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REVIEW OF LITERATURE

NEED/IMPORTANCE OF THE STUDY

STATEMENT OF THE PROBLEM

OBJECTIVES

HYPOTHESES

RESEARCH METHODOLOGY

RESULTS & DISCUSSION

FINDINGS

RECOMMENDATIONS/SUGGESTIONS

CONCLUSIONS

SCOPE FOR FURTHER RESEARCH

ACKNOWLEDGMENTS

REFERENCES

APPENDIX/ANNEXURE

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- Sharma T., Kwatra, G. (2008) Effectiveness of Social Advertising: A Study of Selected Campaigns, Corporate Social Responsibility, Edited by David Crowther & Nicholas Capaldi, Ashgate Research Companion to Corporate Social Responsibility, Chapter 15, pp 287-303.

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- Schemenner, R.W., Huber, J.C. and Cook, R.L. (1987), "Geographic Differences and the Location of New Manufacturing Facilities," Journal of Urban Economics, Vol. 21, No. 1, pp. 83-104.

CONFERENCE PAPERS

- Garg, Sambhav (2011): "Business Ethics" Paper presented at the Annual International Conference for the All India Management Association, New Delhi, India, 19–22 June.

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- Kumar S. (2011): "Customer Value: A Comparative Study of Rural and Urban Customers," Thesis, KurukshetraUniversity, Kurukshetra.

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- Garg, Bhavet (2011): Towards a New Natural Gas Policy, Political Weekly, Viewed on January 01, 2012 http://epw.in/user/viewabstract.jsp

A DIVERSIFIED APPROACH OF FACE DETECTION AND RECOGNITION

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ABSTRACT

Having Face detection and recognition system with all its benefits as an aid to the existing systems like finger print, signature, passwords, identification cards, voice recognition systems etc. will definitely bring great difference and precision. The overall issue of facial recognition is complex, but could be simplified by taking into consideration, portraits that are coherent in terms of orientation, lightening, expression and image quality. This is by far the basis for the growing development in the area of facial recognition. Learning from the strengths and weaknesses of two most widely approved algorithms Eigen faces and Elastic bunch graph algorithms, a thought provoking research has been carried out which resulted in a new working algorithm. In the proposed system, a face image is captured by a web cam or digital camera, in turn converted into a hashed form which is compared with existing image hashed database that has registered users images with permission to enter into a privileged area. Once the image captured matches with one of the images in the database, the person is authorized. The accuracy of this system does not depend on the attributes viz., background of the image, intensity of light (contrast and brightness), zoom in and out, image color and position of the face within the system. In addition to that inclination of the face up to 20 degrees left and right is also handled well.

KEYWORDS
Face detection, Face Recognition, fiducial, Graphical testing, Image processing.

INTRODUCTION

The first attempt to automate facial recognition started in the 1960s in semi-automatic mode. They essentially focused on checking the coherence of measurements between different characteristic points of the face (e.g. the corners of the eyes, the nose, the ends of the mouth and the hairline, etc.). They were not very successful, because faces are by nature very mobile (changing) and measurements between characteristic points are affected by orientation (poses), light variation and distance difference from which pictures were taken, to the extent that specially-developed models quickly proved to be necessary.

At the end of the 1980s, the development of the Eigen faces [2] technique prompted a more intense research effort. This technique is used to detect (find a face in a photo) and to recognize (compare images of faces). Researchers quickly found that the overall issue of facial recognition was complex, but could be simplified by only taking into consideration portraits that are coherent in terms of orientation, lighting, expression and image quality. Research focused on this problem subsequently the responsible organization for such researches defined criteria to obtain controlled portraits and meaningful test sets were created.

At the start of 2007, the NIST (National Institute of Standards and Technology) published the results of its "FRVT 2006 (Face Recognition Vendor Test) ". Its conclusions were quite clear. It led to a point where the operational use of facial recognition on high-resolution frontal images taken in a controlled environment proved to be feasible. But this event obviously did not put an end to work on the recognition of controlled portraits. More improvements are expected, but facial recognition has thus become a biometric technique in its own right.

Since 2007, research has been looking into significantly more difficult problems, in which faces are not viewed frontally; resolution is low or poor image quality. With the MBGC (Multiple Biometric Grand Challenge), the NIST is again seeking to assess performance and has provided researchers with representative data (images and videos of faces under un-controlled conditions). It is the start of a new era and one can expect significant progress over the coming years.

LITERATURE REVIEW

Since 1970, researchers concentrated more on image retrieval. Plenty of works had been done on feature based image retrieval. In this section, the existing CBIR system has presented a good survey of the technical aspects. Ramadevi, et al. [4] has proposed interaction between image segmentation (using different edge detection methods) and object recognition. Edge detection methods such as Sobel, Prewitt, Roberts, Canny, Laplacian of Gaussian (LoG) are used for segmenting the image. Expectation-Maximization (EM) algorithm, OSTU and Genetic algorithms are used to demonstrate the synergy between the segmented images and object recognition.

P. S. Hiremath, Jagadeesh Pujari [5] presented a novel framework for combining all the three i.e. colour, texture and shape information, and achieve higher retrieval efficiency using image and its complement. In this paper, the images are partitioned into non-overlapping tiles. The image and its complement are partitioned into non-overlapping tiles of equal size. The combination of the colour and texture features between image and its complement in conjunction with the shape features provide a robust feature set for image retrieval.

Mungamuru Nirmala et al. [3] proposed the basic concept of content-based image retrieval methods using visual content. The descriptors should be of transformation invariance to measure the similarity between any two descriptors. Instead of comparing the query image as a whole with the images in the database, the descriptors are compared for retrieval. With an extension of the comparison, Relevance feedback technique is used to reduce the gap between the extracted features and targeted descriptors are used as feedback to refine the retrieval process further. Based on the feedback, the descriptor can be redefined and an iterative similarity checking can be implemented to improve the retrieval of proper image with reference to the query image.

Mustafa Ozden, EdizPolat (6) describes a new colour image segmentation method based on low-level features including colour, texture and spatial information. The method uses wavelet frames that provide translation invariant texture analysis. The method integrates additional texture feature to the colour and spatial space of standard mean-shift segmentation algorithm. This new algorithm provides better results than the standard mean-shift segmentation algorithm.

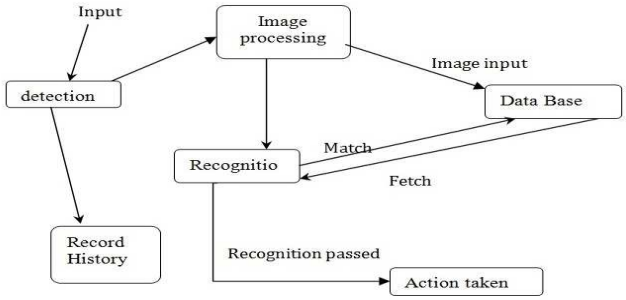
OVERVIEW OF FACE DETECTION AND RECOGNITION PROCESS

Live face detection doesn't give room to unauthorized access. It does not need to make direct contact with the individual as in the case of signature, finger print etc., a case might arise, where an accidental or permanent deformation of the face can create complexity for the system but still can be updated by the administrator with the new input. Studying the above mentioned side effects, and weighing the advantages of face recognition, an attempt is made to develop a simple yet a highly effective system.

For obvious reasons, the human brain and visual organs can be considered as the best existing face recognition machines ever. A specific area of the human brain called fusiform face area (FFA) has been proven to be totally dedicated to this task. The apparent ease of use is the cause for many fantasies, inconsistencies and difficulties while implementing automatic face recognition systems in the field. Because the technology has an outstanding competitor: the human brain which is naturally trained from birth to do exactly the same thing; facial recognition.

The images used for the analysis are either captured by a webcam or a digital camera mounted on the system. The live picture captured is analyzed and is supplied to the PC, triggers an event to control the action of the system which is the general objective of this system.

FIG-1: STATE DIAGRAM OF PROPOSED SYSTEM



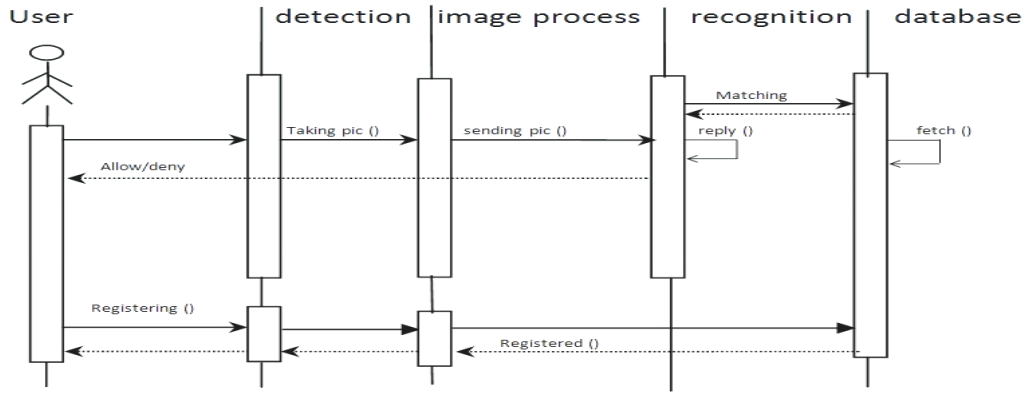
Developing this system generally involves three stages:

a. **Face Detection**, where a photo is searched to find any face, then image processing cleans up the facial image for easier recognition.
b. **Image processing,** to transform the detected image into convenient mathematical representation for further comparison and storage.
c. **Face Recognition** where the detected and processed face is compared with a database of known faces, to match and to decide and identify the person if exists.

Through efficient completion of the above mentioned three stages, the system satisfactorily provides a fairly precise detection and recognition application for further security applications. Based on this background study, this system aims at fulfilling the following objectives:

a. To develop an integrated face recognition system to maintain the security of a certain privileged access area.
b. To thoroughly study and come up with a practical face recognition algorithm for this problem.
c. To implement a precise face detection and recognition system.
d. To provide a two level security to manage the image database
e. To make the system more applicable so to make the interface in the two locally used languages.

FIG-2: SEQUENCE DIAGRAM OF PROPOSED SYSTEM



When the user wants to register, first the system should take his/her current picture of the face and some other related additional information is filled during registration. Then the system detects his/her face and takes the image to generate its standard representation in order to store it for further comparison. Later the representation and all the additional information is saved in the database. When the user wants to log on, first the system captures the user's current picture. Then the image is processed for the standard representation then compares the generated standard representation with the existing image representations, stored in the database. Finally system replies the user by allowing or denying authority based on the comparison outcome.

After the detection process is successfully completed, the recognition process compares the detected face with the images or faces in the database by comparing the distances between each fiducial point of both the faces. As the number of fiducial points increase, the efficiency of the recognition will also be increased since comparison is done based on each and every part of the faces, this leads the system to high accuracy with no confusion.

FACE DETECTION AND RECOGNITION ALGORITHMS

Most facial recognition algorithms use mathematical transformations in order to compare images. These transformations can highlight the distinctive specific features of an image: frequencies, directions, contours, distance etc. Transformed images cannot usually be used by the operator's naked eye. The algorithms we have used in development of our system are Eigen face algorithm and Elastic bunch graph matching algorithm.

EIGEN FACE ALGORITHM

It is a facial recognition technique that consists of learning the distinctive characteristics of faces from a broad sample of portraits using each complete image rather than local characteristics (e.g. the eyes, nose or mouth).

ELASTIC BUNCH GRAPH MATCHING ALGORITHM

This approach uses the structure information of a face which reflects the fact that the images of the same subjects tend to initialize the fiducial points (such as pupil, tip of nose, chin etc.) and deform in the image plane. It makes use of the labeled graph. The edges, distance information and the nodes are labeled in jets. This model graph can then be used to generate image graph. Then the model graph can be translated, scaled, rotated and deformed during the matching

process. This can make the system robust to large variation in the images. Based on the best part of these algorithms, a new algorithmic approach has been proposed for detection and recognition.

PROPOSED ALGORITHM

Step 1*:* Capture a live current image from a web cam/camera.

Step 2: Start the detection process by searching the pupil which shines more or having high intensity of light. To complete the action of face detection, an image detection class with a set of methods has been developed.

searchFace()method

It searches the individual pixels of the image to find the brightest region using the method addRgb() and checks the property of the eye using the checkEye() method. In addition, some important attributes are used to facilitate the searchFace() method namely; eye_mindiff, shine, pix_color, max_xvalue, max_yvalue, eyeL_found, eyeR_found and others.

- **addRgb():** returns the total sum of the color value of the pixel information(RGB).
- **checkEye(pixel):** Makes sure whether the received brightest pixel position is the exact position of the eye with in the image, by comparing the property of the neighboring pixels surrounding the brightest region.

boundFace():

A method to calculate the difference between the two searched eyes, and stores the value in the eye2eye_edge. Depending on the value stored, it calculates a rectangle to bound the face area, using 2*Eye2eye_edge as FaceWidth and 3* Eye2eye_edge as FaceHeight. To get the face inclination teta_rad attribute is used.

Eye2eye_edge= $\sqrt{(((eyeR(x)-eyeL(x)\#\,2+(eyeR(y)-eyeL(y)\#\,2)}$

Teta_rad= $\dfrac{\tan^{-1}[(eyeR)(y)-eyeL(y)]}{eyeR(x)-eyeL(x)}$

drawFaceRegions():

A method that divides the bounded face into small rectangular regions which aids in indicating the regions of fiducial points; To facilitate this method, attributes used are initial points and maximum points of individual regions represented by the attribute names: init_pnt(x,y) and max_pnt(x,y).In addition, methods like rotateRects() and drawRect() are used to rotate the region with respect to the human face inclination while the drawRect() draws all the regions in a rectangular manner.

searchFuditialPoints():

In this method, the relationship between edges and distance is directly proportional and is calculated during registration in recognition stage. searchBright(region) searches the brightest group of pixels within the rectangular regions, and searchDark(region) searches the darkest group of pixels.To calculate the light intensity of the pixels within a region in a group manner, both the methods use averageFudicial() to calculate the average value.

edgeDistance():

It calculates and stores distance between each and every fudicial points in an array. The total number of edges is:

N=nC2

In which, N the number of edges in the image, n the number edges in the cut image.

Step 3: It is time for face recognition which in turn uses some methods and attributes to compare the mathematical representation of the identified face with the representations of the privileged faces stored in database. To complete the activity, following methods are used.

recognize():

This method performs the overall recognition process, viz., loading mathematical representation(edges) of individual members from database, storing the value in a two dimensional array dbedges(rollno,edge), computing the variance between the current image value and the mathematical representation fetched from database using the method getVariance(), and then it compares to find the least variance.

Dist (eyes) = diff (eyeLetf - eyeRight) ----------eqn.[1]

*Dist (k) = [(edges (i) – edges (j))/dist (eyes)]*1000, for i is different from j ----------eqn.[2]*

Total diff = $\sum_{i=1}^{n} diff\,(i)$ *----------eqn.[3]*

Total variance = $\sum_{i=1}^{n} diff\,(i) - \sum_{i=1}^{n} diff\,(i)$ *----------eqn.[4]*

eqn.[1] determines the distance between the two eyes. Once this distance is obtained properly, it serves as reference distance and all the remaining distances can be obtained from the reference distance by drawing a line from the pupil of the eye to all the fiducial points.

eqn.[2] determines the difference of the reference distance between the two eyes and the distance between any two fiducial points (e.g. if the distance between points of I & j is 7 and reference distance is 5, then the difference is 2) and multiplying by 1000 resulting in small decimal value. It makes the system independent of color intensity, color background etc.,

eqn.[3] gives the total difference of all the edges with respect to the reference distance and ***i*** refers to the number of edges in the face.

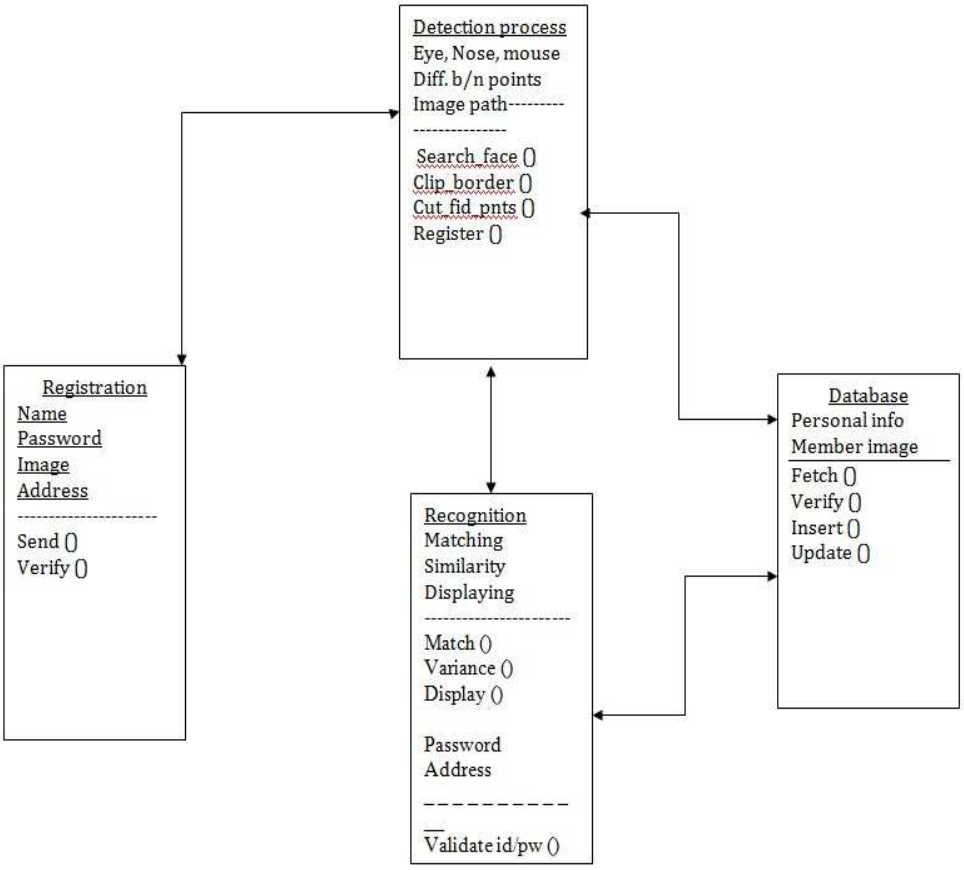
eqn.[4] calculates the total variance of the detected live image and the image already stored in the database by comparing edges of both faces which are in the same position, i.e. edge (i) in detected image when compared to edge (i) in images of the database.

Finally this total variance is converted into percentage range and the system either gives access or rejects based on this percentage value.

Step 4: The face, if it is privileged, it is successfully recognized; if not the administrator has to proceed with the registration. If the comparison fails due to any changes in face, the authorized member requests permission from the administrator and the administrator issues permission after through check.

The detailed class diagram defines the overall view of the system i.e. all the functions and data members available in every class within the system. Every class is defined either in the detection side or recognition side. The functionality of the algorithms applied is clearly presented.

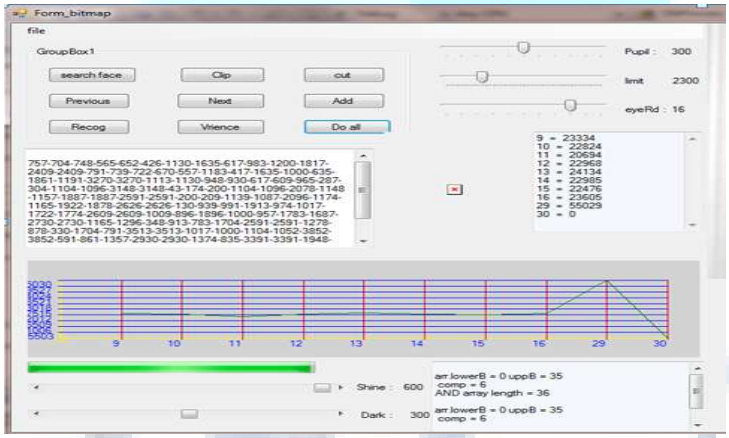
FIG-3: DETAILED CLASS DIAGRAM OF THE FACE RECOGNITION



SYSTEM IMPLEMENTATION, TESTING AND RESULTS

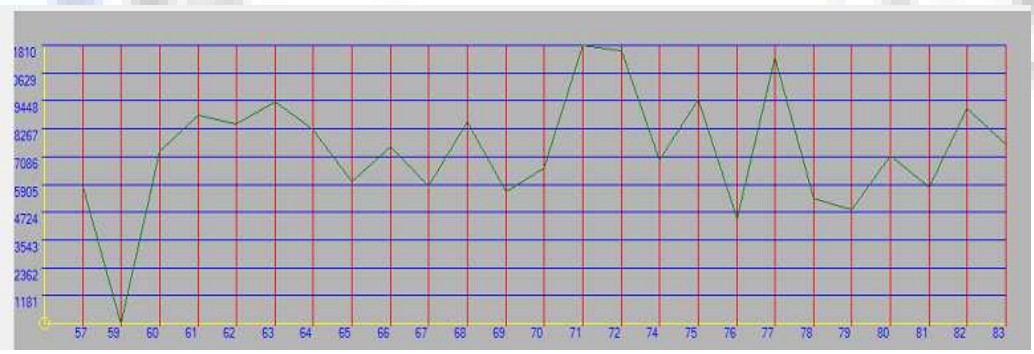
During implementation, prior training guides the user to come up with a quality system as the users of the system may not familiar with face recognition system. One has to follow the sequence of steps viz., searching face, clipping face, cutting face.

FIG-4: CUTTING ALL THE FIDUCIAL POINTS



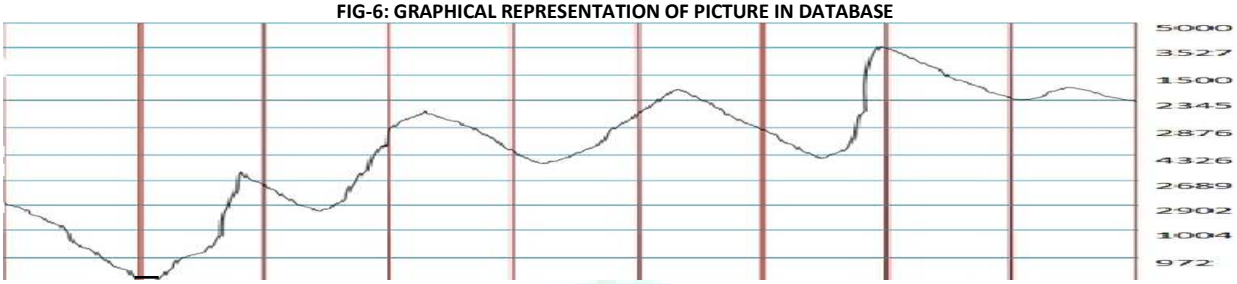
While testing for the successful implementation of the system, a graphical method is used to clearly represent the degree of precision of the recognition. The graphical representation of the individual members is symbolized in the form of a histogram, named as Test Form Histogram which is used to represent the distinguishing variations and similarity among the live detected image with the images stored in the database based up on variance of distance versus image.

FIG-5: THE HISTOGRAM DIAGRAM WITHOUT PICTURE REPRESENTATION



As we can see in the histogram representation above, the picture which was processed in the implementation stage is notified as the 10th picture; likewise the variance difference in comparison to the other privileged pictures is less. Different tests were made using different faces of different people both of those registered in the database as well as those unregistered.

FIG-6: GRAPHICAL REPRESENTATION OF PICTURE IN DATABASE



The variance value of all the registered pictures with the processed picture is indicated in rows. In the first figure, the processed picture is of the user registered in the database so the variance becomes zero with the specific picture in database. In the second figure, since the picture being processed is not of someone registered in the database, the variance difference is very wide.

The third type of test conducted is to make sure that the system does not confuse live image with an image taken from a photo of a privileged user. If a photo is presented in place of a live image, the system denies processing the image by stating "*convenient face is not found*", in a message box. The system is programmed in a way that it can differentiate two dimensional photos from three dimensional live images using the light intensity difference in the pupil as an indicator.

Results of the comparison can be categorized under three percentage ranges. If it is less than 80% it clearly represents significant difference between detected image and image in database due to some changes in the face, hence access is denied. If it is in between 80% to 90%, it denotes utmost similarity but not exact. Detected image can be either identical twin of the image in database or seems that image; in such case the system requests password to give access confidently. If it is greater than 90%, the exactness between the images in comparison is acceptable, and access is granted.

CONCLUSION AND FUTURE ENHANCEMENT

Efficient and effective comparison & retrieval techniques of images are desired because of the explosive growth of digital images. Content based image retrieval is a promising approach because of its automatic indexing and retrieval based on their semantic features and visual appearance. Interest in the potential of digital images has increased enormously over the last few years. However, " a picture is worth a thousand words." Image contents are much more versatile compared with text, and the amount of visual data is already enormous and still expanding very rapidly.

Face recognition is a highly secured identification system aid. This proposed system currently takes frontal pose only; in the future it can be improved to take poses from left and right position of the face as well. It is already planned to add more fuidicial points in order to increase precision of this system [The more fudicial points, the more precise the system will be]. So far the system accepts and handles up to 20 degrees of inclination of the face, increasing this by 10 degrees will bring a good improvement. As a future enhancement, still more efficient system to keep a record of the detailed edges / distances that differentiate the particular similar looking images evolves out.

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