Active safety and security system in vehicle based on ARM microcontroller

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Abstract— The paper presents the system which prevents accident and theft of the vehicle using ARM7 microcontroller. The system consists of two CCD cameras, ultrasonic sensor, accelerometer, GSM module and ARM7 microcontroller. One camera with IR led setup is used for finger vein detection for authentication. The other camera is used for fatigue detection of driver by monitoring the position of eye. If driver's eye is closed for particular interval of time the controller warns the driver by giving alarm. The MATLAB software is used for processing the image of finger vein and compare with stored image in database using template matching. If the captured finger vein image matches with image in database, the LCD display shows access granted and vehicle starts otherwise it will shows access denied. The line detection algorithm is used for detecting vein in the image. The PCA classification is used for feature extraction of eye from the image. The accelerometer is used for detecting the movement of the wheels. The ultrasonic sensor is used for collision avoidance and distance measurement between obstructions behind the vehicle. If the distance between the vehicle used and leading vehicle is below the preset values stored in microcontroller the vehicle slows down and collision will be avoided. The system provides complete safety and security to the vehicle.

Index Terms— Fatigue detection [1], Vein detection [4], PCA, Accelerometer, ultrasonic sensor, GSM.

1 INTRODUCTION

Finger vein recognition is a method of biometric authentication that uses pattern-recognition techniques based on images of human finger vein patterns beneath the skin's surface. Finger vein recognition is one of biometric method used to identify individuals and verify their identity. To obtain the pattern for the database record, an individual inserts a finger into an attester terminal containing a near-infrared LED (light- emitting diode) light and a monochrome CCD (charge-coupled device) camera. The haemoglobin in the blood absorbs near-infrared LED light, which makes the vein system appear as a dark pattern of lines. The camera records the image and the raw data is digitized and sent to a database of registered images. For authentication purposes, the finger is scanned as before and the data is sent to the database of registered images for comparison. The authentication process takes less than two seconds. Blood vessel patterns are unique to each individual, as are other biometric data such as fingerprints or the patterns of the iris. Unlike some biometric systems, blood vessel patterns are almost impossible to counterfeit because they are located beneath the skin's surface. Biometric methods based on fingerprints can be fooled with a dummy finger fitted with a copied fingerprint, voice and facial characteristic-based systems can be fooled by recordings and high-resolution images. The finger vein ID system is much harder to fool because it can only authenticate the finger of a living person.

Fatigue is a major safety concern in many fields, but especially in transportation, because fatigue can result in disastrous accidents. Fatigue is considered an internal precondition for unsafe acts because it negatively affects the human operator's internal state. Research is mainly focused on pilots, truck drivers, and shift workers. Fatigue affects alertness, decreasing an individual's ability to operate vehicle safely and increasing the risk of human error that could lead to fatalities and injuries. Sleepiness slows reaction time, decreases awareness, and impairs judgment.

Fatigue impacts all transportation operators. The increasing number of traffic accidents due to a diminished driver's vigilance level has become a major problem for society.

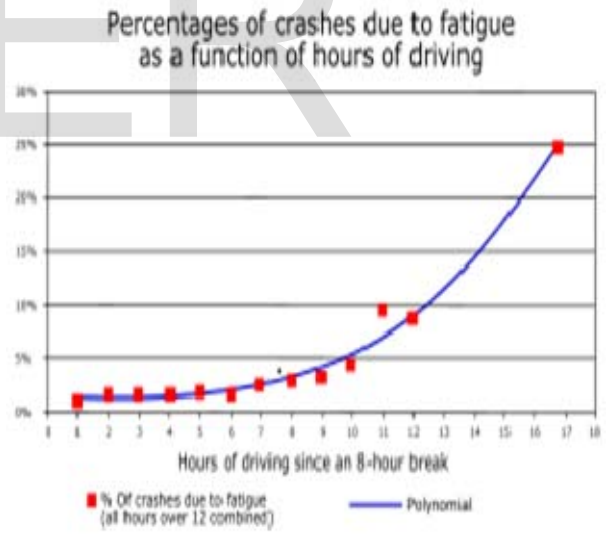

Fig1. Percentage of crashes due to fatigue of driver

2. ARM MICROCONTROLLER

The ARM architecture is a 32-bit RISC processor architecture developed by ARM Limited that is widely used in a number of embedded designs. Because of their power saving features, ARM CPUs are dominant in the mobile electronics market, where low power consumption is a critical design goal. Today, the ARM family accounts for approximately 75% of all embedded 32-bit RISC CPUs, making it one of the most widely used 32-bit architectures in the world. ARM CPUs are found in all corners of consumer electronics, from portable devices to computer peripherals.

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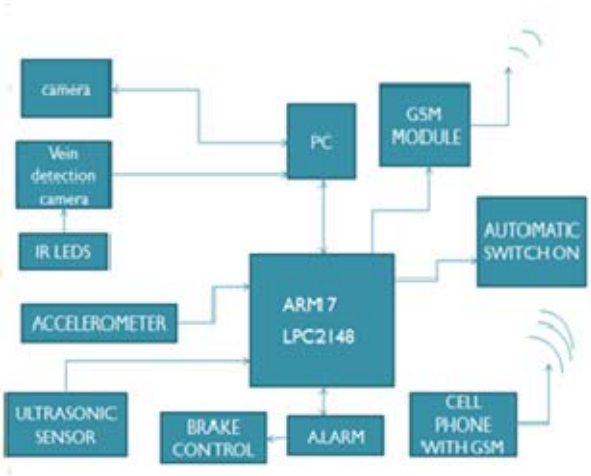
3. BLOCK DIAGRAM OF PROPOSED SYSTEM



4. PROCEDURE FOR FINGER VEIN DETECTION

The sample images of finger are taken for detecting vein in the image. Because the position of fingers usually varies across different finger-vein images, it is necessary to normalize the images before feature extraction and matching. The segmented finger-vein image is then enhanced to improve its contrast. The image is resized to 1/4 of the original size, and enlarged back to its original size [4]. Wiener filter is used for reducing Gaussian white noise in the image using size of neighborhood pixel to detect the mean. The sample image is stored in database for template matching. The finger image captured is compared with image in database and access is granted based on results [4].

Fig2. Sample finger image

4.1 Vein Image Detected

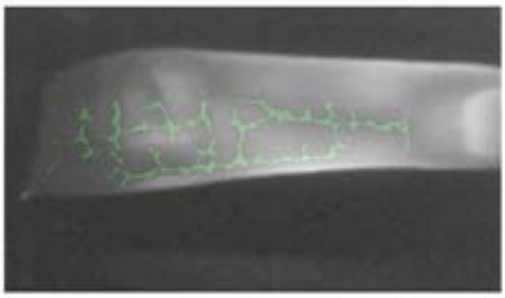
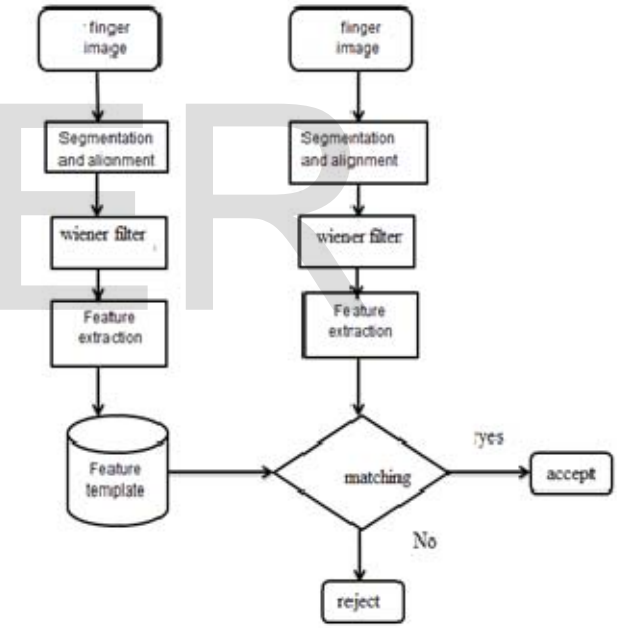


Fig3. Vein detection in image

4.2 Flowchart For Vein Detection



5. EYE BLINK DETECTION

5.1 Algorithm for eyeblink detection

1. The video image of the driver is acquired using camera for fixed number of frames.
2. Feature extraction of eye using pca classifier.
3. The samples of eye position is taken and stored in the database.
4. The video image of driver is captured and eye position of driver is monitored continuously
5. Check the condition if eye is closed for particular time then it shows eyeblink detected.
6. If eye is open then it shows the position of normal.

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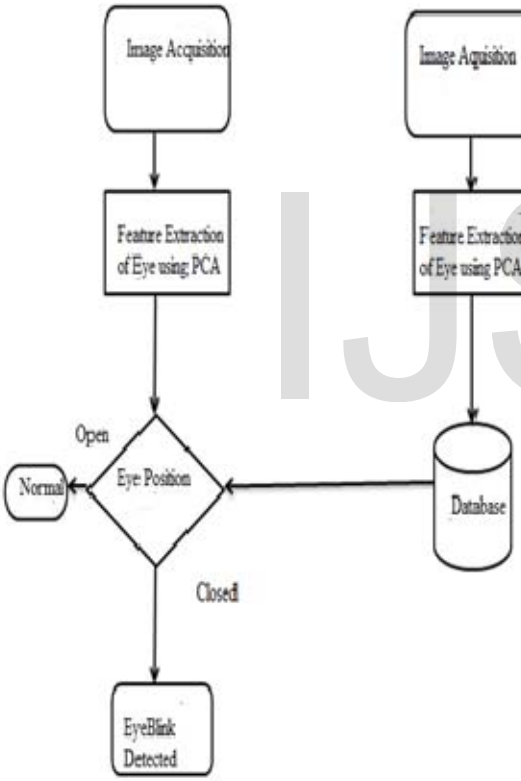
5.2 PCA Classification

Principal component analysis (PCA) is a statistical procedure that uses orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components. The number of principal components is less than or equal to the number of original variables. This transformation is defined in such a way that the first principal component has the largest possiblevariance (that is, accounts for as much of the variability in the data as possible), and each succeeding component in turn has the highest variance possible under the constraint that it be orthogonal to (i.e., uncorrelated with) the preceding components. Principal components are guaranteed to be independent if the data set is jointly normally distributed. PCA is sensitive to the relative scaling of the original variables.

5.3 Flowchart of EyeBlink Detection



6. ACCELEROMETER

The ADXL335 is a small, thin, low power, complete 3-axis accel- erometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full-scale range of ±3 g. It can measure the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration. The user selects the bandwidth of the accelerometer using the CX, CY, and CZ capacitors at the XOUT, YOUT, and ZOUT pins. Bandwidths can be selected to suit the application, with a range of 0.5 Hz to 1600 Hz for the X and Y axes, and a range of 0.5 Hz to 550 Hz for the Z axis. The ADXL335 is available in a small, low profile, 4 mm × 4 mm × 1.45 mm, 16-lead, plastic lead frame chip scale package (LFCSP_LQ).

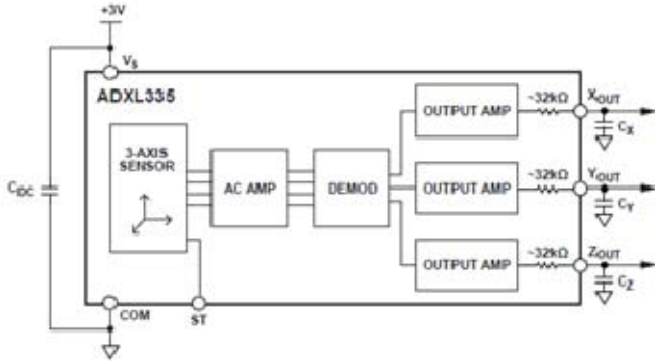


Fig4. Block diagram of accelerometer

7. ULTRASONIC SENSOR

Ultrasonic sensors (also known as transceivers when they both send and receive, but more generally called transducers) work on a principle similar to radar or sonar which evaluates attributes of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors produce high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate time interval between sending and receiving the echo to determine the distance of the object.

Fig5. Ultrasonic Sensor

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8 GLOBAL SYSTEMS FOR MOBILE COMMUNICATION

Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication. GSM represents of a standardization group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan-European mobile cellular radio system operating at 900 MHz. It is estimated that many countries outside of Europe will join the GSM partnership. The range of a channel's limits; the broader the bandwidth, the faster data can be sent. A single on-off pulse of data; eight bits are equivalent to one byte. The number of cycles per unit of time; frequency is measured in hertz (Hz). Kilo is the designation for 1,000; the abbreviation kbps represents 1,000 bits per second 1,000,000 hertz (cycles per second). One-thousandth of a second measure of power of a transmitter. Throughout the evolution of cellular telecommunications, various systems have been developed without the benefit of standardized specifications. This presented many problems directly related to compatibility, especially with the development of digital radio technology. The GSM standard is intended to address these problems

9. THREE STAGES IN ACCIDENT PREVENTION

1. CaseI: If driver's eye is closed for particular interval of time, the microcontroller warns the driver by give alarm.

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2. CaseII: If driver's eye is not closed and still he is in fatigue condition such as he consuming alcohol and in unconscious state. At that time accelerometer check the wheel movements. If it is abnormal, it sends the message to microcontroller which is connected to the brake control.The vehicle automatically slows down and accident can be prevented.

3. CaseIII: If driver's eye is not closed and wheel movements are normal, then the ultrasonic sensor detect the distance from the leading vehicle which prevents the collision by giving signal to the microcontroller and the vehicle slows down.

10. CONCLUSION AND FUTURE WORK

The aim of this work had been to design a system which providing complete safety and security to vehicle. The computing system for the prevention of fatal injuries and loss of lives due to Fatigued state of a vehicular driver and also prevent the theft of vehicle.

Some of the problems with the fatigue detection systems currently under development include the stage of drowsiness being detected and the combination of different measures. More research and development is needed before effective fatigue monitoring systems are standard features in on-road vehicles. The vein detection authentication and fatigue monitoring methods can be enhanced and will be usedin many applications.

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