# Chapter 4
# Tangible Interfaces for Art Restoration

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## ABSTRACT

*Few people experience art the way a restorer does: as a tactile, multi-dimensional and ever-changing object. The authors investigate a set of tools for the distributed analysis of artworks in physical and digital realms. Their work is based on observation of professional art restoration practice and rich data available through multi-spectral imaging. The article presents a multidisciplinary approach to develop interfaces usable by restorers, students and amateurs. Several interaction techniques were built using physical metaphors to navigate the layers of information revealed by multi-spectral imaging, prototyped using single- and multi-touch displays. The authors built modular systems to accommodate the technical needs and resources of various institutions and individuals, with the aim to make high-quality art diagnostics possible on different hardware platforms, as well as rich diagnostic and historic information about art available for education and research through a cohesive set of web-based tools instantiated in physical interfaces and public installations.*

*Figure 1. A traditional approach to art diagnosis and restoration. In this example, a sample region was scraped to determine what lay beneath the wall paint (see the patch on the right side of the image). At one depth, the diagnosticians found a fresco, and the restorers chose to uncover the entire wall to that layer.*



## INTRODUCTION

When you gaze upon a painting in a museum, your eyes could be misleading you. The appearance of a work of art only reveals the current state; its true significance could lie beneath the surface. Traditionally the only means of diagnosing the history of a painting was destructive, but over the past three decades medical imaging techniques have been applied to ancient artwork to peer beneath the surface non-invasively. Many of these studies have revealed a pastiche of sketches, re-workings, alterations and misguided restoration attempts that complicate the authorship and authenticity of the work. These studies are rare; their findings are closed to interpretation; and they are rarely re-evaluated. We believe that the history of our cultural heritage should be open and accessible to a wide audience to motivate conservation efforts and to increase the likelihood of further discovery. Our team is building tangible interfaces for art restoration to make modern diagnostic information widely available and to broaden the interpretation and appreciation of art history.

## ART DIAGNOSTICS

The field of art diagnostics is concerned with revealing the history of a work of art to assess its condition and to help direct conservation efforts. Traditional techniques require technicians to abrade the surface of an image using scalpels and solvents to locate details and layers of interest (see Figure 1). While these techniques are seldom used with important works of art, direct physical interaction is time-tested, intuitive, and almost always collaborative.

Alternatively, medical imaging equipment can be used to produce high-resolution images of the artwork at different wavelengths (e.g. infrared, ultraviolet, x-ray). These represent various materials deposited over the course of the painting's history, from original sketches to layers of pigment and varnish. While safe, multi-spectral scans require specialized training to analyze, and the work is almost entirely carried out on single-user graphics workstations. When analyzing a multi-spectral scan, the diagnostician begins by precisely aligning the co-located high-resolution images with a multi-layered photo editing software on a powerful computer. Then, she looks for anomalies between the layers by zooming into a detail and superimposing two scans in transpar-

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