Design and Implementation of Automotive Vehicle Security System

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Abstract **- Automotive theft has been a persisting problem around the world and greater challenge comes from professional thieves. Modern security system can be deceived by professional thieves therefore a need of biometric authentication technology arises in automotive vehicles. Traditional automotive security systems relay on many sensors and it cost a lot. Once vehicle is lost, no more feedback could be valid to help people to find it back. This paper presents an immobilizer automotive security system that provides information about thief and vehicle position when automobile is lost. The system automatically takes photos of driver and compares his or her face with predefined faces (train databases) to check whether he is an authenticated driver or not. He can have access to the vehicle only if he is an authenticated driver. If he is not an authenticated driver the GSM sends security message to vehicle owners mobile phone and that guides the vehicle owner to logon to his mail to get further details about the vehicle thief i.e image of thief and vehicle location . This is an additional feature of the given system.**

Index Terms **–Train databases, Test databases, Face detection, and Face recognition.**

I. INTRODUCTION

In this proposed embedded car security system, FDS (Face Detection System) is used to detect the face of the driver and compare it with the predefined faces. For example, in the night when the car's owner is sleeping and someone theft the car then FDS obtains images by one tiny web camera which can be hidden in the car. FDS compares the obtained image with the predefined images if the image doesn't match, then the information is sent to the owner through e-mail to his Internet enabled mobile phone. So now owner can obtain the image of the thief in his mobile as well as he can trace the location through GPS. With ARM7 as the core, the new intelligent vehicle security system integrated a various hardware modules such as video capture; GPS positioning the design of the system software used the embedded software developing platform. By the hardware/software co-design, the new intelligent vehicle security system implemented the functions of video capturing, GPS positioning, met the needs of vehicle owners about Vehicle Security. With the development of automobile industry, motor vehicle theft has increasingly become prominent issues. According to National Insurance Crime Bureau (NICB), National wide in 2010, there were an estimated 1.2 million motor vehicle thefts, or approximately 416.7 motor vehicles stolen for every 100,000 inhabitants. Property losses due to motor vehicle theft in 2010 were estimated at $7.6 billion. Currently, automobile manufacturers use computer chips and other common security methods to ensure that even complete copy of the original vehicle mechanical keys, can only open the door, but cannot start the vehicle. However, there is a variety of vehicles decoder on the market, and the thieves can use the decoder to replicate the electronic chip keys, which can start the vehicle, in just a few minutes. Such as the decoder, which used the latest intelligence decoder chip developed by the United States, can unlock the most electronic locks of Mercedes Benz, BMW, Audi, Ferrari and other high-end models. Thus, it will be the sticking point of vehicle alarm to lock or unlock engine, through authenticating the identity legality. There are different biometric technologies which are unique and invariant for a very long time, such as fingerprint, iris, palm print, palm vein, hand vein, finger vein, face, knuckle creases, hand-type and so on, which all can be used as the basis of authentication and the various biological characteristic have their own advantages and disadvantages. Compared to other biometric techniques advantages of face recognition includes

- It doesn't require physical interaction.
- It allows passive identification.
- It doesn't require expert to interpret the comparison.

Thus, we have chosen Face Recognition as a biometric technology for security purpose

II. LITERATURE SURVEY

Narasimhulu. M, Naresh Kumar Reddy. B, Subrahmanya Sharma .G [1], explains the integration of a vehicle inspection system, which significantly increases security in vehicle identification by integrating different computer vision modules. Three different subsystem implementations were presented, namely the license plate recognition system, vehicle manufacturer/ model detection and under-vehicle inspection. The three distinct modules were analyzed and discussed. Results show that each method reaches good success rates, which in turn indicate that these modules can be used to boost the overall performance of an integrated platform for security inspection and access control. Finally, issues such as installation and operation principles were briefly discussed. This system could be installed in entrance check points that require high security standards, such as government

buildings, army camps or country borders and it can considerably facilitate prompt and effective vehicle inspection. Immediate benefits are the ability to reduce the number of personnel required to operate security gates, as well as to increase their level of awareness, while ensuring their personal safety. The new intelligent mobile vehicle checking system uses the detection technique of video capture, the wireless communication technique, meets the traffic auditing department's needs about Mobile Vehicle Checking. The system has the advantages of small size, low costs, full featured and powerful expansibility.

Shardool Patil, and M. M. Sardeshmukh [2], proposes a flexible real time smart car security system using Face Recognition to prevent car from theft, the proposed smart car security system proves to be reliable and helpful in preventing the car from theft as compared to traditional sensor based car security systems. Also the WLD technique for Face Recognition is more efficient than local feature based methods like LBP (Local Binary Patterns), Gabor Filter and PCA (Principal Component Analysis) methods.

Vikram Kulkarni, and G. Narsimhulu [3], discuss that FDS (Face Detection System) is used to detect the face of the driver and compare it with the predefined face. For example, in the night when the car's owner is sleeping and someone theft the car then FDS obtains images by one tiny web camera which can be hidden easily in somewhere in the car. FDS compares the obtained image with the predefined images if the image doesn't match, then the information is sent to the owner through MMS. So now owner can obtain the image of the thief in his mobile as well as he can trace the location through GPS. The location of the car can be displayed to the owner through SMS. So by using this system, owner can identify the thief image as well as the location of the car. This system prototype is built on the base of one embedded platform in which one SoC named "SEP4020" (works at 100MHz) controls all the processes. They also propose a wireless remote video monitoring system, based on GSM/GPRS. Also when the received SMS is replied with a code then functioning of Car will stop. Experimental results illuminate the validity of this car security system.

Robert t. Collins, Alan j. Lipton, Hironobu fujiyoshi, and Takeo kanade [4], presents an overview of video understanding algorithms developed at CMU to perform cooperative, multi-sensory surveillance. A network of smart sensors is deployed that are independently capable of performing real-time, autonomous object detection, tracking, classification and gait analysis. Results from these single-sensor technologies are combined into a coherent overview of the dynamic scene by multi-sensory fusion algorithms running on a central operator control station. The key to data integration From these multiple, widely spaced sensors is computation of object location with respect to a 3-D site model, followed by object hypothesis comparison and matching using a set of viewpoint-independent descriptors. A single user tasks the system through an intuitive graphical user interface. The system automatically allocates sensors to perform these tasks using an arbitration function that determines the cost of assigning each sensor to each task. The system performs a greedy optimization over this cost table to maximize overall system performance. Through this cost-based scheduling approach, multiple sensors are automatically tasked to cooperatively track objects over long distances and through occlusion. Visualizing the relative locations of people and vehicles over a large area is a difficult task. They provide the user with 2-D and 3-D synthetic views of the environment, within which detected people and vehicles are displayed as dynamic agents. This approach has the benefit that visualization of scene events is no longer tied to the original resolution and viewpoint of a single video sensor and the operator can therefore infer proper spatial relationships between sets of objects and between objects and scene features such as Roads and buildings, leading to a better understanding of the Evolving scene.

Anitha Chowdary. Veeravalli and B.Ratna Kumar [5], Authors explain that a finger print detection subsystem is used in cars for providing security to the cars. According to their implementation fingerprint detection subsystem and GPS (Global positing system) is used to detect the car Location, GSM (Global System used for (Mobile communication) Communication and control platform is used to provide security to vehicle. Fingerprint detection module can detect finger prints 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 the base of one embedded platform controls all the processes. It is also much cheaper and 'smarter' than traditional ones.

Rohit Chuttar, Rohit Thakur, Indraneel patil, and Prof.Kunal Ranveer [6], implemented their ideas to design a vehicle security system which is a multi-functionality embedded system which provides emergency indication to prevent accident. This embedded system will sense the obstacle and change of terrain in the journey to indicate to the driver in bad weather conditions or if any obstacle is present in front of running car. This system also provides indication to the driver when the distance between the two cars is reduced indicating other car as obstacle. This system makes use ultrasonic sensor to sense the obstacle along with auto braking mechanism to minimize the speed or in case of urgent braking. This sensed object by sensor is indicated on LCD which will alert the driver to prevent the accident that may lead to fatal. Friction sensing element is turned on depending on type of terrain to prevent accident due to urgent braking or slowing the speed of car. An attempt is made to design a remote sensing device for driver seat movement providing more comfort and flexibility.

D.Narendar Singh and K.Tejaswi [7], compares their implementation with the existing system. The advantage of their system is that can prevent the vehicle theft by using face recognition and they describe that in the present method the camera captures owner's image only. If the vehicle owner's relatives or friends want to start the vehicle it will not start. To overcome this one, they can extend this project by storing multiple faces into the memory. If anyone 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 otherwise, the unknown person's image will go to the owner's mobile. In the current project if the results are unmatched, the unknown person's image will goes to owners mobile only. In future this system can extend for sending the information to police control room for taking immediate action.

Arun Sasi, and Lakshmi R Nair [8], have successfully designed and implemented the Vehicle Anti-theft system in an embedded system. That design was experimented in a Test set up where the primary and secondary layers of protection were subjected to various tests. The LPC 2148 platform based on an ARM 7 Core has been found to working well and the Minutiae based Fingerprint recognition scheme was found to be found to be ideal for the designed application. The Tyre Pressure Sensor and the Vehicle window Vibration Sensors has to be fine-tuned before practical use, to prevent any false alarms.

III PROPOSED METHOD

In the proposed method some additional devices are implemented to protect the vehicle from professional thieves such as FDS (face detection subsystem) used for face detection to detect the authorized owner's face, GSM is used for communication with the original owner by sending SMS/MMS, GPS is used to track the actual position of the vehicle after stolen by the thief and the hardware implementation of automotive security system was done by making use of ARM 7. In the proposed method a web cam will be placed in front of the driver seat. When the driver inserts key into the lock, the ARM 7 generates an interrupt signal which starts the image processing application on PC. After a fixed time interval, the web camera will take the photo and that photo will get processed in the application. Finally, the application will detect whether the driver is authorized or not. If he is not authorized, The GPS module finds the exact location of the vehicle. Also, the image of thief and the location co-ordinates to the owner's registered mobile through mail. That snap of theft provides help for further investigation purpose.

IV.METHODOLY

Smart vehicle Security system is composed of ARM7microprocessor, peripheral equipment, and video capture, GPS positioning module. The detailed hardware composition is shown in figure 1

ARM7 Processor: The circuit of ARM7 microprocessor and peripheral equipment includes a ARM7 chip, a clock circuit, a reset circuit, a 32MB flash memory, . All of these make up the control and process core of the system. The on chip features can significantly reduce the total system cost to design network devices. It has 8 kB to 40 kB of on-chip static RAM and 32 kB to 512 kB of on-chip flash memory, so it can execute longer programming code and has larger RAM to store more data.

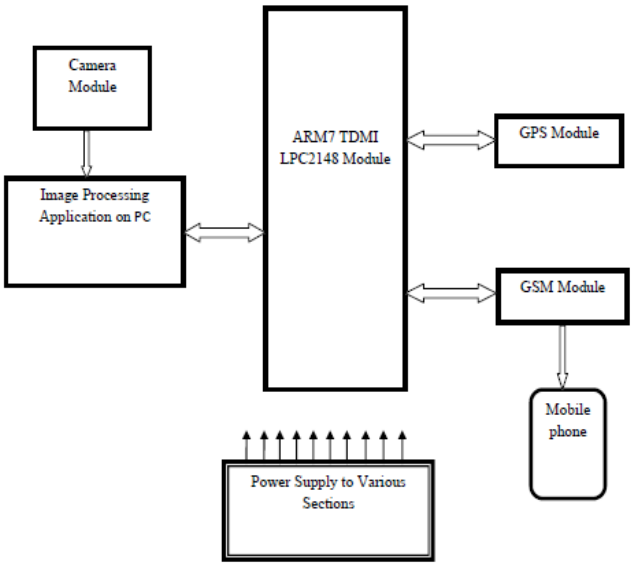

Fig1: Block Diagram of Automotive Vehicle Security System

Image Recognition and Processing: In this embedded smart car security system, FDS (face detection subsystem) aims at detect somebody's face in the car during the time in which nobody should be in the car. FDS obtains images by one tiny digital camera which can be hidden easily in somewhere in one car. FDS is used to detect the face of the driver and compare it with the predefined face, whenever person enters in car FDS obtains images of that person by one web camera. FDS compares the obtained image with the predefined images if the image doesn't match then the information is send to the owner through Mail to his Internet enabled mobile phone.

The Face Detection Subsystem (FDS) consists of following components,

Image Acquisition Subsystem: Image understanding starts with image acquisition. The purpose of image acquisition is to acquire the video images of the driver face in real time. A camera installed in the vehicle, which capture image and sent it to face detection and face recognition stage. The acquired images should have relatively consistent photometric property under different climatic ambient conditions and should produce distinguishable features that can facilitate the subsequent image processing. In real vehicles, a moving vehicle presents new challenges like variable lightening, changing background and vibrations that must be haven in mind in real systems. The image data is transmitted to the Face Detection System by USB channel.

Face Detection: Face detection algorithm extracts face portion alone from the photo taken by a webcam. At first, we get the location of the eye pair easily due to brighter pupil effect. After the location of eye pair, we can easily clip the face area from the input image according the spatial relationships between eye pair and face.

Face Recognition: face recognition is the process of validation of the input image .i.e. it involves comparing the input face with the faces in the database. Photos in the database is called training images and the photo taken during authentication phase is called as test image as illustrated in below fig 2.

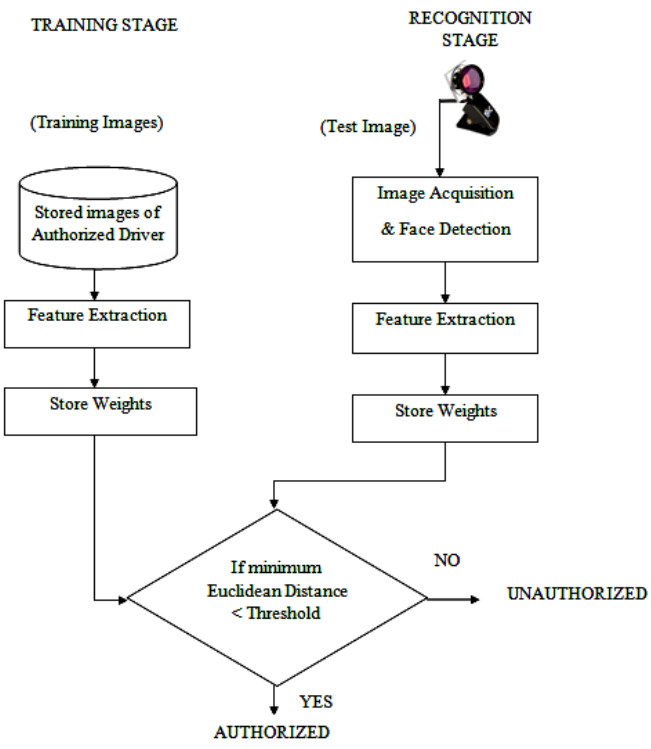

Fig 2. Flowchart of PCA Algorithm

Different approaches were present in the field of face detection methods development in recent years. The state of the art techniques are appearance based methods which includes also a lot of different approaches for face recognition. These methods cover Hidden Markov Models (HMM), Neural Networks (NN), Support Vector Machines (SVM), and Principal Component Analysis (PCA). We give a comparison over the above methods in the Table1

Technology	Accuracy
HMM	84.00%
PCA	98.50%
Neural Networks	95.60%

Table 1: Comparison Different Face Recognition Approaches

From the Table 1, that the PCA Eigen faces algorithm can give a high accuracy. Again it takes less time compared to the other two algorithms that is very important in real time embedded applications. In our embedded automotive security system, the PCA Eigen faces algorithm is used for driver's real time face recognition.

GPS Module: The GPS module can receive the data by connected to ARM7 development-board URAT0 through RS232 port. When the ARM7 chip sends the instruction AT to GPS module, the GPS module starts receiving the data and saves it into memory. This instruction sends the region information with the vehicle license information to the support-server center through GSM net. Because the system is based on GPS data which is sent through GPRS net, it must be initialed at first. The initial instructions are following:

Reset User settings initialized Following are the some instructions that are associated with GPS module and are useful in the system design.

- AT+ID=X: this instruction is used to set the terminal address. Each device must be set the address which indicates its ID, the default ID is 139XXXXXXXX.
- The default address is the SIM card mobile phone number which contains 11 numbers, the address can be changed as required.
- AT+IP=? this instruction is used to inquire the IP address.
- AT+PORT=X:this instruction is used to set the port number of the application software in surveillance center server.
- AT+PORT=? this instruction is used to inquire the port number.
- AT+HTH=X□AT+HTH=? □this instruction is used to set and inquire the time intervals of the GPS positioning information which the terminals send automatically. The unit of the time interval is second.
- AT+BAUD=X,AT+BAUD=? □this instruction is used to set and inquire the initial baud rate. The default is 4800 and does not need changing usually.
- AT+APN=X,AT+APN=? □this instruction is used to set and inquire the connect port of GPRS
- Telecommunication. The default value is CMNET.
- AT+AGREE=X,AT+AGREE=? □this instruction is used to set and inquire the net communication protocol.
- The default value is TCP protocol. The terminal on car supports the UDP and the TCP protocol. Users can change the protocol as needs.

GSM Module: To achieve important information of cars, one GSM module is added into the car security system. Siemens TC35I GSM modem can quickly send SMS messages to appointed mobile phone or SMS server.

V.SOFTWARE DESIGN

Following are the different software's used to design a smart car security system

1. KEIL C
2. MATLAB
3. FLASHMAGIC

VI. EXPERIMENTAL RESULTS

In this project, the real time face recognition is achieved using PCA algorithm. Figure 3 shows the experimental result when the authorized person starts the vehicle

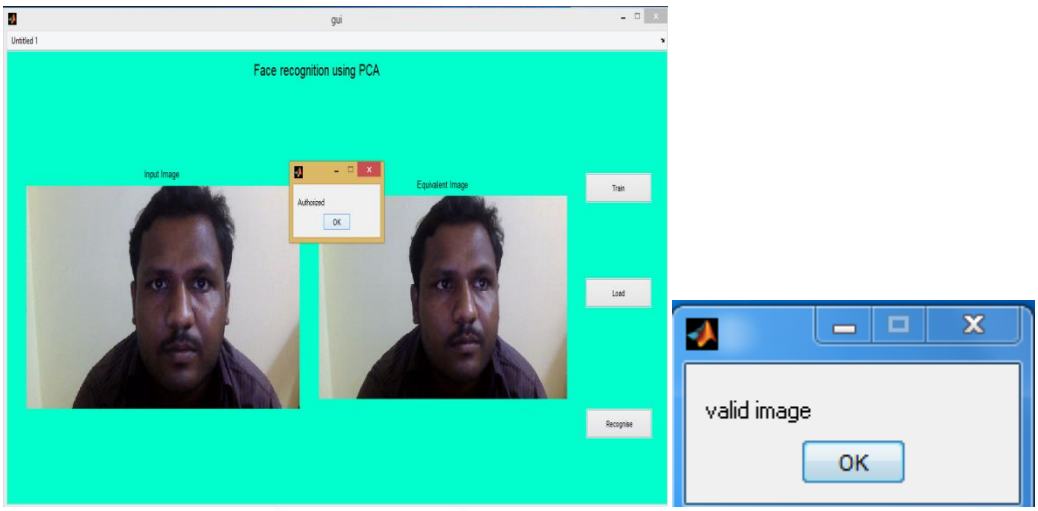

Fig3: Recognition of Authorized Image

Figure4 shows the experimental result when the unauthorized person tries to start the vehicle.

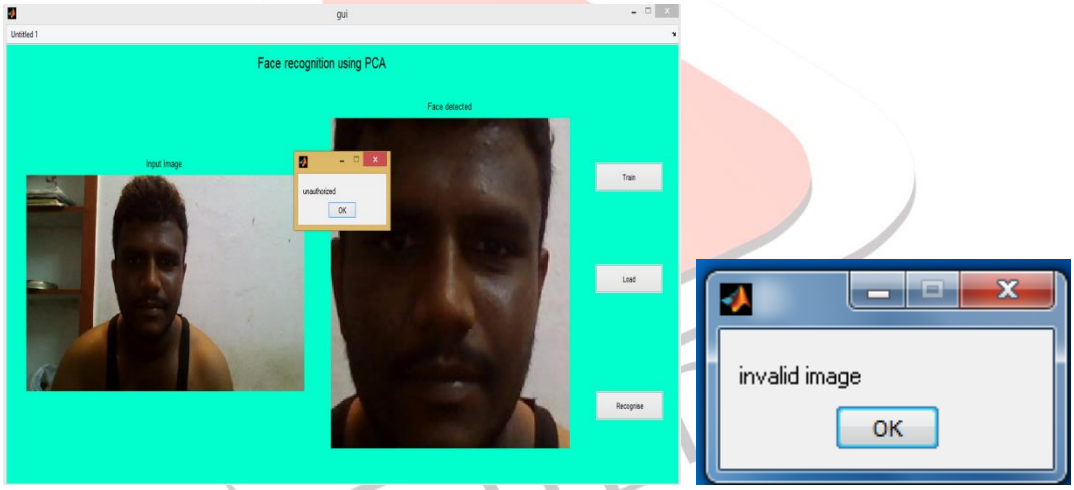

Fig 4. Recognition of Unauthorized Image

The figure5 shows the MMS structure which has been send to the owner's mobile from the vehicle.

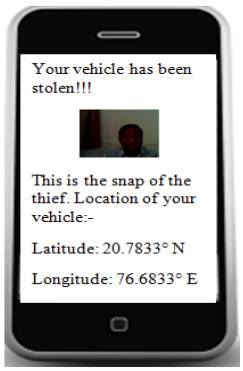

Fig 5. MMS Structure

VII.CONCLUSION

This paper presents the implements the implementation of various image-recognition techniques that can provide the important functions required by advanced intelligent Car Security, to avoid vehicle theft and protect the usage of unauthenticated users**.** This System offers a widely Communication bandwidth with the car control system to Change data and information, and new functional module scan be easily added to the system to upgrade and enhance it.

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