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A PATH FOR HORIZING YOUR INNOVATIVE WORK

INTELLIGENT VEHICLE

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Abstract

As human is progressing various technological changes are being adopted in societies resulting in rapid industrialization. People are moving towards cities leaving behind countryside resulting in higher population there by large number of vehicles and hence number of accidents is increasing. Day by day scenario in cities is changing very fast and leveraged to worsen. Various companies and multinationals across the globe are working towards decreasing the accidents level and finding a better solution for the same. So in order to provide the security to the users, we are supposed to design and develop a model by providing complete range of automation system during driving with accident awareness system based on Zigbee Technology. The system also consist of image processing technique, through which if unwanted user start to drive the vehicle then the system will store the image in the memory, which will be based on Artificial intelligence and Artificial Neural network. Automatic recognition of people is a challenging problem which has received much attention during recent years due to its many applications in different fields. Face recognition is one of those challenging problems and up to date, there is no technique that provides a robust solution to all situations. This paper presents a new technique for human face recognition. This technique uses an image-based approach towards artificial intelligence by removing redundant data from face images through image compression using the two-dimensional discrete cosine transform (2D-DCT). The DCT extracts features from face images based on skin color. Feature-vectors are constructed by computing DCT coefficients. A self-organizing map (SOM) using an unsupervised learning technique is used to classify DCT-based feature vectors into groups to identify if the subject in the input image is “present” or “not present” in the image database. Face recognition with SOM is carried out by classifying intensity values of grayscale pixels into different groups. Evaluation was performed in MATLAB using an image database of 25 face images, containing five subjects and each subject having 5 images with different facial expressions. After training for approximately 850 epochs the system achieved a recognition rate of 81.36% for 10 consecutive trials. The main advantage of this technique is its high-speed processing capability and low computational requirements, in terms of both speed and memory utilization.

INTRODUCTION

Face recognition has become a very active area of research in recent years mainly due to increasing security demands and its potential commercial and law enforcement applications. The last decade has shown dramatic progress in this area, with emphasis on such applications as human-computer interaction (HCI), biometric analysis, content-based coding of images and videos, and surveillance [2]. Although a trivial task for the human brain, face recognition has proved to be extremely difficult to imitate artificially, since although commonalities do exist between faces, they vary considerably in terms of age, skin, color and gender. The problem is further complicated by differing image qualities, facial expressions, facial furniture, background, and illumination conditions [3]. A generic representation of a face recognition system is shown in Fig. 1.

This project presents a novel approach for face recognition that derives from an idea suggested by Hjelmås and Low[1]. In their survey, they describe a preprocessing step that attempts to identify pixels associated with skin independently of face-related features. This approach represents a dramatic reduction in computational requirements over previous methods.

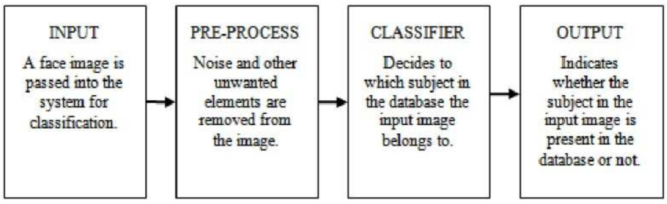


Fig. 1. Generic representation of a face recognition system

This technology of face recognition has been develop to provide authenticate access to car (vehicle).The sensors fixed inside the car will sense the gesture of the person sitting on the driver sit and will match to the database already present in the sensor .This sensor will help identify the theft easily doing unauthorized access of the car

Since skin color in humans varies by individual, research has revealed that intensity rather than chrominance is the main distinguishing characteristic. The recognition stage typically uses an intensity (grayscale) representation of the image compressed by the 2D-DCT for further processing[2]. This grayscale version contains intensity values for skin pixels.

A block diagram of the proposed technique of the face recognition system is presented in Fig. 2. In the first stage, the 2D-DCT for each face image is computed, and feature vectors are formed from the discrete cosine transform (DCT) coefficients. The second stage uses a self-organizing map (SOM) with an unsupervised learning technique to classify vectors into groups to recognize if the subject in the input image is "present" or "not present" in the image database. If the subject is classified as present, the best match image found in the training database is displayed as the result, else the result displays that the subject is not found in the image database. The rest of this paper is organized as follows: Section II discusses DCT computation on face images. Section III describes the design and architecture of the SOM neural network. Section IV shows experimental results, and discusses possible modifications and improvements to the system. Section V presents concluding remarks.

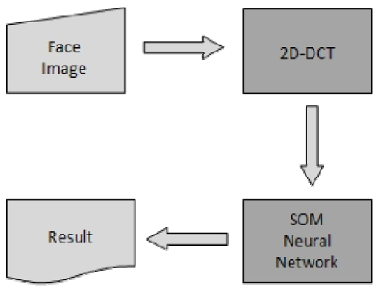


Fig. 2. Proposed technique for face recognition system

II. DISCRETE COSINE TRANSFORM

A. Overview

The discrete cosine transform is an algorithm widely used in different applications. The most popular use of the DCT is for data compression, as it forms the basis for the international standard loss image compression algorithm known as JPEG[5]. The DCT has the property that, for a typical image, most of the visually significant information about the image is concentrated in just a few coefficients. Extracted DCT coefficients can be used as a type of signature that is useful for recognition tasks, such as face recognition[6,7].

Face images have high correlation and redundant information which causes computational burden in terms of processing speed and memory utilization. The DCT transforms images from the spatial domain to the frequency domain. Since lower frequencies are more visually significant in an image than higher frequencies, the DCT discards high-frequency coefficients and quantizes the remaining coefficients. This reduces data volume without sacrificing too much image quality[3]. The 2D-DCT of an $M \times N$ matrix A is defined as follows:

$$B_{pq} = \alpha_p \alpha_q \sum_{m=0}^{M-1}\sum_{n=0}^{N-1} A_{mn} \cos\frac{\pi(2m+1)p}{2M} \cos\frac{\pi(2n+1)p}{2n}, \quad \begin{matrix} 0 \le p \le M-1 \\ 0 \le q \le N-1 \end{matrix} \qquad (2.1)$$

The values B_{pq} are the DCT coefficients. The DCT is an invertible transform, and the 2D-IDCT (2D Inverse-DCT) is defined as follows:

$$A_{mn} = \sum_{p=0}^{M-1}\sum_{q=0}^{N-1} \alpha_p \alpha_q B_{pq} \cos\frac{\pi(2m+1)p}{2M} \cos\frac{\pi(2n+1)p}{2n}, \quad \begin{matrix} 0 \le m \le M-1 \\ 0 \le n \le N-1 \end{matrix} \qquad (2.2)$$

The values α_p and α_q in (2.1) and (2.2) are given by:

$$\alpha_p = \begin{cases} \sqrt{\frac{1}{M}}, & p=0 \\ \sqrt{\frac{2}{M}}, & 1 \le p \le M-1 \end{cases} \qquad \alpha_q = \begin{cases} \sqrt{\frac{1}{N}}, & q=0 \\ \sqrt{\frac{2}{N}}, & 1 \le q \le N-1 \end{cases} \qquad (2.3)$$

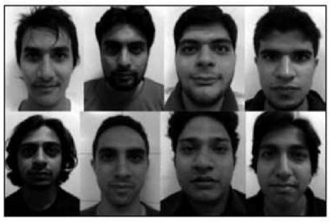
The proposed technique uses the DCT transform matrix in the MATLAB Image Processing Toolbox. This technique is efficient for small square inputs such as image blocks of 8 × 8 pixels. The M × M transform matrix T is given by:

$$T_{pq} = \begin{cases} \sqrt{\frac{1}{M}} & p=0, \quad 0 \le q \le M-1 \\ \sqrt{\frac{2}{M}} \cos\frac{\pi(2q+1)p}{2M} & 1 \le p \le M-1, \quad 0 \le q \le M-1 \end{cases} \qquad (2.4)$$

B. Face Image Preprocessing

Face images of different candidates with different facial expressions are taken with a Canon Powershot S3 IS 6.0 megapixel digital camera in the size of 1200 × 1600 pixels (2.0 megapixels). All face images taken resemble the following general features:

- Uniform illumination conditions
- Light color background
- Faces in upright and frontal position
- Tolerance for tilting and rotation up to 20 degrees



(a)

(b)

Fig. 3. Face images of candidates. (a) Face images of different subjects.

(b) Face image of a single subject with 5 different facial expressions

Face images are preprocessed in Adobe Photoshop CS2. The face image fabrication process is shown in Fig. 4. Image preprocessing includes the following steps:

- Auto adjusting hue and saturation levels
- Adjusting brightness and contrast to fixed scale
- Desaturating 24 bit RGB color into 8 bit grayscale
- Downsizing images to 512 × 512 pixels
- Saving images in jpeg format

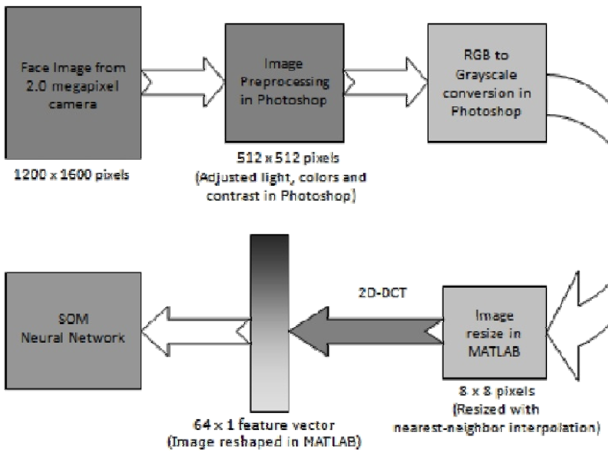


Fig. 4. Face image fabrication process

C. 2D-DCT Image Compression

Nearest-neighbor interpolation is performed using the MATLAB Image Processing Toolbox to resize preprocessed images from size 512 × 512 pixels to image blocks of size 8 × 8 pixels as shown in Fig. 4.

The proposed design technique calculates the 2D-DCT of the image blocks of size 8 × 8 pixels using '8' out of the 64 DCT coefficients for masking. The other 56 remaining coefficients are discarded (set to zero). The image is then reconstructed by computing the 2D-IDCT of each block using the DCT transform matrix computation method. Finally, the output is a set of arrays. Each array is of size 8 × 8 pixels and represents a single image. These steps are represented in Fig. 5 for a sample image. Empirically, the upper left corner of each 2D-DCT matrix contains the most important values, because they correspond to low-frequency components within the processed image block[2].

III. SELF-ORGANIZING MAPS

A. Overview

The self-organizing map also known as a Kohonen Map is a well-known artificial neural network. It is an unsupervised learning process, which learns the distribution of a set of patterns without any class information. It has the property of topology preservation. There is a competition among the neurons to be activated or fired. The result is that only one neuron that wins the competition is fired and is called the "winner"[4]. A SOM network identifies a winning neuron using the same procedure as employed by a competitive layer. However, instead of updating only the winning neuron, all neurons within a certain neighborhood of the winning neuron are updated using the Kohonen Rule. The Kohonen rule allows the weights of a neuron to learn an input vector, and because of this it is useful in recognition applications. Hence, in this system, a SOM is employed to classify DCT-based vectors into groups to identify if the subject in the input image is "present" or "not present" in the image database[3].

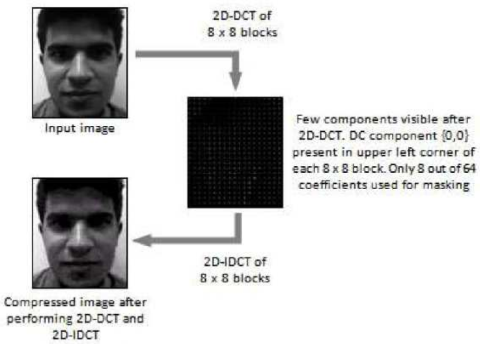


Fig. 5. 2D-DCT computation of face image

B. Network Architecture

SOMs can be one-dimensional, two-dimensional or multi-dimensional maps. The number of input connections in a SOM network depends on the number of attributes to be used in the classification[4].

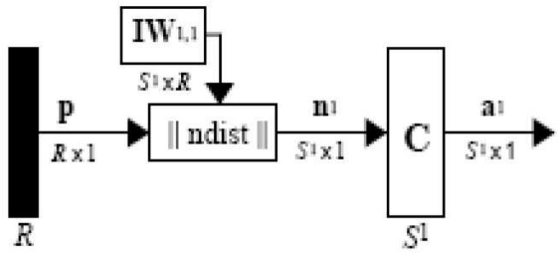


Fig. 6. Architecture of a simple SOM

The input vector p shown in Fig. 6 is the row of pixels of the DCT compressed image. The ||dist|| box accepts the input vector p and the input weight matrix $IW^{1,1}$, which produces a vector having S^1 elements. The elements are the negative of the distances between the input vector and vectors $_iIW^{1,1}$ formed from the rows of the input weight matrix. The ||dist|| box computes the net input n^1 of a competitive layer by finding the Euclidean distance between input vector p and the weight vectors. The competitive transfer function C accepts a net input vector for a layer and returns neuron outputs of 0 for all neurons except for the winner, the neuron associated with the most positive element of net input n^1. The winner's output is 1. The neuron whose weight vector is closest to the input vector has the least negative net input and, therefore, wins the competition to output a 1. Thus the competitive transfer function C produces a 1 for output element a^1_i corresponding to i^*, the "winner". All other output elements in a^1 are 0[8].

$$n^1 = -\left\| IW_{11} - p \right\| \quad (3.1)$$

$$a^1 = compet(n^1) \quad (3.2)$$

Thus, when a vector p is presented, the weights of the winning neuron and its close neighbors move toward p. Consequently, after many presentations, neighboring neurons learn vectors similar to each other[8]. Hence, the SOM network learns to categorize the input vectors it sees.

The SOM network used here contains N nodes ordered in a two-dimensional lattice structure. In these cases, each node has 2 or 4 neighboring nodes, respectively. Typically, a SOM has a life cycle of three phases: the learning phase, the training phase and the testing phase.

C. Unsupervised Learning

During the learning phase, the neuron with weights closest to the input data vector is declared as the winner. Then weights of all of the neurons in the neighborhood of the winning neuron are adjusted by an amount inversely proportional to the Euclidean distance. It clusters and classifies the data set based on the set of attributes used. The learning algorithm is summarized as follows[4]:

1. Initialization: Choose random values for the initial weight vectors $w_j(0)$, the weight vectors being different for j = 1,2,...,l where l is the total number of neurons.

$$w_i = [w_{i1}, w_{i2}, ..., w_{il}]^T \in \Re^n \quad (3.3)$$

2. Sampling: Draw a sample x from the input space with a certain probability.

$$x = [x_1, x_2, ..., x_l]^T \in \Re^n \quad (3.4)$$

3. Similarity Matching: Find the best matching (winning) neuron i(x) at time t, 0 < t ≤ n by using the minimum distance Euclidean criterion:

$$i(x) = \arg\min_j \left\| x(n) - w_j \right\|, \; j = 1, 2, ..., l \quad (3.5)$$

4. Updating: Adjust the synaptic weight vector of all neurons by using the update formula:

$$w_j(n+1) = w_j(n) + \eta(n) h_{j,i(x)}(n) [x(n) - w_j(n)] \quad (3.6)$$

where η(n) is the learning rate parameter, and $h_{j,i}x(n)$ is the neighborhood function centered around the winning neuron i(x). Both η(n) and $h_{j,i}x(n)$ are varied dynamically during learning for best results.

5. Continue with step 2 until no noticeable changes in the feature map are observed.

Training images are mapped into a lower dimension using the SOM network and the weight matrix of each image stored in the training database. During recognition trained images are reconstructed using weight matrices and recognition is through untrained test images using Euclidean distance as the similarity measure. Training and testing for our system was performed using the MATLAB Neural Network Toolbox.

D. Training

During the training phase, labeled DCT-vectors are presented to the SOM one at a time. For each node, the number of "wins" is recorded along with the label of the input sample. The weight vectors for the nodes are updated as described in the learning phase. By the end of this stage, each node of the

SOM has two recorded values: the total number of winning times for subject present in image database, and the total number of winning times for subject not present in image database[2].

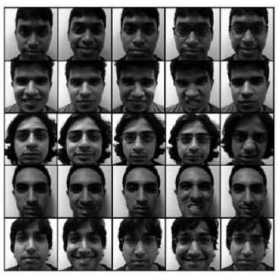
E. Testing

During the testing phase, each input vector is compared with all nodes of the SOM, and the best match is found based on minimum Euclidean distance, as given in (3.5)[2]. The final output of the system based on its recognition, displays if the test image is "present" or "not present" in the image database.

IV. EXPERIMENTAL RESULTS

A. Image Database

A face image database was created for the purpose of benchmarking the face recognition system. The image database is divided into two subsets, for separate training and testing purposes. During SOM training, 25 images were used, containing five subjects and each subject having 5 images with different facial expressions. Fig. 7 shows the training and testing image database constructed.



(a)

(b)

Fig. 7. Training and testing image database. (a) Image database for training.(b) Untrained image for testing

The face recognition system presented in this paper was developed, trained, and tested using MATLAB™ 7.2. The computer was a Windows XP machine with a 3.00 GHz Intel Pentium 4 processor and 1 GB of RAM.

B. Validation of Technique

The preprocessed grayscale images of size 8 × 8 pixels are reshaped in MATLAB to form a 64 × 1 array with 64 rows and 1 column for each image. This technique is performed on all 5 test images to form the input data for testing the recognition system. Similarly, the image database for training uses 25 images and forms a matrix of 64 × 25 with 64 rows and 25 columns. The input vectors defined for the SOM are distributed over a 2D-input space varying over [0 255], which represents intensity levels of the grayscale pixels. These are used to train the SOM with dimensions [64 2], where 64 minimum and 64 maximum values of the pixel intensities are represented for each image sample. The resulting SOM created with these parameters is a single-layer feed forward SOM map with 128 weights and a competitive transfer function. The weight function of this network is the negative of the Euclidean distance[3]. This SOM network is used for all subsequent experiments. As many as 5 test images are used with the image database for performing the experiments. Training and testing sets were used without any overlapping. Fig. 8 shows the result of the face recognition system simulated in MATLAB using the image database and test input image shown in Fig. 7.for this simulation displaying its neuron positions is shown in Fig 10(a). Weights vectors of the untrained image database in Fig. 10(b) and trained image database in Fig. 10(c) in comparison to the simulated 3D-SOM map in Fig. 10(a) are shown below.

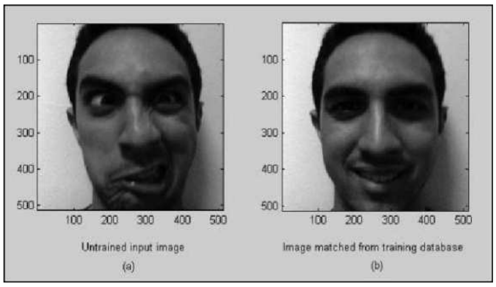


Fig. 8. Result of face recognition system. (a) Untrained input image for testing. (b) Best match image of subject found in training database

The result obtained from this simulation identifies that the subject in the input image Fig. 8(a) is "present" in the image database. The best match image displayed in Fig. 8(b) illustrates that subjects with different facial expressions in the image database can be easily identified. Euclidean distance for DCT-feature vectors for the untrained image database and SOM trained image database is shown in Fig. 9

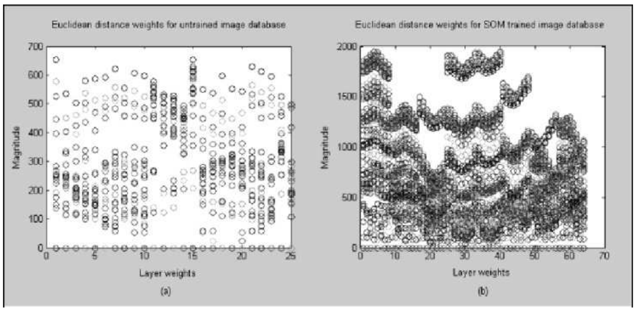


Fig.9.Euclidean Distance weights. a)Untrained Image b)Image database trained with SOM network

As is clear from Fig. 9(a), the untrained DCT-feature vectors are represented by scattered clusters separated by large Euclidean distances. After SOM training, the 25-dimensional image database is transformed into a 64-dimensional map where the magnitude of the layer weights is increased, as shown in Fig 9(b). This transformation produces better classification by grouping similar clusters together, separated by smaller Euclidean distances[3]. A 3D-SOM network map

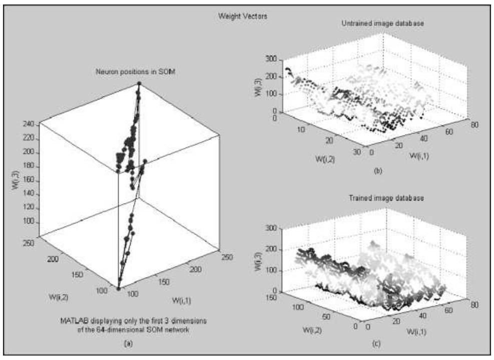


Fig. 10. Weight vectors of SOM. (a) Simulated 3D-SOM.(b) Untrained SOM. (c) Trained SOM

The next section presents results for 3 experiments in which different system parameters were altered. In the first two experiments the number of epochs used for training is 1000, and all experimental results obtained are the average of three consecutive simulations.

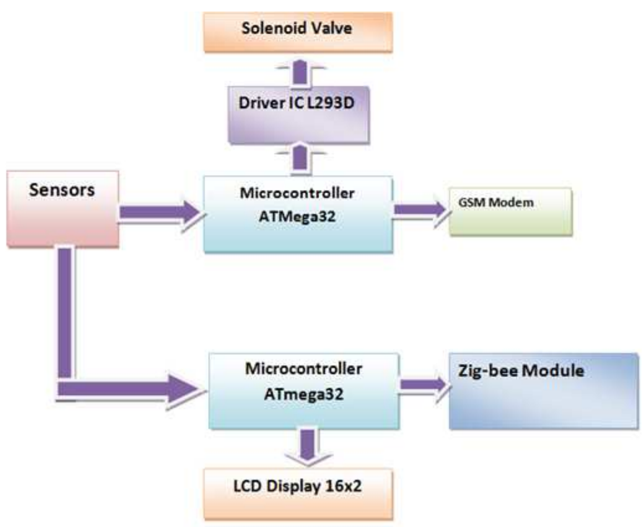
C. DCT Block Size

The first experiment studies the effect of DCT block size on the rate of recognition of the system with each DCT coefficient being used in the feature vector[2]. Table I shows that the best recognition rate obtained is for the case of 8 × 8 block sizes, and this block size was used in all subsequent experiments.

TABLE I
RECOGNITION RATES VS. DCT BLOCK SIZE
Maximum recognition rate is obtained at (8 x 8) block

	DCT block size					
	4x4	6x6	8x8	10x10	12x12	16x16
Recognition rate (%)	73.31	77.43	78.82	75.82	74.64	73.64

V. 2nd CASE:



BLOCK DAIGRAM case 2nd

<u>Components Required</u>

1) Zigbee- Module
2) Microcontroller ATMeag32
3) GSM Modem Sim 300
4) Motor Driver L293D
5) Buzzer
6) Relay

In this case four sensors will be attached inside the car in four direction. If there will be accident occurs, then sensor will be deactivated and controller will consider a logical zero in the region of accident side and send a signal to the microcontroller for processing the message to the control room regarding the accident situation. It will also have the provision for generating an alarm and spreading the radio frequency in a region of 50m so that any passersby vehicle will directly aware regarding the accident condition of the vehicle.

I] ZIGBEE:

a) Using Zig-Bee technology, the information about the accident will be immediately displayed to other vehicle in the range of 50m from its initial position. In case of any blind turns in the route can cause other vehicle to get cursed into the vehicle whose accident has already occurred so to avoid this, Zig-bee plays an important role of displaying the information in other vehicle to avoid further future accidents. The module zigbee is used to enhance the wireless network around that particular device which has implemented zigbee.In this module of intelligent vehicle zigbee is used to identify the wireless sensor in the network. By identifying these sensors Zig-Bee would connect the vehicle to the wireless network immediately .Zigbee uses transmission protocol to transfer the accident information requesting to connect the wireless network. Results of the processing are applied to embedded device called as micro controller.

b) Why Using Zig Bee?

When you hold the TV remote and wish to use it you have to necessarily point your control at the device. This one-way, line-of-sight, short-range communication uses infrared (IR) sensors to enable communication and control and it is possible to operate the TV remotely only with its control unit. Now picture a home with entertainment units, security systems including fire alarm, smoke detector and burglar alarm, air-conditioners and kitchen appliances all within whispering distance from each other and imagine a single unit that talks *with* all the devices, no longer depending on line-of-sight, and traffic no longer being one-way. This means that the devices and the control unit would all need a common standard to enable intelligible communication. **ZigBee** is such a standard for embedded application software and has been ratified in late 2004 under IEEE 802.15.4 Wireless Networking Standards.

ZigBee is an established set of specifications for wireless personal area networking (WPAN), i.e., digital radio connections between computers and related devices. This kind of network eliminates use of physical data buses like USB and Ethernet cables. The devices could include telephones, hand-held digital assistants, sensors and controls located within a few meters of each other.

II] MICRO CONTROLLER

Micro-controller ATM mega 32:

The high-performance, low-power Atmel 8-bit AVR RISC-based microcontroller combines 32KB of programmable flash memory, 2KB SRAM, 1KB EEPROM, an 8-channel 10-bit A/D converter, and a JTAG interface for on-chip debugging. The device supports throughput of 16 MIPS at 16 MHz and operates between 4.5-5.5 volts.By executing instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed. If there will be accident occurs, then sensor will be deactivated and controller will consider a logical zero in the region of accident side and send a signal to the microcontroller for processing the message to the control room regarding the accident situation. The job of the micro controller is to process the information received from the zigbee and immediately transfer information to the GSM module. The micro controller is heart of the complete system.

III] GSM MODULE SIM 300

As soon as accident has occur, GSM modem attached with the system will send message to control room about the accident condition, containing the information about the vehicle No. Type and the side from which the maximum injury happens. The car will have the provision for switching on/off the fuel supply using GSM Modem. This technology will prevent the theft level of the vehicle. The user will send a message to the vehicle, which will be decoded by the microcontroller and send the logical voltage to the driver IC for Relay operation and control of the solenoid valve. This is also applied for preventing car from blast during the accident. When accident occur the GSM will send message to control room and now in reply message can be send from control room to micro controller about information to close the solenoid valves and to close the fuel supply immediately to avoid blast in the car.GSM module is the wireless modem that works in GSM network. Global System for Mobile communication (GSM) is an architecture used for mobile communication. GSM module in our system establishes communication between the vehicle and the user. As soon as GSM recognize the accident or unauthorized user GSM immediately sends information about the person sitting at the driver sit ,information about the location of the vehicle to the control room.GSM also sends information to all the remote vehicle so that the vehicle in the same route can be able to change the route in case of accident to avoid further accident of the vehicle in the same route. GSM/GPRS modems is used in this intelligent vehicle implementation in terms of SMS transmission rate, since the determining factor for the SMS transmission rate is the wireless network. A. GSM/GPS has been used for the sending message and knowing location of the car to the control room immediately

Advantages

1) Provides security to the vehicles
2) No. of theft level will be decreased
3) Police get the real time accident condition of the vehicles

4) Passersby will get the information regarding accidents details.

5) It will be economical for establish the system in the car.

6) Provides the high level of security

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