A Reflexion on Implementation Version for Active Appearance Model

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ABSTRACT

In this paper, the authors propose a distributed schema applied to implement the standard version of the Active Appearance Model (AAM) segmentation approach such as designed by Cootes et al. (1995) (1998). The scheme is intended to be implemented by exploiting the object-oriented software based on remote method invocation as Java-RMI. Implementation is in progress and it is realized step by step.

Keywords: Active Appearance Model (AAM), Distributed System, Image Processing, Java Remote Method Invocation (Java RMI), Segmentation

1. INTRODUCTION

Active Shape Model (ASM) and Active Appearance Model (AAM) were proposed by Edwards Cootes et al. (1995) (1998) as two of the more sophisticated deformable models. In computer vision, these two complementary models are the hottest research topics nowadays. They have proven very successful results in the field of image segmentation. This is especially true in the case of the images containing objects with large variability. ASM statistically builds a shape model while AAM builds statistically a joint shape and texture appearance model. The primary advantage of these models is that a priori knowledge is learned through observations of both shape and texture variation in a training set. From this, a compact class description is derived and can be used to rapidly search images for new object instances (Stegmann, 2000; Stegmann et al., 2003; Yang et al., 2002). In the ASM method, the shape variability is learned through observation. In practice, this is accomplished by a training set of annotated examples followed by a Procrustes analysis combined with a Principal Component Analysis (PCA). The ASM search algorithm allows locating points on a new image, making use of constraints of the shape models. A direct extension of the ASM approach has lead to the Active Appearance

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models. Besides shape information, textural information is included into the model. A new image can be interpreted by finding the best plausible match of the model to the image data. Both have been applied to a wide variety of object tracking problems and give a useful framework for automatic complex image interpretation, especially for facial and medical images analysis (Davoine et al., 2004; Mellakh, 2009; Peyras et al., 2007; Rifai et al., 1999; Yan et al., 2003a; Yan et al., 2003b). Until now, ASM and AAM have been treated as two independent methods in most cases even though they share some basic concepts such as the linear shape model and the same linear appearance model. In theory, they are robust and their implementation is rarely easy. It’s requires careful attention to the entire process. The developed systems in (Davoine et al., 2004; Mellakh, 2009; Peyras et al., 2007; Rifai et al., 1999; Yan et al., 2003a; Yan et al., 2003b) are not fully automatic and are computationally intensive. They are costly and their performance depends on the size of the image database, the images quality, image annotation, etc. Further, these applications are developed in mono site. The database image and the algorithm of analysis or search are both in the same system. In Taguemount et al. (2005) the authors proposed a parallel treatment of algorithms, and the work proposed in Scheinine et al. (1998) describes the design and the implementation of the first prototype of a distributed system for the processing of medical images from different modalities, characterized by object-oriented client-server architecture.

In the same context as Scheinine et al. (1998), we propose to distribute the standard version of active appearance model in a client-server pattern and provide an interactive implementation between the various operations of the model. The AAM model has an attribute that make it ideal for distributed implementation. AAM is computationally intensive making distributed processing an attractive approach. In section 2, we present a brief introduction of AAM method. In section 3, we describe the components of distributed schema of AAM model. In section 4, we present some implementations of some components. The last section concludes this paper and gives some perspectives for our work.

2. BACKGROUND

2.1. Standard Version of Shape and Appearance Models

In this section we describe both models in general. Table 1 in the Appendix lists all symbols of these models and their names.

The standard ASM consists of two statistical models: (1) global shape model, which is derived from the landmarks in the object contour; (2) local appearance model, which is derived from the profiles perpendicular to the object contour around each landmark. ASM uses local model to find the candidate shape and the global model to constrain the searched shape. The AAM handles a full model of appearance, which represents both shape and texture variation (Cootes et al., 1995; Cootes & Taylor, 2001a; Cootes & Taylor, 2001b; Cootes et al., 2001c; Stegmann, 2000, Sung & Kanade, 2007). Many researchers have focused on these methods to solve many image interpretation problems, especially for facial and medical images (Cootes et al., 1995; Cootes et al., 1998, Cootes, 2000; Cootes & Taylor, 2001a; Cootes & Taylor, 2001b; Cootes et al., 2001c; Davoine et al., 2004; Duncan & Ayache, 2000; Edwards et al., 1998; Howe et al., 2004; Hsu, et al., 2002; Monga & Wrobel, 1987; Scott et al., 2003; Stegmann, 2004; Yan et al., 2003a; Yan et al., 2003b; Yang et al., 2002). Figure 1 illustrates the all stages of the AAM model segmentation framework.

In the simplest case, we assume that the training set of shape-texture pairs is \( \Omega = \left( X_i, T_i \right)_{i=1}^N \). The shape \( X_i = \left\{ \left( x_j, y_j \right) \right\} \) is a sequence of \( n \) points in the image, and the texture \( T_i \) is the image patch enclosed by the shape \( X_i \). The annotation stage must be done for each shape in the training set. If we have \( N \) training examples, we generate \( N \) such vectors \( X_i \). In AAM, all the shapes are aligned or
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