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Multi Biometric System Using Face Recognition by SIFT Algorithm and RFID with SMS Reporting System with Voice Announcement

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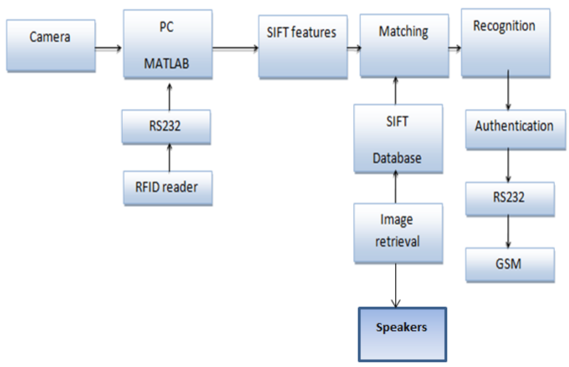
Abstract:

Face recognition is an integral part of biometrics. In biometrics basic traits of human is matched to the existing data and depending on result of matching identification of a human being is traced. Facial features are extracted and implemented through algorithms which are efficient and some modifications are done to improve the existing algorithm models. A face recognition system using the SIFT (Space invariant feature transformation) algorithm was implemented. The algorithm is based on Image features approach which represents a SIFT method in which a small set of significant features are used to describe the variation between face images. Experimental results for different numbers of faces are shown to verify the viability of the proposed method. In this project an approach to the detection and identification of human faces is presented and then recognizes the person by comparing characteristics of the face to those of known individuals is described. And we introduced a new approach that Multi biometric system with RFID and face recognition and give report by SMS to mobile using GSM modem.

Block diagram:



Images:

RFID

Radio-frequency identification (RFID) is the use of a wireless non-contact system that uses radio-frequency electromagnetic fields to transfer data from a tag attached to an object, for the purposes of automatic identification and tracking. Some tags require no battery and are powered by the electromagnetic fields used to read them. Others use a local power source and emit radio waves (electromagnetic radiation at radio frequencies). The tag contains electronically stored information which can be read from up to several metres (yards) away. Unlike a bar code, the tag does not need to be within line of sight of the reader and may be embedded in the tracked object. RFID tags are used in many industries. An RFID tag attached to an automobile during production can be used to track its progress through the assembly line. Pharmaceuticals can be tracked through warehouses. Livestock and pets may have tags injected, allowing positive identification of the animal. RFID identity cards can give employees access to locked areas of a building, and RF transponders mounted in automobiles can be used to bill motorists for access to toll roads or parking. Since

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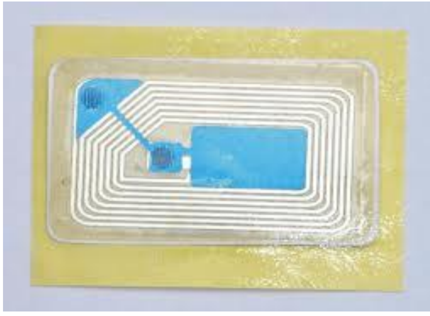
RFID tags can be attached to clothing, possessions, or even implanted within people, the possibility of reading personally-linked information without consent has raised privacy concerns.



Global System for Mobile Communication (GSM)

Definition:

GSM, which stands for Global System for Mobile communications, reigns (important) as the world's most widely used cell phone technology. Cell phones use a cell phone service carrier's GSM network by searching for cell phone towers in the nearby area. Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication.GSM is the name 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.

MODEM SPECIFICATIONS:

The SIM300 is a complete Tri-band GSM solution in a compact plug-in module. Featuring an industry-standard interface, the SIM300 delivers GSM/GPRS900/1800/1900Mhz performance for voice, SMS, data and Fax in a small form factor and with low power consumption. The leading features of SIM300 make it deal fir virtually unlimited application, such as WLL applications (Fixed Cellular Terminal), M2M application, handheld devices and much more.

1. Tri-band GSM/GPRS module with a size of 40x33x2.85
2. Customized MMI and keypad/LCD support
3. An embedded powerful TCP/IP protocol stack
4. Based upon mature and field proven platform, backed up by our support service, from definition to design and production.

RS 232 cable

RS232 means recommended standard, it is a cable in which serial communications can be done. Information being transferred between data processing equipment and peripherals is in the form of digital data which is transferred in either a serial or parallel mode. Parallel communications are used mainly for connections between test instruments or computers and printers, while serial is often used between computer and other peripherals. Serial transmission involves the sending of data one bit at a time, over single communications line. In contrast, parallel communications require at least as many lines as there are bits in a word being transmitted (for an 8-bit word, a minimum of 8 lines are needed) serial transmission is beneficial for long distance communications, where as parallel is designed for short distance or when very high transmission rates are required. The RS-232 interface is the Electronic Industries Association (EIA) standard for the interchange of serial binary data between two devices. It was initially developed by the EIA to standardize the connection of computers with telephone line modems. The standard allows as many as 20 signals to be defined, but gives complete freedom to the user.

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Three wires are sufficient: send data, receive data, and signal ground. The remaining lines can be hardwired on or off permanently. The signal transmission is bipolar, requiring two voltages, from 5 to 25 volts, of opposite polarity.

SIFT:

SIFT key points of objects are first extracted from a set of reference images and stored in a database. An object is recognized in a new image by individually comparing each feature from the new image to this database and finding candidate matching features based on Euclidean distance of their feature vectors. From the full set of matches, subsets of key points that agree on the object and its location, scale, and orientation in the new image are identified to filter out good matches.

The determination of consistent clusters is performed rapidly by using an efficient hash table implementation of the generalized Hough transform. Each cluster of 3 or more features that agree on an object and its pose is then subject to further detailed model verification and subsequently outliers are discarded. Finally the probability that a particular set of features indicates the presence of an object is computed, given the accuracy of fit and number of probable false matches. Object matches that pass all these tests can be identified as correct with high confidence.

A. Scale Invariant Feature Transform:

The presented model uses SIFT, developed by David Lowe [12] to extract features. SIFT transforms image data into scale invariant coordinates relative to local features. The features are invariant to image scaling and rotation, and partially invariant to change in illumination. Large numbers of features can be extracted from typical images. SIFT features are extracted from a set of training images and stored in the database for face recognition. A test image is matched by individually comparing each feature from the test image to the existing database. Best match between the extracted features is based on Euclidean distance of their feature vectors. To generate set of image features, SIFT uses four major stages of computation. Four stages include Scale-Space Extrema Detection, Key Point Localization, Orientation Assignment and Key Point Descriptor [13].

Scale Space Extrema Detection stage detects stable features across all possible scale spaces. Image is first convolved with Gaussian filters at different scales, which results into several Gaussian images. Koenderink and Lindeberg shown that under a variety of reasonable assumptions the only possible scales pace kernel is the Gaussian function. Scale space L(X,Y,σ) is produced from the convolution of a variable-scale Gaussian G(X,Y,σ) with an input image I(X,Y) is defined by,

$$L(x,y,\sigma) = G(x,y,\sigma) * I(x,y) \qquad (1)$$

Then the differences of the adjacent Gaussian images are calculated to generate the Difference of Gaussian images. DoG images D(X,Y,σ) can be computed from the difference of two nearby scales separated by constant multiplication factor k:

$$D(x,y,\sigma) = \big(G(x,y,k\sigma) - G(x,y,\sigma)\big) * I(x,y)$$
$$D(x,y,\sigma) = L(x,y,k\sigma) - L(x,y,\sigma) \qquad (2)$$

After each octave, the Gaussian images are down-sampled by a factor of 2 (next octave), and then the process is repeated.

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After obtaining the DoG images in each octave, SIFT selects the interesting features from the DoG images. In order to detect the local maxima and minima of DoG, each sample point is compared with its eight neighbors in the current image and nine neighbors in the adjacent scales. Every sample point is selected only if it has larger value or smaller value than all its neighbors. Key point Localization is used to determine location and scale. Key points with low contrast and poorly localized features are to be rejected in order to get stable extreme points. Fitting function of the feature point is constructed according to Taylor expansion and is given by

$$D(x) = D + \frac{\partial D^T}{\partial x} x + \frac{1}{2} x^T \frac{\partial^2}{\partial x^2} x \quad (3)$$

where D and its derivatives are evaluated at the sample point. The location of the extremum is determined by taking derivative and equating it to zero. And it can be given as

$$\hat{x} = -\frac{\partial^2 D^{-1}}{\partial x^2} \frac{\partial D}{\partial x} \quad (4)$$

The function value at the extremum helps to reject unstable extrema with low contrast and is given by

$$D(\hat{x}) = D + \frac{1}{2} \frac{\partial D^T}{\partial x} \hat{x} \quad (5)$$

Reject the extremas whose $|D(x,y)| < 0.3$, but it is not sufficient to reject key points with low contrast. The difference-of-Gaussian function will have a strong response along edges, even if the location along the edge is poorly determined. The principal curvatures of poorly defined peak in the difference-of-Gaussian function computed using Hessian matrix will have large value across the edge but a small value in the perpendicular direction. Ratio of principal curvatures helps to eliminate poorly defined key points along the edge. Orientation Assignment determines the key point's direction.

$$m(x,y) = \sqrt{(L(x+1,y) - L(x-1,y))^2 + (L(x,y+1) - L(x,y-1))^2} \quad (6)$$

$$\theta(x,y) = \tan^{-1}((L(x,y+1) - L(x,y-1))/(L(x+1,y) - L(x-1,y))) \quad (7)$$

Once the modulus and angles are computed, the algorithm divides 00 to 360 degrees into 36 bins, where each contains 10. Then it statistics the modulus located in each bin and histogram of gradients is constructed. Each sample added to the histogram is weighted by its gradient magnitude and a Gaussian weighted circular window with an σ that is 1.5 times that of the scale of the key point. The peak of orientation histogram reflects the dominant direction of the area around the key point. If there is any other statistic value which is greater than 80% of the highest peak, then it also used to create a key point with that orientation. Hence multiple key points can be created at the same location and scale but with different orientation.

Key Point Descriptor is constructed for each key point, by computing the gradient magnitude and orientation in a region around the key point location. Key point descriptor is created at each image point of the 16x16 key point neighborhoods. Each window is divided into four areas, where each area is a window of 4x4 sub regions. For each area, compute the histogram in eight directions using the gradient value. The feature description is calculated by considering the direction descriptions of all subfields. The length of feature descriptor will be 4 x 4 x 8=128 elements.

Working of this project:

- Authentication of the candidate is required in many places.
- Here we are performing authentication by using RFID module and face recognition.

- First the user need to place the unique identification card (RFID card) near the module.
- After that the image of the candidate is verified using SIFT algorithm.
- The status will be sent as SMS to the authorized person i.e whether the person is authorized or not.
- Voice announcement.

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