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Analysing the effects of ageing on Iris based Biometric Identification System

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Abstract— Different techniques like mark, content passwords, PINs and so on have been utilized in the past to confirm people's personality. In any case, biometric distinguishing proof framework, which uses the special natural characteristics of people like voice, face, fingerprints, palm and iris to perceive the concerned individual, has totally changed the image of verification based frameworks. It has given secure technique to validation as natural personalities of an individual can't be fashioned. Biometric ID framework coordinates the interesting organic characteristics of people with their information put away as biometric formats. Be that as it may, the natural qualities of individuals changes with age which prompts corruption in the exhibition of biometric confirmation framework and along these lines furnishes an overwhelming assignment to manage. In this paper we investigate age initiated changes in the iris of human eye and analyze how these progressions and other potential causes influence the exhibition of iris based biometric framework.

Keywords— Ageing, Biometrictemplate, Iris, Biometricauthenticationsystem, Pupil

I. INTRODUCTION

Biometric identification system is fast gaining popularity and acceptance around the world for it's unmatchable performance. It uses the unique biological traits of people like voice, face, iris, palm and fingerprints to check the authenticity of an individual. It stores the distinct biological characteristics in the form of biometric templates and matches these templates with the data collected of the concerned individual to check the authenticity.

Iris based biometric identification system works by capturing one or more careful pictures with a complicated, high resolution camera at visible or infrared wavelengths while making sure that the person to be authenticated stays stationary and reflections do not turn out from the tissue layer that obscure any part of the iris. It then precisely matches the iris pattern of the acquired images with the biological templates. The iris is the pigmented elastic tissue that has adjustable circular opening in centre. It controls the diameter of pupil. The iris patterns of left and right eyes are different. It varies from person to person.

In the field of biometric based security ,iris pattern based security system has emerged as the most preferred because of high accuracy and low false acceptance and rejection rates with which it performs identification. It is most frequently used for security related applications. It is used for national security and identity cards such as Aadhar card in India. Some countries have enforced iris recognition systems in airports at points of entry and exit. Google uses iris recognition for accessing their data centre. Iris recognition applications are accessible for the iPhone and different smart phones. Ensuring total security of any premise remain top priority of every individual or commercial identity and for this there are a plenty of products which are already in use and some are going to make their debut in the field of customized security.

Though Iris based biometric identification system provides a foolproof method for authentication but it is liable to be affected by variations in characteristics of iris caused by ageing. Despite the known fact that ageing affects all type of modalities, so far the topic of generating biometric templates robust to variation in ageing has not received much attention. This may be due to the fact that the field of biometric identification system is still relatively new and there is not enough data to study age related affects on biometric identification. One solution is to frequently collect data of the subjects but this is not feasible due to the availability issue. The other solution is to develop biometric identification system that can simulate the effects of ageing. In this paper, biological structural changes in the Iris with respect to age are to be examined and linkage between aging and failure of iris based recognition system is to be found. This paper is organized in following sections. Related work is discussed in section **II**. The proposed system details are provided in section **III** followed by experiments and results in section **IV.** The conclusion of this paper is provided in section **V** with future work direction.

II. RELATED WORK

Various researchers have studied the effects of ageing on iris biometric identification. Work carried out by some of them are mentioned here.

Baker et al. used 6797 images of 23 people to report an adverse, statistically significant increase in **False Non Match Rate** from comparisons of images collected more than 1200 days apart vs. those from short term collections fewer than 120 days apart. This shift in the genuine distribution was noted across a broad range of threshold values. The team first reported in 2009 using a smaller population and a non commercial recognition algorithm.

Fenker et al. reported that recognition error rates increased by 153% over a three year period and by 82% over a period of two year. These results were the primary motivators of the NSIT study. This study made no attempt to compensate for effects of pupil dilation.

Tome-Gonzalez et al. used 8124 images of 254 individuals from the Bio Secure ID database to investigate ageing. The data was collected in four sessions separated typically by one to four weeks to show that inter-collection session false non match rates were higher than intra-session rates. The authors noticed that once a minimum time between samples had passed , error rates did not apparently increase. The authors did not discuss the high session 1 pupil sizes that are evident as being influential. The total duration of the study is so short that any anatomical ageing effect would be smaller than in other cities.

Sazanova et al. used 7628 images of 244 subjects for over a year to produce formal rate-of- change of comparison-score statements of iris ageing for the Maesk and Neuro technology algorithms. They acknowledged the stochastic time-varying nature of contrast, occlusion, illumination and blur as factors that can undermine recognition and used a robust linear regression to estimate coefficients for these and for time between captures. The study did not include dilation in the regression. The work quantified false rejection rates over time at fixed false match rates rather than fixed threshold

Fairhurst et al. used 632 images of 79 users with a Maesk implementation followed by implementation modified to reduce segmentation errors. The authors note the role of dilation, the age related effect of ambient illumination on dilation and conclude that dilation decreases with age and consequently Hamming distance decrease. They noted the inconsistency of Baker's result that dilation change is not responsible for the ageing effect and concluded that ageing effects are the result of the physiology of pupil dilation mechanisms.

III. METHODOLOGY

A. COLLECTING DATA

Iris images were acquired from spring of 2013 through spring of 2016, using an LG 4000 sensor, following the same acquisition procedure in the same laboratory. Overall, the experiments in this paper use images from 644 irises(322 subjects). The total number of images is 22,156 with 2312 coming from the year 2013, 5859 from 2014, 6215 from 2015, and 7770 images from 2016. Subjects from 20 to 64 years old were included in the research. Of the 322 subjects, 177 are male and 145 are female. In the template aging experiments reported in this paper, we consider the dataset in terms of one cohort of subjects imaged over three years of time lapse, two cohorts imaged over two years, and three cohorts imaged over one year. Short time lapse match is a comparison of two images acquired on different days but within a few months of each other and Long time lapse match is comparison of two images acquired in different years. Also, we calculate a bootstrap 95% confidence interval for the estimated change in FNMR. Given an experiment with N participating subjects, the bootstrap randomly selects with replacement N subjects from this pool. For each subject, with M corresponding short time lapse comparisons and K long time lapse comparisons, we randomly select with replacement M short time lapse comparisons and K long time lapse comparisons. This process is repeated 1000 time, and the distributions of these experiments are used to estimate confidence intervals for the change in FNMR. For each bootstrap sample, the FNMR is calculated for both the short and long time lapse comparisons, and the change in FNMR is computed. The mean FNMR over 1000 bootstrap samples is calculated.

TABLE : Experimental Dataset By Period of Time Lapse

Time	**Number of Subjects**	**Number of Images**	**Average # short time lapse matches**	**Average # long time lapse matches**
13-14	88	4553	11986	30470
14-15	157	8046	23882	54417

15-16	181	11734	29120	97879
13-15	40	2097	5829	14282
14-16	124	8082	18963	66849
13-16	32	2338	5244	20888

B. Methodology Process

Algorithm proposed by Maesk, widely accepted for iris recognition, is used. Appropriate changes were made and performance enhanced at the segmentation stage by implementing a new and robust segmentation algorithm.

Calculating Rate of Change in Iris as the age advances

This research paper seeks to estimate the time-dependence of iris recognition due to changes in the iris texture. This is quantified as rate of change of dissimilarity score. It's calculation has been based on averaging results over a large population on the basis that random effects, not otherwise accounted for, will be unbiased. The values quantify change in Hamming distance per day.

Camera effect : The estimate for the B camera is about 0.12 and that for L camera is 0.17. These labels indicate the camera used for the initial enrolment image, and all recognition images were collected using camera B. Thus, the difference here is most likely the direct result of cross camera interoperability effects. This systematic difference in Hamming distance, HD = 0.05, is an order of magnitude larger than any ageing related effects projected over a decade.

Dilation difference : The population means are camera specific: the coefficient for camera B is 0.18, and for camera L is 0.11. This means that if the enrolment and recognition images differ in pupil dilation by 0.1, then this model indicates Hamming distance changes of HD =0.018 and 0.011 for cameras B and L respectively.

Search image dilation : While dilation difference is the primary contributor to increase in Hamming distance, the regressions over the various OPS-XING subsets produce somewhat varied dependencies on dilation which limits the precision of the model.

Left Vs Right eye : The eye itself, left or right, is influential. Right eyes give higher HD values over the whole dataset. This is 0.03 for camera B and 0.02 for camera L. This is because the right eye had been used only when the left eye failed or was not acquired. The number of left eye events in the OPS-XING database is 4,920,638 vs. 725,300 for the right eye.

Variation in eye specific gradients: We see upward and downward trend in Hamming Distance values. These trends are estimated using ordinary least square(OLS) regression without dilation. It is known that if the residual e_{ij} is the difference between the HD for the j^{th} observation of the i^{th} individual and the value predicted by the OLS fit at that time, then the variability of HD around the OLS estimate is summarized for the i^{th} eye as

$\sigma^2_{\varepsilon i} = 1/N\sum_{j=1}^{ni} e_{ij}^2$

Worst Case upward trends: The reasons for ageing in populations this large will inevitably include some cases of disease. Other causes would include contact lens presence and eye surgery. In addition, the regression may yield these gradients simply on the basis of the noisy data. But in many cases the individual is capable of producing a low HD score at the end of interval. This indicates that the iris itself has not aged to the point that successful recognition is impossible.

Downward trends : Some individuals have downward trends. This, by definition , is consistent with a collection of an image similar to the initial enrolment, which would occur under habituation e.g. the subject learns to open eyes widely.

Simulation : To detect any changes in the pattern of iris or to verify the present picture of iris with the subject Harascade.Xml software is used as a tool along with dot net in the front end coding.

IV. Results and Discussion

The client populace was isolated into three gatherings dependent on their age extend : age<25, 25<=age<=60 and age>60. All the accessible examples were characterized to decide a gauge the blunder rates brought about in every one of these age gatherings. Characterization is accomplished utilizing a basic closest neighbour procedure, and blunder – rate execution is assessed.

As appeared in figure, a noteworthy lessening in mistake rate is seen as an element of expanding age over the picked groupings.

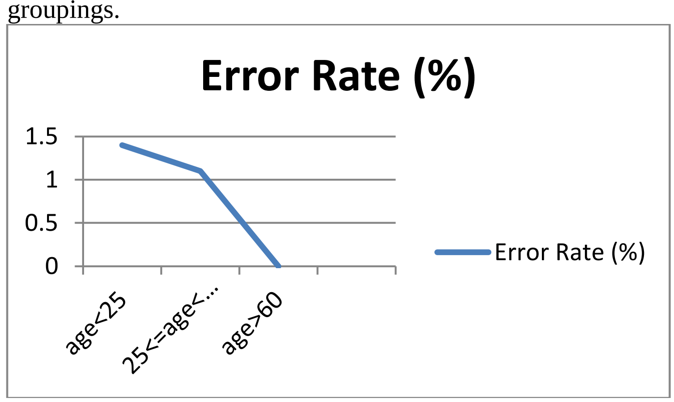

FIGURE I : Approximate error rate with compare to age groups(Courtsey – Sans Institute)

This unmistakably prompts an examination concerning the basic reason, particularly since a totally opposite pattern as for different modalities is observed(for ex. Fingerprints)

Student expansion is another significant factor to coordinate with other trial perceptions so as to describe all the more seriously the connection between acknowledgment execution, nature of obtained iris picture, and subject age..

The Dilation Ratio(DR) of each eye is measured. DR values are found to fall between 0.2095 and 0.6190. Images for the most dilated and least dilated pupils are shown in figure.

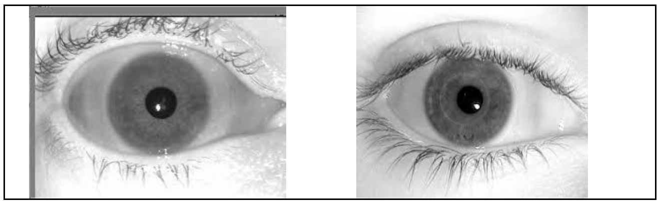

FIGURE II : Dilation in iris as the age advances. (Courtesy- sans institute)

Mean enlargement proportions of each gathering:

age<25 :0.4317

25<=age<=60 : 0.3816

age>60 : 0.3214

This exhibits the expansion qualities of the student change altogether with expanding age, the capacity of the understudy to enlarge broadly in light of occurrence brightening reducing with age.

V. CONCLUSION AND FUTURE SCOPE

This project shows that reduced performance of iris recognition is caused mainly because of aging secondly because of noise and differences in the quality of gallery and probe pairs. It is our assertion that the effect of aging over iris is an important research problem which requires a longitudinal study similar to face biometrics where significant age duration is to be studied.

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