**ON BORDER SECURITY BASED FACE DETECTION SYSTEM**

**A Project**

Submitted in partial fulfillment of the requirements for the degree of

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**Guided By**

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Certified that Abhay kumar tiwari, Shivam kumar dubey, Harsh pandey has carried out the project work presented in this report entitled “ON BORDER SECURITY BASED FACE DETECTION SYSTEM” for the award of Master of Computer Application from SRM Institute of Science and Technology, Delhi NCR under my supervision. The report embodies result of original work and studies carried out by Student himself/herself and the contents of the report do not form the basis for the award of any other degree to the candidate or to anybody else.

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**ABSRACT**

Conventional method of identification based on possession of ID cards or exclusive knowledge like a social security number or a password are not all together reliable. ID cards can be lost forged or misplaced; password can be forgotten or compromised. But a face is undeniably connected to its owner. It cannot be borrowed, stolen or easily forged. Face recognition technology may solve this problem since a face is undeniably connected to its owner except in case of identical twins. The system can then compare scans to records store in central or local database or even on a smart car.

The face is one of the easiest ways to distinguish the individual identity of each other. Face recognition is a personal identification system that uses personal characteristics of a person to identify the person's identity. Human face recognition procedure basically consists of two phases, namely face detection, where this process takes place very rapidly in humans, except under conditions where the object is located at a short distance away, the next is the introduction, which recognize a face as individuals. Stage is then replicated and developed as a model for facial image recognition (face recognition) is one of the much-studied biometrics technology and developed by experts. There are two kinds of methods that are currently popular in developed face recognition pattern namely, Eigenface method and Fisherface method. Facial image recognition Eigenface method is based on the reduction of face-dimensional space using Principal Component Analysis (PCA) for facial features. The main purpose of the use of PCA on face recognition using Eigen faces was formed (face space) by finding the eigenvector corresponding to the largest eigenvalue of the face image. The area of this project face detection system with face recognition is Image processing.

Facial Expression conveys non-verbal cues, which plays an important roles in interpersonal relations. The Facial Expression Recognition system is the process of identifying the emotional state of a person. In this system captured image is compared with the trained dataset available in database and then emotional state of the image will be displayed.

This system is based on image processing and machine learning. For designing a robust facial feature descriptor, we apply the Local Binary Pattern. Local Binary Pattern *(*LBP) is a simple yet very efficient texture operator which labels the pixels of an image by thresholding the neighborhood of each pixel and considers the result as a binary number. The histogram will be formed by using the operator label of LBP.

The recognition performance of the proposed method will be evaluated by using the trained database with the help of Support Vector Machine. Experimental results with prototypic expressions show the superiority of the LBP descriptor against some well-known appearance-based feature representation methods.

Identifying a person with an image has been popularised through the mass media. However, it is less robust to fingerprint or retina scanning. This report describes the face detection and recognition. It reports the technologies available in the Open-Computer-Vision (OpenCV) library and methodology to implement them using Python. For face detection, Haar-Cascades were used and for face recognition Eigenfaces, Fisherfaces and Local binary pattern histograms were used. The methodology is described including ow charts for each stage of the system. Next, the results are shown including plots and screen-shots followed by a discussion of encountered challenges.

**INTRODUCTON**

**Project introduction**

Face recognition is the task of identifying an already detected object as a known or unknown face.Often the problem of face recognition is confused with the problem of face detection. Face Recognition on the other hand is to decide if the "face" is someone known, or unknown, using for this purpose a database of faces in order to validate this input face.

A Facial expression is the visible manifestation of the affective state, cognitive activity, intention, personality and psychopathology of a person and plays a communicative role in interpersonal relations. It have been studied for a long period of time and obtaining the progress recent decades. Though much progress has been made, recognizing facial expression with a high accuracy remains to be difficult due to the complexity and varieties of facial expressions .

Generally human beings can convey intentions and emotions through nonverbal ways such as gestures, facial expressions and involuntary languages. This system can be significantly useful, nonverbal way for people to communicate with each other. The important thing is how fluently the system detects or extracts the facial expression from image. The system is growing attention because this could be widely used in many fields like lie detection, medical assessment and human computer interface. The Facial Action Coding System (FACS), which was proposed in 1978 by Ekman and refined in 2002, is a very popular facial expression analysis tool .

On a day to day basics humans commonly recognize emotions by characteristic features, displayed as a part of a facial expression. For instance happiness is undeniably associated with a smile or an upward movement of the corners of the lips. Similarly other emotions are characterized by other deformations typical to a particular expression. Research into automatic recognition of facial expressions addresses the problems surrounding the representation and categorization of static or dynamic characteristics of these deformations of face pigmentation

The system classifies facial expression of the same person into the basic emotions namely anger, disgust, fear, happiness, sadness and surprise. The main purpose of this system is efficient interaction between human beings and machines using eye gaze, facial expressions, cognitive modeling etc. Here, detection and classification of facial expressions can be used as a natural way for the interaction between man and machine. And the system intensity vary from person to person and also varies along with age, gender, size and shape of face, and further, even the expressions of the same person do not remain constant with time.

However, the inherent variability of facial images caused by different factors like variations in illumination, pose, alignment, occlusions makes expression recognition a challenging task. Some surveys on facial feature representations for face recognition and expression analysis addressed these challenges and possible solutions in detail. The following document is a report on the mini project for Robotic visual perception and autonomy. It involved building a system for face detection and face recognition using several classifers available in the open computer vision library (OpenCV). Face recognition is a non-invasive identi cation system and faster than other systems since multiple faces can be analyzed at the same time. The difference between face detection and identification is, face detection is to identify a face from an image and locate the face. Face recognition is making the decision "whose face is it ? ", using an image database. In this project both are accomplished using different techniques and are described below. The report begins with a brief history of face recognition. This is followed by the explanation of HAAR-cascades, Eigenface, Fisherface and Local binary pattern histogram (LBPH) algorithms.

Next, the methodology and the results of the project are described. A discussion regarding the challenges and the resolutions are described. Finally, a conclusion is provided on the pros and cons of each algorithm and possible implementations.

**PROBLEM DEFINITION**

Nowadays there are various illegal activities happening on crossing the border in exporting and importing of material. So in order to reduce these illegal activities officers are using pen and paper work but some time they are unable to catch the criminal by this pen and paper method. So to improve the security, face detection system is used by which there will be a double check of the men firstly through the face detection and second through the pen and paper work, which will reduce the illegal activities.

Human emotions and intentions are expressed through facial expressions and deriving an efficient and effective feature is the fundamental component of facial expression system. Face recognition is important for the interpretation of facial expressions in applications such as intelligent, man-machine interface and communication, intelligent visual surveillance, teleconference and real-time animation from live motion images. The facial expressions are useful for efficient interaction Most research and system in facial expression recognition are limited to six basic expressions (joy, sad, anger, disgust, fear, surprise). It is found that it is insufficient to describe all facial expressions and these expressions are categorized based on facial actions .Detecting face and recognizing the facial expression is a very complicated task when it is a vital to pay attention to primary components like: face configuration, orientation, location where the face is set.

**OBJECTIVE**

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. 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 recognizing the person easily.

**Certificate from Organization**

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**Platform used**

**Front & Back end used**

**PROJECT ANALYSIS**

**Requirement Analysis**

**Planning**

In planning phase study of reliable and effective algorithms is done. On the other hand data were collected and were preprocessed for more fine and accurate results. Since huge amount of data were needed for better accuracy we have collected the data surfing the internet. Since, we are new to this project we have decided to use local binary pattern algorithm for feature extraction and support vector machine for training the dataset. We have decided to implement these algorithms by using OpenCv framework.

**Software Requirement Specification:**

Requirement analysis is mainly categorized into two types:

**Functional requirements:**

The functional requirements for a system describe what the system should do. Those requirements depend on the type of software being developed, the expected users of the software. These are statement of services the system should provide, how the system should react to particular inputs and how the system should behave in particular situation.

**Non-Functional requirements:**

Nonfunctional requirements are requirements that are not directly concerned with the specified function delivered by the system. They may relate to emergent system properties such as reliability, response time and store occupancy. Some of the nonfunctional requirements related with this system are hereby below:

**a) Reliability**:

Reliability based on this system defines the evaluation result of the system, correct identification of the facial expressions and maximum evaluation rate of the facial expression recognition of any input images.

**b) Ease of Use**:

The system is simple, user friendly, graphics user interface implemented so any can use this system without any difficulties.

**Feasibility Study**

Before starting the project, feasibility study is carried out to measure the viable of the system. Feasibility study is necessary to determine if creating a new or improved system is friendly with the cost, benefits, operation, technology and time. Following feasibility study is given as below:

**Technical Feasibility**

Technical feasibility is one of the first studies that must be conducted after the project has been identified. Technical feasibility study includes the hardware and software devices. The required technologies (C++ language and CLion IDE) existed.

**Operational Feasibility**

Operational Feasibility is a measure of how well a proposed system solves the problem and takes advantage of the opportunities identified during scope definition. The following points were considered for the project’s technical feasibility:

* The system will detect and capture the image of face.
* The captured image is then (identified which category)

**Economic Feasibility**

The purpose of economic feasibility is to determine the positive economic benefits that include quantification and identification. The system is economically feasible due to availability of all requirements such as collection of data from

* JAFFE
* COHN-KANADE

**Schedule Feasibility**

Schedule feasibility is a measure of how reasonable the project timetable is. The system is found schedule feasible because the system is designed in such a way that it will finish prescribed time.

**Software and Hardware Requirement**

**Software Requirement**

Following are the software requirement necessary of the project:

* Python programming language
* Pycharm IDE (selective)
* OpenCV framework
* Windows OS

**Hardware Requirement**

Following are the hardware requirement that is most important for the project:

* Fluently working Laptops
* RAM minimum 4Gb
* Web Camera

**Literature Reviews**

Research in the fields of face detection and tracking has been very active and there is exhaustive literature available on the same. The major challenge that the researchers face is the non-availability of spontaneous expression data [1]. Capturing spontaneous expressions on images and video is one of the biggest challenges ahead [2]. Many attempts have been made to recognize facial expressions. Zhang et al investigated two types of features, the geometry-based features and Gabor wavelets based features, for facial expression recognition.

Appearance based methods, feature invariant methods, knowledge based methods, Template based methods are the face detection strategies whereas Local Binary Pattern phase correlation, Haar classifier, AdaBoost, Gabor Wavelet are the expression detection strategies in related field. Face reader is the premier for automatic analysis of facial expression recognition and Emotient, Affectiva, Karios etc are some of the API's for expression recognition. Automatic facial expression recognition includes two vital aspects: facial feature representation and classifier problem .

Facial feature representation is to extract a set of appropriate features from original face images for describing faces. Histogram of Oriented Gradient (HOG), SIFT, Gabbor Fitters and Local Binary Pattern (LBP) are the algorithms used for facial feature representation [3,4]. LBP is a simple yet very efficient texture operator which labels the pixels of an image by thresholding the neighborhood of each pixel and considers the result as a binary number. The operator labels the pixels of an image by thresholding the 3X3 neighborhood of each pixel with the center value and considering the result as a binary number [3]. HOG was first proposed by Dalal and Triggs in 2005. HOG numerates the appearance of gradient orientation in a local path of an image.

For classifier problem we use algorithms like Machine learning, Neural Network, Support Vector Machine, Deep learning, Naive Bayes. The formation of histogram by using any of facial feature representation will use Support Vector Machine (SVM) for expression recognition. SVM builds a hyperplane to separate the high dimensional space. An ideal separation is achieved when the distance between the hyper plane and the training data of any class is the largest .

The size of the block for the LBP feature extraction is chosen for higher recognition accuracy. The testing results indicate that by using LBP features facial expressions recognition accuracy is more than 97%. The block LBP histogram features extract local as well as global features of face image resulting higher accuracy. LBP is compatible with various classifiers, filters etc.

Face detection is a computer technology that determines the location and size of human face in arbitrary (digital) image. The facial features are detected and any other objects like trees, buildings and bodies etc. are ignored from the digital image. It can be regarded as a specific ‘case of object-class detection, where the task is finding the location and sizes of all objects in an image that belong to a given class. Face detection, can be regarded as a more ‗general ‘case of face localization. In face localization, the task is to find the locations and sizes of a known number of faces (usually one). Basically there are two types of approaches to detect facial part in the given image i.e. feature base and image base approach. Feature base approach tries to extract features of the image and match it against the knowledge of the face features. While image base approach tries to get best match between training and testing images.

**Feature Base Approach:**

Active Shape Model Active shape models focus on complex non-rigid features like actual physical and higher level appearance of features Means that Active Shape Models (ASMs) are aimed at automatically locating landmark points that define the shape of any statistically modelled Department of ECE Page 5 object in an image. When of facial features such as the eyes, lips, nose, mouth and eyebrows. The training stage of an ASM involves the building of a statistical a) facial model from a training set containing images with manually annotated landmarks. ASMs is classified into three groups i.e. snakes, PDM, Deformable templates b) 1.1)Snakes: The first type uses a generic active contour called snakes, first introduced by Cass et al. in 1987 Snakes are used to identify head boundaries [8,9,10,11,12]. In order to achieve the task, a snake is first initialized at the proximity around a head boundary. It then locks onto nearby edges and subsequently assume the shape of the head. The evolution of a snake is achieved by minimizing an energy function, Snake (analogy with physical systems), denoted as snake = Internal + External Where internal and External are internal and external energy functions. Internal energy is the part that depends on the intrinsic properties of the snake and defines its natural evolution. The typical natural evolution in snakes is shrinking or expanding. The external energy counteracts the internal energy and enables the contours to deviate from the natural evolution and eventually assume the shape of nearby features—the head boundary at a state of equilibria. Two main consideration for forming snakes i.e. selection of energy terms and energy minimization. Elastic energy is used commonly as internal energy. Internal energy is vary with the distance between control points on the snake, through which we get contour an elastic-band characteristic that causes it to shrink or expand. On other side external energy relay on image features. Energy minimization process is done by optimization techniques such as the steepest gradient descent. Which needs highest computations. Huang and Chen and Lam and Yan both employ fast iteration methods by greedy algorithms. Snakes have some demerits like contour often becomes trapped onto false image features and another one is that snakes are not suitable in extracting non convex features.

**Low Level Analysis:**

Based on low level visual features like colour, intensity, edges, motion etc. Skin Colour Base Colour is avital feature of human faces. Using skin- color as a feature for tracking a face has several advantages. Colour processing is much faster than processing other facial features. Under certain lighting conditions, colour is orientation invariant. This property makes motion estimation much easier because only a translation model is needed for motion estimation. Tracking human faces using colour as a feature has several problems like the colour representation of a face .

Grey Scale Base:

Grey information within a face can also be treat as important features. Facial features such as eyebrows, pupils, and lips appear generally darker than their surrounding facial regions. Various recent feature extraction algorithms search for local grey minima within segmented facial regions. In these algorithms, the input images are first enhanced by contrast- stretching and grey-scale morphological routines to improve the quality of

local dark patches and thereby make detection easier. The extraction of dark patches is achieved by low-level grey-scale thresholding. Based method and consist three levels. Yang and hang presented new approach i.e. faces grey scale behaviour in pyramid (mosaic) images.

**Edge Base:**

Face detection based on edges was introduced by Sakai et al. This work was based on analysing line drawings of the faces from photographs, aiming to locate facial features. Than later Craw et al. proposed a hierarchical framework based on Sakai et al.‘work to trace a human head outline. Then after remarkable works were carried out by many researchers in this specific area. Method suggested by Anita and Devarajan was very simple and fast. They proposed frame work which consist three stepwise. initially the images are enhanced by applying median filter for noise removal and histogram equalization for contrast adjustment. In the second step the edge image is constructed from the enhanced image by applying sable operator. Then a novel edge tracking algorithm is applied to extract the sub windows from the enhanced image based on edges. Further they used Back propagation Neural Network (BPN) algorithm to classify the sub-window as either face or non-face.

**PROJECT DESIGN**

**PYTHON3:**

Python is an interpreted, high-level, general-purpose programming language. Created by Guido van Rossum and first released in 1991, Python's design philosophy emphasizes code readability with its notable use of significant whitespace. ... Python is dynamically typed and garbage-collected. Python is dynamically typed and garbage-collected. It supports multiple programming paradigms, including procedural, object- oriented, and functional programming. Python is often described as a "batteries included" language due to its comprehensive standard library.

Python was conceived in the late 1980s as a successor to the ABC language. Python 2.0, released in 2000, introduced features like list comprehensions and a garbage collection system capable of collecting reference cycles. Python 3.0, released in 2008, was a major revision of the language that is not completely backward-compatible, and much Python 2 code does not run unmodified on Python 3.

**MACHINE LEARNING:**

The scientific study of algorithms and statistical models that computer systems use to perform a specific task without using explicit instructions, relying on patterns and inference instead. It is seen as a subset of artificial intelligence. Machine learning algorithms build a mathematical model based on sample data, known as "training data", in order to make predictions or decisions without being explicitly programmed to perform the task. Machine learning algorithms are used in a wide variety of applications, such as email filtering and computer vision, where it is difficult or infeasible to develop a conventional algorithm for effectively performing the task.

Machine learning is closely related to computational statistics, which focuses on making predictions using computers. The study of mathematical optimization delivers methods, theory and application domains to the field of machine learning. Data mining is a field of study within machine learning, and focuses on exploratory data analysis through unsupervised learning. In its application across business problems, machine learning is also referred to as predictive analytics.

**OPEN CV:**

OpenCV (Open Source Computer Vision Library) is an open source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products. Being a BSD-licensed product, OpenCV makes it easy for businesses to utilize and modify the code.

The library has more than 2500 optimized algorithms, which includes a comprehensive set of both classic and state-of-the-art computer vision and machine learning algorithms. These algorithms can be used to detect and recognize faces, identify objects, classify human actions in videos, track camera movements, track moving objects, extract 3D models of objects, produce 3D point clouds from stereo cameras, stitch images together to produce a high resolution image of an entire scene, find similar images from an image database, remove red eyes from images taken using flash, follow eye movements, recognize scenery and establish markers to overlay it with augmented reality, etc. OpenCV has more than 47 thousand people of user community and estimated number of downloads exceeding 18 million. The library is used extensively in companies, research groups and by governmental bodies

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**HAAR CASCADE CLASSIFIER:**

Cascade is a machine learning object detection algorithm used to identify objects in an image or video and based on the concept of features proposed by Paul Viola and Michael Jones in their paper "Rapid Object Detection using a Boosted Cascade of Simple Features" in2001. It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images. It is then used to detect objects in other images. The cascade classifier consists of a collection of stages, where each stage is an ensemble of weak learners. The weak learners are simple classifiers called decision stumps. Each stage is trained 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. Each stage of the classifier labels the region defined by the current location of the sliding window as either positive or negative. Positive indicates that an object was found and negative indicates no objects were found. If the label is negative, the classification of this region is complete, and the detector slides the window to the next location. If the label is positive, the classifier passes the region to the next stage. The detector reports an object found at the current window location when the final stage classifies the region as positive their face or non-acumination.

**Face Detection**

Face detection involves separating image windows into two classes; one containing faces (turning the background (clutter). It is difficult because although commonalities exist between faces, they can vary considerably in terms of age, skin color and facial expression. The problem is further complicated by differing lighting conditions, image qualities and geometries, as well as the possibility of partial occlusion and disguise. An ideal face detector would therefore be able to detect the presence of any face under any set of lighting conditions, upon any background. The face detection task can be broken down into two steps. The first step is a classification task that takes some arbitrary image as input and outputs a binary value of yes or no, indicating whether there are any faces present in the image. The second step is the face localization task that aims to take an image as input and output the location of any face or faces within that image as some bounding box with (x, y, width, height).

The face detection system can be divided into the following steps:-

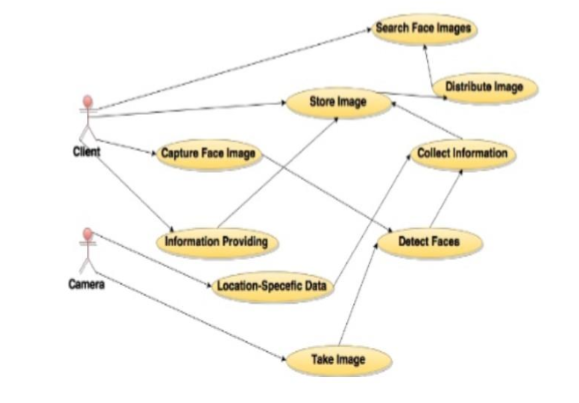
1. Pre-Processing: To reduce the variability in the faces, the images are processed before they are fed into the network. All positive examples that is the face images are obtained by cropping Department of ECE Page 3 images with frontal faces to include only the front view. All the cropped images are then corrected for lighting through standard algorithms.

2. Classification: Neural networks are implemented to classify the images as faces or no faces by training on these examples. We use both our implementation of the neural network and the Mat lab neural network Toolbox for this task. Different network configurations are experimented with to optimize the results.

3. Localization: The trained neural network is then used to search for faces in an image and if present localize them in a bounding box. Various Feature of Face on which the work has done on:- Position Scale Orientation Illumination.

**USE CASE DIAGRAM**

Use case diagram are considered for high level requirement analysis of a system. So when the requirement of a system are analyzed the functionality are captured in use cases. This diagram is a graphic depiction of the interaction among the element of a system. A use case is the methodology used in system analysis to identify, clarify an organize system requirement.



**CHAPTER 4**

**CONCLUSION**

The computational models, which were implemented in this project, 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%, due to the limited number of Eigen faces that were used for the PCA transform. This system was tested under very robust conditions in this experimental study and it is envisaged that real- world performance will be far more accurate. The fully automated frontal view face detection system displayed virtually perfect accuracy and in the researcher's opinion further work need not be conducted in this area. The implemented fully automated face detection and recognition system (with an eye detection system) could be used for simple surveillance applications such as ATM user security, while the implemented manual face detection and automated recognition system is ideal of mugshot matching. Since controlled conditions are present when mugshots are gathered, the frontal view face recognition scheme should display a recognition accuracy far better than the results, which were obtained in this study, which was conducted under adverse conditions.

**CHAPTER 6**

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