Efficient Face Recognition System for Identifying Lost People

Bharath Darshan Balar, D S Kavya, Chandana M, Anush E, Vishwanath R Hulipalled

Abstract*: *In the world, a countless number of people are missing every day which includes kids, teens, mentally challenged, old-aged people with Alzheimer's, etc. Most of them remain untraced. This paper proposes a system that would help the police and the public by accelerating the process of searching using face recognition. When a person goes missing, the people related to that person or the police can upload the picture of the person which will get stored in the database. When the public encounter a suspicious person, they can capture and upload the picture of that person into our portal. The face recognition model in our system will try to find a match in the database with the help of face encodings. It is performed by comparing the face encodings of the uploaded image to the face encodings of the images in the database. If a match is found, it will be notified to the police and the people related to that person along with the location of where the person is found. The face recognition model that we have used maintains an accuracy of 99.38% on the Labelled Faces in the Wild Benchmark which comprises of 13,000 images [1].

Index Terms*: *Face Encodings, Face Recognition, Finding, Lost Kids, Missing People.

I. INTRODUCTION

A missing person can be characterized as the one who can be a child or an adult -- who is lost, voluntarily or involuntarily. There are various categories of missing cases of which only 43% of missing cases' reasons are known, 99% are juvenile runways, 2500 cases are due to family problems and around 500 cases are kidnapped by strangers (which include both teens and adults). Women add about 52% of missing cases and males 48%.

"In India, there are no budgets allocated to finding missing people", claimed by an official source.

A missing person faces many obstacles, few are subjected to death (murder), rape or abusement. People concerned with the missing person such as parents, friends, relatives and guardians are exposed to stress and worries from not knowing whether the missing person is alive or dead.

In our system, the image of the person given by the guardian at the time of missing is stored in the database. The public is given authority to upload photographs of any person in uncertain situations. Automatic detection of match for this picture among the already existing images in the database will be done through our application. This helps the police department to spot the missing person in any place in India.

When a suspicious person is found, the picture at that instance of time is compared with the images uploaded by the guardian/police department at the time of missing through the face recognition model. If a match is found, it will be notified to the police and the guardian in the form of an alert message along with the location of where the person is found. If not found, a new record will be created in the database with the uploaded picture. By this way, it decreases the time taken to search for a person's detail after he is found.

Sometimes, the person has been missing for a long period of time. The age gap is reflected in the image as ageing affects the structure of the face, including shape, texture, etc. The appearance of the person can vary due to ageing, filters, pose, lightings etc. All these factors were considered before choosing the face recognition algorithm.

II. RELATED WORK

Previously, Pournami S. Chandran and his fellow mates from Centre for Development of Advanced Computing have a presented a paper [2] which deals with a similar problem statement and objective. The system proposed by them makes use of Deep Learning based Facial Feature Extraction and matching with SVM (Support Vector Machine)

The images of missing kids are stored in a database. Faces are detected from those images and features are learned by a Convolutional Neural Network. These learned features were used to train a multi-class SVM classifier. They used this method to correctly identify and label the kid.

The main difference between their work and ours is that, here once a lost person is found and if the person's face is not already existing in the database, the public themselves who found that person can register that face as a lost person with the location they found him/her in our portal which was not proposed in their system. This will help the process of searching faster. And their system involves complex algorithms which make the process of extraction and classification slower. These are the main disadvantages of the previously existing systems.

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In August 2016, Rohit Satle and his team presented a paper named [3] which addresses a face recognition system built by using Principal Component Analysis (PCA) method. The two main disadvantages of using the PCA method are that computational complexity is high and it can only process the faces that have similar facial expressions.

Swarna Bai Arniker and team have presented a paper [4] which addresses missing people identification system using RFID Technology. The disadvantage of this system is that the concerned person has to physically wear the RFID tag all the time which is infeasible.

Birari Hetal and her team have presented a paper [5] where they have used SWF-SIFT to compare faces. But SIFT is computationally heavy and therefore costs lots of time as it is based on Histogram of Gradients where each pixel in the patch need to be computed.

In 2015, Thomas M. Omweri and Andrew M. Kahonge have presented a paper [6] where they proposed a system that makes use of mobile-based web service to search for missing people. Here no modern technologies are used to search. The guardian uploads the details of the missing person in the portal. If any person spots the missing person in the portal, he can report it to the guarding using the contact they provided. This is a very straightforward approach and is inefficient.

In 2016, Professor Sumeet Pate and his team presented a paper [7] in which they used the Line Edge Method (LEM) for face recognition to find missing people. The efficiency of the system was 85%.

In 2018, Peace Muyambo from Zimbabwe proposed a face recognition system to find missing people in Zimbabwe in his paper [8] which used the LBPH method recognize faces. The proposed system had a face recognition rate of 67.5%. LBPH algorithm is not sensitive to the variation of luminosity.

III. METHODOLOGY

The proposed system makes use of Face Recognition for missing peoples' identification. The architecture of our framework is presented in figure 1.

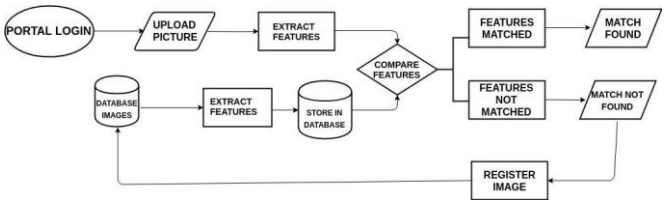

Figure 1. The Architecture of the proposed People Identification System

Here the public or police who finds a suspicious person (child, mentally challenged person, etc.) on the road uploads a picture of that person into the portal. Our algorithm extracts the face encodings of the image as shown in Figure 2 and compare with that of the face encodings of the previously existing images in the database. If a match is found, an alert message will be sent to both the concerned police officer and the parent/guardian of that person in the image. If a match is not found, then the person will be provided with the option of registering that face as a new entry to our database with the location they found and remarks.

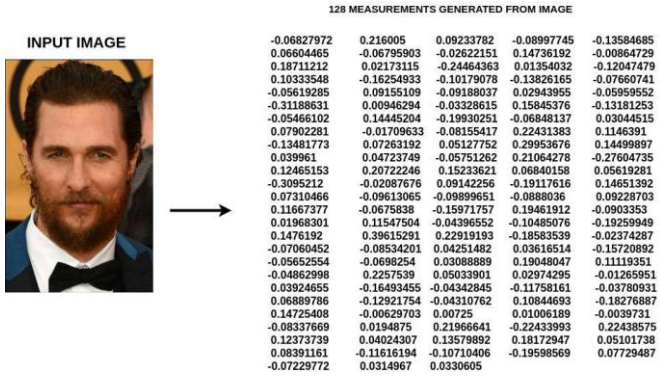

Figure 2. Face Encodings generated from an input image

Whenever public or police upload an image, the face encodings of the image are extracted and then compared to the face encodings of the images stored in the database. If the distance between the encoding of the uploaded image and the encoding of the image in the database is less than or equal to the threshold, then the face in both the images is of the same person as shown in Figure 3 and Figure 4. If that is the case, the user is notified that a match is found along with the picture from the database that matched with the uploaded picture. If the distance between the encodings is more than the threshold, it means that the faces in the images are not of the same person's. By this way, our proposed system will help in identifying the missing people.

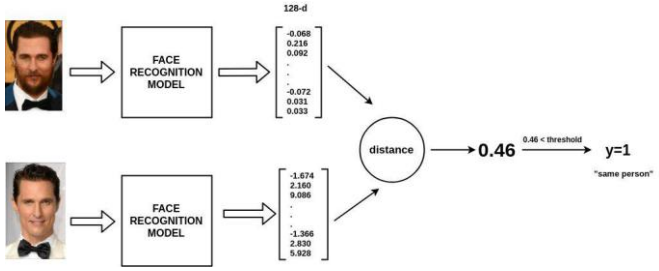

Figure 3. Comparing Face encodings of two images

The model we have used involves three main steps to perform face recognition.

STEP 1: Face detection – Firstly, face patterns are generated using Histogram of Oriented Gradients (HOG) algorithm. The images are made black and white. Here, the part of the images that looks more like the original HOG face pattern is found. Finally, the detected face is bounded by a bounding box.

STEP 2: Sixty eight specific points (landmarks) that are existing on every face are figured out by using the face landmark estimation algorithm. From the landmarks found, image transformations like scaling, shearing and rotation are used by the OpenCV's affine transformation to make the lips and eyes appear in the same location on every image.

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STEP 3: The face images are then passed through deep convolutional neural network. By doing this, we obtain 128 measurements which are 128 dimension hypersphere. And no one knows which parts of the face the 128 measurements representing. All we know is that the network outputs the same 128 numbers for two different images of the same person.

STEP 4: Finally, a linear SVM classifier is used to recognize the face. The classifier has been trained in such a way that it can take the measurements from a test image and gives the closest match as output.

A Flask api interface accompanies our model to give the user a better user experience as shown in Figure 4. When the user opens our application they will be asked to upload a image of the missing person. If a match is found, they will provided with the image and details about the match. If match is not found, they will be asked if they want to register that image as a new entry into our database. If they wish to register, they will be asked to enter the details about the image as shown in figure 5.

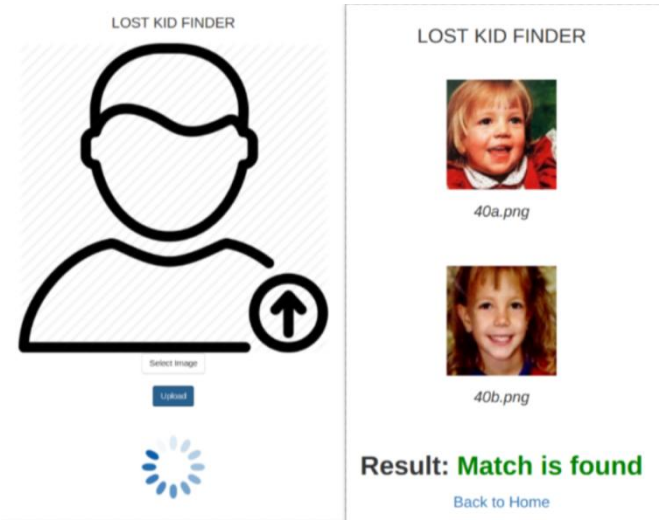

Figure 4. Interface for the system built using the Flask framework

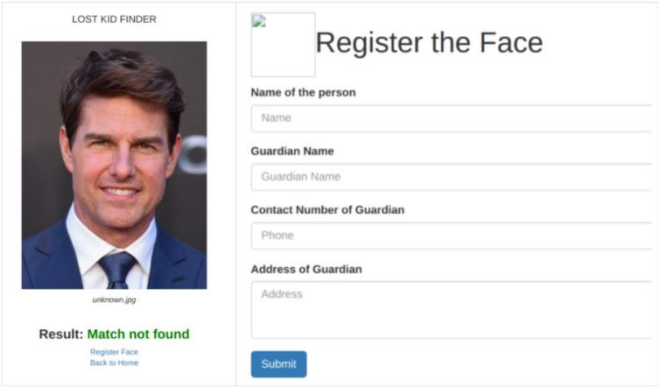

Figure 5. Face Registration form

IV. RESULTS AND DISCUSSION

The Face Recognition model we used has an accuracy of 99.38% on the Labelled Faces in the Wild Benchmark which comprises of 13,000 images [1].

The testing conducted by us yielded an accuracy of 97.5% where the dataset included 82 images – 41 pairs which included images of kids, teens, adults (male and female) with age gap, different hairstyles, filters etc. as shown in Figure 6.

The dataset we used is taken from Imaging and Vision site.

Figure 6. Set of images used as a test set to test the algorithm.

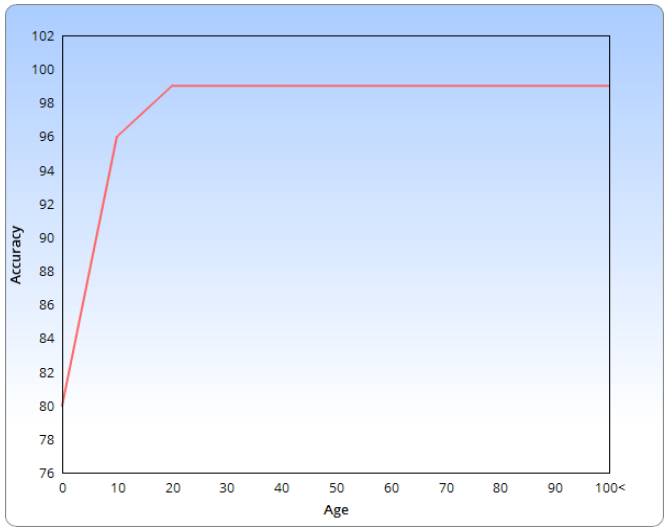

Figure 7. Graph showing the relationship between age and accuracy

V. CONCLUSION AND FUTURE SCOPE

By this way, the process of identifying the missing people is fastened. Our system replaces the manual method of scanning through the databases for each picture to check the match, by an efficient face recognition method which finishes the work in no time.

Though our system has a small limitation i.e. when the age of the person is between the age 0 and 10 the accuracy drops as shown in Figure 7. This is due to the incomplete growth of facial features at that age. We look forward to overcome this limitation in the future.

In the future, we are planning to extend this system further by connecting our system to public cameras and detect faces real-time. The frames will be continuously sent by the public cameras to our system where our system will be continually monitoring the frames. When a lost person is identified in any of the frames, it will be notified to the concerned authorities.

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