Arius3D Solution

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Abstract

The Arius3D Solution combines scanning with the foundation high resolution 3D color laser system, with the Pointstream visualization software which produces archive quality 3D images. The laser scanning process creates a three dimensional digital copy of the physical object; capturing both color and geometry simultaneously at near microscopic resolution. The non-contact laser light measurement process was certified as a secure technology for digital reproduction of 3D cultural artifacts.

The resulting three-dimensional images are viewed on standard personal computers using the Pointstream software application. With Pointstream, the reverse engineering process of fitting polygons to point cloud data is eliminated. A complete scan data set of an object in point cloud format can be processed and used for a variety of 3D and 2D end purposes quickly and easily. For example, images can be embedded into a web page and the data that is presented to the user is scientific data sampled directly from the physical object. Arius3D technology eliminates some difficulties that 3D content providers go through to arrange and apply texture maps. The simplicity of the Pointstream image representation, using a "pixel" as the basic object primitive, enables true progressive transmission of 3D content.

Introduction

Arius3D Inc. color laser scanner was developed by and licensed from the National Research Council of Canada. It is recognized as the only digital image system that simultaneously and accurately captures color and geometrical data of 3D objects. The image is captured at the highest possible resolution - 25 microns. Once an object's image is captured, it can be redeployed in a multitude of resolutions, in a diverse range of file formats and media types.

Other 3D scanning technologies capture color and geometry of the object separately using a variety of techniques and later merge captured images. Computer graphics professionals build complex digital images on computers that can be time consuming, expensive and unsuitable for other applications.

Technology

Proprietary technology consists of object-level color 3D laser scanning system (a tricolor laser scanner and motion system, Figure 1) and two software applications - A3DScan and Pointstream 3DImageSuite.

During scanning process a motion system records each point on the surface of an object registering its color and location in 3D-space. Each scanned point has 6 numeric values: positional values - X, Y, and Z, and color values - R, B, G.

Scanning in the X direction is accomplished by a galvanometer-driven double-sided mirror. The position of each point on the X-axis is developed from the known angular position of the mirror.

Figure 1. *Arius3D laser scanning system*

Scanning in the Y direction is accomplished by motion perpendicular to both the laser axis and the X-axis, usually implemented as a translation stage. The position of each point on the Y-axis is developed from the known position of the stage.

The position of the Z-axis is measured by laser triangulation, enhanced by the application of synchronized scanning geometry. This scanning method uses one side of the galvanometer-driven mirror to deflect the laser across the scanned object while the opposite side of the same mirror is used to cancel the return beam's angular movement across the CCD sensor. With this geometry, only a change in the position of the light spot along the Z-axis produces net movement across the CCD sensor. A patented sub-pixel interpolation scheme is used to enhance the resolution of the CCD sensor.

3DImageSuite is an application for processing point cloud data captured using 3D imaging system. 3DImageSuite contains of an advanced set of tools that allow to view and edit point cloud

data in xyzrgb format. 3DImageSuite exports the Arius3D measurement data into a variety of formats. The Arius3D scan data can be exported and imported as points, polylines, polygons and b-spline surfaces using standard data exchange formats.

Unlike traditional 3D systems that convert scanned 3D data into a polygonal mesh before rasterization, the Pointstream method takes scanned 3D data directly into rasterization. The complex process of fitting polygons to point cloud data and the difficulties of creating and applying texture maps is eliminated.

Applications

Since color measurements are completely independent of the effects of ambient light during scanning process, this system is a perfect solution for the museums that digitize fragile collections and strive for true color capture (Figure 2). The Arius3D image capture system uses a low power non-damaging laser light that is also very important for the museum digitization projects.

While color management is one of the most challenging issues in digitization projects, laser scanning technology provides partial solution to this problem at the very early stage of image capture. Color calibration of scanners, monitor displays, printers, etc., may help to reduce color biases but do not eliminate them completely. Further studies are needed to compare advantages and disadvantages of laser color capture.

Figure 2. *Malaysian hand-painted mask, courtesy of private collection, displays color and geometry capture.*

Arius3D technology provides 3D digital imaging data that enable organizations to research, present, and share unique physical objects in digital form. A great example is an archeological collaboration between three universities: the University of Toronto, Canada, the Smithsonian Institution in Washington DC, USA, and the University of the Witwatersrand, in Johannesburg, South Africa. A fossil of the Massospondylus embryo was digitized using Arius3D Inc. laser system and later a physical object was sent back to South Africa while a digital copy is shared for further research and used as an excellent learning object for online education.

Biography

Susan Dineen is a vice president at Arius3D Inc. with over 20 years experience in the technology development business. At Sony Music Canada, Susan developed and implemented the technology strategy that positioned them as the most technically advanced affiliate in the world. Prior to that, Susan served as the Director of Systems Development and Support with Ault Foods where she developed the application architecture for both mid-range and client server computing environments.

Vika Kravchyna, PhD, is an image library specialist, who is responsible for the development, deployment and marketing Arius3D Inc. image library. Prior to Arius3D Inc. employment, Vika conducted research on information needs related to cultural institutions at the University of North Texas. Development of digital Sepia Photographic collection for the African American Museum of Art in Dallas was one of the major projects Vika was involved.

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