

Automated 3D Reconstruction for Robotic Scanning using Structured Light

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Brief Overview: We were able to capture a number of individual scans and efficiently reconstruct a full set of objects placed in the scanning volume to a high degree of precision including the removal of extraneous data with little or no human intervention.

Scanning and reconstruction start with data gathering.

The arm was manually positioned by a human operator then the position of the end effector was recorded, and the scan was captured.

Output at this stage was a disordered array of point clouds and a simple file containing the x y z rx ry rz rw positional data of the end effector.



Using the positional data of the end effector and a calibration matrix between the origin of the scanner's reconstruction space and the end effector of the arm we were able to transform the origin of every point in the point cloud to the world space, in this case the world space used was the mounting point of the robotic arm to the table.

This would be considered coarse alignment of the point cloud data.

Due to the density of points gathered by the scanner of the table alone, the next logical step is to remove the table plane.

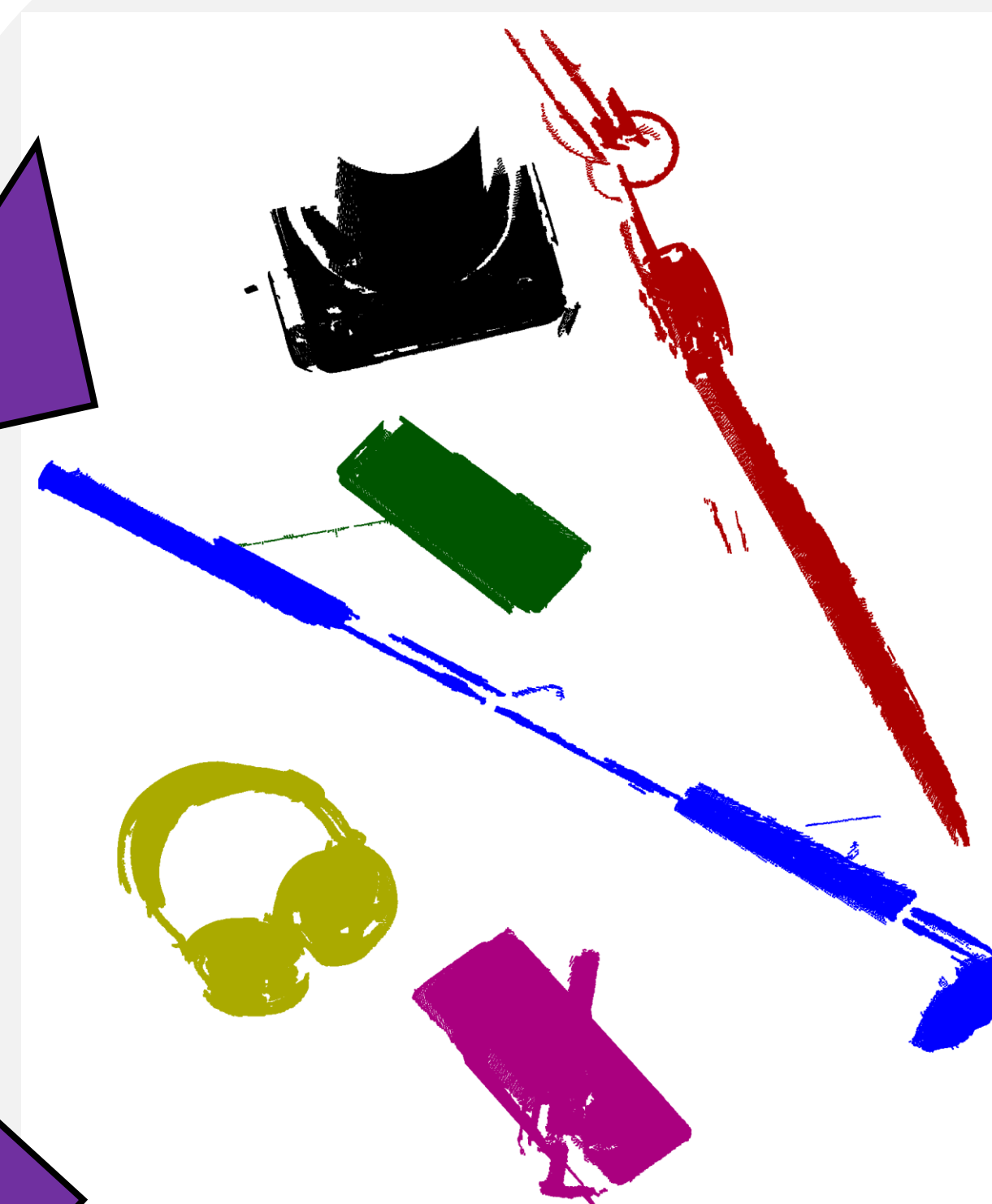
Not only does this make visualisation of the objects easier, it also aids in the segmentation of the objects later.



Next, we can segment the constituent objects of the scan.

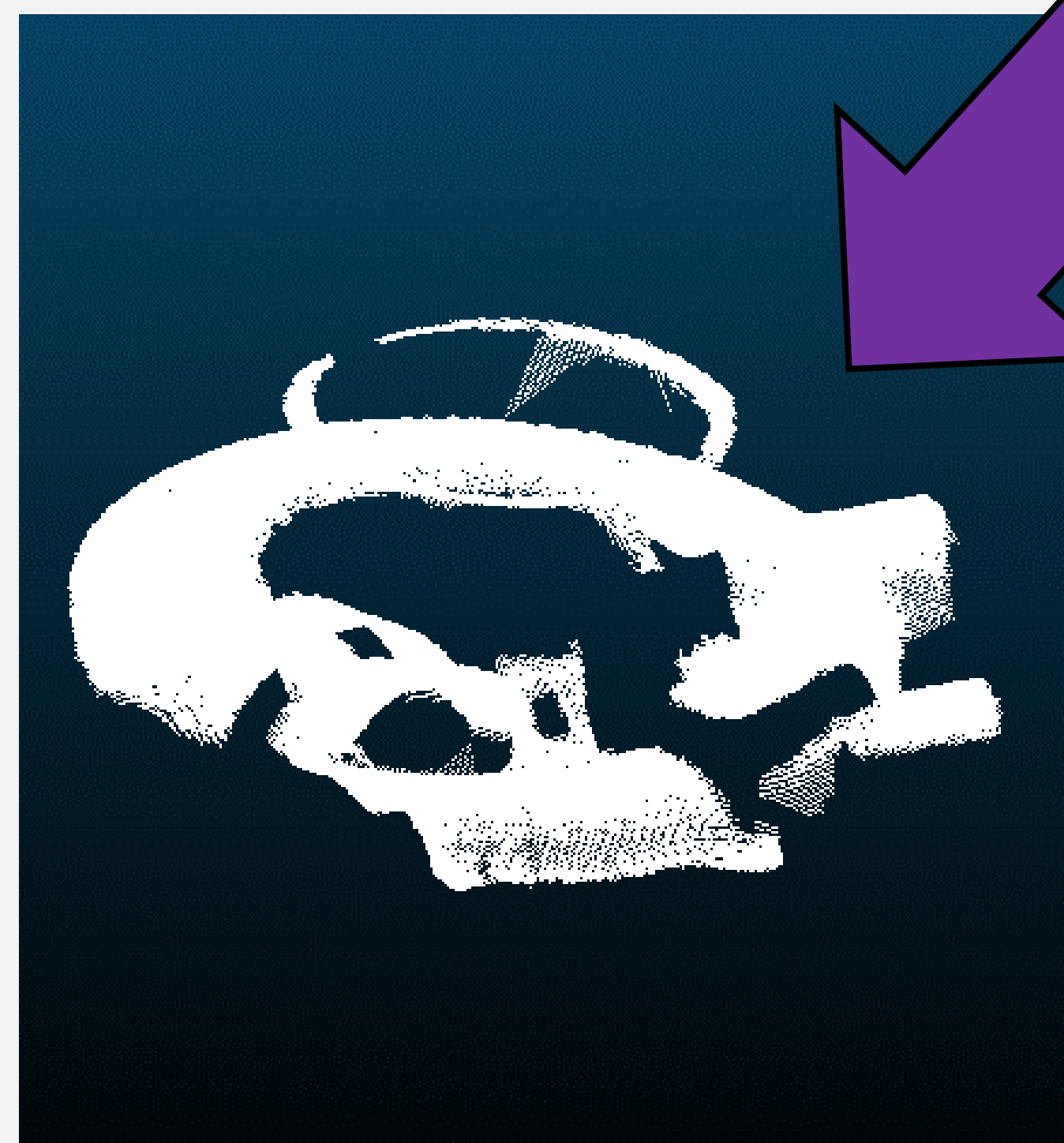
In this case the data was broken down into the set of objects before being coloured for viewing convenience.

The image on the left has been coloured by object.



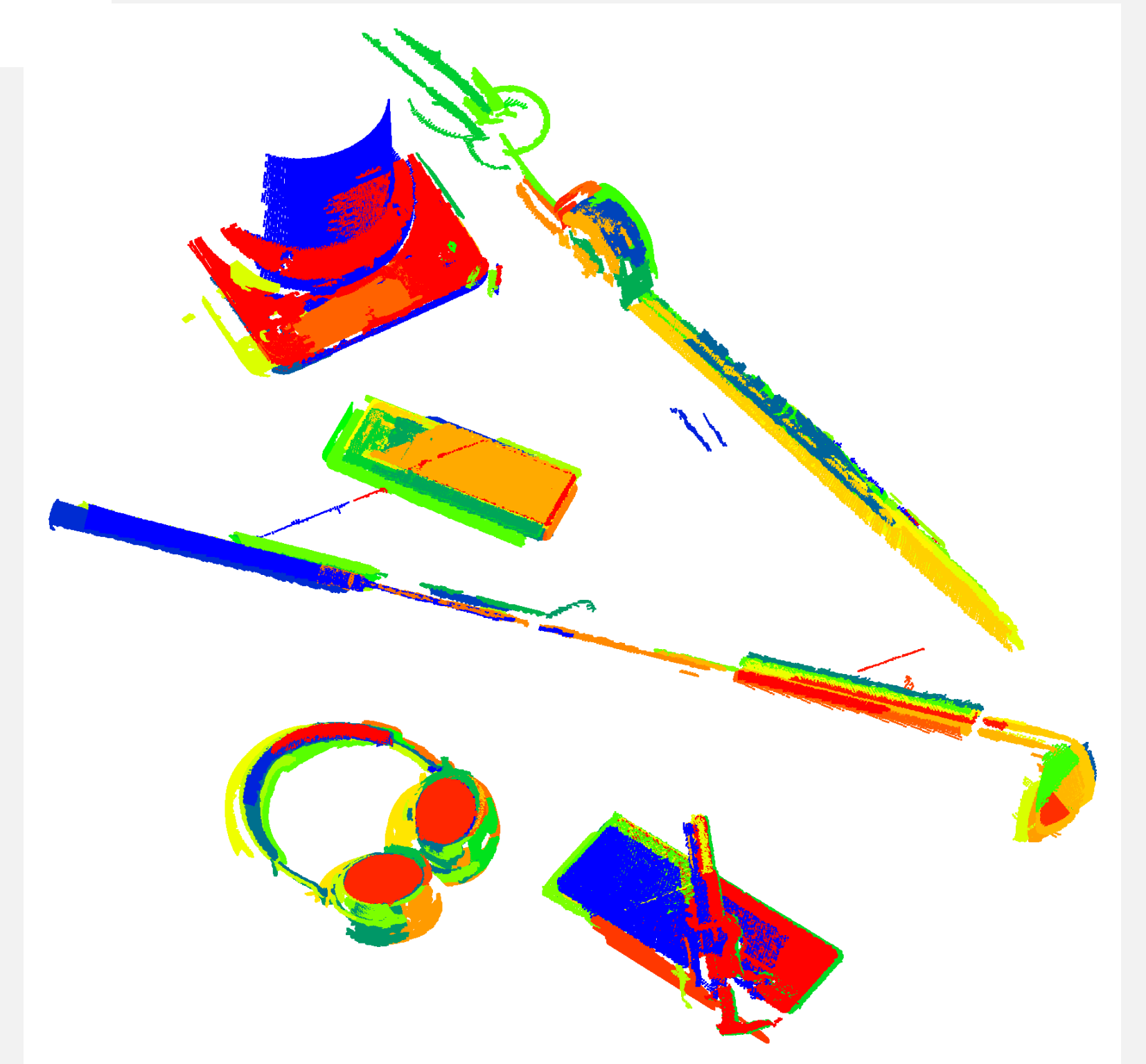
The final stage of gathering clean data before measurements can be taken is fine alignment.

During testing a few methods were trialled with varying success but eventually an optimised traditional ICP method was used.



The image to the right has been coloured based on the point cloud that the section was originally extracted from.

This dataset consists of 33 separate scans.



Future improvements: due to time limitations we were not able to integrate all the features originally envisioned to allow this system to run entirely autonomously. Some of these features included voxel-based occupancy detection to automatically steer the robotic arm to gather more data, the additional capture of colour data and relation of this to the point cloud, and detection of the objects based on object identification instead of point cluster proximity.