

# 3D Image Scanner

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## 1. Scanning vs. Modeling

Scanning and Modeling 3D geometry are two different processes. When an artist models geometry, they have complete control over polygon count and placement. Typically, an artist will shape different parts of a model with more/less polygons to fit their needs. When scanning a model, we have no knowledge of what features are more sophisticated. Therefore, we can only apply polygons evenly across the geometry.

## 2. The Setup

To use this method of 3D scanning, you need the following:

Camera  
Level Line Laser  
Flat Surface

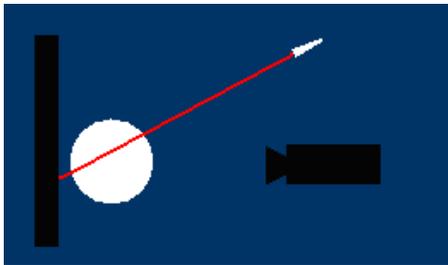


Figure 1. Left to Right. A flat surface, an object, a laser, and a camera.

## 3. How it Works

If you understand how ray tracing or parametric line equations work, you can easily implement a 3D scanner.

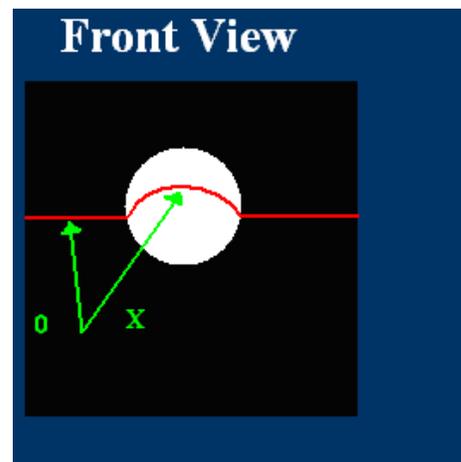
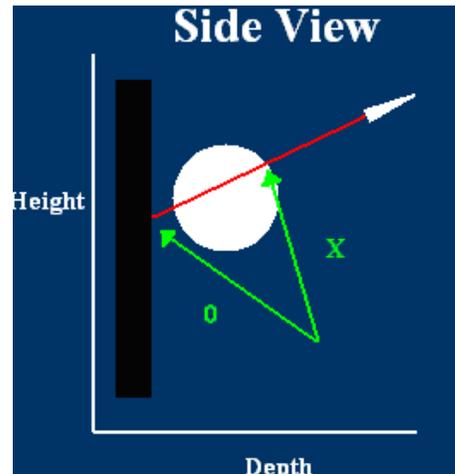


Figure 2,3. Point '0' is a point of zero depth. Point 'X' is a point of depth greater than zero.

Comparing Figure 2 and 3, you can conclude that depth corresponds to height from the camera view.

## 4. Algorithm

1.) Scan the image for the zero height.

\*In my application I left open space on the left side of the image to intersect with the flat surface. By doing this, you will only have to scan the left side of the image for the first occurring red pixel.

2.) Scan all pixels above the zero height.

- \*All pixels below the zero height have no depth information.
- 3.) Subtract the pixel's y value from step 2 from the zero height.
- 4.) Write the height value from step 3 into the height-map at the same x,y location of the pixel from step 3.

## 5. Filtering



Figure 4. XBOX 360 controller scanned with 83 frames.

You can see that filtering is a big issue with creating a height-map. Figure 4 is an unacceptable height-map because it has many gaps in it.



Figure 5. XBOX 360 controller filtered.

Taking Figure 4, we apply a filter to fill in the gaps of the height-map. This is now acceptable to use as a height-map. Other filters like contrast can be applied to enhance the height-map.

### Filtering Algorithm

- 1.) If the pixel has data greater than zero, it

was created by the scan. (P1)

- 2.) Search upward for the next occurring valid pixel. (P2)
- 3.) Create a parametric equation to blend pixels between P1 and P2.

## 6. Conclusion

This method of 3D scanning has been around for over 20 years. It can be used to generate 3D models very fast, but without optimizations, the models will be very high in polygon counts.

Some things to consider when implementing this algorithm:

### Video Frame Size:

Changes Resolution of the Height-Map.

### Number of Frames:

Fills in gaps with real data, rather than our filtered method (See **5. Filtering**), which is an approximation.

## 7. References

- [1] DAVID 3D Scanner  
<http://www.david-laserscanner.com/>