3D Object Imaging using HD Scanner

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INTRODUCTION

The emerging trend in public over the last few years has been the consumer electronics with the adaption of 3D High Definition features. Products that have been released with the demand in entertainment business include 3D TV, 3D glass for screening and gaming console (Nintendo 3DS). The same underpinning principle can be applied to 3D scanners to collect data of an object and construct the digital, 3D model. These scanners varies in size depending on methods and the implemented techniques.

APPLICATIONS

- Medical and Forensic science
  - ⇒ Prosthetics, dental implants
  - ⇒ Forensic scene analysis
- Industrial
  - ⇒ Design, prototyping, quality control
  - ⇒ Reparation or recreation of undocumented parts
- Heritage
  - ⇒ Artefacts preservation and analysis without invasion method
  - ⇒ Documentation of historical sites
- Biometric
  - ⇒ Face shape recognition , 3D fingerprints
- Entertainment
  - ⇒ CGI 3D Models
  - ⇒ Video games

PROJECT AIMS

- Improvements of image quality obtained from the appointed system from 3D3Solutions, Flexscan3D
- Get better understanding of the structured light method in acquiring 3D information
- Pursue method of exporting 3D representation of the object to other software platform
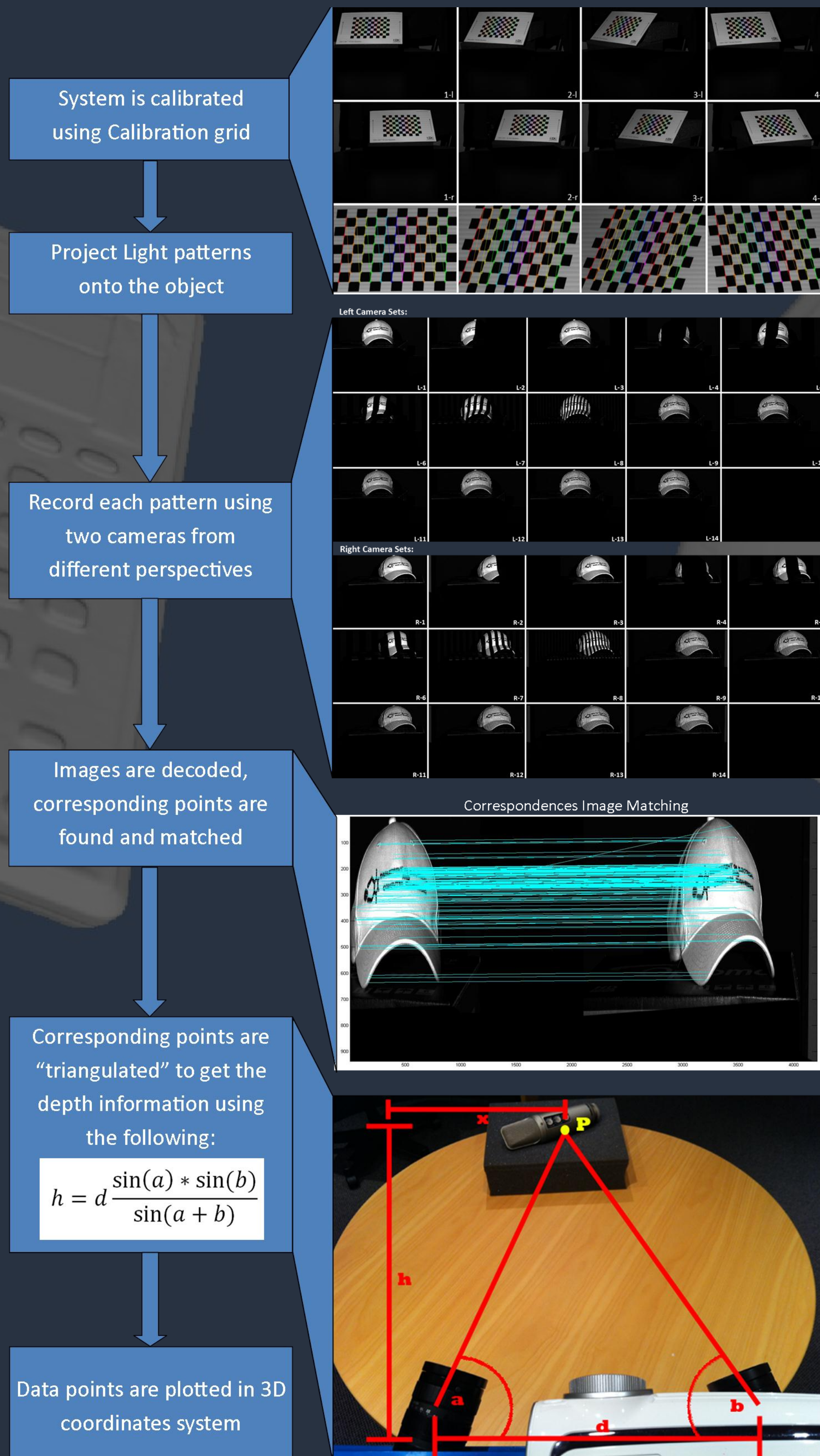
SYSTEM OVERVIEW

3D3Solutions system's Flexscan3D adapts structured light type scanner which projects light patterns. The setup of such system is known as stereoscopic format which use stereo vision principle. It is called stereo vision because the usage of two cameras, separated by distance, in recording image of the same scene which works similarly like human eyes.

System Setup | Stereoscopic Canonical Setup
Projector
Camera

METHODOLOGY

The scanning process of a Structured Light 3D Scanner is as follow:

System is calibrated using Calibration grid

↓

Project Light patterns onto the object

↓

Record each pattern using two cameras from different perspectives

Left Camera Sets:
Right Camera Sets:

↓

Images are decoded, corresponding points are found and matched

Correspondences Image Matching

↓

Corresponding points are "triangulated" to get the depth information using the following:

$$h = d\,\frac{\sin(a) * \sin(b)}{\sin(a + b)}$$

↓

Data points are plotted in 3D coordinates system

RESULTS

Through mathematic of triangulation that was shown, additional 3D information can be derived from the stereoscopic 2D view of an object.
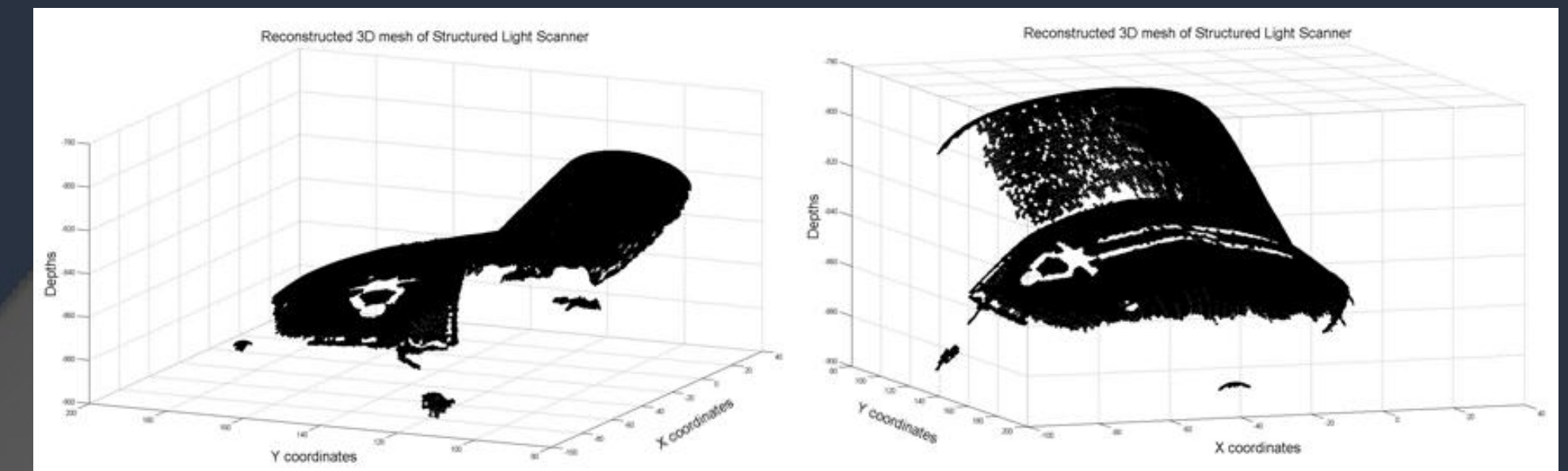
As can be seen in the figure, newly acquired depth information is clearly apparent. This information is not available from just 2D view of the object. The mesh above consists of about 60,000 vertices.

The resulting mesh above is taken from proprietary software, Flexscan3D. The question is how to get the necessary information from the 2D representation of an object.

Stereo 2D Images → ? → Black Box → ? → 3D Mesh Object

RECONSTRUCTION APPROACH

In attempt to understand the process of getting the 2D mesh from the stereo 2D images, the group tried and developed simple algorithm based on the same principal as the proprietary software.
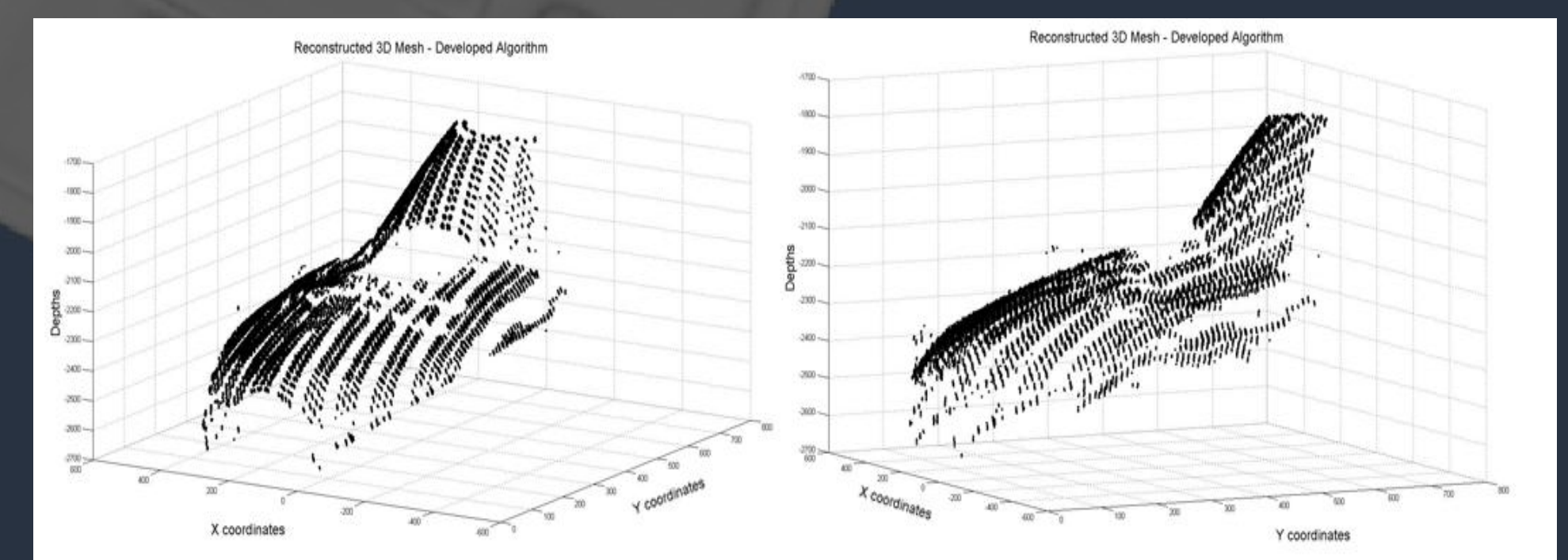
As a comparison to the previous mesh, this figure has about 20,000 vertices. Although the resulting mesh is not as apparent as the proprietary one, the simple algorithm managed to get the basic shape of the object. The reasons being are as follow:

- The camera parameters (angular value a and b) are assumed
- Pixelated striped pattern are taken into account
- Triangulation is done per pixel value instead of per stripe pattern
- Vertical distance is assumed

CONCLUSIONS

- The proprietary software FLexscan3D from 3D3solutions has been set up accordingly and optimised to be able to reconstruct high-detailed 3D mesh.
- Mesh reconstruction without the actual camera parameters is possible with certain degree of error.