Personal Identification using Contactless Live 3D Finger Scans (PI: Dr. Pathak Ajay Kumar; 2013/14)

Fingerprint identification is commonly used for the civilian and law-enforcement applications around the world. Traditional acquisition of fingerprint scans by pressing or rolling of finger against the hard surface (glass, silicon, polymer) or paper often results in partial or degraded images due to improper finger placement, skin deformation, slippages, smearing or due to sensor noise. As a result full potential from the fingerprints is not realized. Therefore, touchless 3D finger imaging systems have emerged to provide ideal solutions to above intrinsic problems. Such 3D approaches can also provide more accurate personal identification as rich information is available from 3D fingerprint images. The main obstacles for emerging 3D fingerprint technologies are: 1) their bulk and high cost, which mainly results from the usage of structured lighting system or multiple cameras; 2) lack of effective 3D representation models for the unique 3D fingerprint features and their matching methodology; and 3) absence of any theoretical/empirical study to ascertain the uniqueness of 3D fingerprints. The goal of this project is to make such significant advances in 3D fingerprint technologies for the real-world deployment. We will firstly design and develop a low-cost, faster, accurate and touchless 3D fingerprint identification approach by exploiting photometric stereo techniques which employs single imaging sensor. The fingerprint skin is a kind of translucent material which exhibits multiple scattering and specular reflections. Therefore, linear models are inadequate to simulate human skin and a great challenge for this project is to develop new theoretical models to accurately simulate fingerprint skin for the precise recovery of discriminant 3D features. Secondly, this project will develop 3D

representation of widely employed 2D fingerprint features by recovering and incorporating minutiae depth and orientation information. Advanced capability to recover and match such extended fingerprint features will significantly improve the accuracy and acceptability of 3D fingerprint technologies that are available today. Finally, this project will develop new theoretical models to ascertain individuality of 3D fingerprints by quantifying the amount of information available in 3D minutiae representation to establish a correspondence between two 3D fingerprint images. A scientific basis for establishing the individuality of 3D fingerprints will not only result in the enhanced confidence/admissibility of 3D fingerprint identification but also establish an upper bound on the performance from the automated 3D fingerprint identification systems. The advanced biometric identification using proposed technologies will enable low-cost, faster, hygienic and more accurate identification of humans for wide range of civilian/forensic applications.