Annotation tool

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1 Introduction

Annotation tool is an application designed to annotate objects in a point cloud scene. Specifically, it was developed to annotate the objects of a desk. The format of the point cloud supported is .pcd[1].

To do that this software can perform:

Plane detection The program guess the desk plane automatically using RANSAC[2].

Plane definition If the plane detection guesses a wrong plane, it is possible to define manually the table plane by picking three points belonging to the table plane.

Desk segmentation Once the desk plane is defined, a desk segmentation is done by picking three points.

Object annotation To annotate an object is defined the position, the orientation and the measures of a bounding box.

Export object's information Export in a .txt file the information of all annotated objects.

Import object's information Import from a .txt file the information of a previous annotated objects.

To annotate each object, a bounding box and its pose is defined as it is shown in the image below:

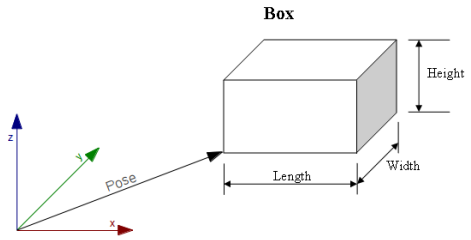

Figure 1: Bounding box and its pose

Also the angle between the front side of the box and the x axis is saved, as well as the points inside the bounding box.

It was developed by Adrià Gallart del Burgo in 2013.

[1] http://pointclouds.org/
[2] http://en.wikipedia.org/wiki/RANSAC

1.1 Prerequisites

Annotation tool requires the following prerequisites to be installed correctly:

1. **CMake 2.8.x or later**. Command to install: sudo apt-get install cmake
2. **QtCreator 2.4.1**. Command to install: sudo apt-get install qtcreator
3. **PCL 1.6.0**. Available from: http://www.pointclouds.org/downloads/
4. **VTK 5.8**. Command to install: sudo apt-get -b source vtk

1.2 Installation

To install the annotation tool execute the sequence of commands:

1. Enter the annotation_tool directory
2. mkdir build
3. cd build
4. cmake ..
5. make

The above commands build the annotation tool in the /bin directory. To run the application:

1. Enter the annotation_tool directory
2. cd bin
3. ./Annotation_tool

2 Interface

2.1 Main Window

The Annotation tool has this appearance:

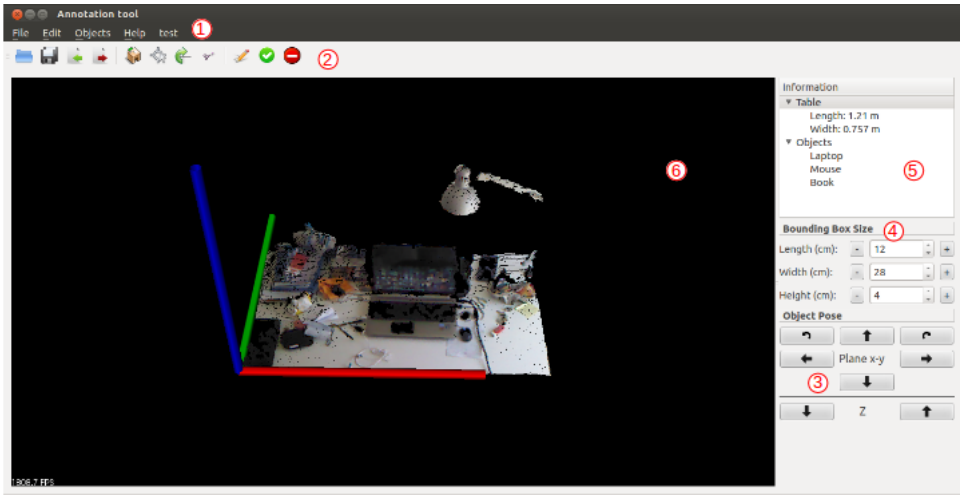

Figure 2: Main window

In the above figure we can see the following sections:

1. **Menu bar**. It has access to the functions grouped in File, Edit, Objects and Help.
2. **Toolbar**. Quick access to some functions.
3. **Pose interaction**. Modifies the pose of the bounding box during the object annotation.
4. **Bounding box dimensions**. Modifies the dimensions of the bounding box that defines the object.
5. **Desk information**. Gives information about all the objects annotated.
6. **3D visualizer**. Are to visualize the point cloud.

2.2 Desk Information

The desk information panel contains information about the table and all the objects annotated. When "Objects" is selected, all the objects are highlighted with different colors. Also a unique object is highlighted when is selected from the list of objects. In the figure below it is shown and example of showing all the objects annotated:

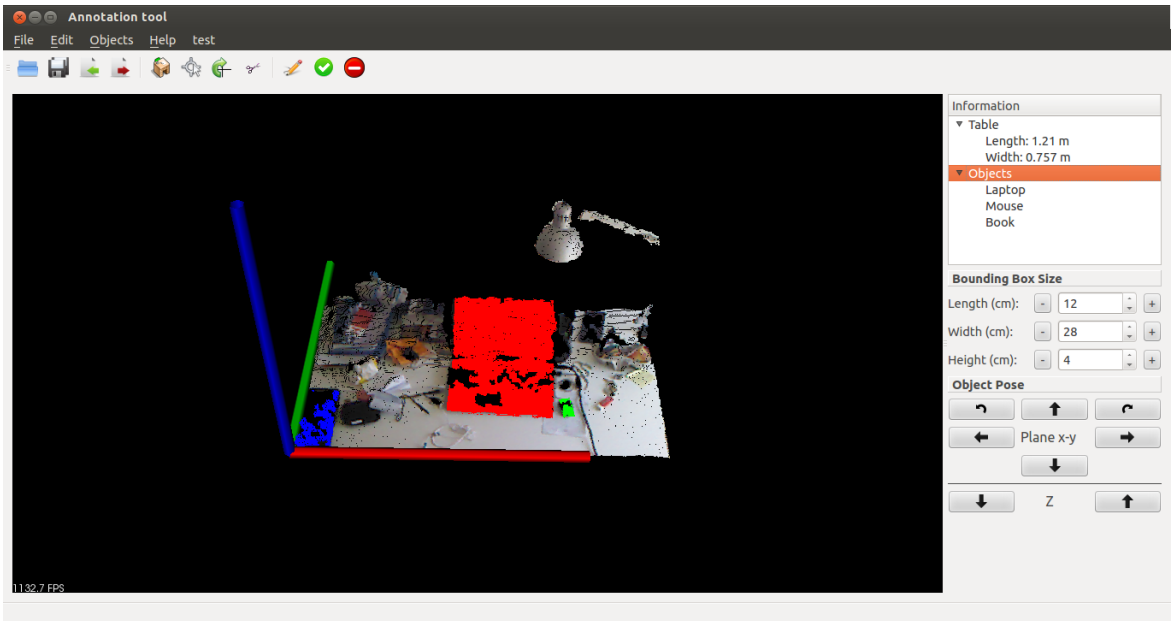

Figure 3: All objects highlighted in colors

2.3 Cloud Display

2.3.1 3D Visualization

The point cloud is displayed in the 3D visualizer. In the visualizer we have the point cloud loaded by the user, the coordinate system and fps information.

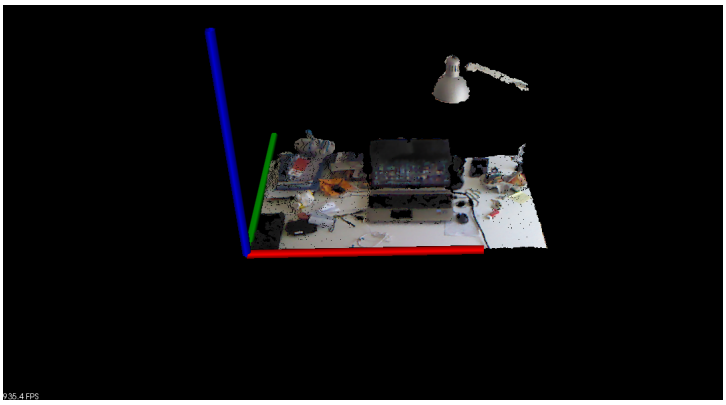

Figure 4: 3D visualizer

2.3.2 Interactivity

Using the mouse, it is possible to change the point of view. The next modifications can be done:

Rotation To rotate around the current center, hold the left button down.

Zoom Zoom in/out is done by scrolling the mouse.

Translate Holding down the scroll of the mouse to perform a translation of the point view.

Using the keyboard is it possible to interact with the visualizer, some are listed below:

Take snapshot Pressing j or J it is possible to take a .PNG snapshot of the current window view.

Display scale grid A scale grid is display on/off by pressing e or E.

Lookup table A lookup table is displayed by typing u or U.

Help If h is pressed all the keyboard interactions are shown given that above there are only some of them.

2.4 Toolbar

The buttons available in the toolbar are listed below:

Button	Command	Description
	Open	Section 3.1.1
	Save	Section 3.1.2
	Import	Section 3.1.3
	Export	Section 3.1.4
	Plane detection	Section 3.2.1
	Plane definition	Section 3.2.2
	Desk segmentation	Section 3.2.3
	Rotation	Section 3.2.4
	Insert object	Section 3.3.1
	Confirm object	Section 3.3.2
	Delete object	Section 3.3.3

3 Functions

3.1 File Menu

3.1.1 Open PCD file

To load a .pcd file the next dialog is open to select the desired file:

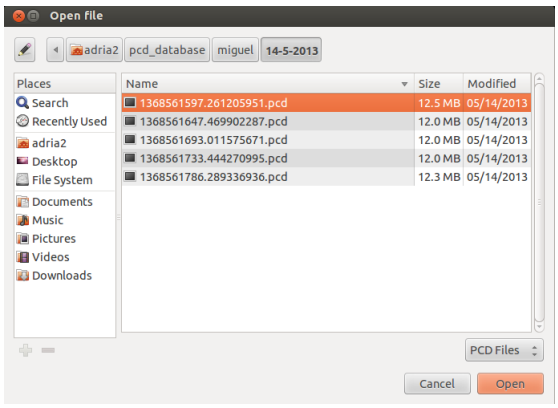

Figure 5: Load file

3.1.2 Save PCD file

Saves the current point cloud as new point cloud. This is useful after doing the desk segmentation.

3.1.3 Import objects information

If in a previous session the user has saved the object's information, this information can be loaded to avoid having to annotate the objects again.

3.1.4 Export objects information

Exporting the object's information save a .txt file with all the information about the annotated objects. At the beginning of the file is saved the information with the format:

Desk length: #length of the table
Desk width: #width of the table
Objects: #number of objects annotated

After the above information, for each object the information saved is:

Name: #name of the object
Pose_x: #x coordinate of the pose Pose_y: #y coordinate of the pose Pose_z: #z coordinate of the pose
Color: #color used to show the object

Length: #length of the bounding box
Width: #width of the bounding box
Height: #height of the bounding box
Angle: #angle between the front edge of the bounding box and the x axis
Points: #number of points of the object in the point cloud and all the indices of all points

3.2 Edit Menu

The software provide some different tools to modify the point cloud loaded such as plane detection, rotation and segmentation. The goal of all the modifications is to change the point cloud to get the coordinate origin in the lower left corner of the table and align the x-axis to the desk's front edge and the y-axis to the left edge of the table.

3.2.1 Automatic plane detection

When using the automatic plane detection the software perform a plane detection using the RANSAC model. Once the plane detection is done, the point cloud is rotated and translated to set the plane x-y equal to the desk plane.

3.2.2 Manual plane definition

Depending on the point cloud, sometimes the automatic plane detection cannot fits exactly the desk plane. In this case picking three points belonging on the plane, the plane is defined and as the automatic mode, the plane x-y is moved to the desk plane.

3.2.3 Rotate z 180

Sometimes, after having the correct plane, is needed to rotate the z-axis of the point cloud 180 degrees to get the correct position of the coordinate system.

3.2.4 Desk segmentation

Once the coordinate system is located in the location explained before. The desk segmentation is done by picking three points. This action remove all the points outside and under the table.

3.3 Objects Menu

The annotation of the objects is the most important feature of this software given that it was developed for that. The annotation tool allows the user to annotate the objects present in the scene. To define an object three parameters are defined: the object pose (from the lower-left corner), the dimensions of a bounding box and the angle between the x-axis and the front edge. The object pose refers to the lower-left corner of the front side of the bounding box.

3.3.1 Insert new object

When the user wants to insert an object, a first bounding box is insert by picking 4 points. The front side of the bounding box has been drawn in red and the points inside the bounding box are highlight. To fit all the points belonging to the object the bounding box can be modify in three different ways:

1. **Translation**. The coordinates of the object pose can be change in each component (x,y,z).
2. **Rotation**. It is possible to change the rotation of the bounding box.
3. **Dimensions**. The width, height and depth of the bounding box can be modify.

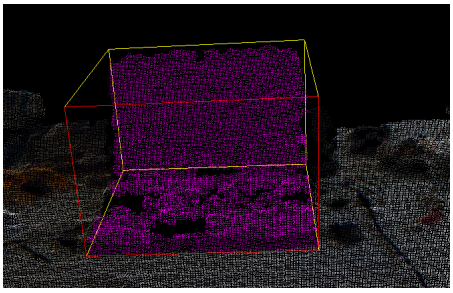

Figure 6: Insert object

3.3.2 Confirm position

Once all the points of the object are inside the bounding box is the time to confirm the position. Then, all the information related with the object is saved.

3.3.3 Delete object

If the user want to delete some of the objects introduced before it is possible to delete it giving the name of the object.

4 Develop

To develop the code and the appearance of the application open the .pro file with the QtCreator. The widget used to visualize the point cloud is the QVTK-Widget. To use the QVTKWidget in the QtCreator gui is needed to copy the file libQVTKWidgetPlugin.so (generated with the VTK installation) and place a copy of this in [QTinstallDir]/plugins/designer/ director.