ABSTRACT

Invariant pattern recognition is an important process in computer vision applications. Most of the texture patterns are either anisotropic or isotropic. The anisotropic textures have physical properties that are different in diverse directions (frequency components modify significantly in dissimilar direction) however isotropic textures provide the same physical properties in all directions (frequency components do not alter appreciably at diverse orientations). Texture analysis play a vital role in the recognition of fingerprints, face, palm, iris, medical imaging and characters since texture features provide significantly less intraclass variability and achieve high interclass discrimination in the pattern classification. In the current literature, various works have been done related with texture analysis. However the problem of translation, rotation and scale invariant pattern analysis is still an open problem for various real-time computer vision applications. Hence the proposed approach focuses on recognition based on the transformation invariant patterns. The proposed algorithms are applied to the iris and license plate recognition systems.

Real-time eye images are acquired in different pan/tilt angles, indoor/outdoor conditions and from normal/eyewear persons. While capturing, challenge-response test is employed for resolving the design issue of liveness checking. Image status checking is a process to select the best frame from the sequence of capturing images, which includes finding closed

eyelashes/eyelids, removing truncation of irises, spectacle reflection and glare free images. This process can be carried out by comparing the magnitude of iris and pupil areas with their tolerance levels. Iris localisation is performed by weight based circular map which locates a flash appeared in the pupil. This method localises the iris independent of its capturing illuminations and other particles such as eyebrows present in the eye images. Local segmentation is used to subdivide the iris into three different segments such as left, right and bottom portions in order to avoid the occlusion of non-iris artefacts such as eyelashes/eyelids.

Vehicle images are captured in different illuminations and distances by varying pan/tilt angles, which assist to evaluate the performance of the proposed methodology and to make the system as trouble-free to deploy in the automatic recognition. The quality frame selection is a process to choose the best frame from the sequence of vehicle images, which is performed by assessing its frequency variations of Fourier transform using support vectors. Optimal threshold analysis is carried out to select the minimum and maximum optimal thresholds from the selected frame in order to do the processes viz., binarisation, localisation and segmentation. It is based on computing the normal distribution of background and foreground illuminations. The weight based density map is used to localise the region of interest from the vehicle image to get the exact location of the license plate (LP) rather than the other approaches such as template matching and correlation methods. Segmentation is a process to slice each character present in the LP, which is carried out by connected components analysis.

The transformation invariant features are extracted from the images using optimised Gabor filters and wavelet transform. The best values associated with frequency, orientation and scaling parameters of Gabor filter are chosen by the Boltzmann machine with k-means clustering approach. The rotation-invariant feature selection is achieved by line integrals, which compute sensor positions either by single or multiple sources along the single or parallel projections respectively. Then wavelets are applied to extract features.

The classifier is designed for recognition of transformation invariant features. This process is accomplished using back propagation, weighted Euclidean distance and hamming neural networks.

In this thesis, a complete system of the transformation invariant pattern analysis is carried out. The classifier is tested with various eye and vehicle images acquired in the real-time conditions and the results are found to be satisfactory.

A cryptography system is implemented and tested with iris keys to encrypt and decrypt the input sequence of bits. Symmetric iris cryptosystem (SIC) and Non-repudiation iris cryptosystem have been implemented to resolve the problems associated with key management and non-repudiation present in the traditional cryptography system. The performances and tolerance of these systems are evaluated by using auto and hetero correlators.