Journal of Applied Information Science
6 (2), December 2018, 01-05
http://www.publishingindia.com/jais

Android Board Based Intelligent Car Anti-Theft System Through Face Recognition Using GSM and GPS

Mohammed Shafeeq K. K.[1] and Maqbool Thoufeeq T.[2*]
[1]Department of Electronics and Instrumentation Engineering, College of Engineering Vadakara, Kerala, India. Email: hotshafeeq@gmail.com
[2]Department of Computer Science, University of Calicut, Kerala, India. Email: maqboolthoufeeq.t@gmail.com
*Corresponding Author

Abstract: A major problem today for car owners is that they are in constant fear of having their vehicles stolen from a common parking lot or from outside their home. Image processing based real time vehicle theft detection and prevention system provides an ultimate solution for this problem. In this project, a low-cost extendable framework for smart car security system is proposed, which consists of a FDS (Face Detection Subsystem), a GPS (Global Positioning System) module, a GSM (Global System for Mobile Communications) module and a control platform. The system described in this project automatically take photos of driver and compares his or her face with database to check whether he is an authenticated driver or not. The face detection subsystem bases on optimized PCA (Principle Component Analysis) algorithm and can detect faces in cars. The other modules transmit necessary information to users and help to keep eyes on cars all the time, even when the car is lost. This system prototype is built on Android Board, controls all the processes. The owner is made able to perform car stopping through the message from his mobile. The GPS module in the car detects the location of the car. So by this system, the identifcation of the thief and the location of the car are simply smarter and cheaper than traditional one.

Keywords: Android board, Global Positioning System (GPS), Global System for Mobile Communications (GSM).

I. Introduction

In this world, everyone and every industry likes to keep in pace with the advancement in the technology. Automobile industry is also not behind in this aspect. Nowadays almost everyone has a car. As purchasing a car is a big investment, people are really concerned about the advanced technologies in automobile industry. Therefore, automobile companies have witnessed a major boost in their technological aspects by introducing automation in the vehicles to provide user friendly and advance features to their customers.

As far as vehicle security is concerned many options are available depending upon the technology being adopted. Many auto theft alarms and devices are installed in cars but they didn't prove to be a solution to the customer's problems. GSM based car / vehicle security system is one of the possible technology solution and it is designed by several groups to identify the car / vehicle location upon getting it stolen. However, the issues in locking / unlocking and switching ON and OFF the car engine upon losing the keyless remote of the car are untouched. It is quite common that a person faces many difficulties in locking and unlocking the car upon losing the keyless remote of the car. Therefore, to tackle these issues an electronic system is developed and discussed in this project. This system is basically using GSM technology to implement different features in a car. Through this system different operations like locking / unlocking and switching ON and OFF of the car can be performed just by sending a text message from user (specific) mobile number to the GSM module installed in the car. Sending SMS with specified format can perform different operations of the car.

With the development and applications of many Android Board techniques, car security system design and analysis are constantly improving. Many new techniques, such as biometric recognition technique, image processing technique, communication technique and so on, have been integrated into car security systems [1] [2]. At the same time, the amount of accident of cars still remains high, specially, lost. So, one practicable car security system should be efficient, robust and reliable. Traditional car security systems rely on many sensors and cost a lot. When one car is really lost, no more feedback could be valid to help people to find it back. We put forward the face detection technique to be applied in car security system because this kind of technique is effective and fast.

Face detection techniques have been heavily studied in recent years, and it is an important computer vision problem with applications to surveillance, multimedia processing, and consumer products. Many new face detection techniques have been developed to achieve higher detection rate and faster. Since

Viola [3] introduced an boosted cascade of simple classifiers using Haar-like features capable of detecting faces in real-time with both high detection rate and very low false positive rates, which is considered to be one of the fastest systems in 2001, much of the recent work on face detection following Viola-Jones has explored alternative boosting algorithms such as Float-Boost [4], GentleBoost [5], and Asymmetric AdaBoost [6]. Most of those techniques were tested on PC platforms with several stand face or non-face databases [7].

The GPS module obtains the precise location by parsing received GPS signal. The GSM module can send the information by as SMS (Short Message Service) message, including real-time position of the lost car and even the images of the driver. All process are controlled by the Android Board, it controls the ECU (Electronic Control Module) module, and also it performs, obtaining images, face detection, retrieving GPS information, sending and receiving SMS.

II. Related Works

A. Face Recognition and Detection

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 systems also have difficulty in matching face images captured from two different views, under different illumination conditions, and at different times. It 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.

There are many algorithms used in face recognition and detection, and many more are being developed. PCA is the best and mostly used algorithm in face recognition. PCA is also known as Eigen faces algorithm. The main idea is to de-correlate data in order to highlight differences and similarities by finding the principal directions (i.e. the Eigen vectors) of the covariance matrix of a multidimensional data. A part of the great efficiency of the PCA algorithm is to take only the best eigenvectors in order to generate the subspace (Face Space) where the gallery images will be projected onto, leading to a reduction of dimensionalities

In this project we use PCA algorithm, the major advantage of PCA is that, it using eigenface approach which helps in reducing the size of the database for recognition of a Test images. The images are stored as their vectors in the database which are found out projecting each and every trained image to the set of Eigen faces obtained. PCA is applied on Eigen face approach to reduce the dimensionality of a large data set.

B. Images from the Camera

In the system prototype, one USB camera is used to catch images in car, and the data are transmitted to FDS module by USB channel, and the data are transferred into jpeg format files by the chip embedded camera before the transmission. Every image is set to be 320*240 pixels in resolution ratio to remain small in size and could be detected fast enough.

C. GSM Module

To achieve important information of cars, one GSM module is added into the car security system. GSM modem can quickly send SMS messages to appointed mobile phone or SMS server. So the owner and the police can be informed at the first time. If another GPRS module is added in, the image data could also sent to an information server, and the real-time circumstance in the car could be seen.

D. GPS Module

GSM (Global System for Mobile Communications), is a standard developed by the European Telecommunication Standards Institute (ETSI) to describe protocols for second generation (2G) digital cellular network used by mobile phones. It became the de facto global standard for mobile communications. GPS technique has been widely used both in military equipments and civil devices in recent years. In this project we use GPS module to obtain current location of the vehicle.

E. Android Board

Android Board device is open source All in One Mini embedded computer especially targets many Android industry applications. This device integrates all the computer's features and interfaces in a very small size, even including host, display and touch panel. It can be used as an end product for a lot of computing and controlling applications across all industries. Because of its open source strategy, people can use it as a development board, get all the source code, documents, and also can discuss the technical issues in the forum.

But, beyond that, the most of the innovative projects can be easily achieved based on it. Here we are using CubieAIO-A20 as our development board. Since CubieAIO-A20's main board is designed with a small computing module which named Einstein-A20. It's physical features are very much convenient for this project. So, Einstein-A20 is very best for this project.

Features of CubieAIO-A20

- All Winner SOC A20 ARM® Cortex™ A7 Dual Core Processor.

- ARM® Mali400 GPU.
- 1GB DDR3@480MHz (960MTPS), 1GB Default.
- HDMI&VGA 1080P@60Hz display output.
- 100M/1000M Ethernet RJ45.
- Wifi+BT 4.0 wireless connection with external antenna.
- SATA 2.0 interface support MSAT.
- Support 3G/4G mini PCIE module with data communication.

III. Algorithm for Face Recognition

Face recognition is the second phase. It involves comparing the input face with faces in the database. PCA algorithm is used for recognizing face [5]. Photos in the database is called training images and the photo taken during authentication phase is called as test image. In the PCA algorithm that we use to implement authentication system, an offline tuning is done after enrollment phase, to determine the threshold. In PCA algorithm a weight vector is computed for all images in the database as well as for the new test image. Test image matches with that image in the database if minimum Euclidian distance between corresponding weight vectors is less than particular threshold. To find out this threshold offline tuning is done. Here each training image is given as test image and minimum Euclidian distance is computed. Thus, we get a vector of Euclidian distances with number of elements equal to number of photos in the database.

Before going into detailed explanation of algorithm, we will see how this algorithm as a whole works. The algorithm can be divided into two stage 1) Enrollment Phase 2) Authentication Phase. In enrollment phase, photos of all drivers who owner wishes to authenticate will be taken and face portion alone will be extracted from those photos to create database. In enrollment phase, we will compute weight vectors for all images in database using PCA algorithm. This weight vector specifies, to what degree the specific feature is present in the original image. Once this is computed, authentication phase starts. In this phase, we will capture the image of person entering vehicle and do image processing on it. Image processing means applying PCA algorithm on it. As in enrollment phase, here also we will compute the weight vector of this test image. Calculate the Euclidian distance between weight vector of test image and each of weight vectors of database images. If new driver is an authenticated driver, then minimum Euclidian distance will be below certain threshold. If minimum Euclidian distance is greater than this threshold, the new driver is not an authenticated one. If it is less than this threshold, the new driver is an authenticated one.

Steps Involved in Algorithm:

1. Get training set of images.
2. Detect face of all training images.
3. Input these images as training set into face recognition stage.

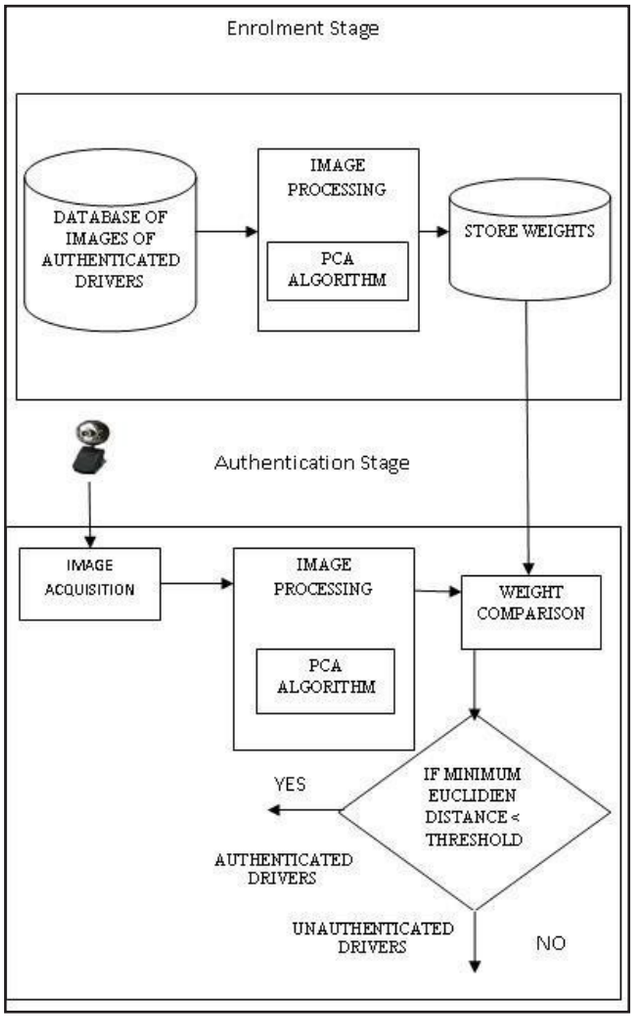

Fig. 1: Block Diagram of Face Recognition System

4. Compute weight vector for input training set using PCA algorithm.
5. Give new test image.
6. Determine whether new image is authenticated or not using PCA algorithm.
7. If driver is not authenticated, an alarm rings and a message will be sent to owners mobile.
8. Owner send the message to the number in vehicle.
9. If message is ”STOP” the ignition valve of the vehicle stopped, the current location of vehicle and image of thief is send to owner’s mobile.
10. If driver is authenticated, no alert.

IV. Proposed System Design

A. Hardware Design

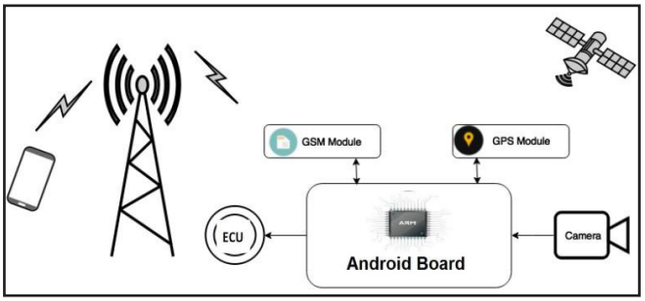

Fig. 2: Block Diagram of the System

The block diagram shown in Fig. 2 completely depicts the components involved in the implementation of the system.

1) Android Board:

   In this project we use Android Board for performing database adding, Face Recognition and response for the messages of authorized person and also controlling of ECU in the car. The user database is stored in the Android Board memory unit. Image processing and detection processes are performed within the Android Board. It is also used as a control platform for this project.

2) GSM Module:

   In this project GSM module is used for communication between the owner and car. The image of unauthorized person and location of vehicle are sent to the owner's phone through this GSM module. Also, we can control the fuel injection of car by using specific SMS commands.

3) GPS Module:

   In this project GPS module is used to track the current location of the vehicle and which is sent to the owner's phone through GSM module.

B. Software Design

The program for the Smart car security is done in JAVA. According to the program face of the driver who sits in the driver seat is captured. Cut the image using Haar-Cascade classifer algorithm and the chopped image is compared with the images in the database by PCA algorithm. If the captured image is in the data base the vehicle can be accessed and an access message is send to the owner. If the captured image is not in the data base, the image is sent with a message of "unauthorized person is trying to access the vehicle" to the owner's mobile.

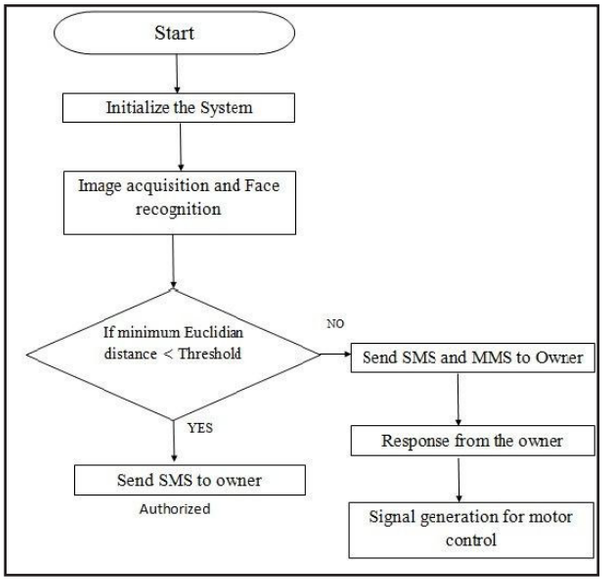

Fig. 3: Flow Chart of the System

The owner has two choices one is to allow the access if the person is accessing the vehicle with his permission and is done by send a keyword "Allow". If the accessing is by a thief the owner can send the keyword "Stop", the ignition valve of the vehicle is stopped. The other helpful keyword is "Locate" which helps to locate the vehicle, done by using the GPS module.

V. Results and Discussion

The program for face detection is coded using JAVA language. This program is run in the Android Board. The image of the person is captured immediately by the USB CAM. This is then cropped to obtain the face. This face detection procedure is depicted in the figure (Fig. 4) shown below in which the face is cropped by the square generated by the Haar Cascade Classifier.

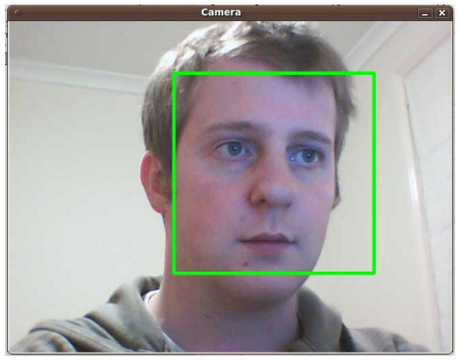

Fig. 4: Face Detection

This detected image is then compared with the predefined images of the owner stored in the database. The minimum euclidean distance exceeds the threshold 'th' an MMS and SMS is sent to the owner's mobile and the ignition valve is ceased according to the SMS received from the owner in response to the MMS. If the euclidean distance is less than the threshold, then its an authorized access an the access is granted. The resultant value is displayed in the result window.

VI. Conclusion

From this we implement theft control techniques that can provide the important functions required by advanced intelligent Car Security, to avoid vehicle theft and protect the usage of unauthenticated users. A secured and safety environment system for automobile users and also the key points for the investigators can be easily found out with the hijacker's image. We can predict the theft by using this system in our day to day life. This project will help us to reduce the complexity and improve security, also much cheaper and smarter than traditional ones. Experiment results show that it takes about 6 seconds to detect one 320*240 colour jpeg image by software which is running on Android Board. It seems to be too long to be used in real-time detection.

References

[1] S. Ajaz, M. Asim, M. Ozair, M. Ahmed, M. Siddiqui, and Z. Mushtaq, "Autonomous vehicle monitoring tracking system," *SCONEST 2005*, pp. 1-4, 2005.

[2] J. A. O'Sullivan, and R. Pless, "Advances in security technologies: Imaging, anomaly detection, and target and biometric recognition," *IEEE/MTT-S International Microwave Symposium,* 2007.

[3] P. Viola, and M. Jones, "Rapid object detection using a boosted cascade of simple features," *Proceedings of the 2001 IEEE Computer Society Conference on Computer Vision and Pattern Recognition*, 2001.

[4] R. Lienhart, A. Kuranov, and V. Pisarevsky, "Empirical analysis of detection cascades of boosted classifiers for rapid object detection," Technical Report, MRL, Intel Labs, 2002.

[5] P. Viola, and M. Jones, "Fast and robust classification using asymmetric AdaBoost and a detector cascade," *NIPS 14*, 2002.

[6] D. E. Goldberg, *Genetic Algorithms in Search, Optimization and Machine Learning*, Addison-Wesley, Longman Publishing Co., Inc. Boston, MA, USA, 1989.

[7] X. Tang, Z. Ou, T. Su, and P. Zhao, "Cascade adaboost classifiers with stage features optimization for cellular phone embedded face detection system," *ICNC'05 Proceedings of the First International Conference on Advances in Natural Computation*, vol. part III, pp. 688-697, Changsha, China, 27-29 August 2005.

[8] J. Xiao, and H. Feng, "A low-cost extendable framework for embedded smart car security system," *Proceedings of the 2009 IEEE International Conference on Networking, Sensing and Control*, Okayama, Japan, 26-29 March 2009.

[9] A. P. Sreedevi, and B. S. S. Nair, "Fast and robust classification using asymmetric AdaBoost and a detector cascade," *IEEE Transactions on Image Processing*, vol. 19, March 2011.