Technology overview:

SCANIFY®

FUEL3D®

Fire up your creativity.

Introduction

SCANIFY® is the affordable, handheld 3D scanner that delivers fast, high-resolution shape and color capture for a range of 3D modeling applications, such as 3D printing, as well as on-screen applications like 3D art, animation and game development. The scanner's ability to accurately capture color 3D models of the human form is ideally suited to the rapidly growing trend of personalization.

SCANIFY is the world's first 3D scanner to combine pre-calibrated stereo cameras with photometric imaging to capture and process a 3D model in seconds.

Capabilities

SCANIFY captures 3D images in an instant, taking just 0.1 seconds to take a single scan from a single viewpoint. SCANIFY has a fixed focus and captures a maximum size of about 40cm/16" diagonal in a single scan, approximately the size of a sheet of letter sized/A4 paper. Acquiring a larger 3D model requires multiple scans to be stitched together.

The ideal imaging distance is around 450mm/18" but the scanner's operating range is fixed at 350mm/14" - 450mm/18".

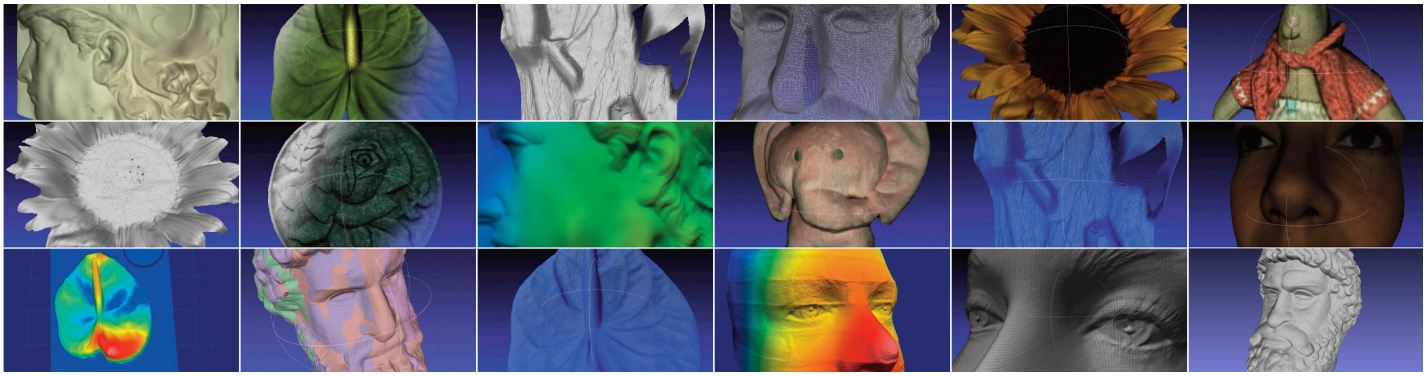
The final output resolution from SCANIFY varies with the distance of the system to the subject. The scanner is capable of a resolution of approximately 350 microns. Approximately 375,000 vertices and 750,000 polygons are captured of a flat surface in a single scan image.

Objects with the following characteristic generally scan well with SCANIFY:

- Continuous surfaces with smooth curvature
- Varying color or texture
- Matte, non-shiny surface
- Opaque

For example:

- The human form
- Fabrics
- Stone and masonry
- Wood carvings
- Sculptures
- Plants, flowers and other organic objects



What lies beneath ...

When taking an image, SCANIFY rapidly acquires a series of stereoscopic 2D photographs with several lighting directions. These are then processed by software to resolve a single 3D model. Under the hood, the scanner combines a number of image processing technologies to allow on-the-spot acquisition of high-quality 3D models:

- High speed capture enables scanning of objects that may move during acquisition
- Movement compensation is used to account for the movement of the scanner as it is being held during a scan
- Photometric-stereo is used to acquire color and high-resolution 3D detail from the subject
- Stereoscopic imaging is used to acquire accurate underlying 3D shape information from the subject
- Data fusion is performed to combine the data output of the photometric and geometric processes to produce a single 3D image.

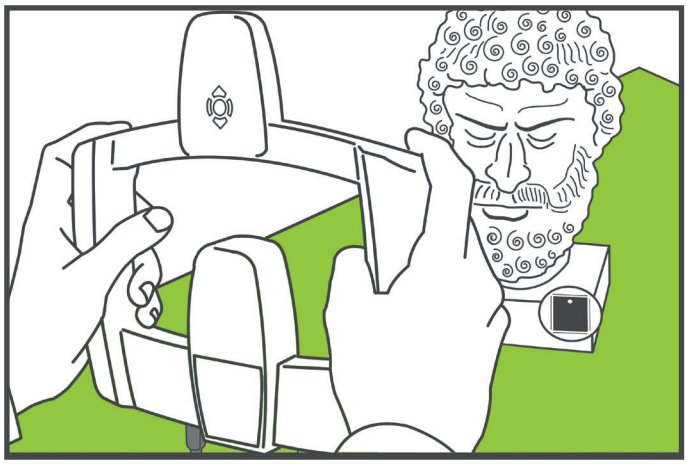
High-speed capture

With all 3D scanners, the movement of a subject presents a challenge and requires the subject to remain completely still throughout the capture process, which can often take several seconds to complete.

A key feature of SCANIFY is the speed with which it acquires the data used to generate a 3D model. The scanner's three Xenon flash bulbs fire almost simultaneously to capture 3D data in under 0.1 second. This rapid speed of capture gives SCANIFY a unique ability to excel in the capture of subjects that may move while being scanned, such as human beings.

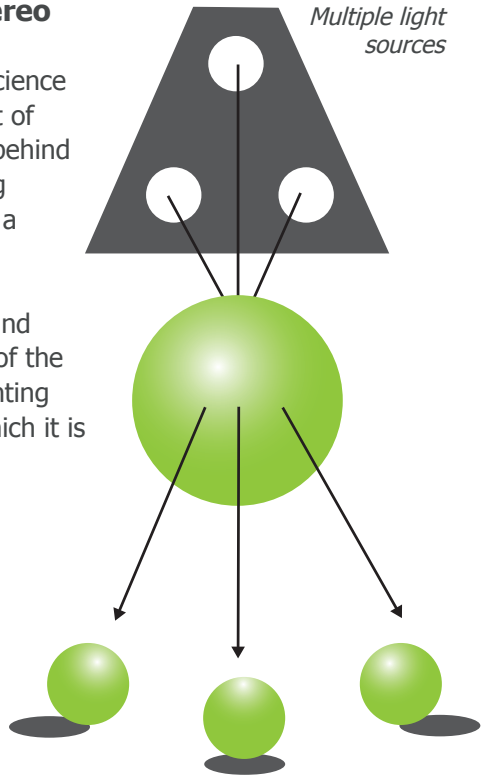
Movement compensation

A key component of the SCANIFY technology is the optical target. SCANIFY is handheld, and so moves during acquisition of the subject. By placing a simple target with specific optical characteristics close beside or on the subject, parameters relating to this movement can be resolved. The principle behind this is that the system knows the size and layout of the optical target, and by looking for the target in the image, the scanner can accurately estimate the relative position and orientation of the scanner with respect to the target.



The target is manufactured to very high standards and cannot be easily reproduced. Replacement targets should only be purchased from Fuel3D or an approved dealer.

Photometric-stereo



Photometry is the science of the measurement of light. The principle behind photometric imaging is that the image of a subject observed by a camera depends on both the shape and material properties of the subject, and the lighting conditions under which it is illuminated.

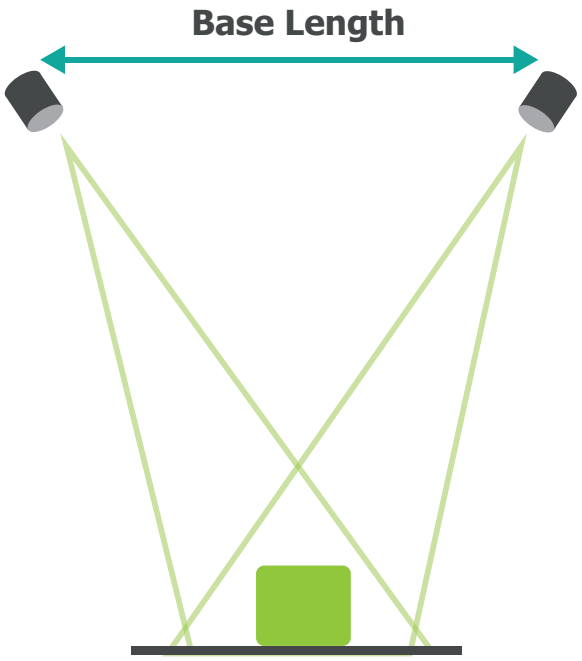
When carrying out photometric-stereo imaging, several images are taken of the subject illuminated by a single dominant light source from a number of different directions. The position of SCANIFY's flash units provides the scanner with this information. Image processing techniques examine how the observed illumination levels across the subject vary with the change in lighting direction, calculating the direction of the "normal" to the surface of the subject for each pixel in the image, alongside maps of reflectivity. The resulting "normal map" is then integrated to provide a highly detailed 3D "range map" of the surface.

Traditional photometric-stereo systems are bulky, requiring many light sources and careful calibration. They are not portable and are generally regarded as inappropriate for capture of live subjects.

Stereoscopic imaging

Stereoscopic 3D imaging resolves depth using optical triangulation, which involves resolving distance from parallax. In SCANIFY this is achieved by using stereoscopic imaging (two cameras and lenses) to acquire a matched pair of images of the subject, then identifying and correlating the location of features between the two images to sub-pixel accuracy.

For this to be possible the subject must have a degree of random surface texture, either from variation in color, or from having a rough or wrinkled surface. The output from the geometric imaging technique is a 2D range map analogous to that provided by photometric imaging, with better underlying accuracy but lower resolution. Stereoscopic 3D imaging gives accurate measurements of bulk shape in all three dimensions.



Stereoscopic 3-D

Data fusion

SCANIFY's software incorporates proprietary algorithms to combine the data from its photometric and geometric 3D imaging systems to produce a single 3D model that is both accurate and has high resolution of surface detail. In essence, the high-accuracy, low-resolution geometric 3D data is used as a skeleton on which the higher resolution photometric 3D data is overlaid. The resulting 3D images consist of a large number (several hundred thousand) of samples, each having XYZ coordinates (surface location in millimeters) and material properties (color) in 8 bit RGB.

Limitations

As with all 3D scanners, there are some scenarios in which SCANIFY will resolve data better than in others. Objects with certain characteristics may not be suitable for scanning, or may require technical workarounds to capture successfully.

Such characteristics include:

- Objects with cavities or protrusions, where the scanner can only image what it 'sees' from its view point and cannot capture part of an object that is hidden behind another
- Very dark objects, where the object will absorb light from the flashes which lowers the amount of detail.
- Mono-color objects with no texture, which do not provide surface information for the scanner to work effectively
- Reflective or shiny objects, where light reflects off the surface to prevent accurate surface measurement
- Transparent objects, where light transmits through the surface to prevent accurate surface measurement
- Objects with sharp edges and corners, where the scanner will trend to smooth objects with geometric features with flat surface and sharp corners.