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AI for Detection of Missing Person

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***Abstract*— Identifying missing people and bringing them back to their families has become a universal issue. Various research publications are examined in this paper. Each of the existing mechanisms has merits and demerits. But the issues related to bringing back missing people have not been perfected 100%. Computing technology has evolved in recent years to include a wide range of flavors that can be used in practically every sector. Information plays a critical function in the computing system, notwithstanding the rapid-fire rise of technology. Every day, a considerable number of people, including children, teenagers, mentally challenged people, elderly people with Alzheimer's disease, and others, go missing around the world. In India, more than 500 missing person concerns are estimated to go unaddressed every day. Face recognition technologies have become increasingly important in recent decades. A facial recognition system is a computer application that can recognize or verify a person by analyzing a digital image or a video frame from a video source. Facial feature detection and recognition are extensively used in current world scenarios and technologies. Artificial intelligence, on the other hand, has given solutions to the issues of the ultramodern world. Artificial intelligence (AI) has been developed to help humans and machines communicate more effectively. The proposed mechanism has been successfully implemented to accurately identify a face with a precision of 90% when compared to 59% using KNN and 43% using SVM with PCA.**

Keywords: Artificial Intelligence, Open CV, Haar Cascade Classifier, Face Detection, Facial Recognition System

I. INTRODUCTION

Every day, a considerable number of people, including children, teenagers, mentally challenged people, elderly people with Alzheimer's disease, and others, go missing around the world. These people are kidnapped, sold as slaves, forced to labor as children, or forced to beg on train platforms, in small stores, or pushed into prostitution, human trafficking, or other illicit activities. The majority of them have gone untraced. This work is extremely beneficial to the government in terms of reducing the amount of time and manpower required to locate missing persons. Friends, relatives, parents, and guardians who are concerned about the missing person will experience stress and worry as a result of not knowing if the missing person is alive or dead. There is a tremendous need to bring an end to numerous situations of kidnapping, human trafficking, prostitution, and other unlawful enterprises in which people are enslaved with no possibility of escape. This would be achievable only if these individuals could be located swiftly and safely. The goal of this work is to assist in the investigation of cases and the rapid identification of victims. For this reason, we decided to create a system that will aid in the identification of missing people using face recognition, utilizing machine learning, deep learning, and artificial intelligence. We are concentrating on the face recognition challenges in our minds. Face identification must deal with a number of complex issues, including position, illuminations, and emotion, as well as backdrop imaged head size and orientation. Faces must be depicted in such a way that they can be distinguished from all other faces, which is a challenge. Face detection, face normalization, face feature extraction, and matching are the four modules that make up a face recognition system. Our research focuses on analyzing several face recognition algorithms and investigating how to propose a face recognition algorithm with improved performance.

TABLE 1. Depicts persons missing in year 2016, 2017, and 2018

Year	Male	Female	Transgender	Total
2016	1,16,418	1,74,021	-	2,90,439
2017	1,16,467	1,88,382	418	3,05,267
2018	1,23,339	2,23,621	564	3,47,524

***Source*:** Report on Missing Women and Children by NCRB

In the data given in table 1 has been collected from [26] it is seen that the cases related to missing persons are increasing rather than decreasing.

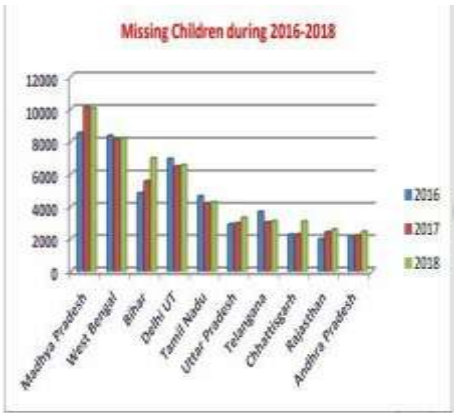

FIGURE 1. Graphical Representation of Missing Children during 2016-2018 (State-wise)
Source: *The Hindu*

II. LITERATURE SURVEY

The survey analyzes the various existing methodologies for the identification of missing persons. All of the articles are relevant to the proposed work and are based on matching features in the faces to identify them. It was found that common machine learning methods and technologies such as the KNN algorithm, Support Vector Machine, Random Forest, OpenCV, Dlib, Haar Cascade Classifier, Face Recognition, Face Modeling, and Face Detection are implemented in all of the articles, with varying degrees of accuracy. Articles on how different researchers applied facial recognition techniques to find missing people are listed in the table 2 given below.

In [1], the methodology involves using KNN classifier to identify missing person with their photos. When a person goes missing, a report is opened with photos and information such as name, age, and complexion. The KNN Classifier will then be used to train the classifier for cases that have been registered. To implement the prediction algorithm on each photo, all of the photos that have been accumulated will be used. If there is a match, it will be reported. All of the cases that have been verified will be shown. In [2], an AI based algorithm Searchious has been proposed. Searchious is a hybrid of an Android app for the general public and desktop software for police stations that uses a KNN-based enhanced face recognition algorithm. 68 facial points are registered and an encoded string of characters is generated after the photo passes through the face recognition phase. This key will be unique to each person. This key is now in use, and all of the photos in the database are matched to it. The police officer and the user are both notified if a match is found. A new case is opened if the match cannot be found in the police database. In [3], numerous research publications are analyzed. Each work is evaluated in terms of the author's strategy, implementation approaches, merits, demerits, future scope, and conclusion. The papers studied are also based on locating missing persons.

In [4], Histogram of Oriented Gradients (HOG) algorithm is used to create face patterns. The facial landmark estimation algorithm is used to determine sixty-eight particular points that exist on every face. Based on the landmarks discovered, the OpenCV library uses image modifications like scaling, shearing, and rotation. The images of the face are then fed into a deep convolutional neural network. Finally, the face is recognized using a linear SVM classifier. The classifier has been trained to be able to take measures from a test image and return the closest match as an output. In [5], the system employs a video or image of a human face as an input, and the processing unit is a Raspberry Pi model 3B with a camera module that helps capture photos, as well as Open CV, which is installed with the Python IDLE compiler. Haar Cascade Classifier is used to classify the images. The image from the database is compared with the image from the database, which is done using OpenCV. Face data is collected and assigned a unique identifier for the aim of training to recognize and distinguish people.

In [6], a deep learning CNN prediction model has been developed. The FGNET public dataset has been used for missing children. Following the training model, the image of the uploaded child will be compared to determine whether or not this child is in the database. The SVM Multiclass classifier is used to extract images based on age and other attributes, and the discovered face is then fed into the CNN model to determine whether or not the face exists. In [7], an approach for identifying missing children that blends deep learning-based face feature extraction with KNN-based matching. The face recognition method is implemented on the MATLAB 2018a platform, which splits the database photos into training and test sets. The convolutional network is simply used as a high-level feature extractor in the technique, and the trained KNN classifier is used to recognize the children.

In [8], a high-level system design approach for facial recognition that implements AWS recognition with the help of AWS Recognition. It will recognize a face in the image and record the face ID along with metadata in an S3 bucket. If the compared photographs are the same, an SNS notification will be sent to an email address. AWS Recognition analyses the submitted image and generates a unique face id that is unique for each face. The face id will be utilized as a unique key in DynamoDB to keep the missing person's relevant details. In [9], a model in which suspect photographs are uploaded via user interface, and past criminal and missing children's images are scraped from the internet. Haar Cascade Classifier is used to detect faces. BeautifulSoup package scrapes photographs from an online source that includes information about criminals and missing people. Face vectors are compared for similarity, and a similarity level is determined using the matching characteristics of both photos. Facepplib API library of python is used to compare the templates.

In [10], the victim's faces are collected and kept in a database with a unique identification. The classifier is trained using Haar Cascade, a machine learning-based approach that uses a large number of positive and negative images. To identify the victim, a unique primary key is assigned.
Each image's histogram values are stored in a local binary pattern histogram. The face Recognizer uses the captured image from the camera to save the histogram values of each image. In [11], the purpose of a CCTV camera is to detect a criminal who is present in a public place. The face-encodings are extracted from the collected photos. If the encoding values match the encoding values of the obtained image, the criminal image, name, and "criminal found" message will display on the screen. In [12], the OpenCV module is used for face

detection and identification. The PIL image module is used to read the grayscale picture and use the face that is recognized in each frame to train the recognizer. Face detection is done using the Haar Cascade algorithm. The Face Recognizer object is constructed, with functionalities for training and recognizing faces. The LBPH algorithm is used to extract local characteristics from photographs. Only those features that help increase the classifier accuracy are chosen using the Adaboost method.

In [13], the system collects faces in real time consisting of 24 persons in the form of 1056 images with resolutions of 112*92. Efficient RTFR (Real Time Face Recognition) is used to recognize faces with a known database. Convolutional Neural Network (CNN) which is used for feature extraction capacity from real time facial images and VGG 16 Deep Convolutional Neural Network with transfer learning are used for improving recognition accuracy. Finally, evaluation of two classifiers is measured using precision recall F1-score and accuracy. In [14], CNN architecture built with Keras, an open-source neural network library built on top of Tensorflow. The Viola Jones algorithm is used to detect faces in real time, and the cropped face image is then transformed to a grey scale of 120120 pixels and sent to the first convolution layer. In [15], Haar cascade and LBP classifiers are the two approaches used. Images are loaded into both systems using both ways. The photographs are exhibited after being converted to grayscale. The face in the image is separated into multiple blocks in LBP, and the Histogram for each block is determined. In [16], Haar Cascade Algorithm is used to detect human faces in a crowd. The input photos are correctly recognized. It also stores the time and the person's name in a text document. The technology recognizes the face through a rectangular window, which is then marked with his name. The detected person's information is saved in a text document. When a missing person is located, this information is shared with authorities and parents. A voice output is also produced by the system. In [17], the Android app captures photographs and sends them to a recognized workstation, where the PCA algorithm is used to see if the input image matches the database image. The outcome is communicated to the user. Furthermore, the user's location can be collected in order to track the activity of the missing child. In [18], Different machine learning algorithms are compared. The learning features from input data are controlled by a feed forward neural network, which is used from 2D convolutional layers. One or more non-linear processing layers are combined with a deep convolution neural network. The communication input layer and output layer of a deep convolution neural network are coupled by many hidden layers. In the method of linear discriminant analysis, the local features of the images are described. In [19], missing Person is a mobile application that offers a variety of functionalities, facial recognition, storing cases to a database, and matching photographs from the database. Upload an image and match the face to find a person. Compares it to the photographs contained in the database. If the image name matches, we can find out more about the missing person by looking up that image name in the admin panel's database. However, if the image does not match the database images, the message "this is not matched" is displayed on the screen. In [20], dlib is utilized in the system, and a user with a valid email ad dress can register with a single button click. Registered NGOs and law enforcement agencies with access to the national database can enter details and photos of children who have gone missing or been located. To lessen the load on the CPU, the age and gender variables are taken into consideration. The location API can be used to get a location.

In [21], it uses an on-device API to recognize entities in a photo without requiring any additional contextual metadata. The Face API detects the entire face without relying on precise landmark data. The source database and the image database are compared. Once a match is detected, this module sends an alert e-mail with the person's current position to the registered family members, as well as to police officials. The database automatically deletes information about the identified person. In [22], the network was trained using the Python programming language and modules such as OpenCV and Haar Cascade Classifier. With the Dlib library, the algorithm was deployed on hardware components including a Raspberry Pi and a Pi camera node. Human faces are detected by the camera. If a match is identified, an email is sent to the responding team. In [23], to file a complaint and store the data in the database, this system employs a login page. The Dlib toolkit is used to produce 136 * 3 facial landmark points from a missing person's facial key points. Then, using these points as input, the KNN classifier is trained to predict confidence. If the confidence is over 60 it is the same person.

In [24], Face photos are retrieved from a central database and the learning features required to train the face-recognition algorithms are extracted. The Viola–Jones technique is used to extract feature images from a huge sample set, and the cascade AdaBoost algorithm is used as the face detector, with a bounding box placed around the human face to localize the complete face region. In [25], this system gathers photos, which are then preprocessed to eliminate noise and redundancy from the three databases. The Haar cascade is used to extract features. The image is processed in real time and compared to processed images saved in the citizen database. It is then compared to the photos held in the local watch list database to check if a match is discovered, or it is scanned again in the international database if no match is found. If a match is found, the person you're seeking for is recognized.

TABLE 2. Comparison of related works

YEAR OF PUBLICATION	TITLE	METHODOLOGY	ADVANTAGES	LIMITATIONS
2020	[1]	KNN Classifier	Direct expenses and Indirect costs can be reduced.	Only when the data is limited the results look good.
2021	[2]	KNN based enhanced algorithm	The time is drastically reduced, resulting in increased production and efficiency.	The KNN has a 59 percent accuracy rate.
2021	[3]	Combination of OpenCV and KNN.	The use of the "HaarCascade frontal face default.xml" dataset.	There are some difficulties with the pixel size and image motion in this work.
2019	[4]	HOG with CNN and SVM Classifier.	The Face Recognition model utilized has a 99.38 percent accuracy rate.	when the age of the person is between the age 0 and 10 the accuracy drops
2021	[5]	HaarCascade Classifier	Continuous recordings of live video are made	Rotational invariant
2021	[6]	CNN and SVM Multiclass classifier	The SVM classification had 99.41% accuracy rate	VGG is a slower and more complex
2020	[7]	KNN Classifier and CNN	The accuracy of the classification is improved.	Additional processing is required, and the use of GPU is recommended
2021	[8]	AWS Recognition	It has obtained 98.40 percent accuracy.	API works best with professional videos shot in normal colour and lighting conditions with a frontal field of view
2020	[9]	Haar Cascade Classifier	Less memory space.	Affects performance in small modifications requiring long training period
2021	[10]	Haar Cascade Classifier with HOG	In a single frame or video, the model can detect many faces.	Because of LBPH, the computational complexity in terms of time and space is increased
2021	[11]	open-CV	Since the system's processes are automated, it saves time.	It takes up a lot of space because all the data must be stored first before they can be compared
2018	[12]	Haar Cascade And Lbph Algorithm	Recognize faces in a variety of lighting conditions	As compared to three databases, the computation time is increased.
2021	[13]	VGG 16 Deep Convolutional Neural Networks.	99.37% accuracy results for real time face images	It takes a lot of time to train
2020	[14]	CNN and Viola Jones algorithm	The optimum recognition accuracy was 98.75 percent.	320 photos used for training, remaining 80 images were used for testing.
2021	[15]	Haar cascade and LBP classifiers	Accuracy of Cascade is higher than LBP	Fewer faces detected.
2020	[16]	Haar Cascade Algorithm	A vocal output is generated by the system. This will aid blind people in detecting through their CCTV.	Instead of a database, a text document is utilized to store information
2016	[17]	PCA algorithm	The PCA algorithm has a calculated accuracy of around 91 percent.	Small datasets make interpretation difficult
2020	[18]	CNN and Linear Discriminant analysis	Each work is assessed in terms of its virtues and flaws.	Every subject in every stance must be photographed in a gallery.
2020	[19]	Android Application with a face matching algorithm	Efforts are made to implement it with much more accuracy.	Admin must manually update the database on a regular basis
2021	[20]	Dlib and CNN	Deep learning library with a high efficiency rate.	Dataset over-training
2020	[21]	On-device API (ML Kit on Android)	The Android app sends the missing person's current image and GPS location to the family and a nearby police station	Extremely heavy for the app, causing it to be too huge
2021	[22]	Haar Cascade Classifier with the Dlib library	The proposed method has a 72.9 percent accuracy rate	The accuracy rate of the proposed work is 72.9 percent.
2021	[23]	The Dlib toolkit is used with KNN classifier	Negates the need for manual search.	For prediction, a confidence score is used.
2022	[24]	Viola–Jones technique	Even when dealing with low-resolution photos, more efficiency is obtained.	The dataset used in this work isn't available to the public
2019	[25]	Haar cascade Classifier	Removes the need for manual thumbprint authentication.	As an open source system, it poses a privacy concern.

III. METHODOLOGY

Finding missing person using support vector machines which utilizes intermediate output of convolutional neural networks for face detection. Convolutional Neural Networks (CNN) and Support Vector Machines (SVM) are two algorithms that have been shown to recognise various patterns. CNN serves as a trainable feature extractor in this system, while SVM serves as a recognizer. This hybrid model gathers information from raw photos and makes predictions automatically. When compared to previous studies on the same database, this fusion appears to have produced better results i.e., a recognition rate of 90% without rejection.

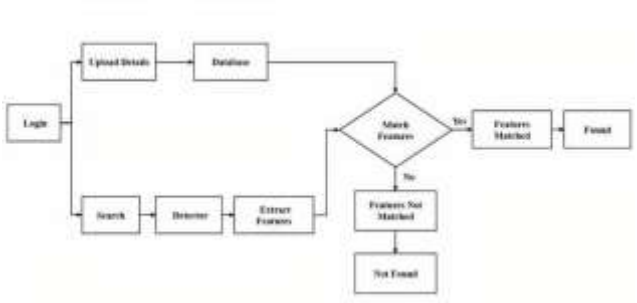

FIGURE 2. Workflow model

A. Reporting a Missing Person

In case an individual goes lost, family individuals or companions will be able to report the case on the framework. They will be able to enroll by entering people valuable points of interest such as title, age, sex, date of birth, address etc. All the subtle elements will be put away in database that's sqlite3. Real time dataset will be made and pictures will be spared in an empty folder.

FIGURE 3. Login Page

Figure 3 represents the Login module which is a gateway module that enables users to log in by inputting their password and username.

FIGURE 4. Home Page

FIGURE 5. Registering New Case

B. Reporting a Found Person

If a person who has been reported missing is located, they might be reported as rescued. The missing individual's current location and contact information, as well as the information of the person who reported the case, should be provided. It's possible that the reporter will need to be contacted for more information. On the system, users will be able to look for their missing loved ones. Python SQLite3 module is used to integrate the SQLite database with Python. It provides a straightforward and simple-to-use interface for interacting with SQLite databases.

Figure 4 and Figure 5 represents the Home Page and Registering new case, in this system there are functionalities to file FIR or register a case, save data i.e, store the captured images into the database, view records, Check datasets, change passwords, the details like the case no., name, age, gender, specific intricate details if wished to be specified, the space is also provided.

FIGURE 6. View Database

FIGURE 7. Dataset

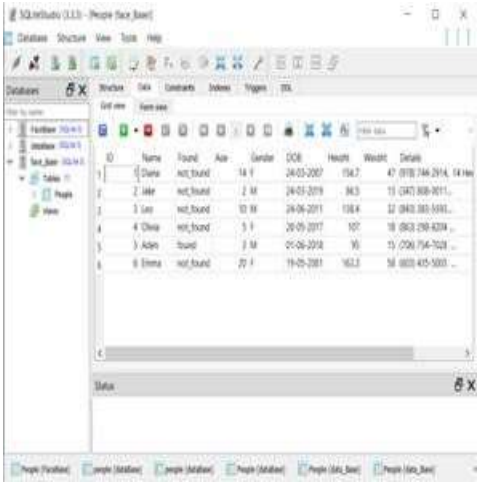

FIGURE 8. Database

Figure 6, Figure 7 and figure 10 shows the output of the dataset, real time status of the database with respective names.

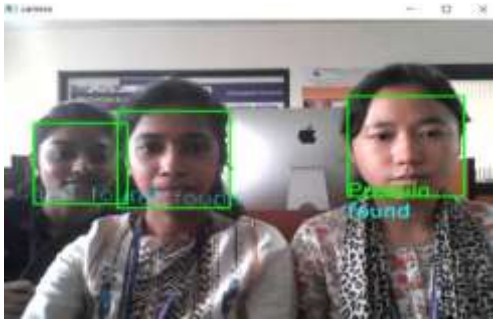

FIGURE 9. Detecting the person

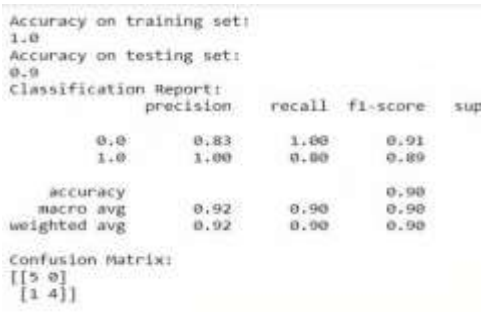

FIGURE 10. Accuracy

Figure 9 and figure 10 shows the output of the implementation of the proposed system. The proposed mechanism is successful in identifying the person under consideration.

Tkinter is a Python GUI that allows users to interface with an underlying application by allowing them to interact with various functions via the display, which they may touch, tap, and swipe on.

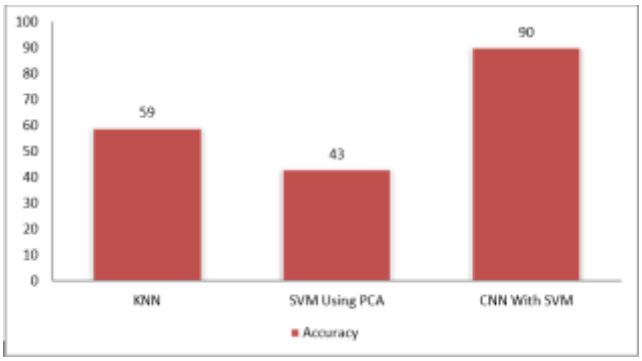

FIGURE 11. Comparative analysis

The comparison of KNN, SVM utilizing PCA values and CNN with SVM is shown in Figure 11. The accuracy of the CNN with SVM is 90%, which is significantly greater when compared with the methodologies used in [2].

IV. RESULTS

The purpose of this work was to provide an outline of face detection and tracking in order to locate a missing individual. We've devised a system for locating missing people using CCTV cameras, face photos, and a variety of other capturing devices. When the individual is thought to be seen anywhere, the singular's information will be specified into the system, and the image in the database will be quickly compared. The system achieves 90.00 percent accuracy while increasing efficiency and reducing computation time.

V. CONCLUSION

A country with such a large population cannot afford to lose its valued inhabitants to criminals' treachery and malice. And, in the case of India, when our children go missing and are never discovered, they are either left to beg or handicapped in such a way that they are barely recognizable. Face detection technology is just getting underway, and there are a number of different applications where it can be used. When used appropriately, this technology can be advantageous. Our work will improve the current person-finding system. It is very possible for ordinary civilians to intervene using our proposed technique. While doing so, they can speed up the process of locating missing people. The time spent by the police and those associated with the person is drastically reduced, resulting in increased production and efficiency. In future this system will be refined and be able to identify the location of a person through CCTV footage captures to track and save a missing person as fast as possible.

VI. REFERENCES

[1] Mithilesh Kumar etal, "locating Missing Persons Using Artificial Intelligence", Vol 11, Special Issue I, May 2020, 43-46

[2] Mrs. Vishakha Shelke Mr. Gunjan Mehta Ms. Prajakta Gomase Ms. Trisha Banger, "Searchious: Locating missing people using an optimised face recognition algorithm",Fifth International Conference on Computing Methodologies and Communication (ICCMC 2021) IEEE Xplore Part Number:

CFP21K25-ART

[3] Neha Gholape, Ashish Gour, Shivam Mourya, "Finding missing person using Ml, AI", Volume:03, Issue:04, April- 2021

[4] "Efficient Face Recognition System for Identifying Lost People", ISSN: 2249 – 8958, Volume-8, Issue-5S, May 2019

[5] Adlan Hakim Ahmad, Sharifah Saon, Abd Kadir Mahamad, Cahyo Darujati, Sri Wiwoho Mudjanarko, Supeno Mardi Susiki Nugroho, Mochamad Hariadi, "Real time face recognition of video surveillance system using haar cascade classifier", ISSN: 2502-4752,2021

[6] K Ashok Kumar, P Anupama, P Naveen, S Poojitha, "Missing Child Identification System using Deep Learning and Multiclass SVM", Volume XII, Issue II, ISSN: 0975- 4520

[7] Suman, "Nearest Neighbor for Missing Child Identification", International Journal of Engineering Research and Management (IJERM), ISSN: 2349- 2058, Volume-07,

Issue-12, December 2020

[8] Sanskar Pawar, Lalit Bhadane, Amanullah Shaikh, Atharv Kumbhejkar, Swati Jakkan "Find missing Person Using AI",
Volume: 08 Issue: 12 2021 p-ISSN: 2395-0072

[9] S. Ayyappan and S. Matilda, "Criminals and missing children identification using face recognition and web scrapping", IEEE ICSCAN 2020.

[10] M. Bharathwaj, K. Pravalika, Y. Keerthi, "Missing Child Identification Using Deep Learning", Volume 9, Issue 2021,
ISSN: 2320-2882

[11] Nagnath B. Aherwadi, Deep Chokshi, Sagar Pande, Aditya Khamparia, "Criminal Face Identification System Using Face Identification." ,2021

[12] Piyush Kakkar, Mr. Vibhor Sharma (2018) "Automated Criminal Identification System using Face Detection and Recognition", Volume: 06 Issue: 10, e-ISSN: 2395-0056

[13] Showkat Ahmad Dar, S Palanivel, "Performance Evaluation of Convolutional Neural Networks (CNNs) And VGG on Real Time Face Recognition System", Volume 6,

Issue 2, Page No 956-964, 2021

[14] Pranav KB and Manikandan J, "Design and Evaluation of a Real-Time Face Recognition System using Convolutional Neural Networks"

[15] Anirudha B Shett , Bhoomika, Deeksha, Jeevan Rebeiro, Ramyashree, "Facial recognition using Haar cascade and LBP classifiers"

[16] Roshin John, Basil Kuriakose, "Face Detection and Tracking to Find the Missing Person", Volume-3, Issue-6,
June-2020, ISSN (Online): 2581-5792

[17] Rohit Satle , Vishnuprasad Poojary, John Abraham , Mrs. Shilpa Wakode, "Missing Child Identification Using Face Recognition System", Volume 3 Issue 1 July – August 2016,
ISSN No 2348-7208

[18] Bhupendra Chourasiya, Deepak Dangi, Hari Agrawal, Kavita Namdev, "Finding missing people using Face Recognition: A Comprehensive Case Study", Vol. 8, Issue 2, 2020, ISSN (online): 2321-0613

[19] Ahtasham Ansari, Aditya Singh, Abhishek Sagar, Komal, "Android based Application – Missing Person",

Volume: 07 Issue: 03, Mar 2020, e-ISSN: 2395-0056

[20] Aditya Mahimkar, Dilip Jain, Siddhesh Kadam,Dr. Kishor T. Patil, "NEST - Missing Child Tracking and Identifying",ISSN-2349-5162,Volume 8, Issue 52021

[21] \R. Jhanani, S. Harshith, T. Kalaichelvi, V. Subedha, "Mobile Application for Human Facial Recognition to Identify Criminals and Missing People Using Tensor Flow", Volume-3, Issue-4, April-2020, ISSN (Online): 2581-5792 [22]Anthony UAdogheetinosa,Noma-OsaghaeKennedy OkokpujieUduebholo, Emmanuel Edose, "A Haar cascade

classifier based deep-dataset face recognition algorithm for locating missing persons", ISSN:1992-8645,2021

[23] Shefali Patil, Pratiksha Gaikar Divya Kare, Sanjay Pawar, "Finding Missing Person Using AI",Vol.2, no.6, June 2021, ISSN (Online): 2582-7898

[24] Adnan Nadeem, Muhammad Ashraf, Kashif Rizwan, Nauman Qadeer, Ali AlZahrani, Amir Mehmood and Qammer H. Abbasi, "A Novel Integration of Face- Recognition Algorithms with a SoftVoting Scheme for Efficiently Tracking MissingPerson inChallenging Large- Gathering Scenarios"Sensors 2022, 22, 1153. https://doi.org/10.3390/s22031153

[25] Apoorva.P, Ramesh.B and Varshitha.M.R "Automated criminal identification by face recognition using open computer vision classifiers"

[26] https://ncrb.gov.in/en