

A Modular Approach and Voting Scheme on 3D Face Recognition

Hamimah Ujir, Lai Chung Sing and Irwandi Hipiny

Faculty of Computer Science and Information Technology, Universiti Malaysia Sarawak, Malaysia.

uhamimah@fit.unimas.my, sing_0630@hotmail.com, mhihipni@fit.unimas.my

Abstract— In this paper, we carried out a modular approach human 3D face recognition across neutral and six basic facial expressions experiments. Initially, a face model is decomposed into several modules before the 3D facial points for each of the modules are extracted. Three sizes of modules are used in our experiments: 2-Module, 6-Module and 10-Module. We apply Support Vector Machines as the classifier to each of the modules. A Majority Voting Scheme (MVS) and Weighted Voting Scheme (WVS) are constructed to infer the emotion underlying a collection of modules. From the analysis, we conclude that 10-Module outperforms 2-Module and 6-Module. In addition, the modules with low amount feature vectors and only contain boundary feature vectors perform worst.

Keywords— 3D face recognition, modular approach, Support Vector Machine (SVM), Majority Voting Scheme (MVS)

I. INTRODUCTION

Face processing research has evolved from 2D to 3D. Compared to 2D face recognition, 3D modality has much more to offer. 3D data offer out of plane movement that cannot be captured by 2D data. Therefore, the face pose data are easily acquired. Moreover, the illumination problem is removed when using 3D.

Face recognition is a biometric method which is nonintrusive and can be used even without the subject's knowledge [1]. As one of the most important biometric techniques, face recognition has clear advantages of being natural and passive over other biometric techniques which requiring cooperative subjects such as fingerprint recognition and iris recognition [2]. Face recognition has become a popular area of research in computer vision as well as one of the most successful applications of image analysis and understanding [3].

Recognizing a human face with face expression is another challenge for face processing research community. Each of the basic facial expressions has levels of intensity which depend on the level of intensity of each facial feature. The intensity level of a facial expression is important as it will lead to a false impression of people's emotion if misinterpreted. For instance, the smiling face with low intensity can be easily misinterpreted as a neutral facial expression [4]. The decomposition of a face

into several modules promotes the learning of a facial local structure and therefore the most discriminative variation of the facial features in each module is emphasized [5].

This paper reports the experiments on 3D face recognition using three different modules across neutral as well as six basic expressions {anger, disgust, fear, happy, sad, surprise} and it is organized as follows. In section II, we give the preliminaries: we explain the existing 3D face databases, survey on modular approach in 3D face recognition and describe the voting scheme. Section III presents our framework and Section IV is devoted to experimental results and their discussions. Finally we draw our conclusions and future works in Section V.

II. PRELIMINARIES

A. 3D Face Databases

Research in 3D face recognition has been conducted for several decades. In order to train and evaluate various face recognition algorithms, a number of databases have been created over the past two decades [6]. However, the databases that provide 3D facial landmarks are limited. Table I shows a comparison on 3D face databases. Among the databases, there are only two 3D face databases that are available publicly and provide at least six basic facial expressions together with 3D landmark points, which are BU-3DFE Database and Bosphorus Database. Our experiments are performed on Bosphorus database which we have been granted an access.

TABLE I. COMPARISON ON 3D FACE DATABASES [7]

Database	Size (Adults)	Content	Landmarks
BU-3DFE [8]	100	6 basic expressions	83 facial landmarks
Bosphorus [7]	105	6 basic expressions	24 facial landmarks
ICT-4DRFE [9]	23	6 basic expressions, 2 neutral, 2 eyebrows, 4 eye gaze and 1 scrunched face	N/A
[10]	52	6 basic expressions and 11AUs	N/A