Sindh Univ. Res. Jour. (Sci. Ser.) Vol.43 (1-A) 63-68 (2011)

SINDH UNIVERSITY RESEARCH JOURNAL (SCIENCE SERIES)

Using nose Heuristics for Efficient face Recognition

M. Sharif[1], S. Mohsin[1], R. A. Hanan[1], M. Y. Javed [2] and M. Raza[1]

[1]Department of Computer Science, COMSATS Institute of Information Technology, Wah Cantt-Pakistan
muhammadsharifmalik@yahoo.com, smohsin@comsats.edu.pk, ahad_523@hotmail.com, myjaved@ceme.nust.edu.pk, mudasssarkazmi@yahoo.com

[2]Department of Computer Engineering, National University of Science and Technology, Peshawar Road, Rawalpindi, Pakistan

Abstract: In this paper, we present a new solution for fast face image searching from a database by using some existing techniques and by filtering images through a few proposed heuristics. In filtering stage the database search is on the basis of some numerical values which we get from the image. Then the image is segmented in different parts and each part is searched in different nodes simultaneously in order to speed up the searching process. This algorithm is firstly proposed for same pose images and with same capturing distance. The basic idea is to search numerical values instead of whole images by filtering a large number of records. Thus actual searching becomes easy and optimum. The basic task is to form the heuristics and check their efficiency of working. Moreover, the grid architecture is proposed to distribute that work on to different nodes to make result more efficient and faster. This architecture gives a facility to search images in parallel manner.

Keywords: Face, Heuristics, Face, Recognition, Speed

I. INTRODUCTION

The face recognition is most research wanting field in computer science now a days. This has become a need of modern world as security threats are increasing with every passing day. It plays an important role in different disciplines of computer science like Image Processing, Computer Graphics, Artificial Intelligence and Computer Vision. Face detection also plays an important role in some other fields like video conferencing, human computer interface (HCI) and video surveillance (Ranjani Balaji et. al., 2006). The face searching through database is very slow, so it is very challenging to search face images with large databases in an efficient manner.

Various successful face detection mechanisms have been implemented in the field and they have shown approximately 90 percent accuracy in results. It includes feature-based, statistical method based, Hidden Markov Models, Eigen vectors (Chang, K. I et. al., 2003),(Guo, S.Li, Z et. al., 2000),(Jvo-Hwee Lim et. al., 2004),(Tobias K¨olsch et. al.,2004),(YOSSI ZANA et. al., 2006). Although it consumes more time if database contains millions of images, the previous techniques are successful as far as they are working with limited database such as the FERET database managed by the ogy. This contains more than 14,000 images (Ranjani Balaji et. al.,2006), (Othman and Aboulnasr et. al.,2000). With the increasing security threats, a real time image searching on the spot has become necessary in threat prone areas. If some terrorist enters the area of his potential terror targets, then he needs to be identified immediately. The face image databases and face detection is being used in different companies but it should be implemented on larger scale.

The system should take images and search for any suspicious person on any sensitive area. It can be only possible if searching of face images from databases becomes fast. When millions of images are stored on a database, the exhaustive or brute force (Akisato Kimura et. al., 2004) approach is not applicable. Similarity of image can be measured in three phases which are pixel matching, feature matching and semantic similarity matching. These phases make searching process too slow. The searching can become efficient if we bypass image search on the basis of heuristic. This paper proposes heuristics for bypassing some of the avoidable steps.

Most of the image recognition systems require performing computation on each image to identify a required image from a given pool of images. For this purpose an exhaustive or brute force is required. The

exhaustive search involves a lot of unnecessary computations and in the worst case O (n) is the complexity and mostly in real time search, this technique fails to perform our required task. (Byung Cheol Song et. al., 2001)

If we analyze the different features of face such as nose, ears and template of face then we will find that some of the features of faces are varying slightly and some of the features are totally different from each other. The other fact is that if we compare values other than that of complete images, it will take far lesser time. So if we designate values to sub-images then we can out rightly exclude many images from searching because of their too apparent dissimilar features. For example if we have ten thousand images in the database then hundred or two hundred images may resemble all features like ear length and height, nose length and height, eyes length and height, face template length and height etc. Thus the actual number of images for searching becomes far lesser than the actual total number of images.

One of the most popular approaches for face recognition is discussed by Ara. V. Nefian (Ara V. Nefian et. al.,1998) in this scheme, the image is divided into different strips and then the face image is recognized step wise. The problem with this scheme is that some strips which contain eyes are recognized if the picture of this area is taken in similar situations. i.e. eye in some images is closed and in some images is full open (Ara V. Nefian et. al.,1998).

II. MATERIAL METHOD

The proposed technique algorithm includes some previously implemented techniques and then suggests some improvements to bypass a large number of face images for optimizing database searching.

A. Steps for Searching Face Images

The following are the steps for acquiring an image and searching it from the database.

- Create database of images.
- Store heuristic parameters (values) in database. (Heuristics will be discussed later).
- Place sensors and cameras.
- Acquire image for searching.
- Perform image segmentation.
- Calculate Heuristics values.
- Search images according to heuristic parameters (containing numerical values which speed up the searching from actual image searching)
- Start actual image searching on different nodes including pixel matching, feature matching and semantic similarity matching.

These steps have some sub-steps to perform searching through databases.

B. Architectural View of a Whole System

The image searching process is done in different phases which work in parallel manner. The following is the working architecture for image searching through databases.

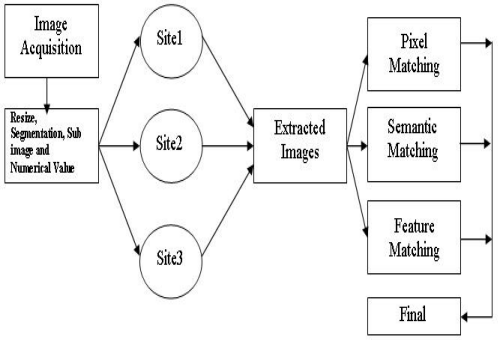


Fig 1. Architectural View

The image acquisition, segmentation and taking sub images of images is the first phase. Then taking heuristic value and comparing it with the database images is the second phase. The last phase is the actual optimized searching. The feature searching is bypassed because of the heuristic checking. This heuristic (discussed later) is made on the basis of face features.

C. Algorithm Steps

The algorithm of our proposed technique has five steps. This includes different phases. In each phase one task is performed in modular manner. This approach is adopted because different modules can be interpreted on different nodes and it fastens up the speed of searching by processing in distributed manner.

The first phase is acquisition of picture. In proposed technique initially our assumption is that the picture is captured form the same distance as the picture which is stored in the database. The second phase is to resize the face area of the picture. The third phase is to take sub images of face. The focus is on nose portion initially. The next step is to change that area into grey scale and count the white and black pixels and also count the values which are neither black nor white.

The images containing in database are already passed through these phases. The last phase is to query these numerical values to filter images. The numerical search takes much less time than actual image search which

need pixel matching, feature matching and semantic similarity matching. In the last and final phase all the filtered images go through actual image searching to recognize the picture.

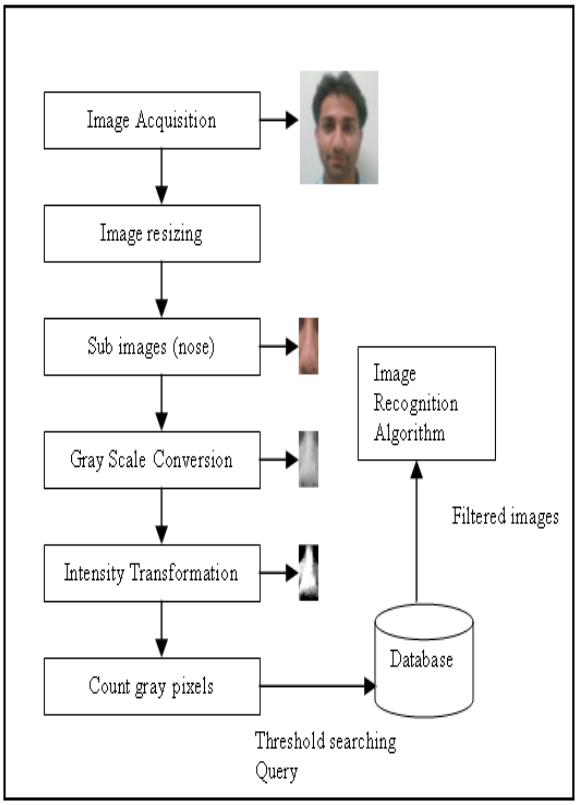


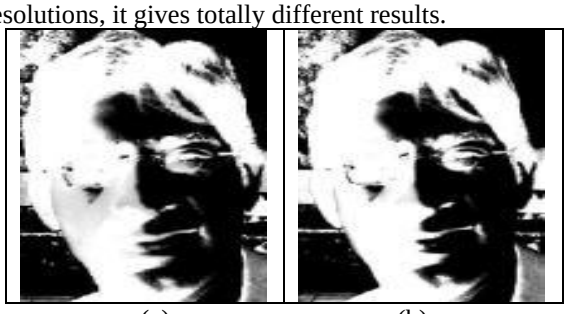
Fig 2. Algorithmic steps

III. RESULTS DISCUSSION

We analyze different parameters for images and see how irrelevant images can be excluded from the database search.

A. Resolutions Effect

This technique has initially been proposed for images with straight posture and for same resolution and size. It is because when we take picture from different resolutions, it gives totally different results.



(a) (b)

Fig 3. Same images with Different resolution

As the two images above have different resolution and if we analyze the right side of the image then fig 3(a) has more black pixels and fig 3(b) has light grey scale pixels. So the pictures with different resolutions give different results for the same person. So this technique is employed on same resolution pictures in similar conditions.

B. Same Images Threshold

The same images in same scenario and of same resolution give approximately same count of black, white and grey scale pixels. To define the threshold values is the most important step in the proposed technique because we have to remove the unnecessary images for searching. The images displayed below are of same person taken in the same posture but with slight difference in the brightness of light. In some cases the light is dim and in some cases light is clear.



Fig 4. Images for analysis

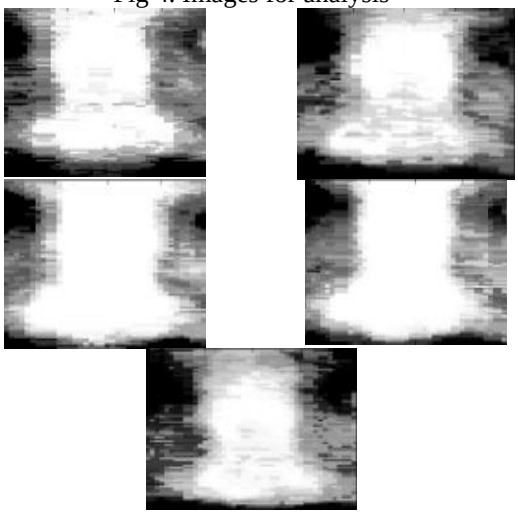


Fig 5. Gray Scale Nose Analysis

Table 1 Threshold Value

Image Name	Img 1	Img 2	Img 3	Img 4	Img 5	Threshold
Gray Scale Value	4268	4194	4255	4225	4303	4150 - 4350

The table shows the values of grey scale pixels of the images that all the values give the result from 4150 to 4350. So the threshold lies between these ranges. The grey scale pixels give the aroused area of nose and according to the size of nose these values vary.

C. Image Variation Analysis

The face feature of different persons varies. There is very less probability that two persons have an exact match of their features.

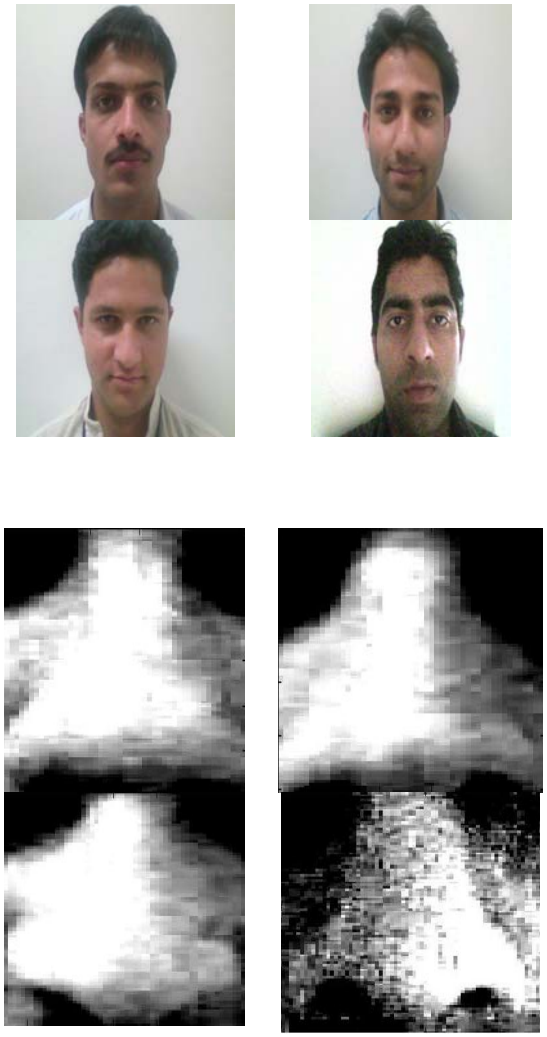


Fig 6. Different Image Analysis

Table 2 Value difference

Image Name	Img 1	Img 2	Img 3	Img 4
Gray Scale Value	3888	4931	5750	5481

The above results show that the noses of different persons have variation. So this variation can be stored as numerical value in the database and when image is to be searched with in the database that numerical value can be extracted from face and searched to find which value comes within that heuristic. It filters all the images which are not satisfying heuristic values. The heuristic optimizes the search.

D. Threshold Range and Image Filtering

As the nose area of the image is converted into grey scale and then pixel values are adjusted from .5 to 1, the shaded area gives the black pixels output and the rest of pixels give grey output. The sub image also gives the area of nose portion. The grey values are added and taken as a heuristic for searching image. These values are necessarily unique for every image and these values may vary when new image of same face is acquired. So the threshold range starts with the narrow range and then it becomes wider to acquire the exact image for recognition.

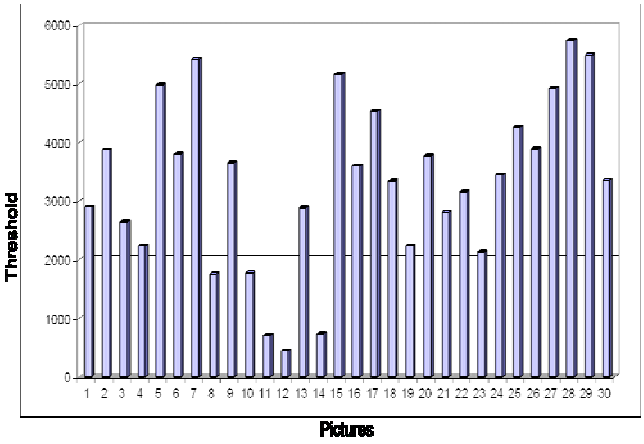


Fig 7. Sample images heuristic values variation graph

We take sample of 30 images given at the end of this paper and check their results in Matlab. The 30 images of different persons are stored and then the new image is taken to be searched from database to check the threshold ranges and filtered images. The 5 queries give the following results.

Table 3 heuristic ranges and filtered images

Queries	Heuristic Value	Threshold Range	Remaining Images	Filtered Images	Filtered Image percentage
Q1	3593	Range 3393---3793	4 images	26 images	86%
Q2	2632	Range 2332---2932	4 images	26 images	86%
Q3	3193	Range 2493---3893	14 images	16 images	53%
Q4	2677	Range 2627---2727	1 image	29 images	96%
Q5	2594	Range 2194---2894	6 images	24 images	80%

In this table the maximum range is mentioned to obtain the desired table but in start the values are incremented and decremented by 50. The image is passed through an image recognition algorithm. If it is the desired image the search is ended. Otherwise that image is marked and the process is continued. The marked image indicates that this image has already been passed through the process of recognition and failed so it does not need to be considered again.

Table 4 Threshold variations and marked images

Image	Weight to increment and decrement	Range	Acquired Images	Marked Images
Image 1	50	2582---2682	Image 3	-
-	100	2532---2732	Image 3	Image 3
-	150	2482---2782	Image 3	Image 3
-	200	2432---2832	Image 21	Image 3
-	250	2382---2882	Image 13	Image 3, Image 21
-	300	2332---2932	Image 1	Image 3, Image 21, Image 13

The algorithm showed in fig 8 is to search image form narrow to wide range.

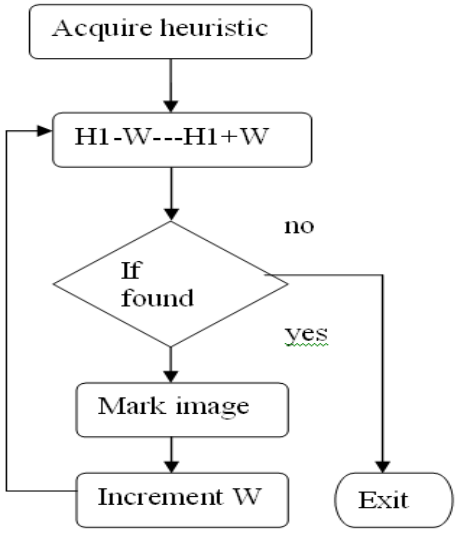


Fig. 8 Searching Algorithm to search image from narrow to wide range

The H1 is the lower range of threshold and H2 is higher range of threshold. W is the weight added to the higher range and subtracted from lower range to check image into wider range.

IV. APPLICATION AREAS

The application areas for this technique are limited because it is working on same resolution. This technique can be used where single resolution images are taken for identification. The major use for this technique can be for passport office and for identification cards office.

The problem with this technique is its limitations of finding heuristics of face for it. These heuristic vary with respect to different resolutions and different sizes. The picture can be resized and taken to the same size for processing but if resolution is changed then it gives totally different results.

V. FUTURE WORK

Initially the focus of our technique is on the nose area of face. The future work is to improve that technique by working on other features of face especially on ears, and whole face area. This technique is restricted to check straight posture images. On side pose this technique is not applicable. The future work is to give the heuristic which is also capable of supporting the side pose images.

The final goal is to search images from databases and recognize the exact image. This research can explore the way to uniquely identify images by numerical values based on face feature and face area. This can make the image recognition from database as normal searching.

VI. CONCLUSION

This brute force approach for image recognition is too slow. So there is a need of such algorithms that speed up the search. The search on numerical values is very fast than otherwise image searching, so there is need of storing some image numerical values to speed up the search. These values work as heuristics. The images heuristics which meet the range of acquired image values are considered for actual search. The rest of the images are excluded and not considered for searching.

VII. ACKNOWLEDGEMENTS

This is the extended version of our own paper presented and published as Conference proceedings in “International Conference on Computers & Emerging Technologies” (ICCET 2011) held on 22-23 April 2011 at Shah Abdul Latif University, Khairpur, Sindh, Pakistan.

REFERENCES

Akisato Kimura, Takahito Kuwanishi and Kunio Kushino, "Similarity-Based Partial Image Retrieval Guaranteeing Same Accuracy As Exhaustive Matching", IEEE International Conference on Multimedia and Expo (ICME), 2004 Morinosato-Wakamiya, Atsugi-shi, Kanagawa, p 1895-1898

Ara V. Nefian, Monson H. Hayes Iii, "Face Detection and Recognition using Hidden Markov Models", International Conference on Image Processing, 1998

Byung Cheol Song, Myung Jun Kim, and Jong Beom Ra "A Fast Multiresolution Feature Matching Algorithm for Exhaustive Search in Large Image Databases". IEEE Transactions On Circuits And Systems For Video Technology, MAY 2001, VOL. 11, NO. 5,

Chang, K. I., Bowyer, K. W. and Flynn, P. J., "Face Recognition Using 2D and 3D Facial Data", Workshop in Multimodal User Authentication, Santa Barbara, California, Dec., 2003, P25-32.

Guo, S.Li, Z, and Chan, K. "Face Recognition by Support Vector Machines", proceedings of the 4th IEEE international conference on Automatic Face and Gesture Recognition, Grenoble, France march 2000. P 196-201

Jvo-Hwee Lim and Jesse S. Jin "Combining local class patterns and discovered semantics for image retrieval", International Conference on Image Processing (IEEE (ICIP)), 2004, P 401-404

Othman and Aboulnasr, T. "Hybrid Hidden Markov Model for Face Recognition", Proc. of the Fourth IEEE Southwest Symposium on Image Analysis and Interpretation, Austin, Texas. April 2000.P 36-40

Ranjani Balaji, Rob Byrd, "Real Time 2-D Face Detection Using Color Ratios and K-Mean Clustering", Proceedings of the 44th annual southeast regional conference, ACM, March 2006, Pages: 644 - 648

Tobias K¨olsch, Daniel Keysers, Hermann Ney and Roberto Paredes , "Enhancements for Local Feature Based Image Classification", Proceedings of the 17th International Conference on Pattern Recognition, 2004, P 248 - 251

YOSSI ZANA and ROBERTO M. CESAR, "Face Recognition Based on Polar Frequency Features", ACM Transactions on Applied Perception (TAP), 2006, ISSN:1544-3558, P62 - 82

SAMPLE IMAGES:

