ON BORDER SECURITY BASED FACE DETECTION SYSTEM

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Abstract- *Border Security is a process which measures border control policies adopted by a country or group of countries to fight against unauthorised travel or trade across its borders, to limit illegal expatriate, combat transnational crime, and prevent wanted criminals from travelling. The system will help in keeping a check on those personnel's who forge with the legal document with an intension to cross the border. In a survey of Border Security of whole Indian Context there are various such system have been built since 2010 as Wireless Sensor Network system named "Panchendriya", Automatic and Manual switch mode target weapon system for border security using ultrasonic sensor. In this paper we have made use of Haar-Cascadian along with LBPH Algorithm with their functioning. Thereafter we represent the comparison of most recent face recognition techniques that have been used in the last 10 years. Then after The Proposed Prototype model of this project is discussed and shown through Simulation in the paper.*

Keywords: Border Security, Border Surveillance, Haar-Cascade Classifier, Face Detection, Face Recognition, LBPH, Criminal Identification.

1. INTRODUCTION

The main objective is to identify the correct identity of person by the use of face detection method if their identity is matched with the database then they allow to cross by the border. In a way of doing this we can increase the security aspect of the border [1]. Also through Face Detection Method we will reduce pen and paper work as it is done digitally and this will increase the security level which will reduce the illegal activities and will help the officers in recognising the person easily and also doing the Criminal Identification. Face recognition is the task of identifying an already detected object as a known or unknown face [9]. Face recognition is a software application adapted to identify individuals via tracking and detecting. The main intention of this paper is to recognize the faces of people. This approach can be executed practically in crowded areas like Borders, airports, railway stations, universities and malls for security. The main target of this paper is to enhance the recognition rate and accuracy [10]. Nowadays, almost all countries are facing the problem of internal security from their border areas. Terrorists and intruders are disturbing the tranquillity and consonance of the country. The casualty prompted by the recent Pulwama strike and Uri attack against Indian military force reveals the significance of effective surveillance in the border region. Traditional border patrol systems require a huge number of military persons, and high-cost, high-tech surveillance devices employed in unmanned border patrol systems, So in a survey on Border Security of whole Indian Context various System are described that have been built so far. There is a System that is still in use that is "Panchendriya" a hybrid Wireless Sensor Network

system which is being utilizing the integration of five types of sensors: Geophone, Hydrophones, Microphones, Infrared sensors and Camera sensors for effective surveillance and detection of human intrusion in the abovementioned border scenarios with early warning capability. But there is still some problem in this system regarding the recognition rate which can be affected by the Environment factor and the people cannot be identified properly. So to overcome with that problem a proposed system can be discussed in this Paper. Haar-Cascade is a machine learning object detection algorithm used to identify objects in an image. It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images.

In the prototype it is shown that the vehicle will be approaching towards the process of checkpoint, the people of the vehicle will undergo their personal screening with the help of surveillance camera since we have already maintained the database (registered faces) of all the people who mitigate across the border, Face detection system if finds the screened faces with any of the faces stored in the database, they will be granted permission to move across the border. During screening if any individual face is not matched with the database then his access will be denied and he want be permitted to cross the border ,he will go some other legal procedure to get the permission. Below Diagram is the flowchart of On Border Security System-

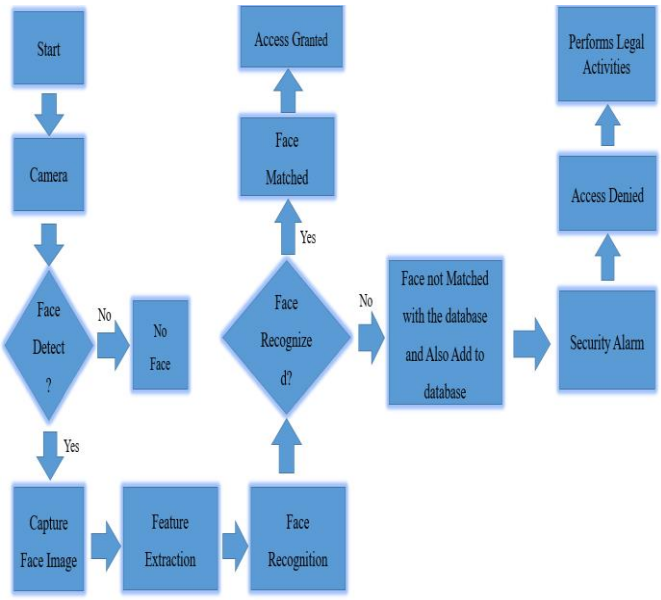

Fig -1.1: Flowchart of On Border Security System

2. TECHNOLOGY USED

2.1 Haar-Cascade Classifier

Haar-Cascade is a machine learning object detection algorithm used to identify the objects in an image. It is most widely used algorithm in border security. In this approach there is a cascade function which is trained by lot of positive images and negative images. The cascade classifier contains collection of various stages, where each stage is a group of weak learners. The weak learners are simple classifiers called decision stumps. Each stage is being trained by using a technique called boosting. Boosting provides the ability to train a highly accurate classifier by taking a weighted average of the decisions made by the weak learners [8]. In below diagram features of Haar Cascade Classifier is discussed-

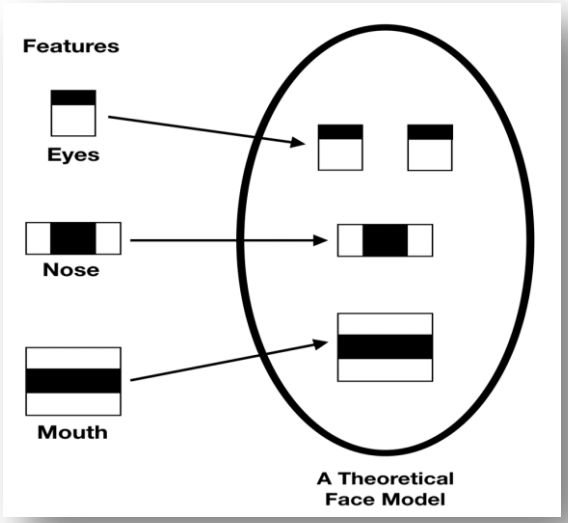

Fig -2.1: Haar- Cascade Features

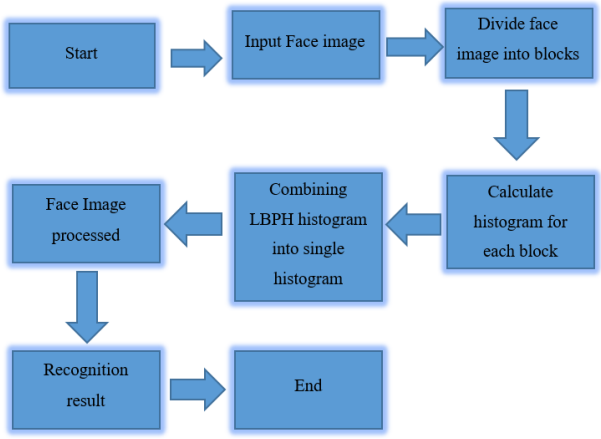

Fig - 2.2: LBPH model for On Border Security System

2.2. LBPH

For Face Recognition, The Local Binary Pattern Histogram (LBPH) algorithm is a simple solution on face recognition problem, which can recognize both front face and side face. To solve this problem, a Modified LBPH algorithm based on pixel neighbourhood grey median (MLBPH) is proposed. The first step of the LBPH is to create a histogram of an intermediate image that describes the original image in a better way, by highlighting the facial characteristics. To do so the algorithm uses a concept of a sliding window, based on the parameters radius and neighbours [4]. Below Diagram is Working of LBPH Algorithm-

2.3 Open-CV

Open CV is a Python library which is designed to solve computer vision problems. Open CV supports a wide variety of programming languages such as C++, Python, and Java etc. Support for multiple platforms including Windows, Linux, and Mac OS. Open CV Python is nothing but a wrapper class for the original C++ library to be used with Python. Using this, all of the Open CV array structures gets converted to/from Num Py arrays. This makes it easier to integrate it with other libraries which use Num Py. For example, libraries such as SciPy and Matplotlib. Next up on this Open CV Python Tutorial blog, let us look at some of the basic operations that we can perform with Open CV [5].

3. LITERATURE REVIEW

To have an insight into the Border Security in the Whole Indian Context, The below table shows a comparison of various techniques used in On Border Security Based Face Detection System with the objective and analysis-

Table – 1: Comparison of Methods used in Border Security Face Detection System

References	Objective	Method	Result
[1]	The main objective of the research is to show the IOT Based Security System (IBSSS) aims at reducing the burden on forces and providing an additional layer of security with high precision and Accuracy.	IOT, LDR	They Concluded that the LDR is the best method to achieve the better recognition rate.
[2]	The main aim of the research is to show the Smart Border Surveillance System using Wireless Sensor.	WSN	The proposed system could be a great help in enhancing The security of our border regions especially, the areas facing extreme climatic or terrain conditions where human Deployment is a major peril.
[3]	The main aim of the research is to show the prototype model of criminal identification by using the raspberry-pi and the Face detection and Face Recognition Algorithms.	Haar- Cascade Algorithm and LBPH Algorithm	The recognition rate attained by this process will be 95%-98%. There will be deviation in the result on account of the distance, camera resolution and lightning.
[4]	The main aim of the research is to show functioning of the automatic and manual weapon system for Border Security.	Method of Microcontroller	They Concluded that the proposed system greatly benefits the soldiers and our Indian Automatic and Manual switch Targeting weapon system is feasible for highly secure areas.
[5]	The main aim of the research is to implement the face recognition Security System using the PCA Algorithm.	Eigen faces, PCA	The recognition rate attained by this process will be 81%-85% and also proposed that PCA is best method among other algorithms.
[6]	The main objective of the research is to analyse the benefits and drawbacks of many improved face recognition Techniques.	SVM and HMM	They concluded that the methods of SVM and HMM can produce better face recognition results.
[7]	The main aim of the research is to propose the recognition rate using Genetic Algorithm.	Genetic Algorithm	They concluded that Genetic Algorithm is the best method to produce better recognition results i.e. 80%.
[8]	The main aim of the research is to propose a supervised auto encoder, which is A new type of building block for deep architectures.	Supervised auto-encoder , Neural network	They proposed that the Supervised auto-encoder method to get better accuracy results and also gives the relevant benefits.
[9]	The main objective of the research is to propose depth analysis of current research trends of CBIR and its potential applications in the field of biometric security.	CBIR, CBFR	They proposed that the CBFR method resolves the robustness problem of current face recognition systems as well as provides high recognition performance irrespective of Training.

[10]	The main objective of the research is to propose a computational model for Person's Authentication in Face Recognition Security System.	Elastic bunch method, graph matching	They concluded that graph matching is the best method to produce better recognition results i.e. 78%.
[11]	The main aim of this research is to analyse an adaptive classification system (ACS) is Proposed for video-based face recognition Security System.	DPSO	They proposed that in future the accuracy will be 75-78%.
[12]	The main Objective of this research is to analyse the motion detection concept used in the proposed system	Motion Detection Algorithm, SAD	They Concluded that the the detection of moving object from the image sequence. Requires very less pre-processing of the frames from image sequence.
[13]	The main aim of this research is to propose to label a Self-Organizing Map (SOM) to measure image similarity.	SOM	They concluded that on using the neural network SOM algorithm the recognition rate will be approached to 70-75% in future.
[14]	The main objective of the research is to propose the discussion of Correlation method in the field of Face Recognition Security System.	Correlation Technique	They Concluded that on using the Correlation Method, the recognition rate in future will be 65-70%
[15]	The main objective of this research is to propose the novel system for combining depth and intensity information to improve face recognition systems.	LDA	They Concluded that on using the LDA method gives the better depth and intensity information of confidence.

4. METHODOLOGY

4.1 Dataset Collection

When benchmarking an algorithm it is recommendable to use a standard test data set to be able to directly compare the results. There is another way to choose the data set specific to the factor to be tested (e.g. how algorithm behaves when given images with lighting changes or images with different facial expressions), so we took some sample of photos about 250 using Haar-Cascade Classifier method using Open-CV by webcam in different environment. In Below Diagram few sample of data is shown-

Fig - 4.1: Image Samples for dataset using Haar-Cascade

4.2. Training

In the training module the dataset images can be trained using the various training algorithms in on border Security based Face Detection System the Haar Cascade Training Algorithm is used to train the model which contain the various sample of images into an accurate angle and size using Open-CV which comes with detector as well as Trainer [6]. Its Features are shown in the figure 2.1.

4.3. Recognition

For the recognition we use the LBPH algorithm in which the sample of images which are collected in database can be matched in real time if face can be matched then the door unlock and the following person is allowed to cross the border. The flowchart of LBPH is shown in the figure 2.2.

When the system is attached to the video surveillance camera the recognition system searches the field of view of a video camera for faces. A multi-scale algorithm is used to search for faces in low resolution. Once a face is detected, the system determines the position of head, size and pose. A face needs to be turned at least 35 degrees toward the camera for the system to register it.

The image of the head is scaled and rotated so that it can be registered and mapped into an appropriate size and pose [1]. Normalization is performed regardless of the head's location and distance from the camera. The system translates the data of face into a unique code for further processing. This coding process allows the easier comparison of the newly acquired facial data to stored facial data. The newly acquired facial data is compared to the stored data is compared to the stored data and (ideally) linked to at least one stored facial representation [8].

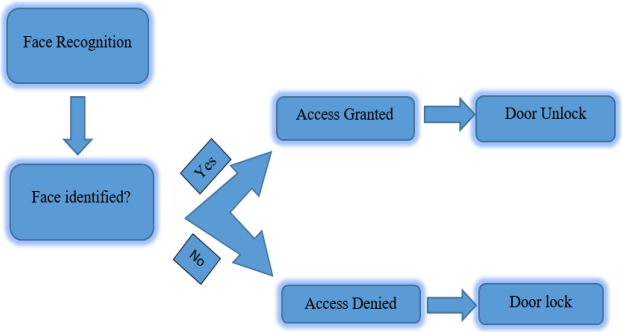

Fig - 4.2: Flowchart of Security based face recognition.

4.4. Prototype Model

- As per the set the motion sensor will detect the arrival of vehicle.

Fig - 4.3.1: Motion Sensor

- As the Vehicle approaches towards the Barrier the whole component hardware and software of face detection system starts working.

Fig - 4.3.2: Approaching of Vehicle

- As per the set up the surveillance camera will start detecting the individual face.

Fig - 4.3.3: Detection by Camera

- The screened faces will automatically matched with the stored databases.

Figure 4.3.4 Opening of Barrier

- After the matching of faces is done, the system will grant access and the people will allow to cross the border.

Fig - 4.3.5: Crossing of Car across Border

Note- If the faces are found unmatched with the original database so those people will undergo some other legal procedures.

5. RESULT AND DISCUSSION

The output proposed in this article by the recognition of accuracy is 82% but this model is refined in the future to improve the security level more effectively and even at the time of forming the dataset, each person will get designated using an id number. While recognition, when the test person image matches with the dataset then a message will get send like an unauthorized person symbolizes criminal or thief through internet of things, if the test person image does not get matched with the dataset then no message will get send symbolizes a normal human being.

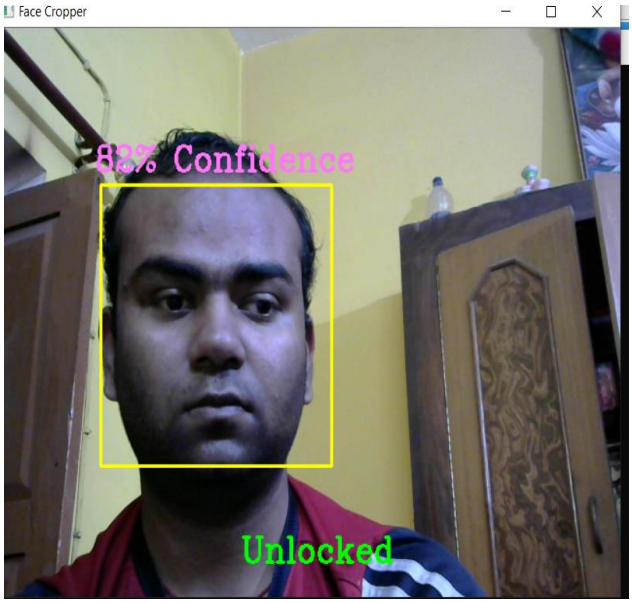

Fig - 5.1: Final output screen with Accuracy

6. CONCLUSION AND FUTURE WORK

The computational models, which were discussed in this article, were chosen after extensive research, and the successful testing results confirm that the choices made by the researcher were reliable. The system with manual face detection and automatic face recognition did not have a recognition accuracy over 90%. Hence it

can be concluded that the Accuracy is maximum 90% and not less than 80%, so it is clear that the accuracy is fully depend on the environment factor and presently all the researchers are working on this real time project and mainly they are working on accuracy and efficiency but in future the accuracy can be beyond 90% and large number of sample images can be effectively used to train the proposed model in order to increase its efficiency and accuracy as well at the security aspect on border. These automated system can be used to identify or check the identity of individuals crossing border in just few seconds based on their facial features. Face Recognition and Detection using this Proposed Automated System is used when issuing identity documents and helpful in prevention of ID Fraud and Identity Theft. The algorithms are compared on the basis of two parameter computation time and accuracy in term of speed HoG Algorithms bit faster algorithms Followed by Haar-Cascadian and CNN. The Hog Algorithm perform pretty well but some issues in identifying small faces. So we preferred Haar-Cascadian Classifier Algorithm which performs around as good as Hog Overall.

So we personally used mainly Haar-Cascadian in our proposed project due to its speed and accuracy. This Algorithm when provided an ideal atmosphere the accuracy achievable is 95-97%. In future when this proposed project implemented practically with all essential hardware and software components it will minimize the efforts of border guards in screening the individual and keep them safe from any fraud intruders into the border.

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