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INTRODUCTION

In the installation of a smart home, documentation and mapping of a room can be a time consuming and sometimes inaccurate if done by hand due to human error. Making a moderately accurate 2D map of two rooms, along with all the motion sensors inside the rooms took several days to get from measurements and drawings to a scalable image file that can be used for documentation and visualization of data.

Google's A.T.A.P. (Advanced Technology and Projects) group has been working on something called Project Tango, a tablet that has a few extra sensors on it which allow it to use sense more than a normal tablet.

Some of Project Tango's core features are:

- Depth sensing
- Motion tracking
- Area learning

Some of the sensors that allow the Project Tango Tablet to sense these are:

- ✓ An IR (infrared) projector and IR-RGB camera to pick up the projector's points (similar to how a Microsoft Kinect™ senses depth, they use point cloud data)
- ✓ A fisheye camera (which is used to help it track motion)
- ✓ An accelerometer and gyroscope (used to track movement of the tablet itself)

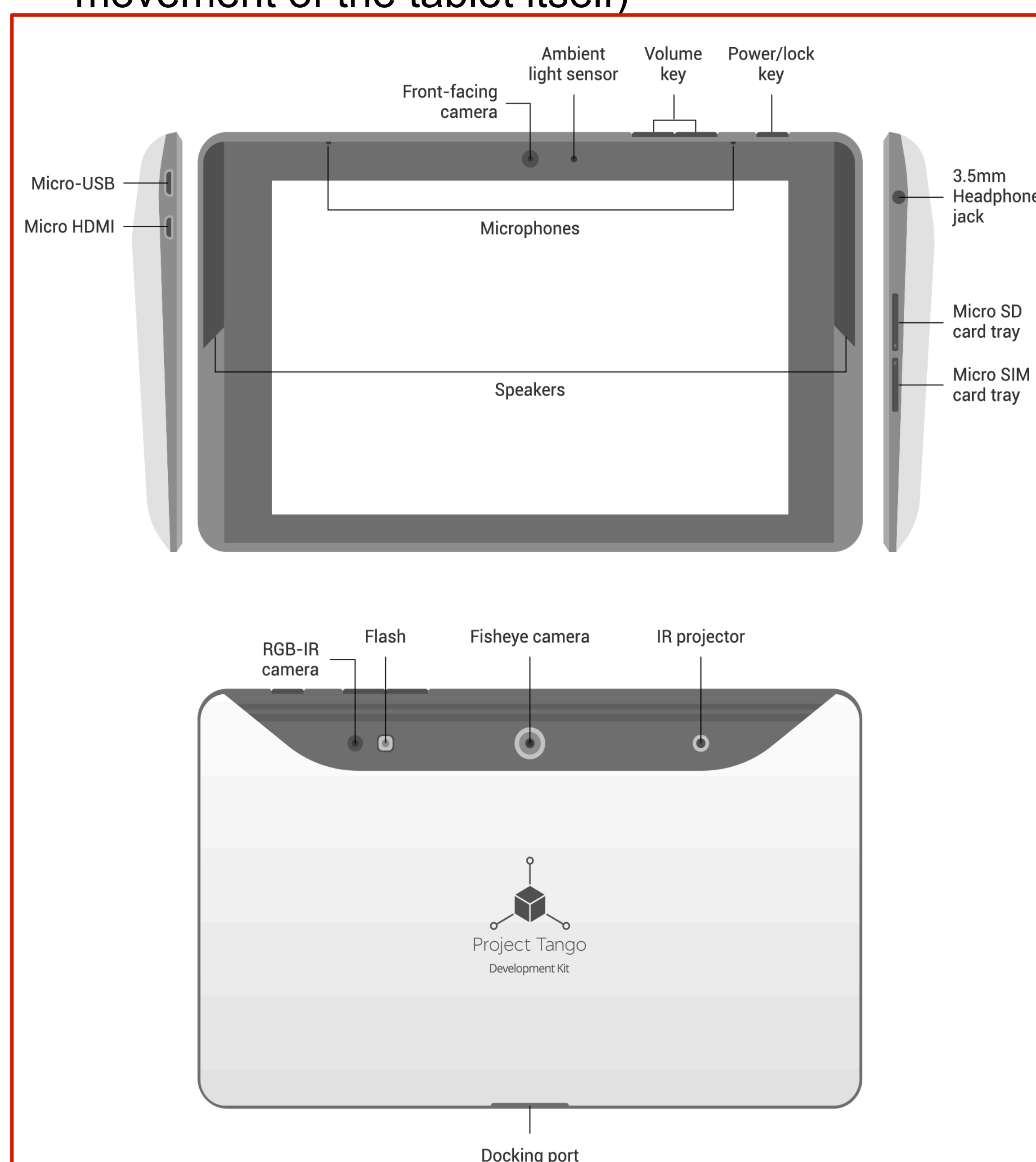


Figure 1: Google Project Tango Tablet

(images taken from <https://developers.google.com/project-tango/images/hardware/tablet-hardware.png>)

Once the Project Tango Development Kit was received, it was configured and a few apps were downloaded onto it to test its depth sensing capabilities. Voxxlr is a free app from the android store which gathers depth and color information from the tablet's sensors and displays the data as colored cubes or voxels.

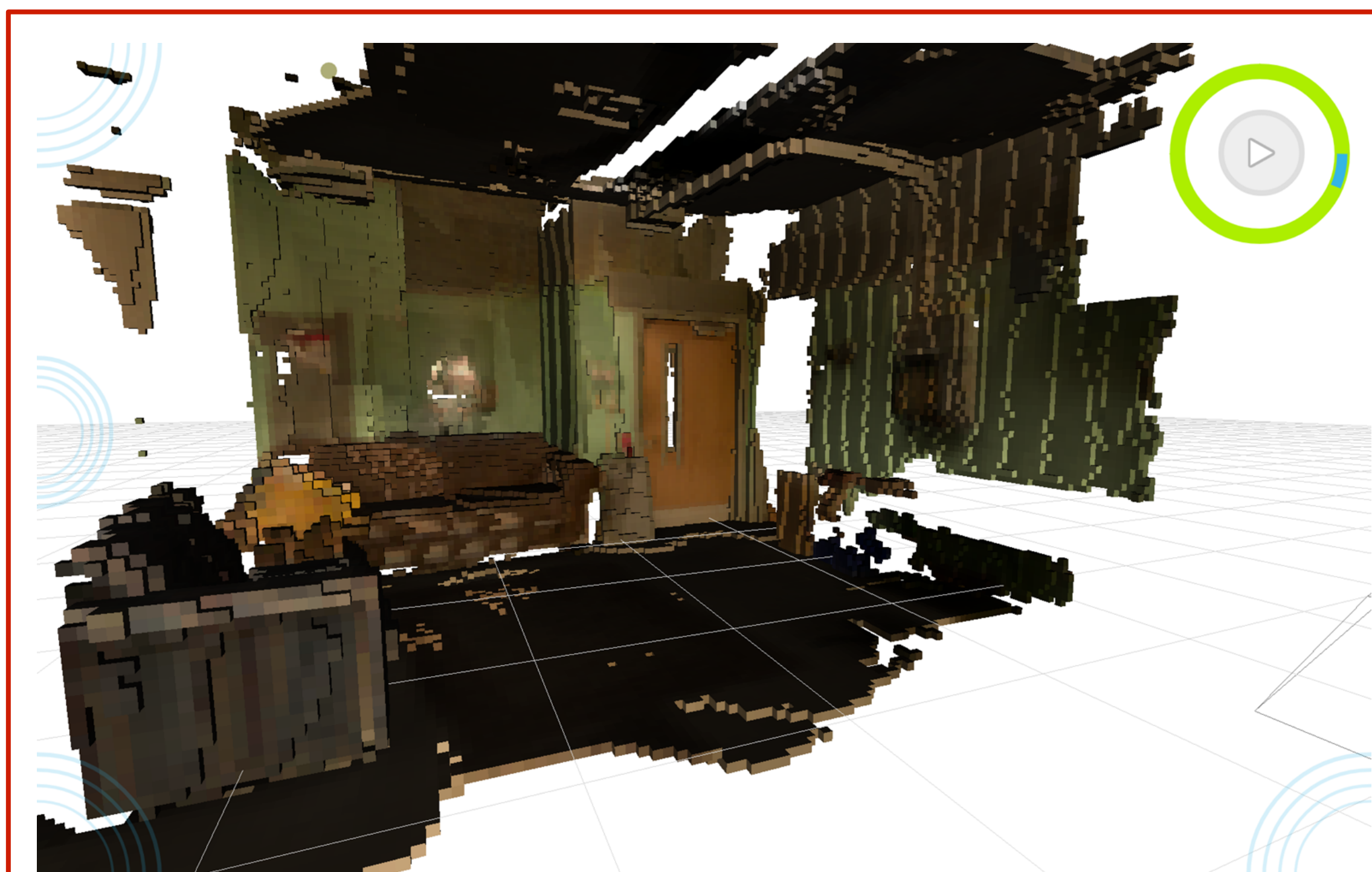


Figure 2: Screenshot of stairwell scanned with Voxxlr
Notice how everything is made of cubes.

After that Google's Experimental Mesh Builder (available on GitHub) was loaded onto the tablet. This app scanned much faster than Voxxlr did, however it didn't color what it generated like Voxxlr did.

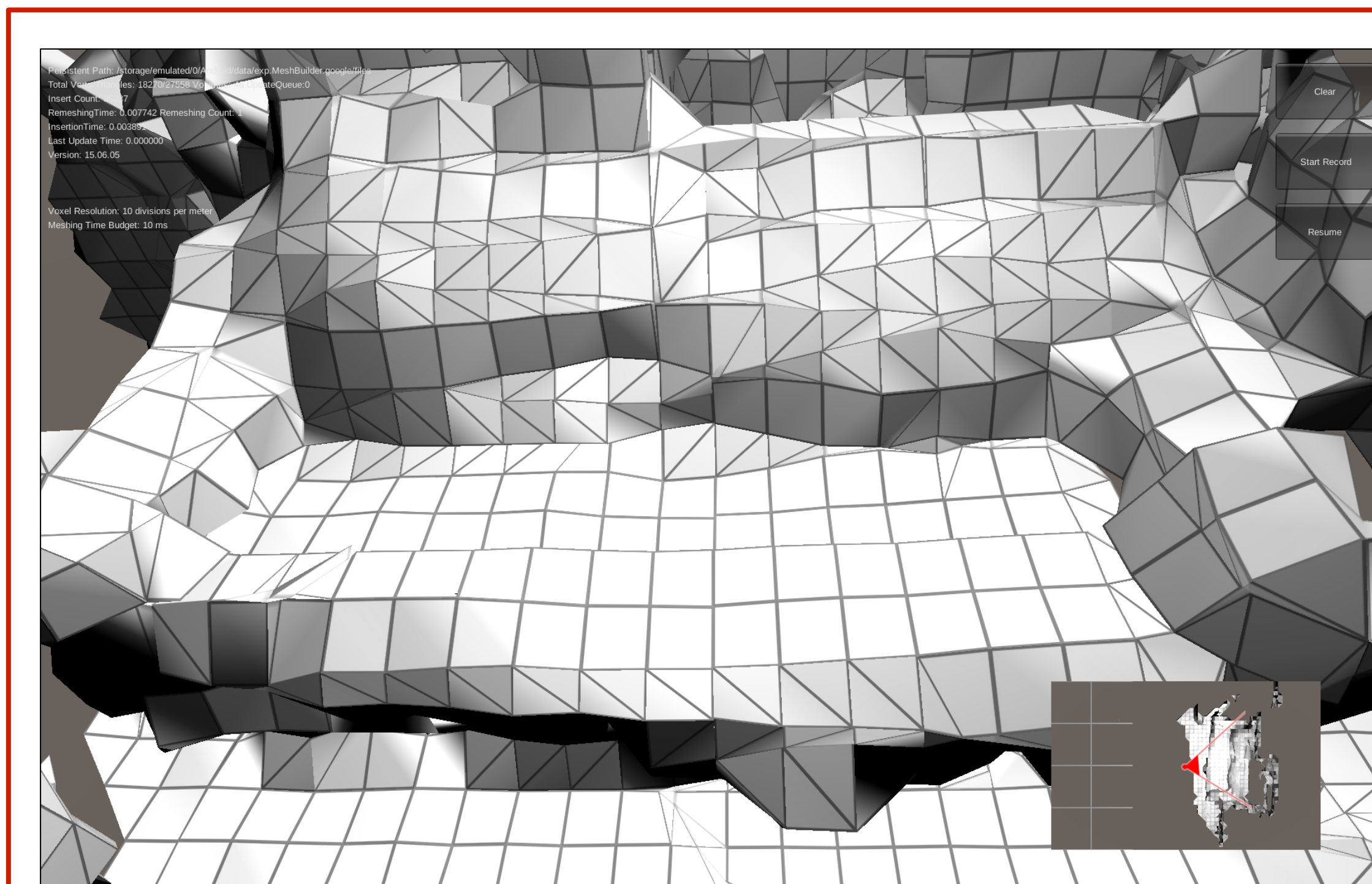


Figure 3: Screenshot of couch scanned with Google's Experimental Mesh Builder

This app uses a modified version of the Marching Cubes Algorithm



Marching Cubes
Algorithm demo
(0:17)



Real time 3D
reconstruction on
mobile
(2:39)



Say Hello to
Project Tango
(2:57)



Google I/O 2015
(40:01)



3D Reconstruction
on mobile
(1:10)



Project Tango site

We developed another mesh builder with more options by modifying some of the code Google used in their Experimental Mesh Builder app.

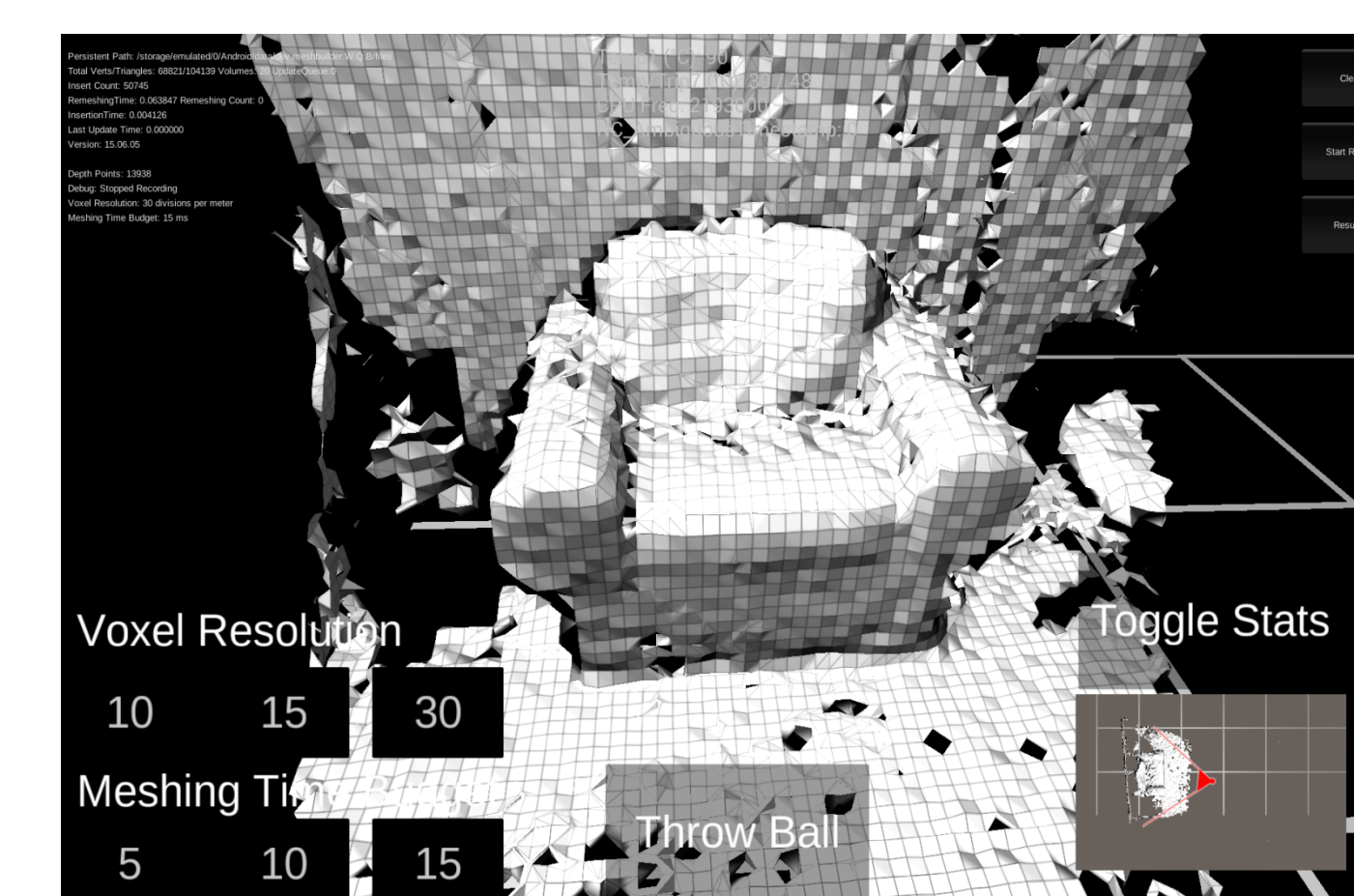


Figure 4: Picture and Screenshot of Chair scanned with our modified app

We modified the code in Google's Experimental Mesh Builder to have changeable resolution and mesh to improve scan speed or accuracy.

RESULTS

We were able to get scans from all the apps after brief use of them. None of the apps could seem to detect anything made of glass and had difficulty with getting depth points on black objects leading to holes in the scan. The overall quality of the scan was dependent almost as much on the user and their experience using the device almost as much as the app they are using.

CONCLUSIONS AND FUTURE IDEAS/WORK

The IR's point cloud data is a key part of the depth sensing. IR has its limitations however,

- Add ability to change the mesh texture from a grid
- Add help button to give users information on how to get the best scan possible
- Add ability to place markers/points on the mesh (For example this could be used to place markers for sensors in a scan of a smart home)
- Fix a few minor bugs with the user interface