNN classifier model also has the output fed to it. The predicted output is compared against the actual output to realize the error in prediction. The magnitude of the error indicates how wrong our predicted values are higher or lower than expected. Then the layers attached to one another give indication of the direction and magnitude of change to reduce the error. This information is then transferred backward through the network and this process is known as "back propagation". Based on this information the weights are adjusted. This cycle

of forward propagation and backward propagation is iteratively performed with multiple inputs. This process continues until our weights are assigned such that the network can predict the faces correctly. In most of the cases this brings our training process to an end.

Different layers in training

To train a model, the model needs to recognize pictures. The training generates 128 measurements for each face.

The training process works by looking at 3 face images at a time:

. Load a training face image of a known person

Load another picture of the same known person

? Load a picture of a totally different person

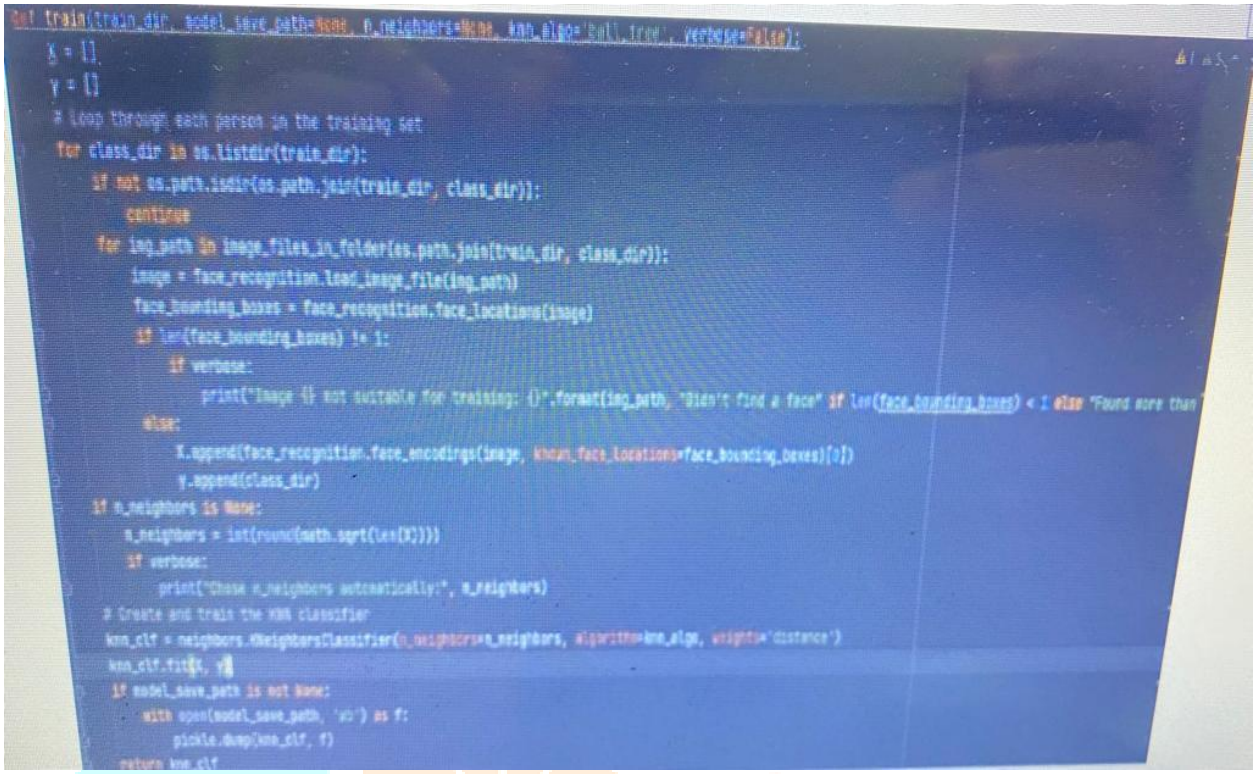
The neural network learns to accurately provide 128 measurements for each person after performing this step millions of times for millions of photos of thousands of distinct people. A set of ten photographs of the same individual should yield nearly the same measurements.

So, now we will see how the training code works with respect to the pictures that we want to specifically set and preserve in our dataset. Firstly, we categorize the pictures that we have, and that we want to use in our system. Create a Folder which contains the files of all the persons, whose faces we want to train by using the training code. Then insert some good amount of pictures in each file and name the file with the respective person's name.

When we run the training code now, it will be evident that the system will try to loop through each and every file present in the dataset folder, which we have given as the input. So, now the system tries to loop through each and every picture inthe person's file and it repeats the same procedure for each and everyperson's file. Now, a basic overview, or an idea is achieved by the system on how to differentiate between the faces.

Theabovestatementhasbeenmentioned duetothe factthatthesystem tries to generate a set of unique vector values, which have been encoded specifically, so that those values represent each and every face uniquely. This is achieved by the constant analysis of each and everypicture of a single person, and the same is repeated for all the remaining peoples' files as well. So basically, here we are trying to ensure whether the system is accurately assigning the encoded vector values uniquelyornot. The neural network here tries to generate upto 128 different values for each and every unique face present in the dataset, so that it can be ensured that no setof twovector valueswill be the same thereafter.

On the other hand, one might think that the system might encounter a problem with twins or identical people, but it is assured by the neural network that itwill not be the case, as all of the encoded values cannot be precisely the same, even for identical people. The system cameras as well as the training procedure are so advanced and efficient that they even detect the differences which are almost insane tobecaptured by the human eye. With data in the dataset which is at leastnearly precise, it would be cinch for the system to encode the faces which it has encountered, properly.

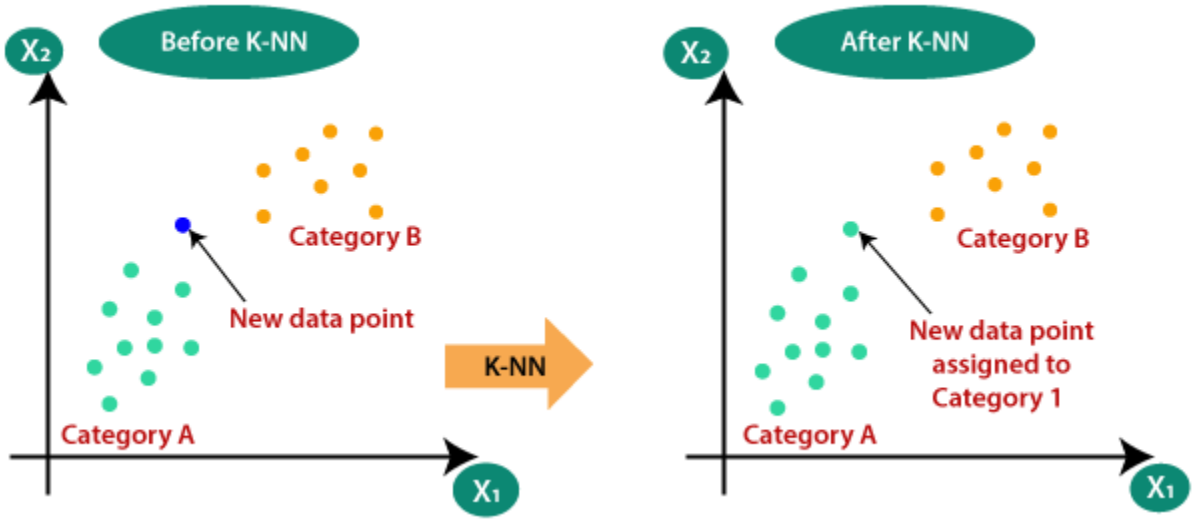


4.2.5 KNN Classifier

K-Nearest Neighbors (KNN) is one of the simplest algorithms used in Machine Learning for regression and classification problem. KNN algorithms use data and classify new data points based on similarity measures (e.g. distance function).

Classification is done by a majority vote to its neighbors. The data is assigned to the class which has the nearest neighbors. As you increase the number of nearest neighbors, the value of k, accuracy might increase.

We will import K Neighbors Classifier from sklearn.neighbours to implement the k-nearest neighbors



4.2.6 Pickle Library

Python pickle module is used for serializing and de-serializing python object structures. The process to convert any kind of python objects (list, dict, etc.) into byte streams (Os and Is) is called pickling or serialization or flattening or marshaling. This is used to dump the image as a binary file to the KNN classifier model.

4.2.7 OpenCV Capture video from Camera

Python has a number of image and video processing libraries. OpenCV is one among them. It is a large library that aids in the provision of numerous image and video operations functions. We can capture video from the camera using OpenCV. It allows you to create a video capture object that can be used to capture videos using a camera and then conduct operations on them.

Steps to capture a video:

Use cv2.imshow() method to show the frames in the video.

Breaks the loop when the user clicks a specific key.

def capture () :

videoCaptureObject = cv2. VideoCapture (0)

result = True while (result):

ret, frame = videoCaptureObject. read () cv2. imwrite ("test/test_image.jpg", frame) result = False videoCaptureObject. release () cv2. destroyAllWindows ()

OpenCV code for video capture

4.2.8 PI Library

The Python Imaging Library (PI) gives image editing capabilities to the Python interpreter. For image objects, the ImageDraw module provides 2D graphics. This module can be used to create new photos, annotate or retouch old photographs, and generate graphics for web use on the fly.

ImageDraw.Draw.rectangle() //Draws a rectangle

ImageDraw.Draw.text() //Draws the string at the given position

4.2.9 Testing

The encoding vector is calculated for the captured images, then the encoded vector is comparedor searched for existingrelated images in themessage library with with thean allowed error. If the image is found in the dataset a "WELCOME
person NAME" is produced. Else if an image is not found in the dataset a message thatsays "UNKNOWN PERSON" is produced.

4.2.10 Play Sound

The function (sometimes called) playsound
is the sole thing in the play sound module (). It only takes one argument: the path to the sound file you want to play. This could be a local file or a web address. On Windows, windll.winmm is used. WAVE and MP3 have both been tried and found to work. Other file types might also work

Use case diagram:

Use case diagrams represent the overall scenario of the system. A scenario is nothing but a sequence of steps describing an interaction between a user and a system.

Thus, a use case is a set of scenarios tied together by some goal. The use case diagrams are drawn for exposing the functionalities of the system

Use case diagram is a graphical representation of what a system must do.They emphasize what must happen in a system.

Actors are entities or people that are operated within defined rules in a system. Use cases are a set of actions, services and functions that the system needs to perform.

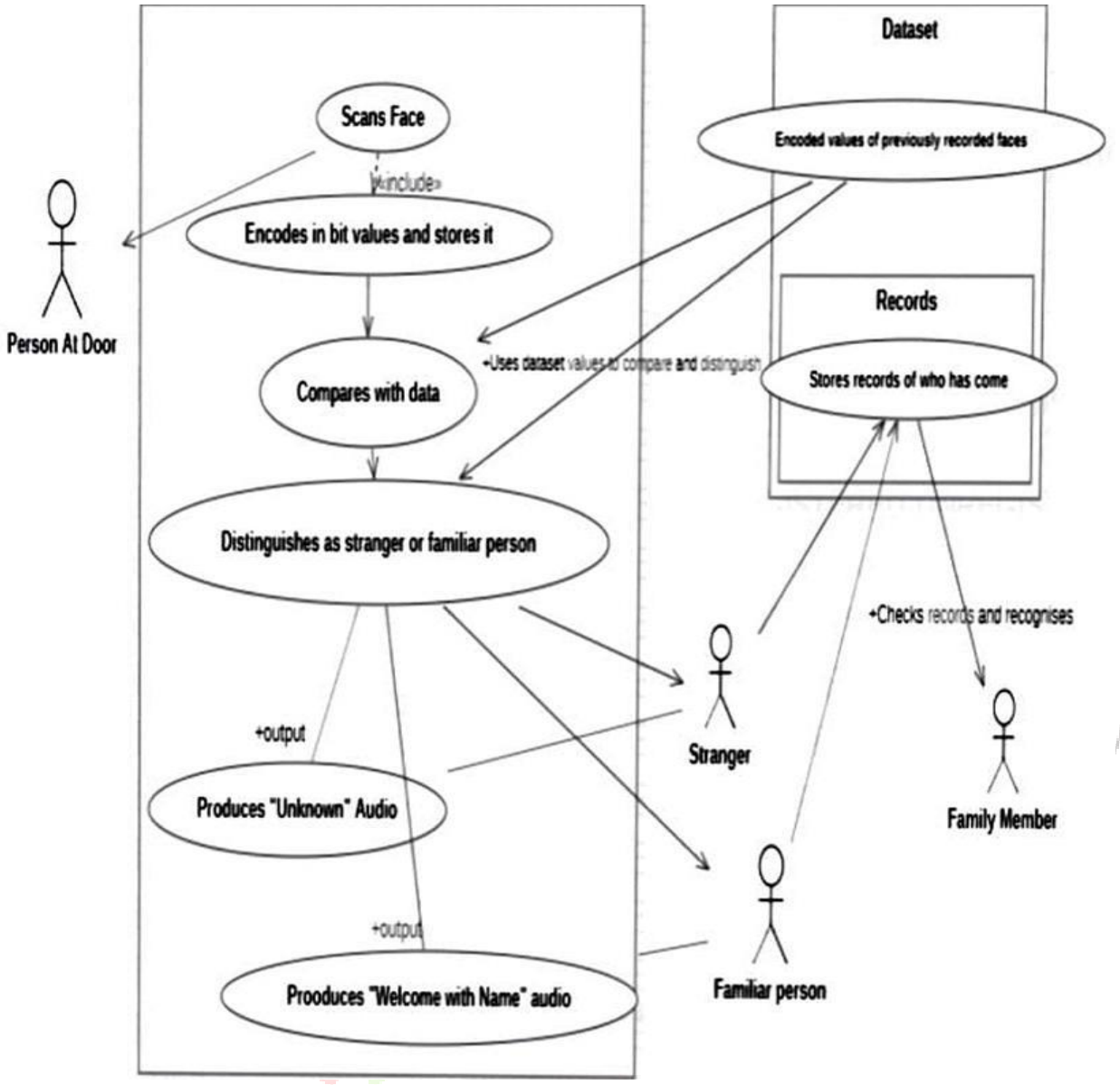
Use case models the functionality of the system with the help of using actors and use cases.

A use case in software is a single task performed by an actor. The actor is important for this concept.

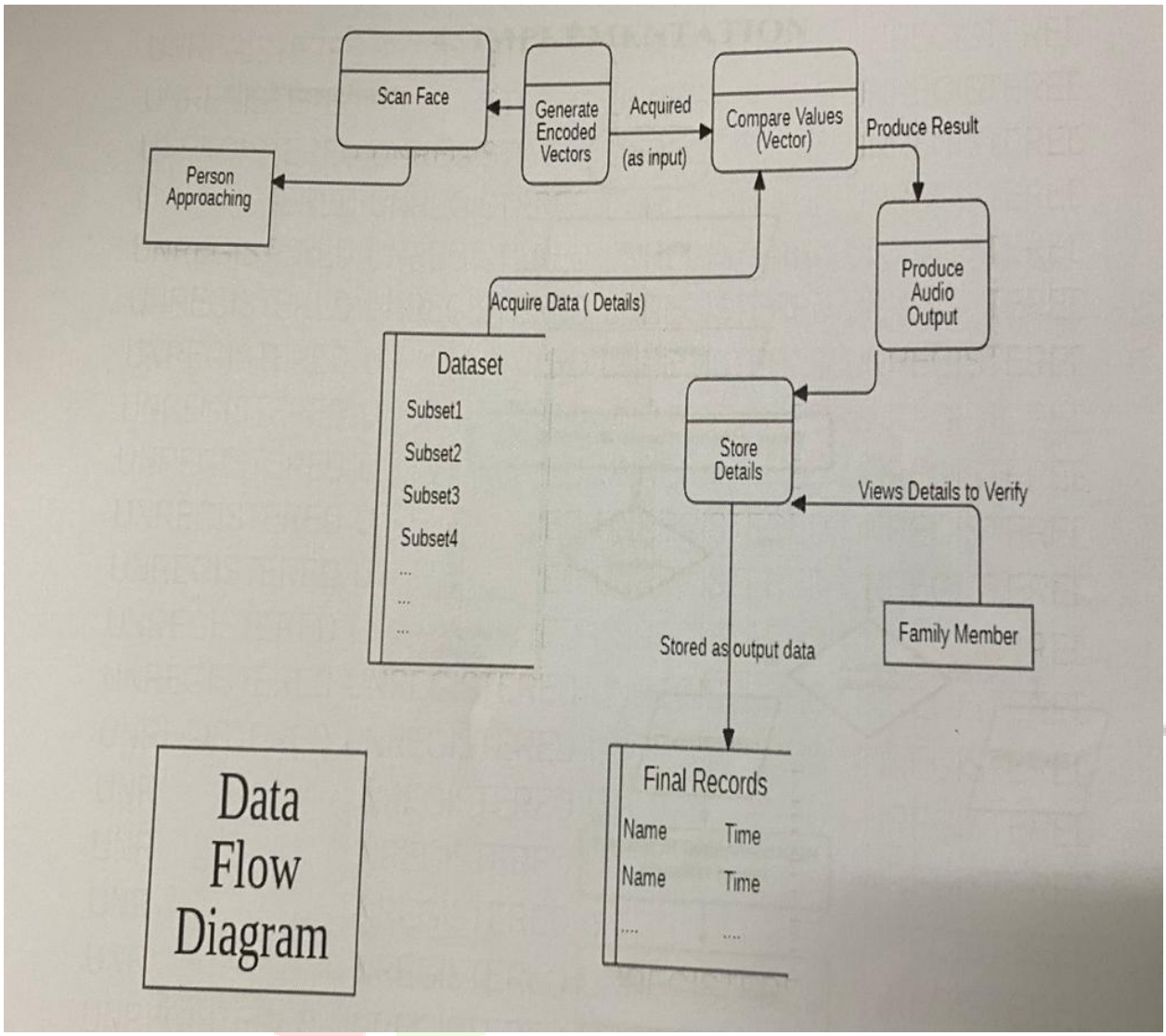
To put it simple, use cases describes how users will utilize the product.They require us to think about why user's needs the service that we are providing and how we can make that service work best forthem.

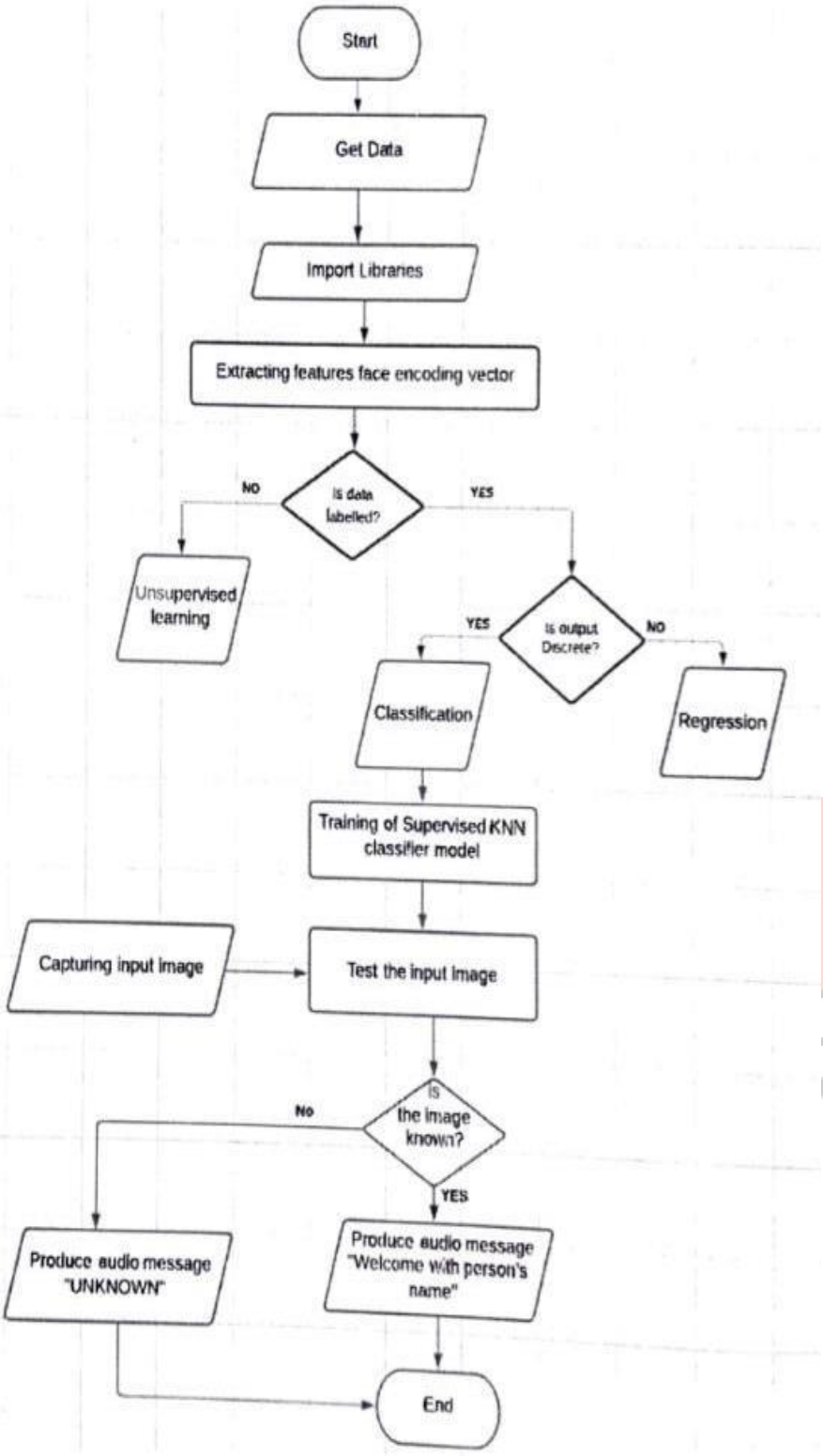
Use cases are also a great way to align a team around a common understanding of what customers look like - even people who have never interacted with the customers directly. Therefore, use cases are intended to clarify the cohesive purpose behind specific engineering requirements the system must meet.

USE CASE DIAGRAM



DATA FLOW DIAGRAM





FLOW CHART OF FACE DISCENMENT SYSTEM

CHAPTER-5

APPLICATIONS

* Protects children and elders at homes

*Control access to unauthorized areas

*Facilitate secure transactions To check if people are wearing masks or not

*Track school attendance

*Protect schools from threats

*Find missing persons

*Aid Forensic investigations

* Smart advertising

*Identify robbers

*Validate identity at ATM's

*Make air travel more convenient

*MusIc composition

CHAPTER-6

ADVANTAGES

• Enhanced security

• Fast recognition

• Automatic welcoming

• Friendly device for elders and children

• Easy to install and use

• Automatic security monitoring and keeps track of unknown persons visited nearby.

• Reliable

• Efficient

•Very Robust Model

• Clear Audio, Text Outputs

• Smooth in performance and, no hiatus is detected in any of the processes

Chapter -7

Conclusion

This device has been tested and it successfully detects the faces and greets the person. We have taken a basic idea of machine greeting a person and developed it using machine learning. Its practical implementation can go beyond domestic purpose. With day to day advancement, the accuracy in face recognition has increased up to 98%. Hence, with provided utmost security it is quite impossible for any burglar to enter the room without concern of the owner.

We have taken a nominal idea of machine greeting a person and have developed it using machine learning, which has benefits in terms of high security. Processes like facial recognition, accurate classification, and management & storage of data with perfect precision have been carried in this project. It's practical implementations can go beyond domestic purposes. This idea can be used for enhancing commercial need security too. Therefore it can be concluded that, with utmost provided security, it is impossible for strangers or burglars to enter a house or room without the owner's

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