**AN ENGINEERING MINOR PROJECT**

**MID-TERM REPORT**

**ON**

**REAL TIME FACE DETECTION AND TRACKING SYSTEM**

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1. **ABSTRACT**

The face detection system will accurately determine the locations and sizes of all possible human faces. The faces are then scaled to a recognizable size and passed to a face recognition system implemented by Desmond Eustin van Wyk that can accurately determine the identity of a person and decide whether or not to grant them access to a facility.

The aim of this project was to develop an algorithm that detects human face. We adapted the concept of eigen face in order to achieve the goal. To detect the face region a method was used. Morphological techniques were used to fill the holes that were created after the segmentation process. From the skeletonizing process, a skeleton of the face was obtained from which face contour points were extracted. Facial features can be located in the interior of the face contour. We used several different facial-images to test our method. We achieved a detection rate of over 90%.

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4. **INTRODUCTION**
   1. **Background**

In this project a face detection system is implemented and integrated into an Access Control system. Face detection systems locate the size and scale of human faces in images and video sequence, if present. Face detection is the first step for Face localization, Face Tracking, Facial Expression recognition, and Face Recognition.

Face detection in itself is a challenging problem. The difficulty resides in the face that faces are non-rigid objects. Face appearance may vary between two photographs of the same person, depending on the emotional stage, lighting conditions or pose. This is why so many methods have been developed in the past years.

The goal is to detect very quickly faces in cluttered backgrounds. This situation can be found in many applications as surveillance of public places, common Access Control conditions. Thus far learning-based approaches have been the most effective and have therefore attracted a lot of attention the last years. Viola and Jones introduced an impressive face detection system capable of detection frontal-view faces in real time.

* 1. **OBJECTIVES**

The main aim of this project is to develop and propose a system to detect human faces in digital images effectively, no matter what person’s ethnic, pose. Input images may be varied with face size, complex of background and illumination condition.

Also, cross-platform is used to increase the utilization.

* 1. **TOOLS USED IN THIS PROJECT**

In this section, tools will be described in the following:

**JAVA**

Java is a general purpose, high – level programming language developed by Sun Microsystems. Java is a programming language that produces software for multiple platforms. When a programmer writes a Java application, the compiled code (known as bytecode) runs on most operating systems (OS), including Windows, Linux and Mac OS. Java derives much of its syntax from the C and C++ programming languages.

**JAVA DEVELOPMENT KIT (JDK)**

A Java Development Kit (JDK) is a program development environment for writing java applets and applications. It consists of a runtime environment that "sits on top" of the operating system layer as well as the tools and programming that developers need to compile, debug, and run applets and applications written in the java language.

**OpenCV**

OpenCV is a synonym of open computer vision library, which has at least 500 algorithms, documentation and sample code for real time computer vision. OpenCV is originally developed by Intel and launched in 1999. It is free for commercial and research used. OpenCV library is cross-platform which means it can execute on Windows, Mac OS X,Linux ,PSP and other embedded devices.

The library is mainly written in C, which makes it easily possible to transfer into specific platforms. Example application of OpenCV library is Human-Computer Interaction, Object Identification, Segmentation and Recognition and so on.

1. **LITERATURE REVIEW**

In the early stage, face detection algorithms mainly focused to detect the frontal human face. However, newer algorithms try to consider the different view of face as a core of face detection.

The first of face detection system has been developed since in early 1970’s. Due to the limitation of computation, system can’t be satisfied the requirement of users, which is identify passport photograph real time.

At the beginning of 1990’s, techniques are proposed focused on the face recognition on and increase the need of face detection. Many systems were constructed to deal with video streaming. In the past few years, lots of methods are developed at least more than 150 methods.

1. **METHODOLOGY**

In general FD can be implemented by four methods: knowledge-based methods, template matching, invariant feature methods and learning based methods. These methods will be introduced with the following:

1. **Knowledge based methods:** The models are used human knowledge to find a face patterns from the testing images. Based on the nature of human faces, algorithms scan the image from top-to-bottom and left-to-right order to find facial feature. For instance, face should be including two eyes and mouth

**Pros:** Easy applied into simple rules

**Cons:** difficult to detect in invariant background, such as different pose, uncontrolled illumination. Well results based on well-defined rules. This algorithm does not work on the pose.

1. **Template matching method:** The model is used templates to find out the face class and extract facial features. Rules are pre-defined and decide whether there is face in the image. For instance, using filters to extract the contours of face shape.

**Pros:** Simple to apply this method.

**Cons:** Similar to knowledge-based method, hard to detect face in different poses. Algorithms are sensitive to scale size, face shape and pose.

1. **Invariant feature methods:** The model is bottom-up approaches and used to find a facial feature (eyebrows, nose), even in the presence of composition, perspective vary, so it is difficult to find a face real time using this method. Statistical models are developed to determine the faces. Facial features of human faces are: shape, texture, skin.

**Pros:** Unlike knowledge-based method, it is invariant to pose and expression.

**Cons:** not suitable to detect facial features from uncontrolled background, time consuming algorithms. Detection rate is not accurate because of need to combine different feature and processing it.

1. **Learning based methods:** The models are trained from a set of training set before doing detection. For the large amount of training data, it can be provided high accuracy recognition rate to resist variation, expression and pose of faces images. For instance, many of “non-face” and ’face’ images import into the system. Machine learning techniques are employed to train the system based on the statistical properties and probability distribution function. Principle component analysis(PCA), Support Vector Machine(SVM), Naïve Bayes Classifier, Hidden Markov Model Neural Network and Ada-Boost are well known classifiers to use for face detection.

**Pros:** fast to detect face. Can be detected different pose and orientation if have enough training set. Showed a good empirical result.

**Cons:** need more and more “non-face” and “face” sample for training, need to scan different scale.

**CONCLUSION**

In this mini-theses, we discussed the implementation of a face detection system to be used for access control. The focus was thus to implement a face detection system good enough to be used for access control. Access control systems normally use video cameras that deliver image data of poor quality and that also contain much noise [3]. The focus was also on developing a real-time face detection system. The Viola and Jones have been most suited for our requirements, thus we implemented a detector strongly based on the Viola and Jones detector.