International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-6, April 2020

Surveillance using Face Recognition in Smart Cities

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Abstract: ***In this project safe city demonstrates how the security in India can be increased with the help of video surveillance using facial recognition. In the Aadhar Card database, the Indian Government has stored fingerprint and Iris details of every civilian in India. But the Indian Government is only using the Fingerprint details in the voting system to avoid fake votes. With the help of this project any person roaming in the city limit can be easily monitored. This will be a very useful technology for the Police Department of India to track the criminals and to reduce crime rate. Whenever a person or criminal is needed to be traced***

, the photo of the target is uploaded into the software. The uploaded photo will be cross-checked by the software with the videos captured from the surveillance cameras. It will then identify the person based on the percentage of accuracy to be matched. In the past 5 years Indian Government have made many cities into smart cities. But now it's time to build safe cities for India.

Keywords**: Eigenface,** ***Face Recognition, TensorFlow, Computer Vision, Surveillance, Machine Learning***

I. INTRODUCTION

Face recognition is one the most evolving security measure which is replacing number locks, pattern locks, fingerprint sensors etc., in the modern mobile phones. It is an emerging technology to provide security and to trace activities of a group or an individual. There are several modules and face recognition algorithms to identify people. Eigen face classifier algorithm is being used in this project to detect faces. The facial details of a person are captured and they are converted into matrix format. Likewise, all the details of the people must be maintained in a database so that their facial reading can be used to make this massive idea possible. In case of any emergency to find a thief or a criminal, his/her photo must be uploaded into the software. The surveillance cameras which are placed in every nook and corner of the city will detect faces of every individual coming across the cameras.

Revised Manuscript Received on April 30, 2020.
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Their faces will be automatically compared with the victims' photo. Then based on the accuracy level which we give, the victims can be found out without manually looking into the cameras. This is will ultimately increase the security of India and it will make Indian cities, a safer place to live. Indian Government launched "100 smart cities mission "in the year 2015 and it was a huge success. The cities were given free Wi-Fi and most of the government systems like education counselling, gas payment etc. were digitalized. In the upcoming years those cities can be made into safe cities with this project. Currently India does not have enough amount of surveillance cameras in streets.

II. RELATED WORK

Probably the most important thing in surveillance with face recognition is that it needs high definition cameras so that it can capture lot of pixel information of the target. Based on the clarity of the image, the accuracy of the prediction would increase. The facial images of every individual in the city will already be stored in the Aadhar card database, which can be easily accessed at any time. The suspected image of the person can be cross verified and can be found whether his/her image is there in the criminal list.

Parkhi et al [1] (2015) did Deep face recognition proposal. The purpose of this paper is to recognize face either from a single photograph or from a collection of faces tracked in a picture. Convolutional neural network (CNN) very large-scale training data sets are the reason for the recent progress. Rather large-scale data set can be installed in the loop by a mixture of automation and person and traverse through the complexities of deep network training and face recognition to present methods and procedures for achieving comparable condition.

Li et al [2] (2015) have created a Multi-attribute learning for pedestrian attribute recognition in surveillance scenario. In video surveillance, visual pedestrian attributes like gender, backpack, dresses, are very important for identifying a person. There are two drawbacks in the existing methods for attributes recognition. The first one is handcrafted features (e.g. histograms, binary patterns). They cannot cope well with the difficulty of real video surveillance scenarios. The second one is the relationship among pedestrian attributes is ignored. To solve the two drawbacks, they proposed two deep learning-based models which can be very useful to recognize pedestrian attributes. The deep learning architecture that recognizes multiple attributes jointly (DeepMAR) is proposed to exploit the relationship among attributes. One attribute can contribute to the representation of other attributes in the DeepMAR. For example, the gender of men can contribute to the representation of short hair and wearing shirts. Recent Experiments on popular pedestrian attribute datasets shows that our proposed models achieve the state-of-the-art results.

De-la-Torre et al [3] (2015) made a Partially-supervised learning from facial trajectories for face recognition in video surveillance. It is often costly or impracticable to obtain sufficiently high-quality facial reference samples of targets. Adaptive multiple classifier systems (MCSs) have been successfully applied to video-to-video FR, where an ensemble of 2-class classifiers is used to model the face of each target person. In his paper he proposed a new adaptive MCS, based on facial trajectories, for partially supervised learning of facial models over time. For robust spatio-temporal recognition and for facial model self-updating, information from a face tracker and individual-specific ensembles is integrated during operations. For each individual, the tracker defines a facial trajectory that appears in a video It will lead us to the target individual A learning-and-combine strategy is employed to avoid corruption of knowledge during ensembles

self-updating.

Bouchrika et al [4] (2016) worked towards automated visual surveillance across multiple cameras. While personal privacy has become a major concern, surveillance technology is now becoming omnipresent in modern society. This is due primarily to the increasing number of crimes, as well as the essential need to provide a safe and secure environment. Recent research findings have now verified the likelihood of individuals being noticed by the way they walk, i.e. gait. For the derivation of gait kinematics as well as anthropometric measurements a vision-based marker less extraction system is being implemented to create a gait signature. Recent research, using gait in biometrics and forensic analysis, fuels the innovation of our approach. The experimental results demonstrated the robustness of our approach to effectively identifying walking people as well as its ability to distinguish gait characteristics for different camera views, achieving a simulated identity detection score of 73.6 per cent for 2270 video sequences. However, experimental results demonstrated the ability of the proposed identity monitoring tool in actual surveillance systems to identify individuals walking.

Neves et al [5] (2016) made a Biometric recognition in surveillance scenarios. Wider worldwide installation of surveillance cameras, and subsequently, work into automated surveillance systems has gained more attention from the scientific community than before. At the same time, biometrics research is also becoming more popular, and the increasing number of approaches designed to address specific degradation factors of unconstrained environments supports this. No automated monitoring system which performs reliable biometric recognition in such an environment has become available in spite of these recent efforts. They highlight two distinct features, i.e. (1) We focus on approaches designed to work in unrestricted environments and monitoring scenarios and (2) The ultimate goal of the surveillance system is biometric identification, as opposed to behavioral analysis, detection of abnormalities or recognition of actions.

Motlagh et al [6] (2017) created a UAV-based IoT platform: A crowd surveillance use case. Among an ever-growing community of amateurs and service providers,

unmanned aerial vehicles are gaining a lot of popularity. To widen the use case scenarios of UAVs, emerging technologies, such as and mobile edge computing and LTE 4G/5G networks in this article, we discuss the potential of UAVs, equipped with IoT devices, to deliver great heights of IoT services. This article presents a high-level view of a UAV-based integrative IoT platform for delivering large-height IoT services, together with the overall system orchestrator. As an imagined application use case, the article shows how UAVs can be used for face-recognition based crowd surveillance. To assess the use case, we are researching the offloading of video data processing to a MEC node as compared to local video data processing on board UAVs. The Open Source Computer Vision Local Binary Pattern Histogram method is used to perform face recognition. The results obtained demonstrate the effectiveness of the MEC-based offloading approach in saving UAVs ' scarce energy, reducing recognition time for processing, and promptly detecting suspects. The effective usage of UAV can be achieved with the help of improved networking systems. Punithavathani et al [11] studied the transition mechanisms which are found to be more effective in IP version 4 and 6.

Tang et al [7] (2016) made a Vehicle detection and recognition for intelligent traffic surveillance systems. Type recognition and detection is directly applicable for various operations in a traffic surveillance system which is of static image-based vehicles and is highly practical. This paper represents reconnaissance processing and automatic vehicle detection. First, hair-like features and AdaBoost algorithms are used to extract and create classifiers for features that are used to locate the vehicle over the image data. Then according to the outside interference on the image and the random position of the vehicle, a local binary pattern operator and the Gabor wavelet transform is used to extract multi-orientation vehicle features and multi-scale. Finally, the image is divided into small regions from which sequences of histograms are extracted and concentrated to represent the features of the vehicles. The main component analysis will be adopted in order to achieve a low-dimensional histogram function that is used to calculate the similarity of different vehicles in Euler space, and the closest neighborhood is used for final classification. The typed experiment shows that our detection rate exceeds 97 percent, with a false rate of just 3 percent, and that the recognition rate of the vehicle exceeds 91 percent, while maintaining a fast processing time. It shows exciting implementation potential for real-world applications.

Bhuvaneswari et al [10] used the concept of human movement detection in an IoT system integrated with machine learning techniques. Artificial Intelligence techniques are becoming more and more common in areas such as healthcare [13 -15] were diseases are earlier identified with the predictive systems by training the neural networks with the appropriate datasets. Sreeja et al [12] (2014) optimized the pattern matching algorithms in order to classify certain dataset. Optimization of algorithms helps in improving the efficiency of the classification by minimizing the possible error rates. Yang et al [8] [2017] did aNeural aggregation network for

video face recognition. The paper presents a Neural Aggregation Network (NAN) for video face recognition. The network uses face video or face image set of a person with a different number of face images as its input, and produces a compact, fixed-dimension feature representation for recognition.

The entire network is composed of two factors. The feature embedding factor is a deep Convolutional Neural Network (CNN) which maps each face image to a feature vector. The aggregation factor consists of two blocks which adaptively aggregate the feature vectors to form a single feature inside the convex hull bridged by them. Due to the attention mechanism, the aggregation is invariant to the image order.

According to Mulyono et al [9] [2019] have done Performance Analysis of Face Recognition using Eigenface Approach. Principal component analysis (PCA) uses the Eigenface algorithm to recognize faces. Eigenface used to reduce dimensionality and find the best vector for distributing the facial image in the fascial space. This method has been popularly used and implemented in various previous researches to recognize human face images. It can recognize facial images with various threats such as detecting faces even after plastic surgery and combining them with facial image reconstruction techniques. This research aims to examine the performance of the PCA-Eigenface method to recognize human face images from several databases that have their own challenges, such as the lack of illumination of facial images, significant variations in expression and the use of accessories such as specs.

III. IMPLEMENTATION OF THE PROPOSED SYSTEM

When these needs are satisfied Indian Smart cities are ready to become a safe city. The cameras which are embedded with computer vision which is installed in traffic signals, main roads, streets, etc. Will now monitor all the people in the frame. If the police department have a suspect on an individual, they need not follow him to know his details. Instead the face captured in the video will be cross checked with the Aadhar card database and their details can be viewed in an instance. If a particular person needs to be traced, they can set the image of the person in search mode so that if the particular person is captured in frame he can be easily traced down. For this purpose, a massive centralized database must be maintained to make it possible for the authorities to identify merely anyone by capturing their face. As a result, it will be a powerful tool for public safety. Facial recognition algorithms are growing exponentially faster and more powerful using a technology called deep learning.

Using complex algorithms facial recognition system startup by identifying all of the faces in the given image or live video in a web camera. For each face the algorithm measures out key data points like the distance between the eyes or the color of the skin and then use those measurements to create a template and the compare them to the templates in the other database. The more data we have, the better the systems do. Millions of users in social media upload their photos everyday under terms and service that basically allows tech companies to do what they want to do with the images. Not only people, objects like car, motor cycle etc., can also be captured using

computer vision and their Numbers can be captured to maintain a detail of list of vehicles passing an area in specific time. Basically, it makes the video searchable. Our project is built in Python 3.0 with a face recognition algorithm. All the details of the people must be maintained in a database and their facial reading can be used to make this massive idea possible. It can be done with a web camera in a laptop or in a Web camera with a raspberry pi installed in it. This is will ultimately increase the security of India and it will make Indian cities a safe place to live.

A. Renovate Aadhar card:

Even though the Indian Government is having the facial details of all the civilians, a single photo of a person cannot be used for proper surveillance. So, a 360-degree image of a person must be added to the Aadhar card so that the face can be recognized perfectly. A 360-degree photo will cover the image of a person in all the angles and let the way to track down people irrespective of angles. For this purpose, Aadhar card must be renovated .i.e., an additional feature of facial details must be added to the Aadhar database.

B. Increase Surveillance Camera:

Demand for professional video surveillance cameras has grown rapidly. It is estimated that in 2006, less than 10 million surveillance cameras were shipped worldwide, which grew to more than 100 million in 2016 and is forecast to make more than 130 million in 2018. The video surveillance system which can automatically match a person's face against a database of individuals is widely being used in various applications. In 2018, China is expected to account for more than 46 per cent of global revenues from professional video surveillance equipment. Despite this, the Chinese market possesses some unique features that make it very different from other regional markets. This has led to the suggestion that there are two markets for video surveillance equipment-the Chinese market and the non-China global market. It is forecast that only about 10 per cent of all cameras shipped in China in 2018 will account for HD CCTV cameras. Between 2012 and 2017 the Chinese market grew at an average annual rate of 13.3 percent. I By comparison, over this time, the world market excluding China has grown at an annual average rate of 2.6 per cent. Despite all of this, camera shipment growth in China has been slowing as the market is becoming increasingly saturated. Continued high market growth would progressively rely on shipments of deep learning-enabled equipment at higher prices next generation.

C. Included Libraries and Frameworks:

The libraries and packages used in this project is to make every single task efficient and faster. They are selected in such a way that it can handle huge task without any lag. The database connectivity is completely handles using PyMongo and it can be visualized in the UI using Robo3T. The pipeline of the project is designed using apache airflow. The machine learning model used to capture

The faces is built using TensorFlow. Let's look at that elaborate.

Python

Explicit programming to make a computer perform a job or a task is avoided by using machine learning. Nowadays machine learning is used everywhere and most of the technical companies are moving towards the field of machine learning. In one form or the other. Google Search engine, Amazon Product recommendations, LinkedIn, Facebook etc, all these systems have machine learning algorithms embedded in their systems.

The data collected from several sources are used to gain an insight from the huge data. It helps to know what is happening and what to do in future. Python is a high-level programming language and is a great object-oriented, interpreted, and interactive programming language. There are interfaces for many systems calls and also to libraries.

Open CV

Open Source Computer Vision Library is a software library for machine-learning. OpenCV was used by the commercial products to promote the use of machine perception and as a common infrastructure for CV applications. Being a BSD-licensed software, OpenCV allows use and modification of the code simple for companies. The library has more than 2500 developed algorithms, which include a comprehensive set of computer vision and machine learning algorithms, both classic and state-of - the-art. These algorithms can be used for face detection and recognition, objects identification, distinguish human actions through videos, detect movements in camera, moving objects, get objects of 3D models, create 3D point clouds from stereo cameras, stitch images together to create a high-resolution image of a whole scene, find similar images from a collection of pictures, delete red eyes from flash images, track eye movements, identify scenery and create markers to overlay them with augmented reality, etc. OpenCV has a user community of more than 47 thousand people and an annual download number of more than 18 million. The library is widely used by corporations, research groups and government bodies. Various startups are making extensive use of OpenCV such as Zeitera, Applied Minds and VideoSurf along with well-established companies such as Yahoo, Intel, IBM, Microsoft, Goggle, Sony, Honda, Toyota using this library. OpenCV's deployed uses range from putting together street view pictures, detecting intrusions in Israeli video surveillance, tracking mine equipment in China, helping robots navigate and pick up items in Willow Garage, swimming pool detection of drowning accidents in Europe, interactive art in Spain and New York, screening of debris runways in Turkey, inspection of product labels in factories around the world and rapid face detection in Japan.

TensorFlow

TensorFlow is an open-source math library used for machine learning applications such as neural networks. Using TensorFlow we have trained a model with more than 5000 human faces which includes all the age categories and also human faces from different parts of the world. As a result, we got an accuracy of 96% for the trained model. It can be used in

the real-life use-cases, in monitoring and splitting human faces in videos captured from surveillance cameras.

CMake

Your system needs CMake, an open-source, cross-platform tool family designed to build, test, and package apps, installed. Using simple platform and compiler-independent configuration files, CMake controls the software compilation process, and creates native make files. In response to the need for a strong, cross-platform build environment for open-source projects such as ITK and VTK, Kitware developed a suite of CMake tools.

Dlib

Dlib is a modern C++ toolkit that contains machine learning algorithms and tools to create complex C++ software to address real-world problems. It is used in a wide range of areas, including robots, embedded devices, mobile phones and large high-performance computing environments, both in industry and academia.

PyMongo

MongoDB is a cross-platform document-oriented database program. Defined as a NoSQL database program, MongoDB uses JSON documents. MongoDB is developed by MongoDB Inc. and licensed under the Public License Server Side. (SSPL). In python pymongo module storing and collecting data from database is preferred. It is imported from pymongo client and connected to database. Each individual's image is captured and converted to a string and stored in a database. They can be accessed with a unique Id that is automatically generated when a data is entered into the database.

Apache Airflow

Apache airflow is used to handle the complete flow of the project. It is been used to design the pipeline. The structure will be in the form of Directed Acyclic Graph (DAG). When the dag is triggered the tasks will be executed parallelly. The main advantage of using airflow is that it won't execute the inputs given by the user (loaded photo) in queue. Every individually triggered DAG will run simultaneously without any delay. Using airflow, we can know the status of every tasks in the DAG. It will notify us whether the task is running or success or failure. In case of failure it will send a failure of task mail to the mail ID to which we have given access.

Algorithm:

We have used Eigen Face algorithm in detecting the faces. It is the name given to a set of eigenvectors when used in the computer vision The Eigen faces forms a set of all images used to build a complete covariance matrix. This induces dimension reduction by allowing the original training images to be interpreted by the smaller

collection of base images.

Face Recognition System Based on Eigenfaces Method

An uniqueness is the name given to a group of eigen vectors when used in the human face recognition computer vision problem. The uniqueness vectors are derived from the probability distribution covariance matrix over the high-dimensional face image vector space. The individual faces themselves form a base collection of all images used to construct the matrix of covariances. It creates dimension reduction by allowing the original training images to be interpreted by the smaller set of base images. Classification can be done by evaluating how the set basis represents faces.

D. Work Flow

The complete pipeline of the project is handled using apache airflow. The videos are captured from the surveillance cameras may be stored in database or it may be a live footage. The image of the person to be traced is loaded initially.

The loaded image will be matched with all the frames captured in the complete video. If the victim's image comes in the frame, it will cross - check with the loaded photo and if it matches more than the accuracy level, it will give an output as match found. The captured photo will be stored in database as a string value.

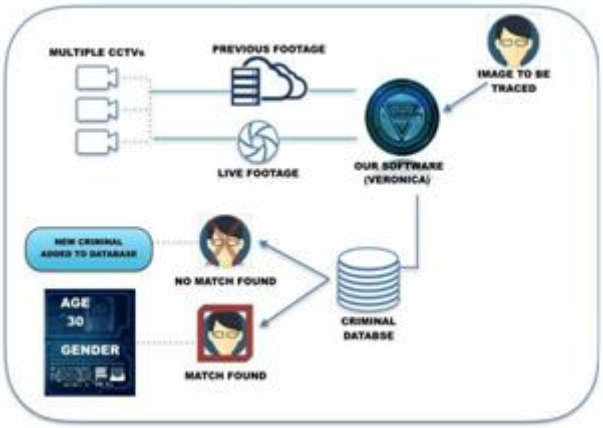
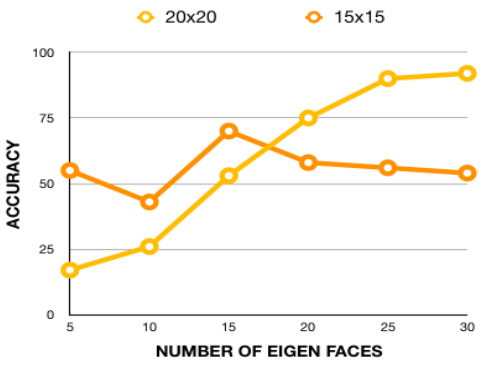


Fig. 1.Workflow of the system

Every image stored in db using PyMongo will be having a unique-id. Additionally, if the cross check with the criminal database. At the end of the pipeline, it will update us about his past records of crime, age, name etc.

IV. RESULT AND DISCUSSION



The photos which was taken for the experiment are of two sizes namely 15x15 and 20x20. The figure demonstrates relationship between the number of Eigen Faces and its accuracy from the model created. From the figure it is understood that when the number of Eigen faces increases, accuracy also increases. When 15x15 images are considered, when the number Eigen faces is more than 15, the accuracy falls down. This shows 15 Eigen faces is more than enough. In 20x20 faces the accuracy maintains between 90 to 95 percentages when the number of Eigen faces stands between 25 to 30.

V. CONCLUSION

Facial recognition is one of several artificial intelligence technology branches that have already started redefining what's possible. It was only a science fiction in film for a decade, and can now be made literally real. By 2020, that technology will make India one of the world's well-developed nations. It'll quickly become a part of it for the people of India. We have very advanced tools so that we can use them to do good and bad things but the key is the way we choose.

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