Da Vinci’s Mona Lisa
A Modern Look at a Timeless Classic

Dennis Lin¹, Jilin Tu¹, Shyamsundar Rajaram¹, Zhenqiu Zhang¹, and Thomas Huang¹

Beckman Institute, University of Illinois Urbana Champaign, Urbana, IL

Abstract. There has been some controversy over the true subject portrayed in Leonardo da Vinci’s Mona Lisa. In particular, there are suggestions that the painting is in fact a self-portrait. In this paper, we analyze the shapes of the features in the Mona Lisa and a known self-portrait of Leonardo da Vinci using active shape models. We conclude that the two faces have very distinct features and that they appear to be of different genders.

1 Introduction

The Mona Lisa by Leonardo da Vinci is arguably one of the most famous pieces of art in the world. In [1], Schwartz argues that the surface painting, supposedly of Lisa Gherardini, is actually a self-portrait of Leonardo. She supports her claim by noting that the eyes, nose-tip, and mouth of the Mona Lisa lines up with a known self-portrait of da Vinci. However, she does not take into account the possible range of face shape variation in the human population. We attempt a more sophisticated analysis by constructing an active shape model [2] (ASM) of human faces. These models capture a mean shape and can describe the correlation in the ways that the shape vary. In addition to using a more advanced model, we expect a more reliable result because we are using more landmarks. Our results contradict that of Schwartz and suggest that the two images feature distinct faces.

2 Analysis

One of the first things that we noticed when we began our analysis is that the Mona Lisa has cracks which may obscure its texture; the da Vinci self-portrait is lacking in texture altogether. Thus, we use only shape information in our comparison. To accomplish this, we built an ASM face model, which will tell us about the natural range of variation in face shapes. We also tuned a k-nearest neighbor gender classifier to check the shapes of Mona Lisa’s features.

2.1 Database

We used a manually labeled database of 488 frontal faces of different ethnicities. The database contains 151 females and 337 males. Each face was labeled with
87 landmarks, as shown in Figure 1. We also manually labeled the Mona Lisa image and the da Vinci self portrait, as shown in Figure 2.

2.2 Active Shape Model

Active shape models [2] (ASM) are an effective way to represent deformable objects such as faces. In this section we review the original ASM model as well as our modifications of that algorithm.

Preprocessing. Although similar in spirit, our preprocessing steps differ significantly from those specified in [2]. In his paper, Cootes distinguished among three types of landmarks. Type 1 landmarks include eye and lip corners, which have semantic meaning and are relatively easy to localize. For faces, type 2 landmarks would include the points along the bottom of the nose because they correspond to regions of high curvature. Finally, we have many type 3 points around the face boundary which are interpolated from type 1 and type 2 points. The inconsistencies of manual labeling causes these points to slide along the curve, dramatically increasing variance. We took several steps to reduce this effect. First, we aligned on the eye corners instead of doing a least-square solution on all of the points as suggested by the original paper. We also fit a cubic spline to the edge and resampled the points so that they are more equally spaced, as shown in Figure 3. Finally, we enforced symmetry by averaging the left and right halves of the face.