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Real-Time Facial Age Estimation Using Image Processing For Automated Control Systems

G.Meenakshi[1], E.Kaviyarasan[2], S.Sumathi[3]

[1]*Assistant Professor, Dept. of ECE, Velammal Engineering College, Chennai, India.*
[2]*Student, Dept. of ECE, Velammal Engineering College, Chennai, India.*
[3] *Assistant Professor, Dept. of ECE, Velammal Engineering College, Chennai, India.*

Abstract - *Due to the temporal property of age progression, face images with aging features may display some sequential patterns with low-dimensional distributions. It is intuitive for us to apply manifold analysis to age estimation. To bring out the advantages of manifold learning, some methods should be combined with appropriate regression models. In this paper, a novel framework of age estimation via multiple linear regressions on the discriminative aging manifold of face images is proposed. For a new testing image, the extracted low-dimensional feature with the learned regression model is used to estimate the exact age or an age interval.*

Key Words: Principal Component Analysis (PCA), Age Identification, Currency Identification.

1. INTRODUCTION

The methods used in this paper are applicable to the precise age estimation, since each testing image is labeled with a particular age value chosen from a continuous range. In addition to the foregoing state-of-the-art work, the Sequential Pattern is used to characterize the ageing factor. Since each face image corresponds to a unique age label, a relatively large size data set should have a significant trend for some underlying sequential patterns. Currency identification is done by using the above method. Identification of age is useful in many applications to avoid so many misuses. This can be implemented in Internet surfing for Minors, Cigarette and Alcohol vending machine, and also in age specific shopping centers, to avoid the teenagers from consumption of alcohol and also in vehicles, to avoid riding of vehicle by minors that may result in accidents.

1.1 EXISTING PROBLEM

Due to the temporal property of age progression, facial images with aging features may display some sequential patterns with low-dimensional distributions. The few existing methods on the age estimation via face images can be divided into three categories:

Anthropometric model - These methods are suitable for the coarse age estimation, for example, classifying face images into four classes: infant, teenager, middle-aged people, and the elderly.

Aging pattern subspace - To handle highly incomplete data due to the difficulty in data collection, Aging pattern Subspace (AGES) models a sequence of personal aging face images by learning a subspace.

Age regression -In the regression case, facial features are extracted from an appearance-based shape-texture model. An input face image is then represented by a set of fitted model parameters. The regression coefficients are finally estimated according to a known regression function.

Fig -1: Examples of facial aging images with different expressions.

2. PRINCIPAL COMPONENT ANALYSIS

Principal component analysis (PCA) is one of the most valuable results from applied linear algebra, which is used abundantly in all forms of analysis - from neuroscience to computer graphics, because it is a simple, non-parametric method of extracting relevant information from confusing data sets[].

It is a mathematical procedure that transforms possible number of correlated variables into a smaller number of uncorrelated variables, which is called principal components. The first principal component accounts for the variability in the data, and each succeeding component accounts for as much of the remaining variability. It is also called discrete Karhunen-Loève Transform (KLT), the Hotelling transform or Proper Orthogonal Decomposition

(POD). It is used for data analysis and for making predictive models. It involves the calculation of the Eigen value decomposition of a data covariance matrix or singular value decomposition of a data matrix, usually after mean entering the data for each attribute.

If a multivariate dataset is visualized as a set of coordinates in a high-dimensional data space (1 axis per variable), PCA supplies the user with a lower-dimensional picture, a "shadow" of this object when viewed from it's (in some sense) most informative viewpoint. PCA is closely related to factor analysis; indeed, some statistical packages deliberately conflate the two techniques. The Steps for Computing PCA using the Covariance Method are as follows:

Organize the data set.

Calculate the empirical mean by using

$$\mathbf{x} = \begin{pmatrix} X_1 \\ X_2 \\ \vdots \\ X_p \end{pmatrix}$$

Calculate the deviations from the mean.

$$s = \sqrt{\frac{\sum_{i=1}^{n}(X_i - \bar{X})^2}{(n-1)}}$$

Find the covariance matrix.

$$\operatorname{var}(\mathbf{X}) = \Sigma = \begin{pmatrix} \sigma_1^2 & \sigma_{12} & \dots & \sigma_{1p} \\ \sigma_{21} & \sigma_2^2 & \dots & \sigma_{2p} \\ \vdots & \vdots & \ddots & \vdots \\ \sigma_{p1} & \sigma_{p2} & \dots & \sigma_p^2 \end{pmatrix}$$

Find the eigenvectors and eigen values of the covariance matrix.

$$cov(X,Y) = \frac{\sum_{i=1}^{n}(X_i - \bar{X})(Y_i - \bar{Y})}{(n-1)}$$

$$C^{n\times n} = (c_{i,j},\ c_{i,j} = cov(Dim_i, Dim_j)),$$

Rearrange the eigenvectors and eigen values.

Compute the cumulative energy content for each eigenvector.

Select a subset of the eigenvectors as basis vectors.

Convert the source data to future vector.

Project the feature vector of the data onto the new basis.

$$FeatureVector = (eig_1\ eig_2\ eig_3\ ....\ eig_n)$$

3. AGE ESTIMATION USING IMAGE PROCESSING

Age Estimation is done using a technique called principle components analysis. It is a vector space transform used to reduce multidimensional data sets to lower dimensions for analysis. It is used in expostulatory data analysis and for making predictive models. Using PCA we calculate Eigen value decomposition of a co-variance matrix or singular value decomposition of data matrix, usually after mean centering the data of each attribute.

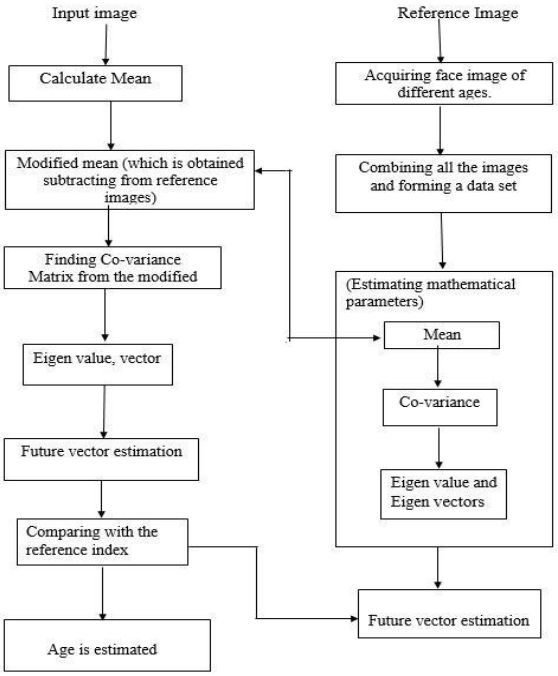

Fig -2: Age Estimation Using Image Processing.

4. PROPOSED WORK

This work is implemented with the application of vehicle automation. 52% of the children under the legal driving age are not allowed to drive cars because it is not entirely safe.

For this purpose only, age identification is required. The driving person age is identified by using MATLAB by setting the age to a limited threshold value. If the driving person age is above the threshold, then it checks for the alcohol consumption of that person. If he is alcohol free, then the vehicle ignition will be ON and the vehicle starts running. If the driver age is below the threshold, then it won't allow the ignition to start. So, it will check for age and alcohol consumption, and then only it will allow the ignition of the vehicle to start. Below fig 3, shows the block diagram of the proposed work done.

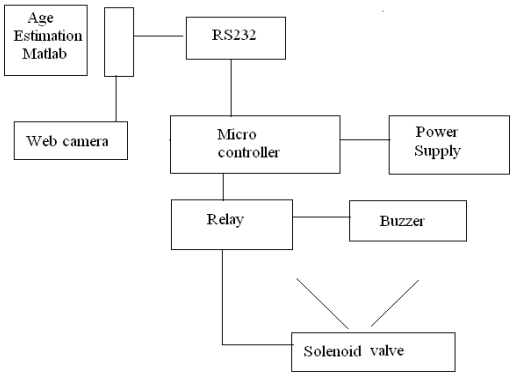

Fig -3: Block Diagram.

There are some shapes in the currency notes, which are as: black triangle, rectangle, circle etc. Every currency note has an embossed print within which there is a particular mark. Even people with visual impairment can identify the denomination with the help of this. Identification marks for various denomination Notes are shown below.

Table -1: Identification Marks on various Denomination Notes.

Notes	Marks	Notes	Marks
10/-	NA	20/-	▮
50/-	▮	100/-	▲
500/-	●	1000/-	◆

By using this, currency identification is done.

5. RESULTS

By using MATLAB, the defined weights are analyzed and compared. Based on the skin, texture, emotions, the age is identified. From the data base the following image, shows the identification of age.

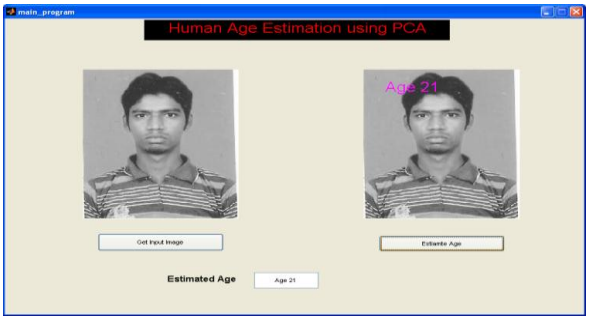

Fig -4: Age Identification by MATLAB.

By comparing the shapes on currency notes, the currency is identified, which is shown in the fig 5.

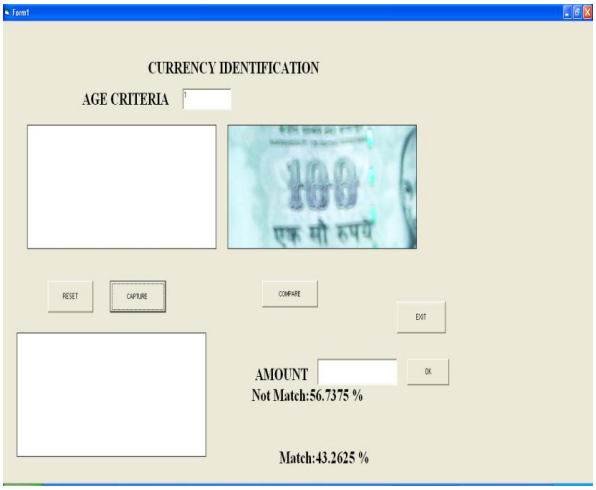

Fig -5: Identification of currency.

6. CONCLUSIONS

In this paper, a new framework for face- image-based automatic age estimation is proposed. A manifold learning method is introduced for learning the low-dimensional age manifold. The support vector machine and support vector regression methods are investigated for age prediction based on the learned manifolds. To improve the age estimation performance and robustness, a Locally Adjusted Robust Regress (LARR) can be designed. LARR method gives better age estimation than the purely robust regression by SVR or purely classification by SVM and the LARR method outperforms many state-of-the-art approaches to age estimation. In future, local adjust ranges can be estimated in a data-driven manner instead of specified values, which may further improve the accuracy.

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