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**CHAPTER 2**

**REVIEW OF RELATED LITERATURES AND SYSTEMS**

**A. Foreign Literatures**

According to **Wei-Lun Chao, “Face Recognition” of 2010**, the illumination variation has been widely discussed in many face detection and recognition researches. This variation is caused by various lighting environments and mentioned to have larger appearance difference than the difference caused by different identities.

Face Recognition: After formulizing the representation of each face, the last step is to recognize the identities of these faces. In order to achieve automatic recognition, a face database is required to build. For each person, several images are taken and their features are extracted and stored in the database. Then when an input face image comes in, we perform face detection and feature extraction, and compare its feature to each face class stored in the database. There have been many researches and algorithms proposed to deal with this classification problem, and we’ll discuss them in later sections. There are two general applications of face recognition, one is called identification and another one is called verification. Face identification means given a face image, we want the system to tell who he/she is or the most probable identification; while in face verification, given a face image and a guess of the identification, we want the system to tell true or false about the guess.

According to **Sushma Jaiswal, Dr. (Smt.) Sarita Singh Bhadauria and Dr. Rakesh Singh Jadon’s, “Comparison between Face Recognition Algorithm-faces, Fisherfaces and Elastic Bunch Graph Matching” of 2011,** eigenface is a practical approach for face recognition. PCA reduces the dimension size of an image greatly in a short period of time. The accuracy of Eigenface depends on many things. As it takes the pixel value as comparison for the projection, the accuracy would decrease with varying light intensity. Besides, scale and orientation of an image will affect the accuracy greatly.

Pre-processing of image is required in order to achieve satisfactory result Advantages of this algorithm are that the eigenfaces were invented exactly for that purpose what makes the system very efficient. A drawback is that it is very sensitive for lightening conditions and the position of the head, it Fast on Recognition, and Easy to implement Disadvantages-Finding the eigenvectors and eigenvalues are time consuming on PPC The size and location of each face image must remain similar PCA (Eigenface) approach maps features to principle subspaces that contains most energy.

According to **Young Kyung Lee, Eun Ryung Lee. and Byeong U. Park's, “Principal Component Analysis in Very High-Dimensional Spaces” in 2011,** A particular disadvantage of PCA is that the principal components are typically linear combinations, which makes the results difficult to interpret, especially when training set ***d*** is very large. Recent years have seen several proposals that give ‘sparse’ solutions, that is, solutions that 934 YOUNG KYUNG LEE, EUN RYUNG LEE AND BYEONG U. PARK involve only a few nonzero loadings; see Jolliffe, Trendafilov, and Uddin (2003), Zou, Hastie, and Tibshirani (2006), d’Aspremont et al. (2007), d’Aspremont,Bach, and Ghaoui (2008), Shen and Huang (2008), Leng and Wang (2009), and Witten, Tibshirani, and Hastie (2009).

We are concerned with the case where d, the dimension of X, is comparable to, or even larger than, the sample size n. The standard PCA is known to yield inconsistent results in such a high-dimensional case, see Johnstone and Lu (2009). We propose a method that gives consistent estimators of the principal component loading vectors.

According to **P. T. Chavda and S. Solanki, “Illumination Invariant Face Recognition based on PCA (Eigenface)”** **of 2014,** Principal component analysis (PCA) is standard technique used in statistical pattern recognition and signal processing for data reduction and Feature extraction. As the pattern often contains redundant information, mapping it to a feature vector can get rid of this redundancy and yet preserve most of the intrinsic information content of the pattern. These extracted features have great role in distinguishing input patterns. PCA is also known as eigenface method.

Illumination change: The direction where the individual in the image has been illuminated greatly effects face recognition success. A study on illumination effects on face recognition showed that lighting the face bottom up makes face recognition a hard task.

According to **Tarun Kumar** and **Karun VermaIt, “A Theory Based on Conversion of RGB image to Gray image” of 2010,** Grayscale Image is also known as an intensity, gray scale, or gray level image. Array of class uint8, uint16, int16, single, or double whose pixel values specify intensity values. For single or double arrays, values range from [0, 1]. For uint8, values range from [0,255]. For uint16, values range from [0, 65535]. For int16, values range from [-32768, 32767].

Gray levels represent the interval number of quantization in gray scale image processing. At present, the most commonly used storage method is 8-bit storage. There are 256 gray levels in an 8 bit gray scale image, and the intensity of each pixel can have from 0 to 255, with 0 being black and 255 being white.

According to **Ralph Gross, et al., “Face Recognition Across Pose and Illumination”,** Besides face pose, illumination is the next most significant factor affecting the appearance of faces. Ambient lighting changes greatly within and between days and among indoor and outdoor environments. Due to the 3D structure of the face, a direct lighting source can cast strong shadows that accentuate or diminish certain facial features. It has been shown experimentally and theoretically for systems based on Principal Component Analysis that differences in appearance induced by illumination are larger than differences between individuals.

**B. Local Literatures**

According to **Prospero C. Naval, Jr, “Recognizing Faces using Kernel Eigenfaces and Support Vector Machines” of 2003,** Principal Component Analysis (PCA) is used for extracting relevant features from high-dimensional data sets. It performs an orthogonal transformation of the coordinate system in which the data is originally described. After coordinate transformation, it is often the case that only a subset of the new coordinate values is necessary to describe most of the data. This subset is called the principal components of the data. The principal components possess large variance.

According to **Jerome Paul N. Cruz, et al., “Object recognition and detection by shape and color pattern recognition utilizing Artificial Neural Networks” of 2013,** the value of the weight and bias varies in every neuron. The process of determining the value of weight and bias is called learning or training. The algorithm used for learning is called back propagation algorithm. In this learning method, a desired output or target is given with a corresponding set of inputs. In the architecture of the artificial neural networks, back propagation algorithm requires 52 input elements and five output or target elements per set.

According to **Ma. Christina D. Fernandez, et al., “Simultaneous Face Detection and Recognition using Viola-Jones Algorithm and Artificial Neural Networks for Identity Verification” of 2014,** there are 7 facial features to be extracted and these are the skin color, color of the eye, the distance between the two eyes, the width of the nose, the height and width of the lips, and the distance between the nose and the lips. These are then detected, extracted, and measured from the person’s processed face   
image. These measurements are then passed through processes which will produce a representation of these characteristics in numerical vector form.