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Anti-Theft Vehicle System using ARM 11

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Abstract
The development of vehicular design brings public many conveniences in life but also brings many problems at the same time, for example, traffic congestion, difficult in monitoring dispersive vehicle, theft and other series of problems [3]. Due to the insecure environment the ratio of vehicle theft increases rapidly. Because of this is manufacturers of luxury automobiles has the responsibilities for taking steps to ensure the authorization for the owners and also in built the anti-theft system to prevent the vehicle from theft. The proposed security system for smart cars used to prevent them from loss or theft using Advanced RISC Machine (ARM) processor. It performs the real time user authentication (driver, who starts the car engine) using face recognition, using the Principle Component Analysis (PCA) algorithm. According to the comparison result (authentic or not), ARM processor triggers certain actions. If the result is not authentic means ARM produces the signal to block the car access.

Keywords: PCA, FDS, NOOBS

1. Introduction
Automatic face recognition is a widely used biological recognition technology. In comparison with other identification methods, face recognition has direct, Friendly and convenient features. Human can visually identify people by human face. People can be fairly identified even in the very serious visual stimulated situation [2]. Now the market share of face recognition is just less than the fingerprint recognition and the proportion are increasing, which have broken the situation that fingerprints recognition monopolized the market in the international biological recognition market. Therefore, it is very important for the research of face recognition technology. This project, which is based on ARM11 and Linux operating system, is a portable device and meets the requirements of up to date Identity Authentication; it also can be used in many areas. The embedded face recognition system is based on ARM 11 development board, including transplantation of Linux operating system, the development of drivers, detecting face by using face class Haar feature, and then recognizing face by using PCA transform algorithm [1].

Block Diagram of Proposed System
A. Overview of the project
In this project, we propose an extendable emergency response system for smart car to prevent them from loss ortheft as shown in fig. 1 using Advanced RISC Machine (ARM) processor (RISC means Reduced Instruction Set Computing). In this method, the Face Detection Subsystem (FDS) aims at detect somebody's face (who try to access the car).By using PCA algorithm we can get the common eigen values of the person and it compares the image by finding the nearest value in some mathematical form which as like a function. If the person matches vehicle starts [5].

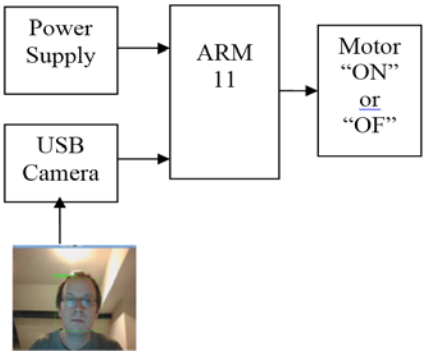

Fig 1: Block Diagram of Proposed system

B. Face Detection System (FDS)

Face recognition is a non-intrusive method, and facial attributes are probably the most common biometric features used by humans to recognize one another. The applications of facial recognition range from a static, controlled authentication to a dynamic, uncontrolled face identification in a cluttered background. While the authentication performance of the face recognition systems that are commercially available is reasonable, they impose a number of restrictions on how the facial images are obtained, often requiring a fixed and simple background with controlled illumination. These system also have difficulty in matching face images captured from two different views, under different illumination conditions, and at different times. 'th' is the threshold value depending on the real time environment (varies from 300- 400). lt is questionable whether the face itself, without any contextual information, is a sufficient basis for recognizing a person from a large number of identities with an extremely high level of confidence.

C. Principle Component Analysis (PCA)

The purpose of PCA is to reduce the large dimensionality of the data space (observed variables) to the smaller intrinsic dimensionality of feature space (independent variables), which are needed to describe the data economically. The main idea of using PCA for face recognition is to express the large 10 vector of pixels constructed from 15 facial image into the compact principal components of the feature space. This can be called Eigen face Projection.

D. Embedded Control System

The ARM is a 32-bit Reduced Instruction Set Computer (RISC) Instruction Set Architecture (ISA) developed by ARM Holdings. It was known as the Advanced RISC Machine, and before that as the Acorn RISC Machine. The relative simplicity of ARM processors made them suitable for low power applications. This has made them dominant in the mobile and embedded electronics market as relatively low cost and small microprocessors and microcontrollers

IMPLEMENTATION OF SYSTEM

system is based on Raspberry Pi Model B+ board, which is a low cost, credit-card sized computer. Based on this hardware platform, Embedded Linux operating system and drivers are developed firstly, and then face recognition system is achieved on the operating system.

A. Transplantation of Embedded Linux

New Out Of the Box Software (NOOBS) is an easy operating system install manager for the Raspberry Pi. NOOBS is designed to make it easy to select and install operating systems for the Raspberry Pi without having worry about manually imaging your SD card.on first boot NOOBS will format your SD card & allow install Raspbian. Raspbian is free operating system based on Debian optimized for the Raspberry Pi hardware. An operating system is the set of basic programs & utilities that make your Raspberry Pi run.

B. Embedded Human Face Recognition System

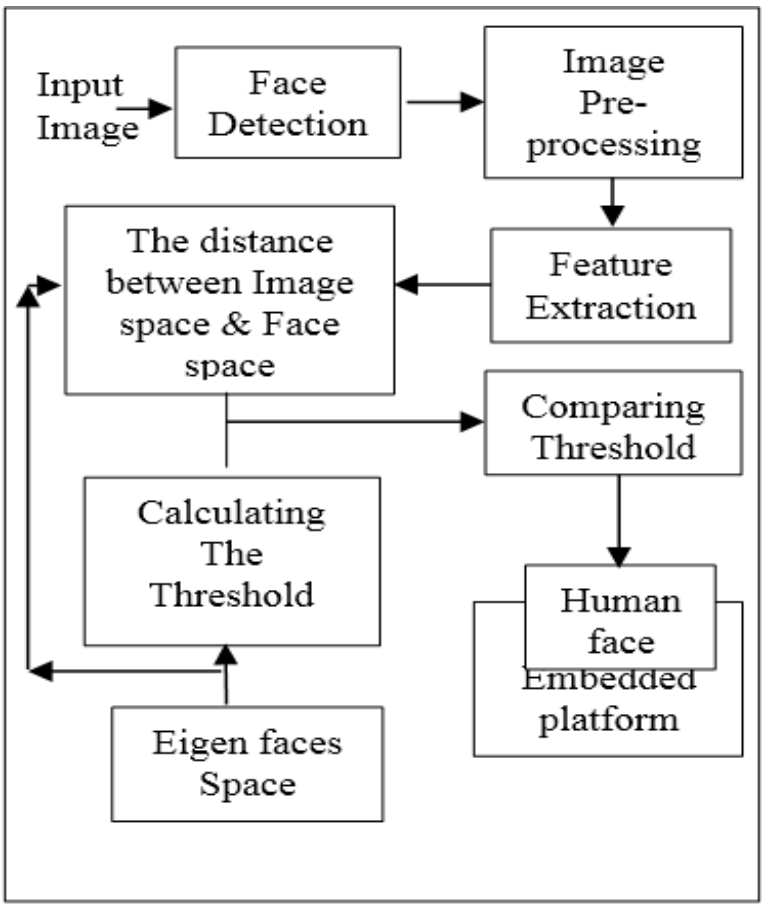

Fig 2: Flow chart of face recognition system

In the above Figure 2 the first step is to detect human face. Face detection is one of the main technical parts of the automatic face recognition system. Face detection needs to determine whether the given image is a face, if it is someone's face, and then return the position of the face. In order to better recognize all of the faces in the image, the system use face class Haar feature to detect human face [1]. After having gotten all of the faces, the next step is finding the special face. Compared with traditional face recognition system, in this thesis the embedded face recognition system is based on the Gabor feature extraction algorithms of the face region and principal component analysis (PCA) with nearest neighbour classifier as the core algorithms of the system identification. Face samples are pre-processed for extracting the Gabor feature vector, by using PCA to reduce the feature vector's dimension and we can get face PCA subspace of the sample Gabor feature, we call it face space. And then the input faces are projected into the subspace of face PCA and get image face. The distance from face space to image faces as a measure of face similarity.

Analysis of the Main Algorithms

A. Face Detection Base on Haar Feature

Viola [1] wrote a paper which has been published in 2001, can be said as watershed of real time face detection technology, they implement the real time face detection by integrating Adaboost and cascade algorithms, face detection is beginning to make practical. Papageorgiou and viola extract features from images based on the application of wavelet transform, and put forth the original concept of local Haar like features. The feature database contains 3 types and 4 different forms of features. The 3 types: 2 rectangles feature, 3 rectangles feature, and 4 rectangles feature. The 4 forms are shown in Figure 3.

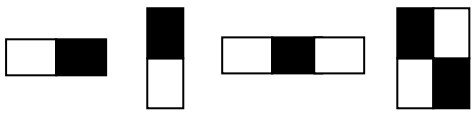

Fig 3: The original forms of Haar-like features

Now we generate classifiers which are based on the basic principles of Adaboost face detection.

Simple classifier: The input window x, is an eigenvalue of the jth rectangle feature, the jth feature is generated into the form of a simple classifier: indicated the value of a simple classifier; is thethreshold; indicated the direction of inequality, the value is 1.

Strong classifier: the learning process of Adaboost algorithm can be understood as "the process of greedy feature selection." For solving a problem by weighted voting mechanisms, with plenty of the weighted combination of classification function to make the determination. The key of algorithm is to give the good classification function a bigger weight value; the bad one is given a smaller weight value. Adaboost algorithm is a very good way that can find out a few features to effectively classify target.

Cascade strong classifier: By Adaboost algorithm the strong classifier is made of the important features, and can be used to detect face. During the testing process due to have to Scan all different sizes windows in tested image's every position, the number of detection windows are so many. During the process of actual facedetection we should adopt Classification classifier of "first weight and then light". At first, using the simple strong classifier which includes more important features to find non-face windows and delete them. As the importance of features declines, the number of classifiers is increasing, but the number of detected windows is declining.

B. Human Face Image Recognition Based on PCA

If the direct use of the above high dimensional Gabor feature vector for classifier training and image recognition, will cause the disaster of high dimensions. Therefore, we need to reduce the dimensions of high dimensional Gabor feature vector. PCA is a statistical dimensionality reduction method, which produces the optimal linear least squares decomposing of a training set. Kirby and Sirovich (1990) applied PCA to representing faces and Turk and Pentland (1991) extended PCA to recognizing faces. The algorithm is based on an information theory approach that decomposes face images into a small set of characteristic feature images called "eigenfaces", which may be thought of as the principal components of the initial training set of face images. Automatically learning and later recognizing new faces is practical within this framework. Recognition under widely varying conditions is achieved by training on a limited number of characteristic views. The approach has advantages over other face recognition schemes in its speed and simplicity, learning capacity, and insensitivity to small or gradual changes in the face image. The main idea of the PCA (or Karhunen-Loeve expansion) is to find the vectors that best account for the distribution of face images within the entire image space. These vectors define the subspace of face images, which we call "face space". Each vector is of length , describes a by image. Because these vectors are the eigenvectors of the covariance matrix corresponding to the original face images, and because they are face like in appearance, we refer to them as "eigenfaces".

Use

System test

A. Face Detection

The face class Haar feature is used to detect human faces. As shown in fig. 4

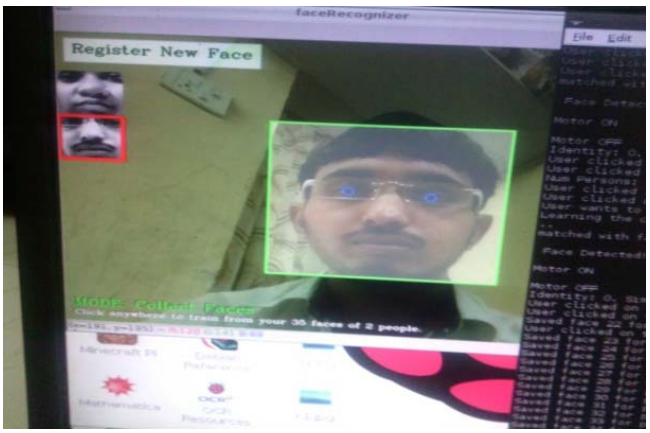

Fig 4: original images

Final images of face detection by using face class Haar feature are shown in fig. 5

B. Training Data of PCA

Now projecting the sample images into subspace, getting The training data of PCA as shown in fig. 6

Then real-time getting human face image, using Euclidean Distance measures the human face image, and testing the

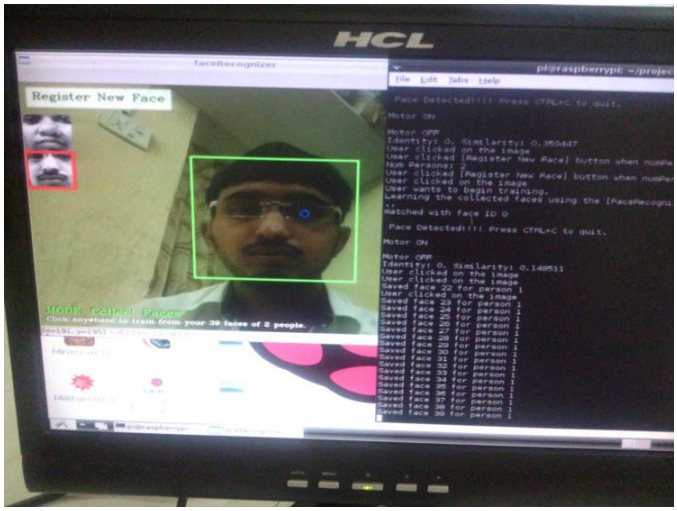

Fig 5: final images of face detection

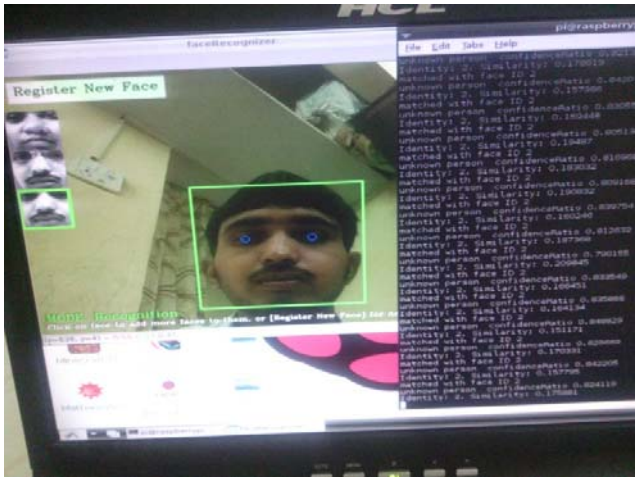

Fig 6: The sample images & training data of PCA

Similarity of the training faces and the image. If the measured difference is in the range of threshold value, it indicates real-time image meets the requirements and the image exists in the face space, and then finding the most similar face in the face space and outputting the corresponding personal information, or the image can't be recognized and system logs out. The number of training images can be bigger if it is needed for expanding the scope of recognition. The several system tests steps show that the system can recognize face to meet the requirements and get the corresponding person's information.

Hardware Setup

As shown in figure 7 Hardware set up consist ARM 11 Raspberry Pi Board with Raspbian Camera module and motor will start and stop with respect to Known and Unknown person. Graph shown in figure 8 which is Training data set vs. recognition rate. Implemented System provides 70% to 90% recognition accuracy.

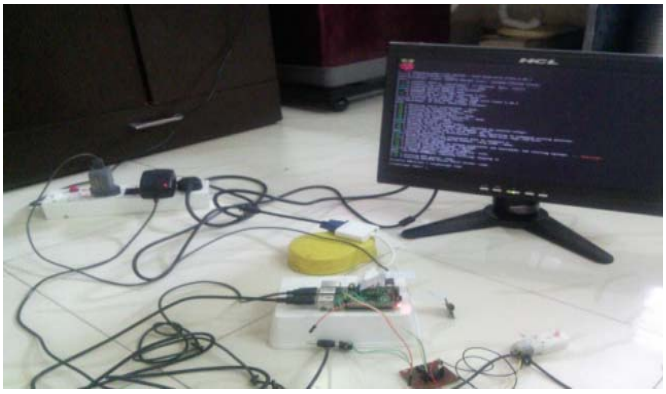

Fig 7: The sample images & training data of PCA

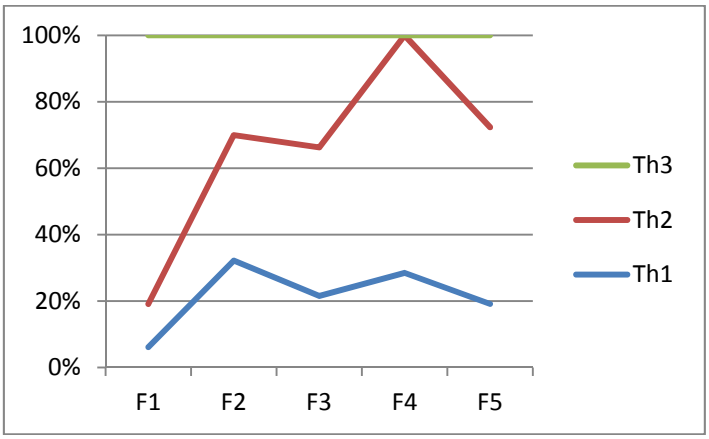

Fig 8: The sample images & training data of PCA

Conclusion

The the present method the camera captures owner's image only. If the owner's relatives or friends want to start the vehicle it will not start. To overcome this one, we can extend this project by storing multiple faces into the memory. If any person wants to start the vehicle, the camera compares the person's image with the all stored images. If the result is matched the motor will start. In future we can extend this by sending the unknown person's image to the owner's mobile as well as the information to police control room for taking immediate action.

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