LiveScan3D manual (a work in progress)

LiveScan3D is a system designed for real time 3D reconstruction using multiple Kinect v2 depth sensors simultaneously at real time speed. The produced 3D reconstruction is in the form of a coloured point cloud, with points from all of the Kinects placed in the same coordinate system. Possible use scenarios of the system include:

- capturing an object's 3D structure from multiple viewpoints simultaneously - Figure 1,
- capturing "panoramic" 3D structure of a scene – Figure 2,
- increasing the density of a point cloud captured by a single sensor, by having multiple sensors capture the same scene.

At the moment connecting multiple Kinect v2 devices to a single computer is difficult and only possible under Linux. Also, the number of the devices or capture speed might be low, because of the limitations of the PCI-E bus.

Because of those limitations, in our system each Kinect v2 sensor is connected to a separate computer. Each of those computers is connected to a server which governs all of the sensors. The server allows the user to perform calibration, filtering, synchronized frame capture, and to visualize the acquired point cloud live.

Figure 1: A setup for capturing an object from multiple viewpoints.

Figure 2: A setup for capturing a panoramic 3D reconstruction.

Step by step configuration (Tutorial 1)

In this tutorial we describe step by step how to configure and run LiveScan3D with Kinect v2 sensors in a scenario where all Kinects are able to see a single calibration marker. In order to start you will need to:

- have at least one Kinect v2 sensor,
- download LiveScan3D from http://ztv.ire.pw.edu.pl/mkowalski/ where it is available as a compiled binary and source code,
- download and install the Kinect for Windows SDK 2.0 on each machine you intend to use as a client,
- have all of the computers you will use in the same network,

- print the calibration pattern "calibration0.jpg" on a piece of paper (A4 size should be enough).

Once you have all of the preliminary steps completed, run the LiveScanClient application on each of your client computers. If everything is working fine, you should see the RGB camera stream of your Kinect inside the application window.

Next, choose a computer that will act as a server (this computer may also be a client at the same time), we recommend that it is the most powerful of the available machines. Run the LiveScanServer on the chosen machine and click "Start server" to begin listening for client connections. Connect each of the clients to the server. If the client is running on the same machine as the server, there is no need for an IP address.

At this point your server window should show some clients connected. You can press "show live" to see the output from the sensors. Here you will notice two things, first of all the point clouds from different devices are not aligned, second of all the frame rate might be low. The first problem arises, because the clients are not "calibrated". By calibration here I mean "knowing the location of the Kinect sensor in the scene". As for the low FPS in the live view window, please read the section of the manual about this window.

In order to calibrate the clients you need the printed calibration pattern. Once printed, attach it to something rigid and place it in a position where it is visible to all sensors. Note that the calibration pattern (marker) must be visible to the sensor's depth and color stream, you can check if it is by pressing "show depth" in the client window.

Now there is only one last thing you need to do, which is to make sure that the server knows which marker you want to use. In order to make sure that is the case go to settings and make sure that under "calibration markers" you have a maker with id 0. Now all you have to do is press calibrate and the data from you Kinects should align. You can check if that is the case in the live view window.

If there is a demand I will keep extending this manual to different scenarios such as "what if I want to place may Kinects in a configuration where not every sensor can see that one single marker".
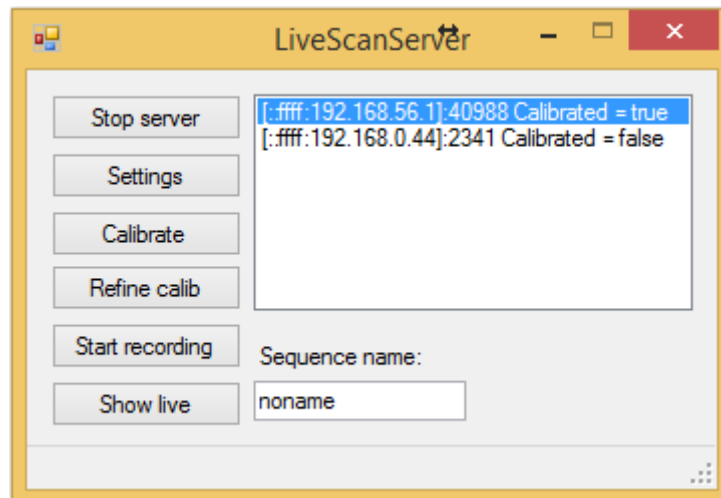
LiveScanServer

Main window

Figure 3: The main window of the server application. It shows two clients connected, one of which is calibrated.
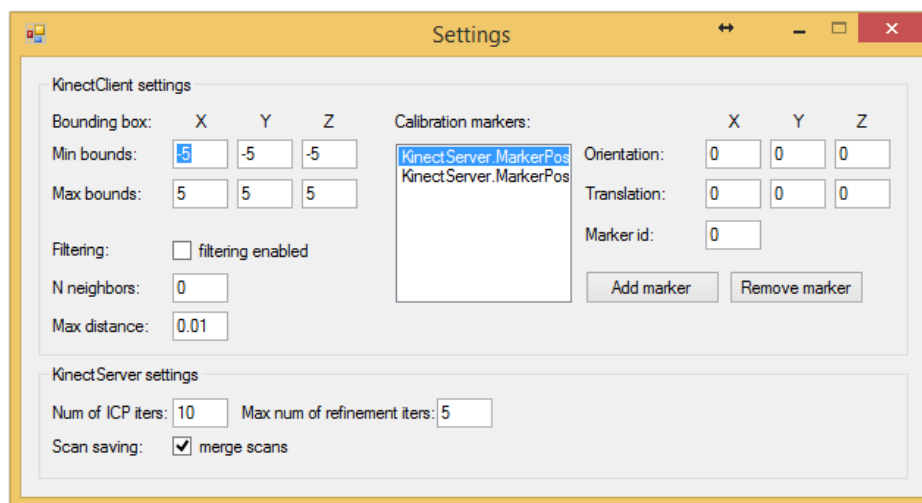
Expect more details here soon.

Setting window

Figure 4: The settings window of the server application. Two markers are defined.

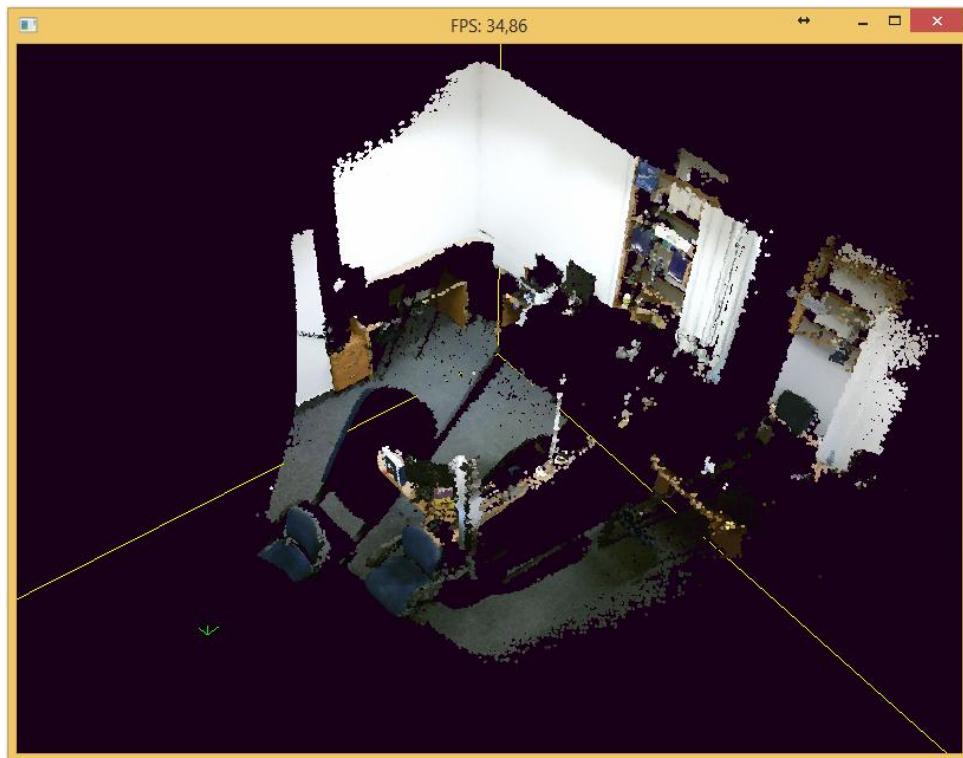Expect more details here soon.

Live view window

Figure 5: The live view window, the number of frames per second (FPS) is visible in the window's title.

This window show the reconstructed point cloud from all of the sensors. The frame rate here depends greatly on the speed of you network and on the number of devices you are using. In the future (hopefully near future), we plan to work on reducing the size of the point clouds, which should increase the FPS.

Remember than even when there are only a few frames per second in this window, the frame rate should be high if you record the frames (using the "Start recording" button in LiveScanServer).

There is a number of ways to move around the reconstructed point cloud in this window:

- Left mouse button – lets you rotate the point cloud,
- Right mouse button – lets you move the camera,
- Mouse wheel – zoom in/zoom out,
- W, S, A, D keys – let you move the camera around like in an FPS game,
- +, - keys – change the size of the points.