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1. Installation and mouting

1.1. Installation

For clarity of assembly all the basic elements can be assembled on the floor, then fix the elements on the ceiling step by step. In the beginning, you will need to fix the projector. The size of the image on the wall should not exceed 5 meters in width (the recommended maximum image size is 5x3.1 meters).

Important: To place the interactive sensor, there must be at least 10 centimeters of free space between the upper edge of the image and the ceiling (or another structural element).

Before mounting the projector on the ceiling, it is possible to turn on the projector below on the floor to match the projection dimensions. It should then be mirrored on the ceiling. The top edge of the projection will align with the center of the projector lens. (Pic. 1). The ceiling mount adjustment allows you to adjust the height of the projector from 35 to 46 centimeters.

If the height of the room is much higher and does not allow you to mount the projector at the desired height, you must use an amount with a larger pitch, or "increase" the central part of the mounting rod with a pipe of a similar diameter.
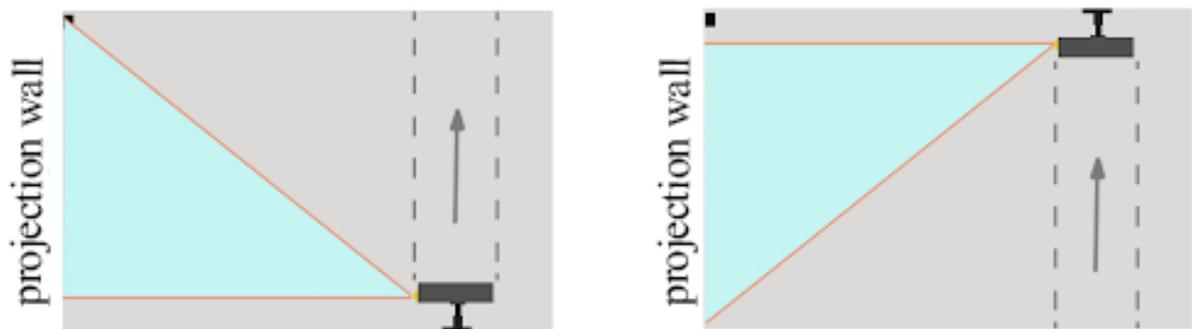
Pic. 1 Preparing to mount the projector

Once the projector is installed, you can install the system unit. You can place the computer anywhere you like, as long as the USB and HDMI cables are long enough to connect the interactive sensor and the projector, so we recommend that you place the computer on the ceiling or wall near the projector (Pic. 2). After installing the computer, you can proceed to mount the sensor. A detailed description of how to connect, place and configure the sensor is described in paragraph **1.2 Mounting the sensor**
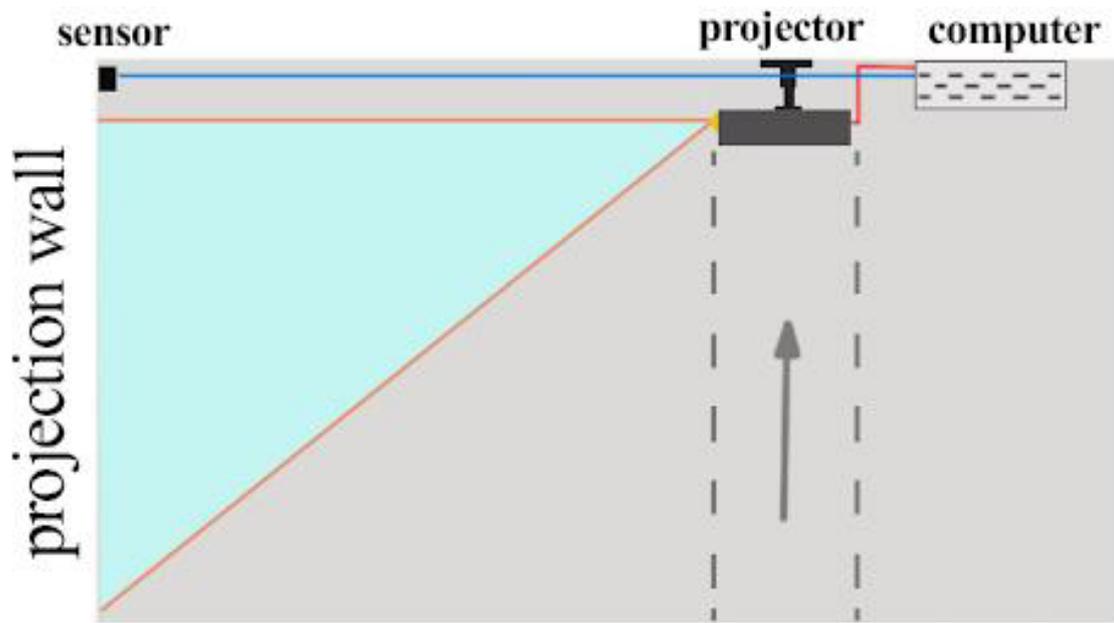
Pic. 2 Example of a computer location

1.2. Mounting the sensor

The sensor is equipped with the following components (Pic. 3):

RPLIDAR A2M7 model sensor;

USB adapter for connection to the sensor (connected in the factory);

Micro-USB cable to connect the USB adapter to the computer;

Auxiliary power cable (plus power adapter);

USB extension cord for easy connection of the sensor to a computer
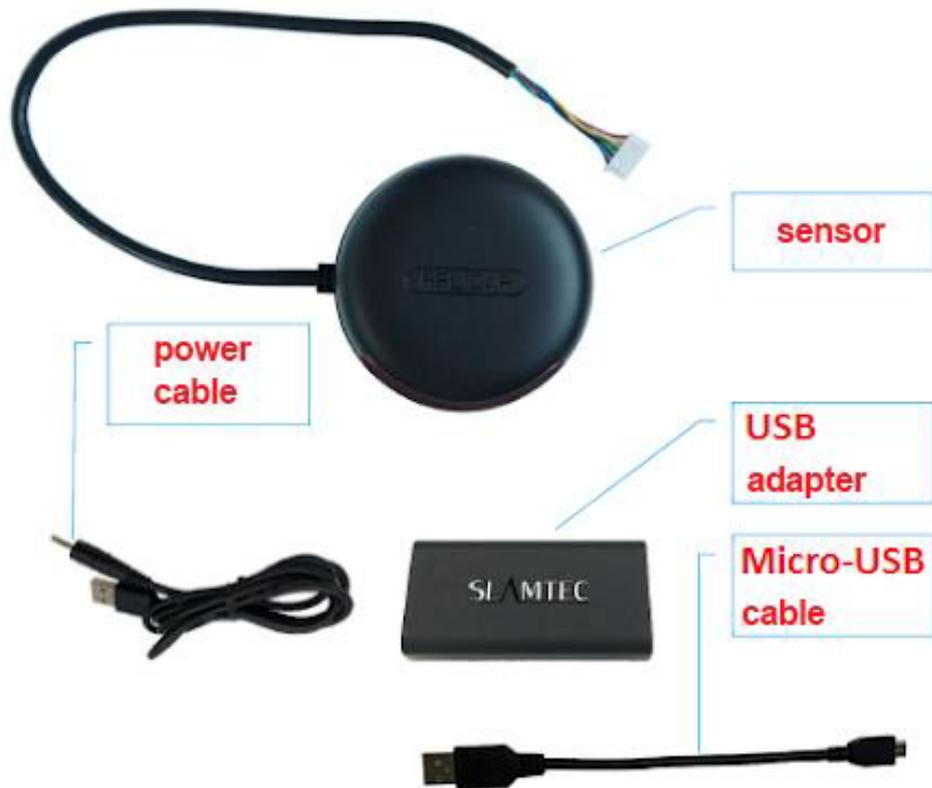
Pic. 3 Sensor kit

Important: Before connecting to a computer, make sure that the connection speed selection on the USB adapter is set to 256,000 (Pic. 4).


Pic. 4 Selecting the speed of the USB adapter

The general circuit of switching with a USB adapter is shown in Pic. 5. The USB adapter is connected to the computer using a Micro-USB cable and a USB extender.


Pic. 5 Switching diagram with USB adapter

Important! When using a USB extension cord longer than 5 meters, it is necessary to additionally power the USB adapter using an additional power cable, which is connected to the 220V network using a power adapter. The characteristics of the power adapter are 5 V and not less than 1.5 A. (Pic. 5).

The sensor is mounted in two options - in the middle at the top or at the bottom of the projection (Pic. 6). It is recommended to mount the sensor above the upper edge of the projection (or below the lower edge, respectively).
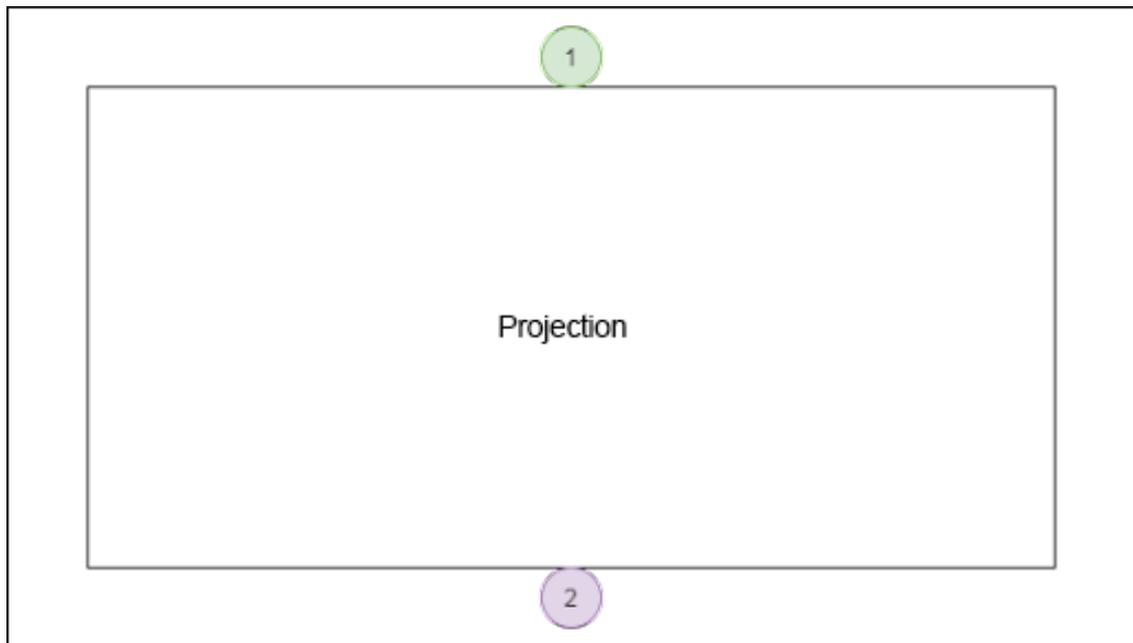
Pic. 6 Options for mounting the sensor on a surface with projection

When mounting it is necessary to leave a gap between the mounting surface and the sensor support to avoid "sharing" of the point registration line due to possible curvature of the mounting surface (see paragraph **1.3 Checking the correct installation of the sensor** (Pic. 7). The point registration line of the sensor is at the level of the technological optical windows of the rotating part of the sensor. If protective housing is supplied with the sensor, this requirement will be met when mounting the housing on the surface.
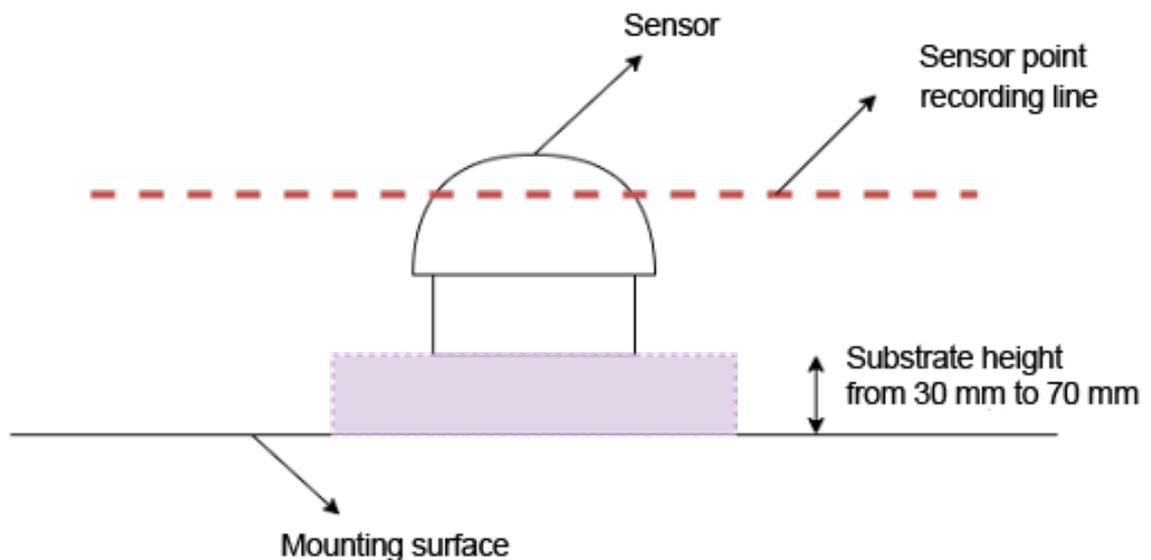

Pic. 7 Recommendation for installing a backing under the sensor support

1.3. Checking the correct installation of the sensor

When mounting the sensor, it is necessary to check several conditions and, if necessary, adjust the installation.

The sensor must "see" all four corners of the projection - each touch to one of the four corners of the projection must be registered as a set of points at the corresponding location on the "terrain map". The process of checking the visibility of the projection angles is described in paragraph **2.2.4 Calibrate the sensor relative to the projection position**. If the projection angle location does not register points from touching the projection, then there is a "blind spot" of the sensor, which may occur due to a number of the following reasons:

1. The sensor is not installed parallel to the projection surface (wall/floor) (Pic. 8), or the surface is not flat - it is not a plane, it is "curved" and "protrudes" beyond the registration line of the sensor points (Pic. 9). In this case, the registration line of the sensor points will be "cut off" up to the location of the projection edges (Pic. 10).
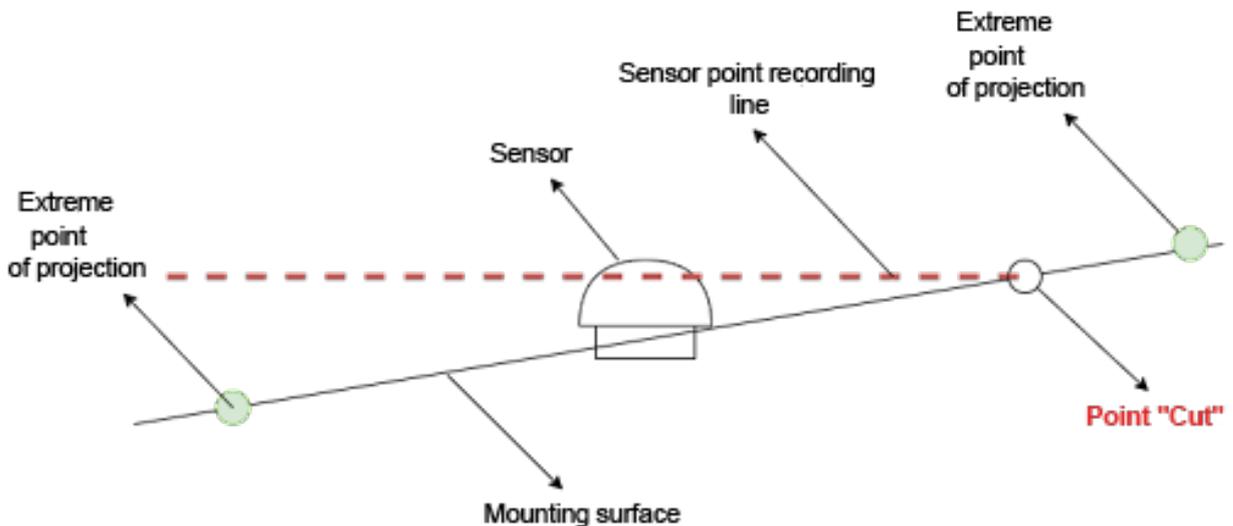
Pic. 8 Schematic to demonstrate the problem of non-parallel installation of the sensor
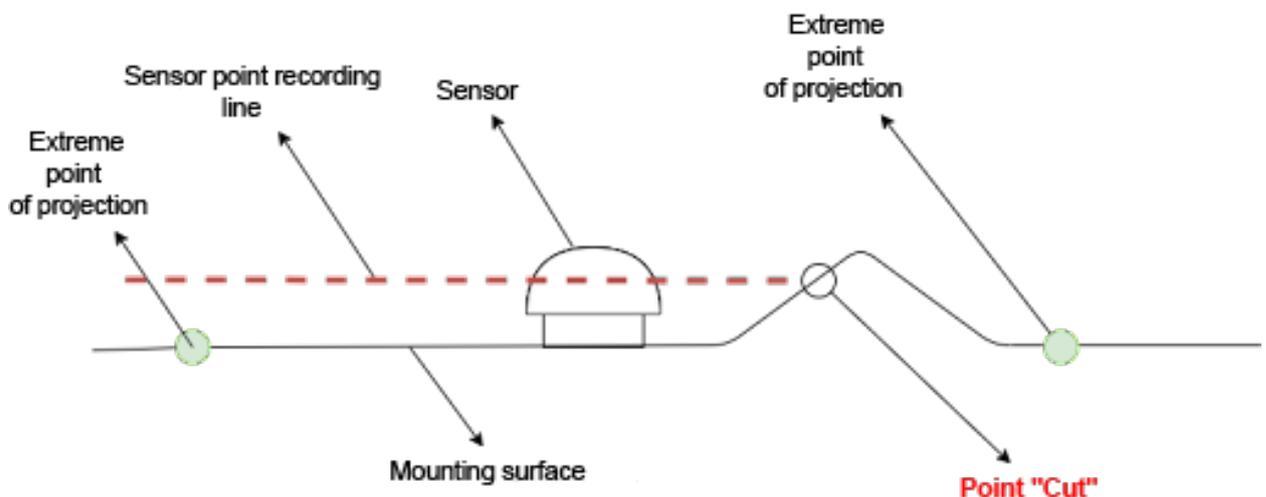
Pic. 9 Schematic demonstration of the curved mounting surface problem
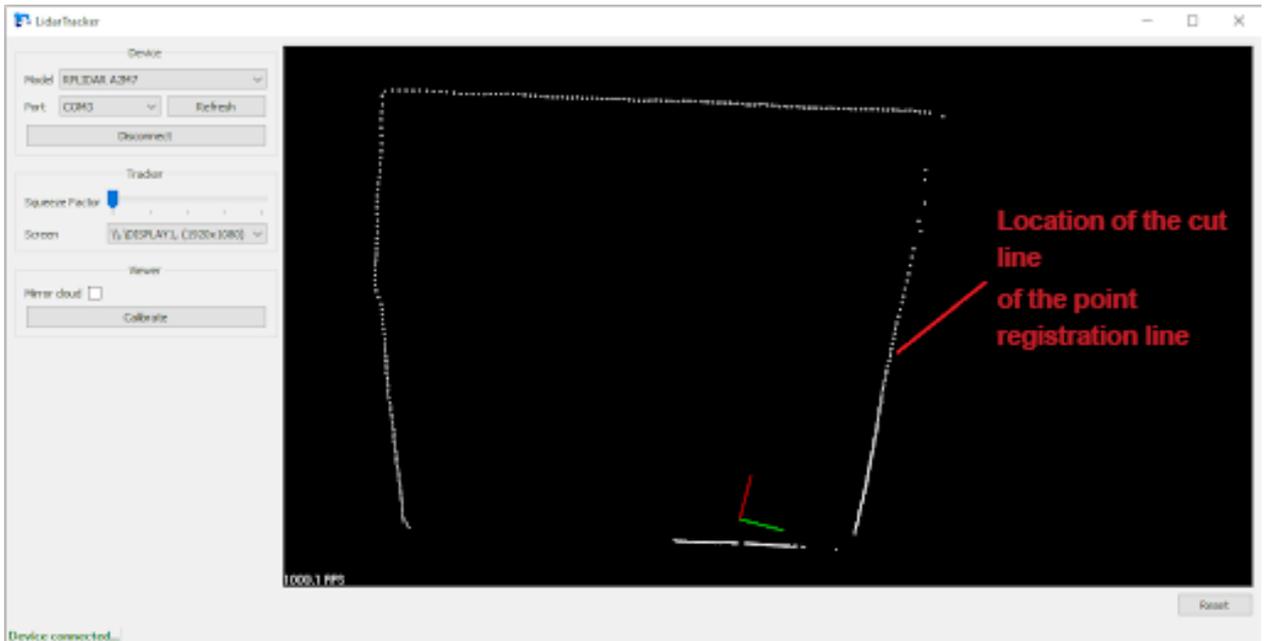
Pic. 10 Illustration of the "cut" problem on the "terrain map"

This defect can be eliminated by aligning the sensor parallel to the projection plane, or by raising it higher from the projection plane, in case the plane is curved so that the sensor point registration line becomes higher than the irregularities of the mounting plane.

2. Foreign objects are blocking the sensor's view of the corners (possibly the sensor's protective housing itself, which may come with it). In this case, it is worth removing foreign objects and finding a position for the sensor where nothing will prevent it from registering the locations of all four corners of the projection on the "terrain map".

2. Configuring the software

2.1. Description of the software package

The system is a set of two programs:

 LidarTracker – a means of recognizing human interaction with the projection;

 InteractiveLauncher – game menu for end user (check the end user guide in our website).

On the desktop of your computer, there are corresponding shortcuts to launch programs.

2.2. Configuring the Projection Interaction Tool

2.2.1. Starting the program

Start the program **LidarTracker** by double-clicking the left mouse button on the program shortcut on the desktop.

The program starts and runs in the background. The program icon is displayed in the system tray (Pic. 11).


Pic. 11 Displaying the LidarTracker icon in the system tray

To display the main program window, left-click on the program icon in the tray or use the context menu to select the **Open** (Pic. 12).

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Pic. 12 LidarTracker context menu

The main program window is shown in Pic. 13.
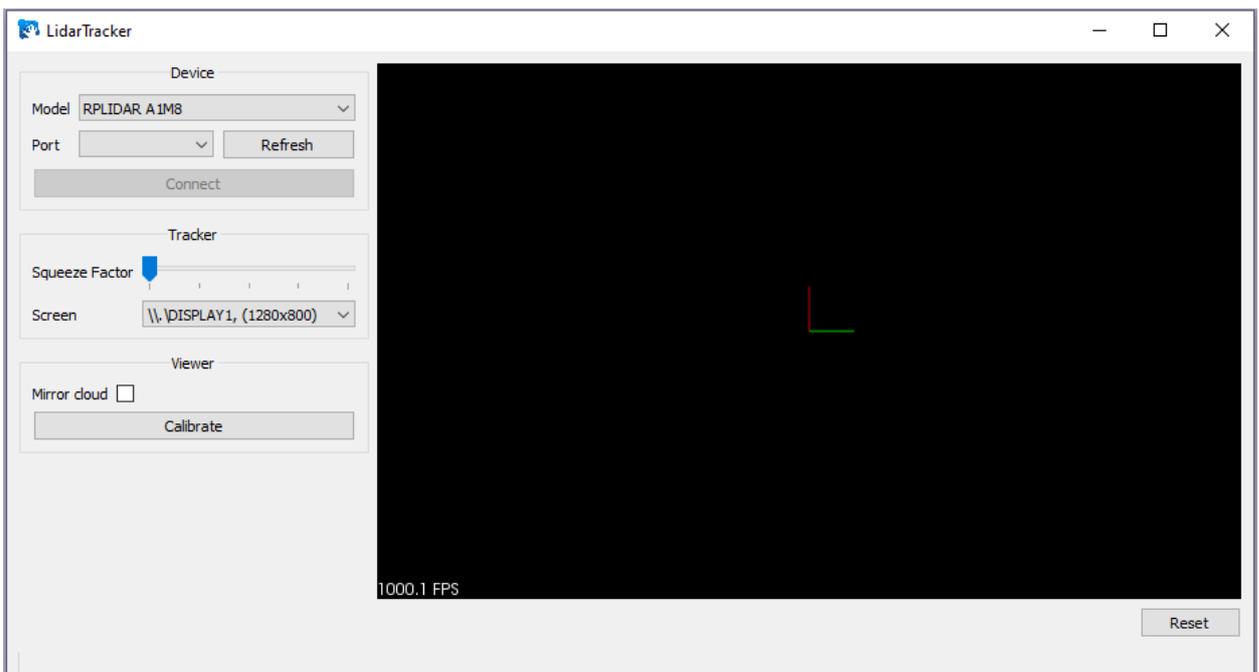
Pic. 13 Main window of the program

2.2.2. Setting up the pairing of the sensor with the program

Connect the laser sensor to the computer and press [Refresh] that updates the list of connected sensors. The **Port** field should display the name of the port that will be used to pair with the sensor, button [Connect] should become active (Pic. 14). Otherwise, check if the sensor is correctly connected to the computer and press repeatedly [Refresh].
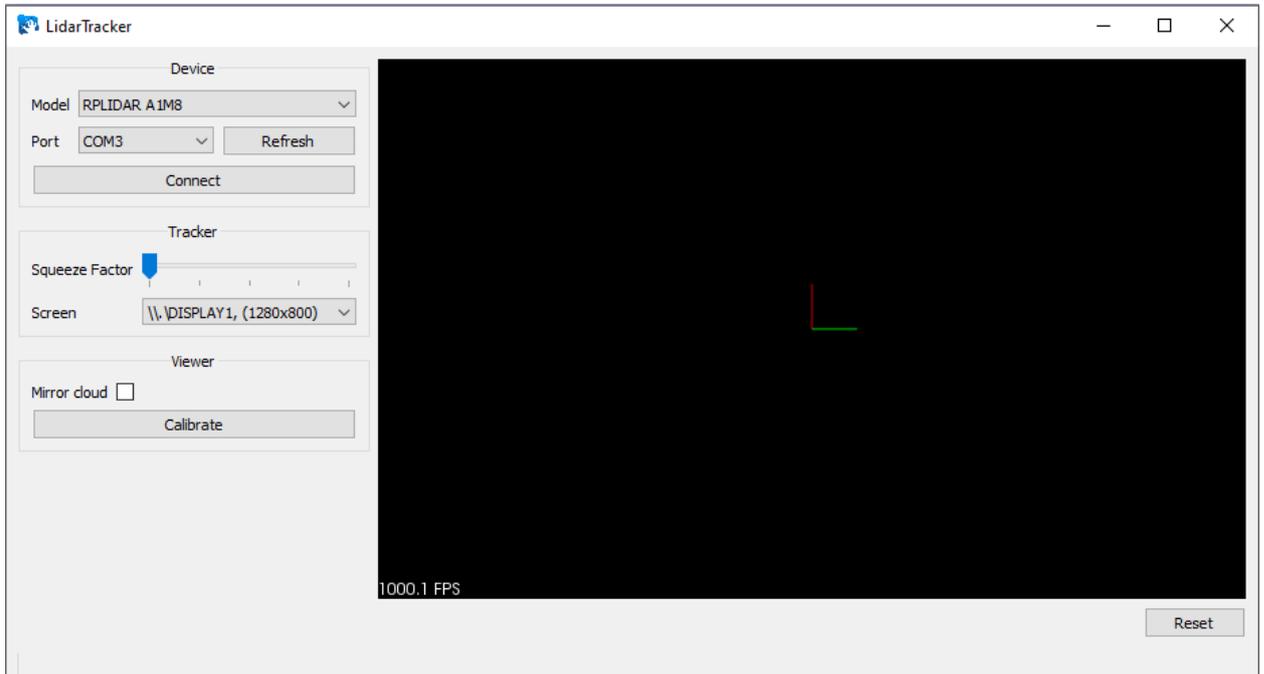
Pic. 14 Program readiness for pairing with the sensor

Select the sensor model from the **Model** list. To pair the program with the sensor, click

[Connect]. Starts to establish communication with the sensor, the

button [Connect] becomes inactive until the pairing process is completed. When the process is complete, you will see «Device connected…» in the program status bar and the display of the "point cloud" from the sensor (Pic. 15).
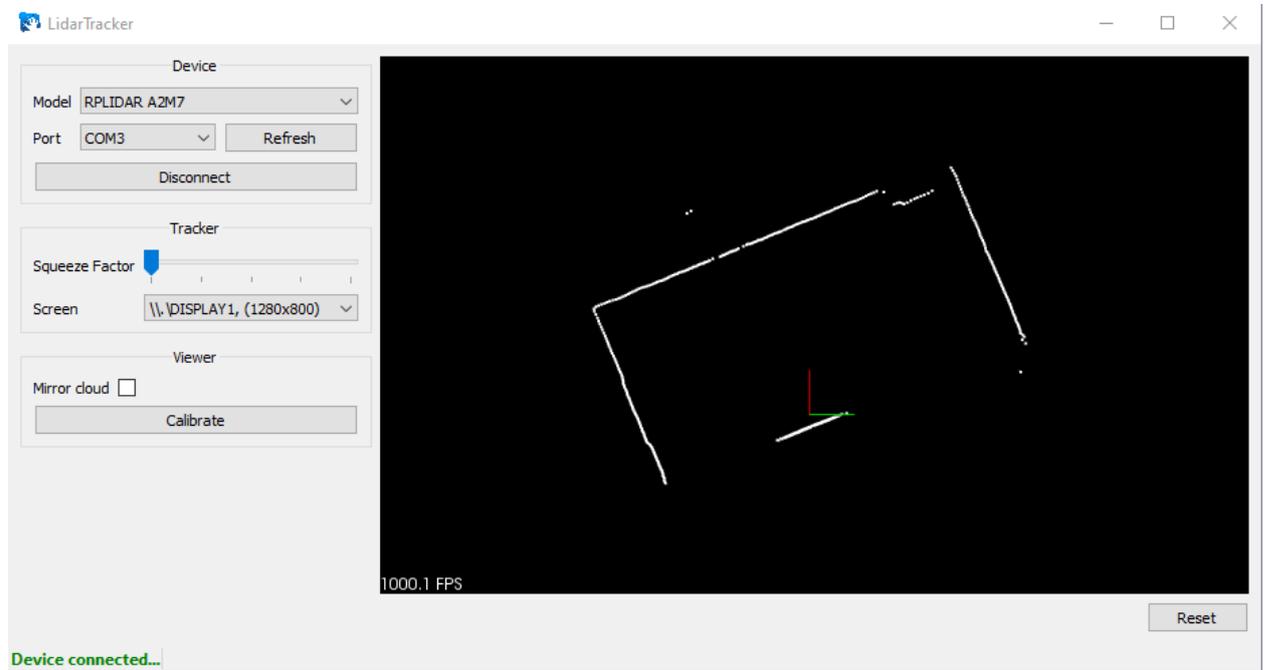
Pic. 15 Result of successful connection of the program to the sensor

If unsuccessful, in the status bar you will see «Connection error…» . Check if the sensor is correctly connected to the computer and conforms to the installation recommendations (see paragraph **1.2 Mounting the sensor**).

If you see «Device communication error…» in the status bar when the program is running, it means that an error has occurred in the communication process between the program and the sensor or an error in the sensor itself. It is necessary to check the integrity of the physical connection between the sensor and the computer, break the current connection by pressing [Disconnect] and re-initiate the pairing with the sensor by pressing [Connect].
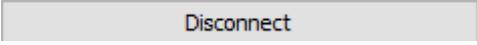
12
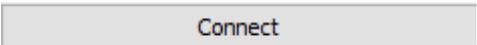
2.2.3. Setting the type of data displayed from the sensor

The sensor captures a "terrain map" - a set of points in the sensor installation plane, where each point is characterized by its distance from the sensor. More formally, this set is called a "point cloud". By processing the point cloud from the sensor, the program highlights the necessary objects on the two-dimensional "terrain map", namely any human interaction with the projection (touching the projection with hands, feet, other objects).

In Pic. 15 the location of the sensor is represented as an image of the coordinate axes , and the objects being registered - a cloud of points, in the form of white dots (Pic. 15, Pic. 17).
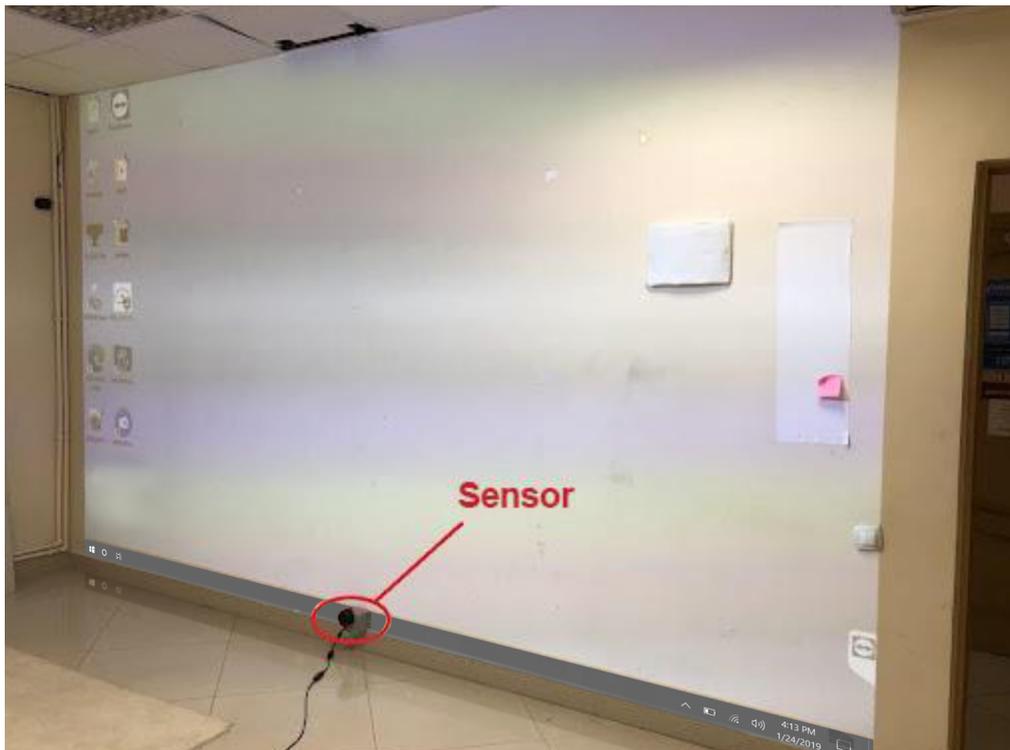
Pic. 16 Example of mounting the sensor on the wall
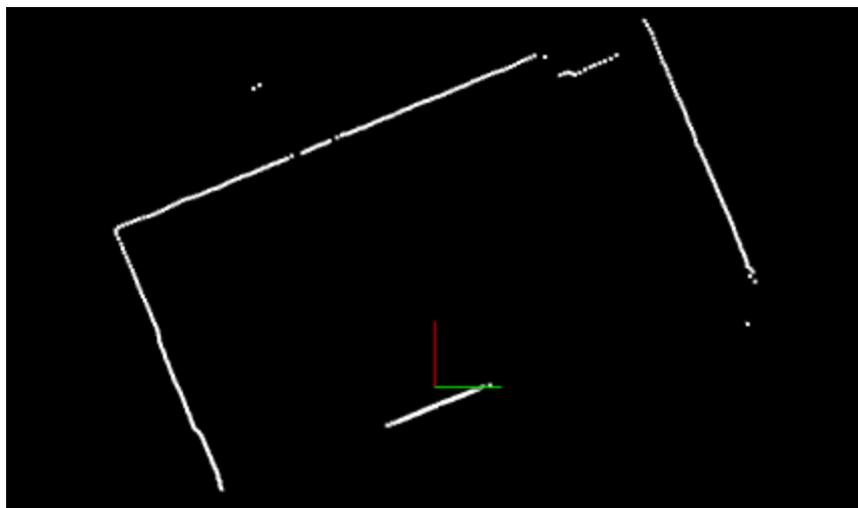
Pic. 17 Displaying data from the sensor (point cloud)

Pic. 17 shows a "terrain map" corresponding to the sensor installation in Pic. 16. Each white dot represents a part of some real object in space - for example, the upper white line represents a part of the ceiling, the lines on the sides represent the side walls perpendicular to the wall with the projection, the line below represents a part of the floor (Pic. 17).

For the convenience of working with the point cloud, it should be aligned with the projection position in space. In Pic. 17 we see that the point cloud is rotated relative to the real position of the projection in Pic. 16 (it is possible to draw an analogy with the "horizon tilting" which should be eliminated).

There are the following methods for navigating a point cloud:

> By moving the mouse with the left button held down, you can move the center of the window relative to the point cloud;

> You can use a scroll to change the scale of the point cloud display;

> Holding down the **Ctrl** key and the left mouse button you can rotate the point cloud with the mouse

To restore the point cloud visibility in case the point cloud is hidden during navigation, press .
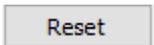
Important: If the sensor is installed so that it is rotated to the projection surface, you should check the checkbox **, otherwise the point cloud will be displayed mirrored concerning the projection position.**
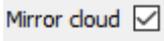
To align the point cloud with the projection position, you need to rotate the point cloud so that

the red coordinate axis is directed relative to the position of the probe in the sample in Pic. 18 or Pic. 19.
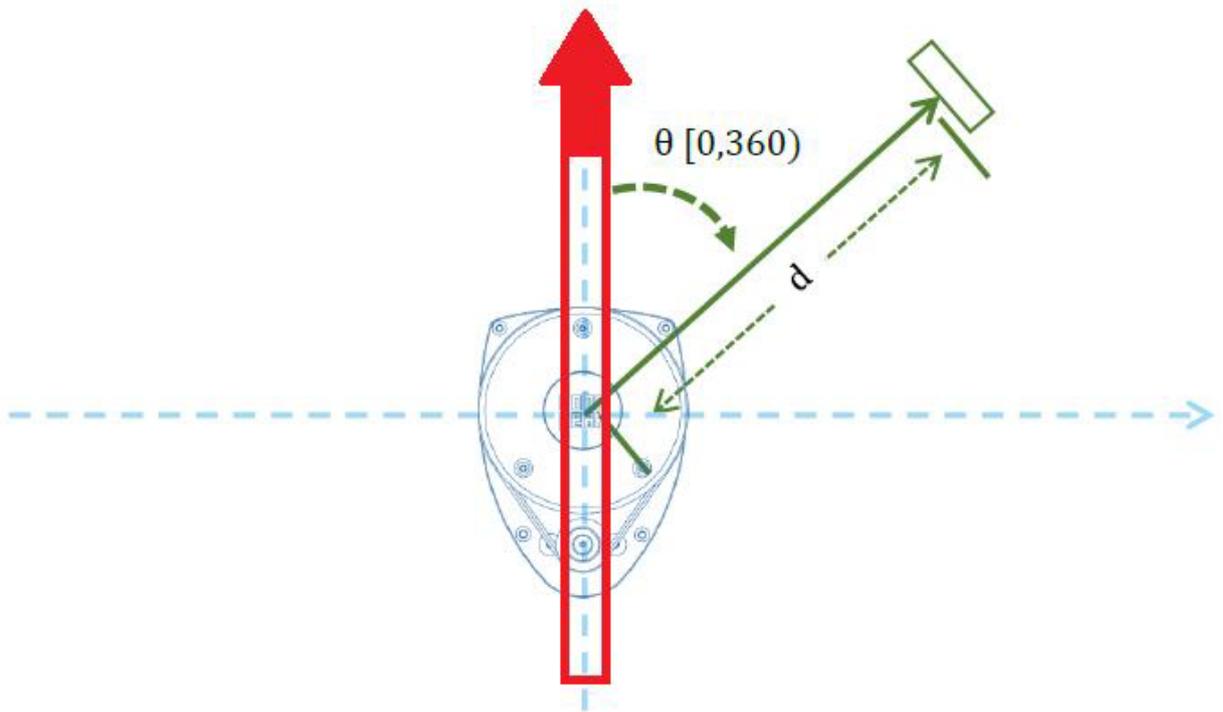
Pic. 18 Reference axis direction for the RPLIDAR A1 sensor family
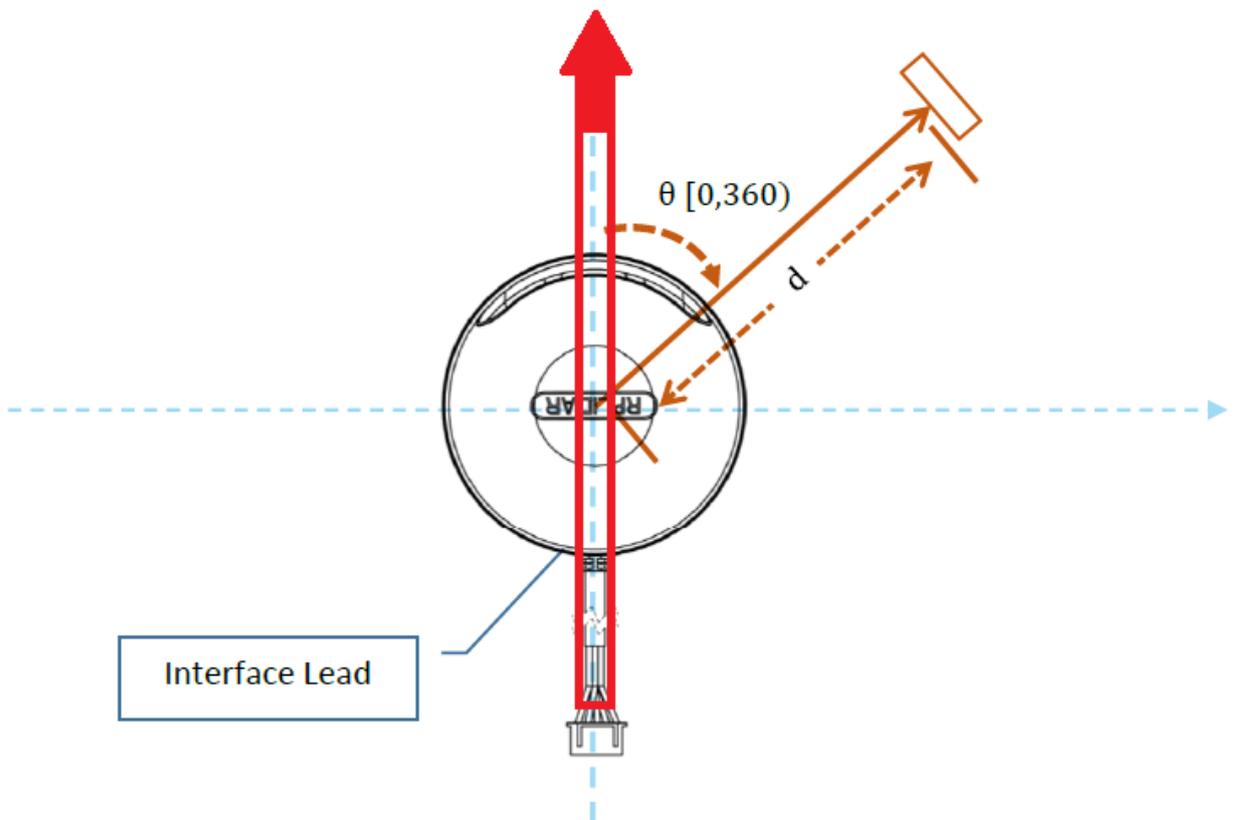
Pic. 19 Reference axis direction for the RPLIDAR A2 sensor family

Pic. 16 shows an example of sensor installation.

Pic. 20 Determining the direction of the sensor reference axis

The corresponding rotation of the point cloud is shown in Pic. 21.
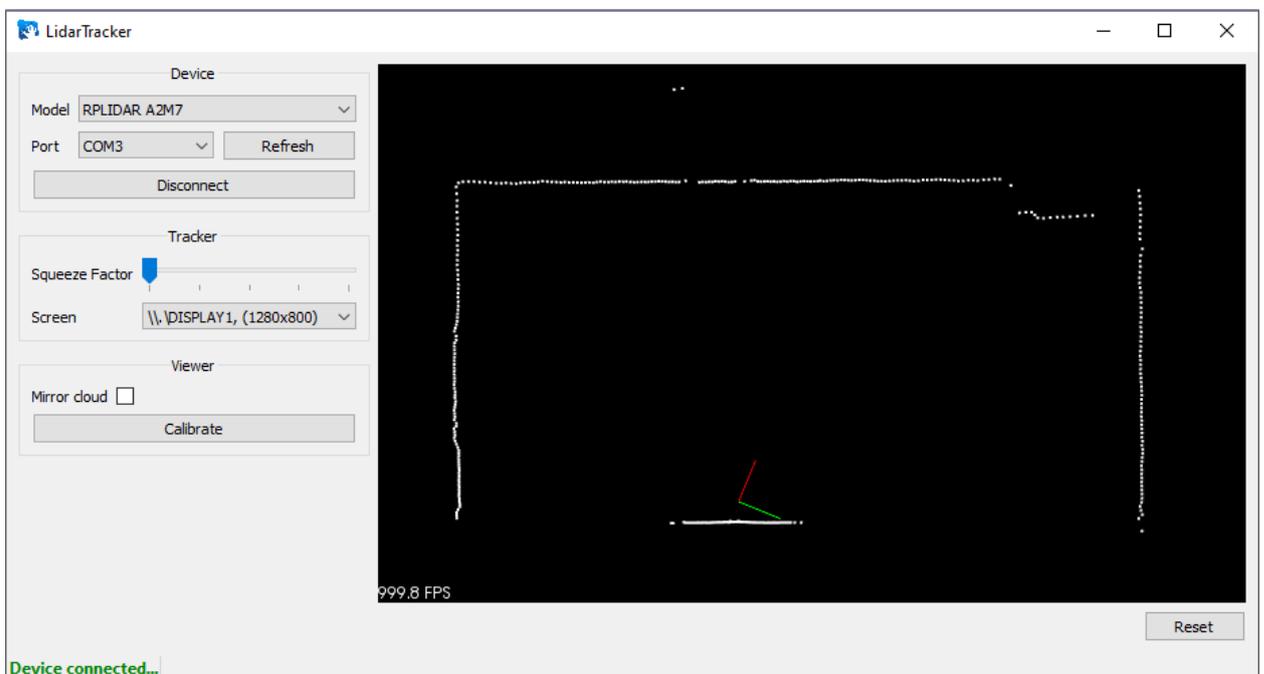
Pic. 21 Aligning the point cloud with the sensor mounting option

You can see that in Pic. 20 and Pic. 21 the directions of the red axes coincide, and the point cloud is aligned with the projection. When mounting the sensor on top of the projection, you may need to rotate the point cloud 180 degrees - if the sensor "looks down" (the reference axis of the sensor is directed downward).

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2.2.4. Calibrate the sensor relative to the projection position

The task of the calibration step is to tell the program where the projection is located on the "terrain map" recorded by the sensor.

When the hand or other object touches the projection, the sensor determines the place of contact as a set of points (Pic. 22, Pic. 23)
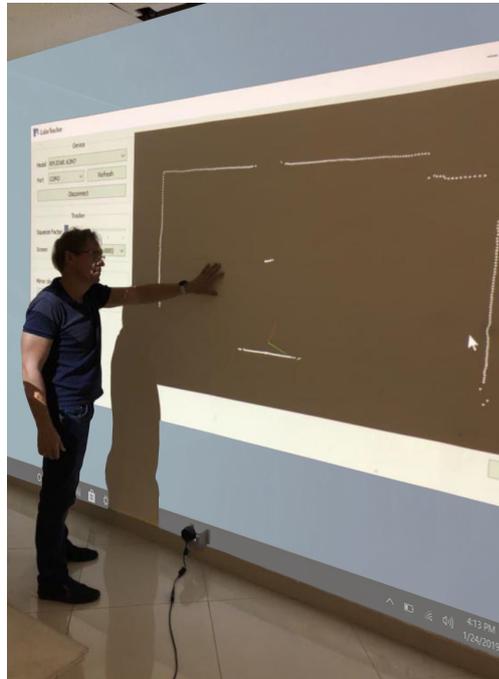
Pic. 22 Example of interaction with a projection
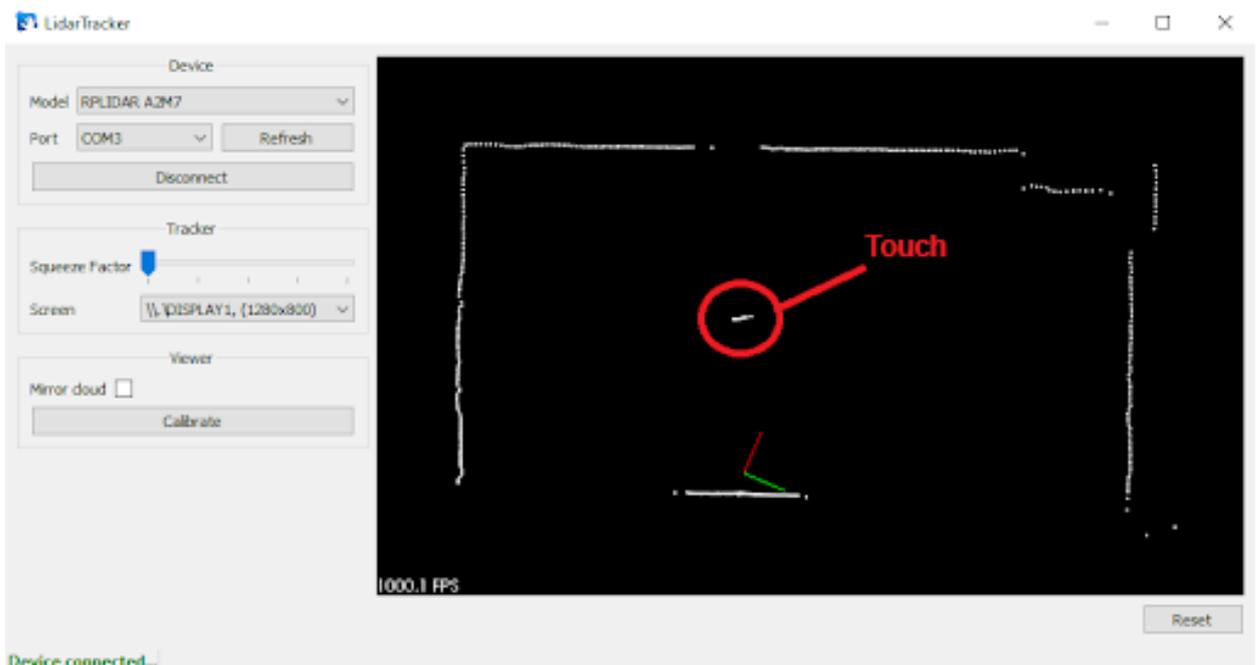
Pic. 23 Definition of a touch by a probe as a set of points

Thus, by touching the four corners of the projection you can tell the program its location on the "terrain map" recorded by the sensor.

Press [Calibrate] to start the calibration process.

Tap the upper left corner of the projection (Pic. 24).
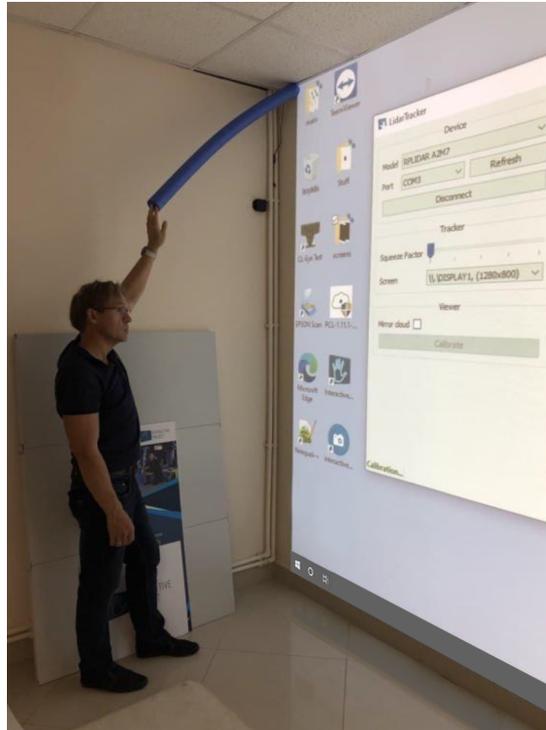
Pic. 24 Touching the upper left corner of the projection

In the program, the touch will be displayed as a set of points at the corresponding location (Pic. 25).
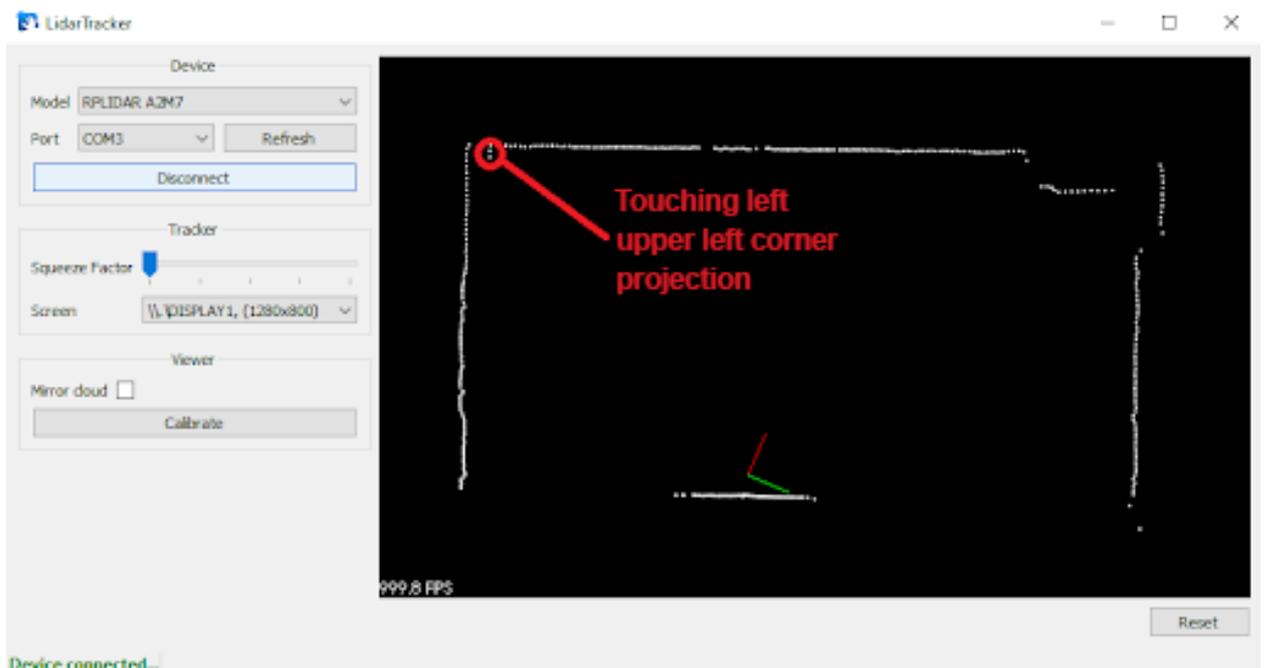
Pic. 25 The set of points corresponding to the top left corner touching

It is necessary to put the mouse cursor on the set of points corresponding to the touching and mark the place of touching by double-clicking the left mouse button. The marked place will be displayed as a red square, which will be the position of the upper left corner of the projection (Pic. 26).
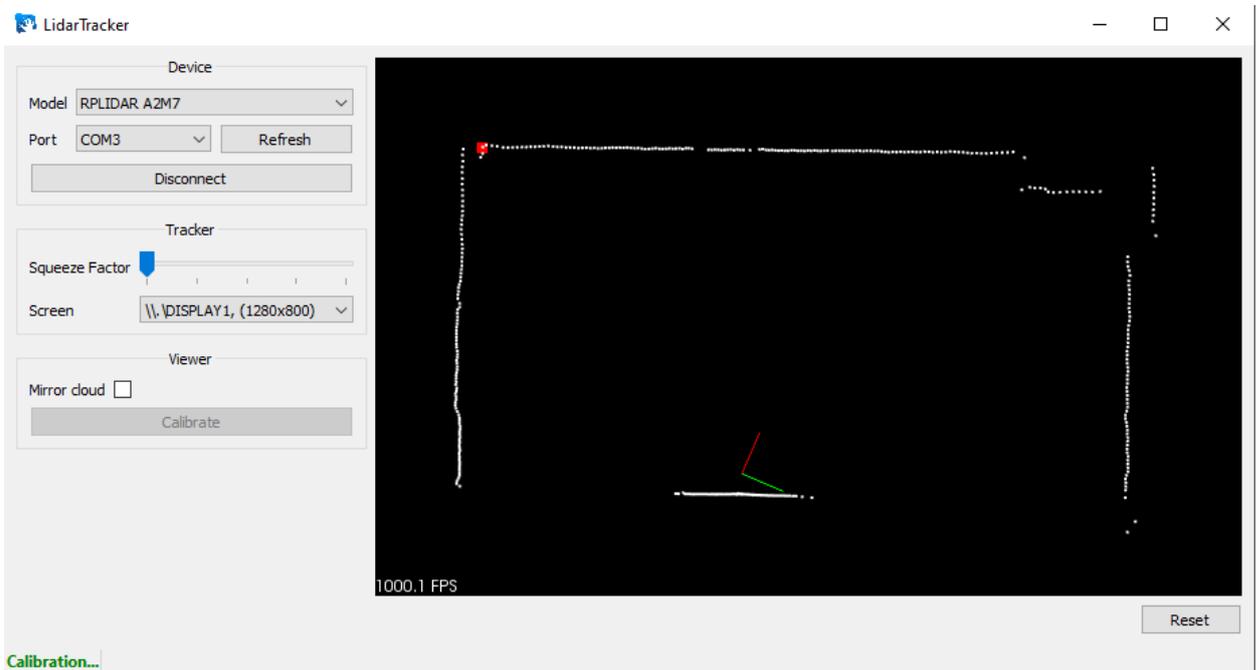
**Pic. 26 Setting the upper left corner of the projection**

The more precisely the position of the projection corners is specified, the more accurately the interactive system will react to touches - otherwise, there may be response drifts when processing touches to the projection. Then the upper right (Pic. 27, Pic. 28), lower left (Pic. 29, Pic. 30), and lower right (Pic. 31, Pic. 32) projection angles are set in a similar way (**order is important!**).

Pic. 27 Touching the upper right corner of the projection
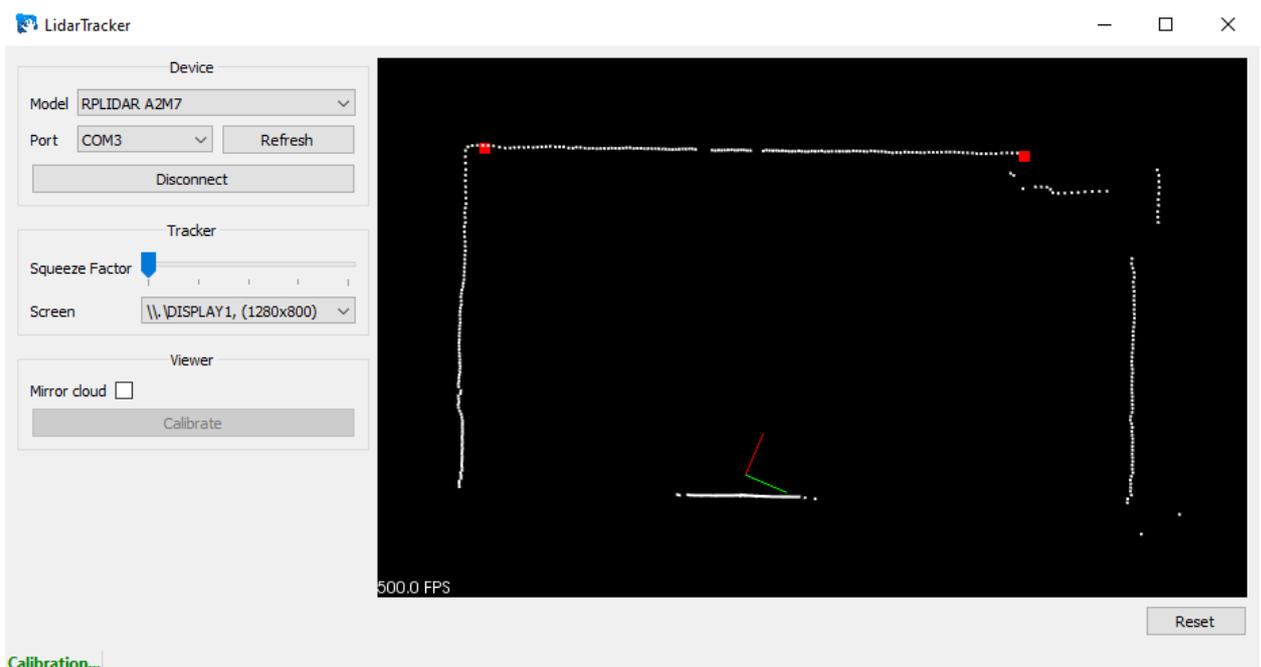
Pic. 28 Setting the upper right corner of the projection
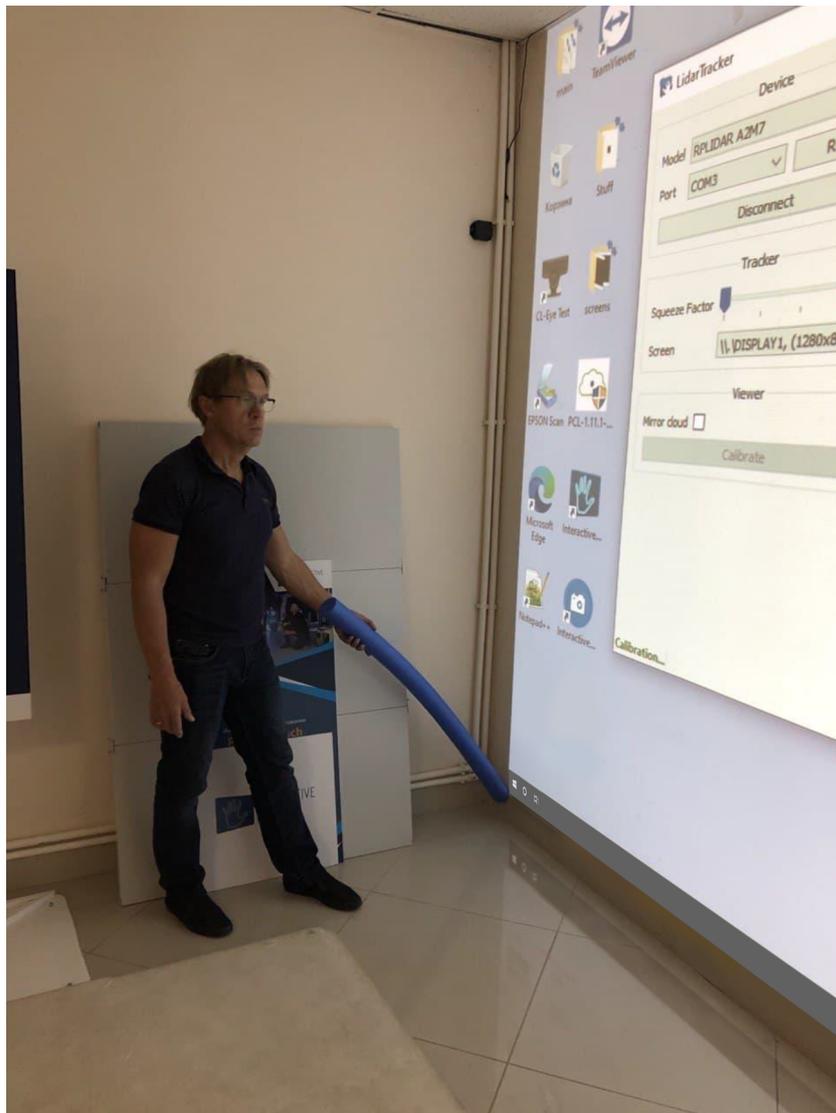
Pic. 29 Touching the lower left corner of the projection
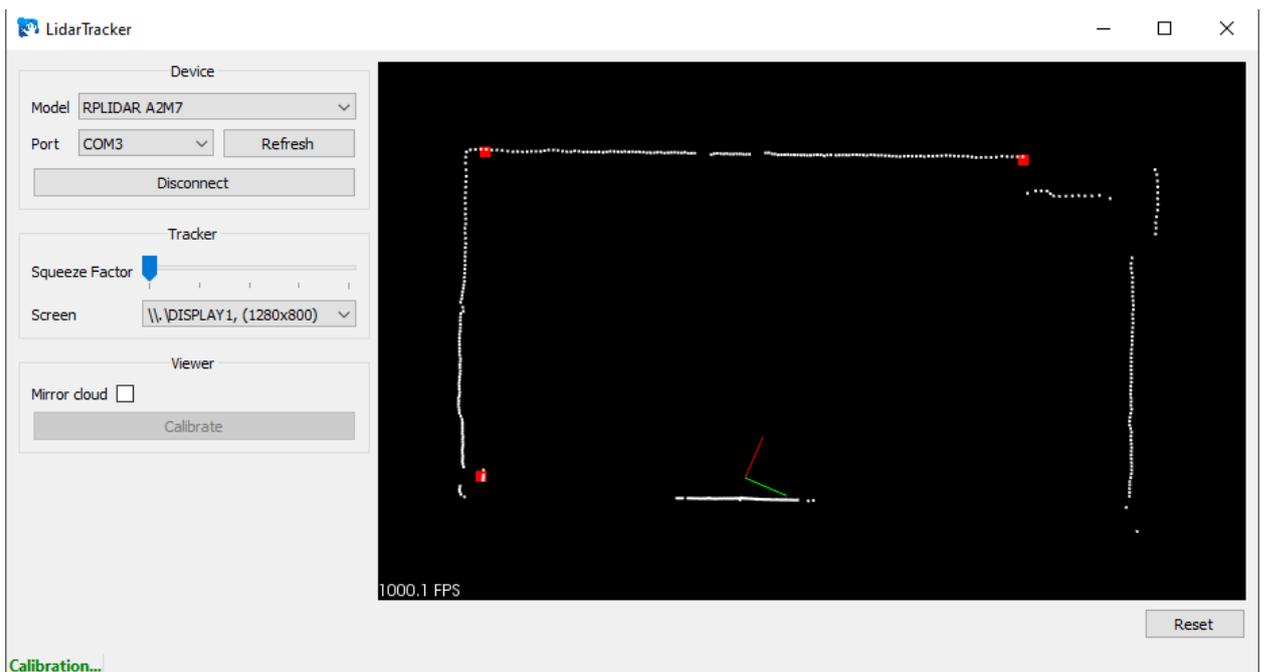
Pic. 30 Setting the lower left corner of the projection

Pic. 31 Touching the lower right corner of the projection
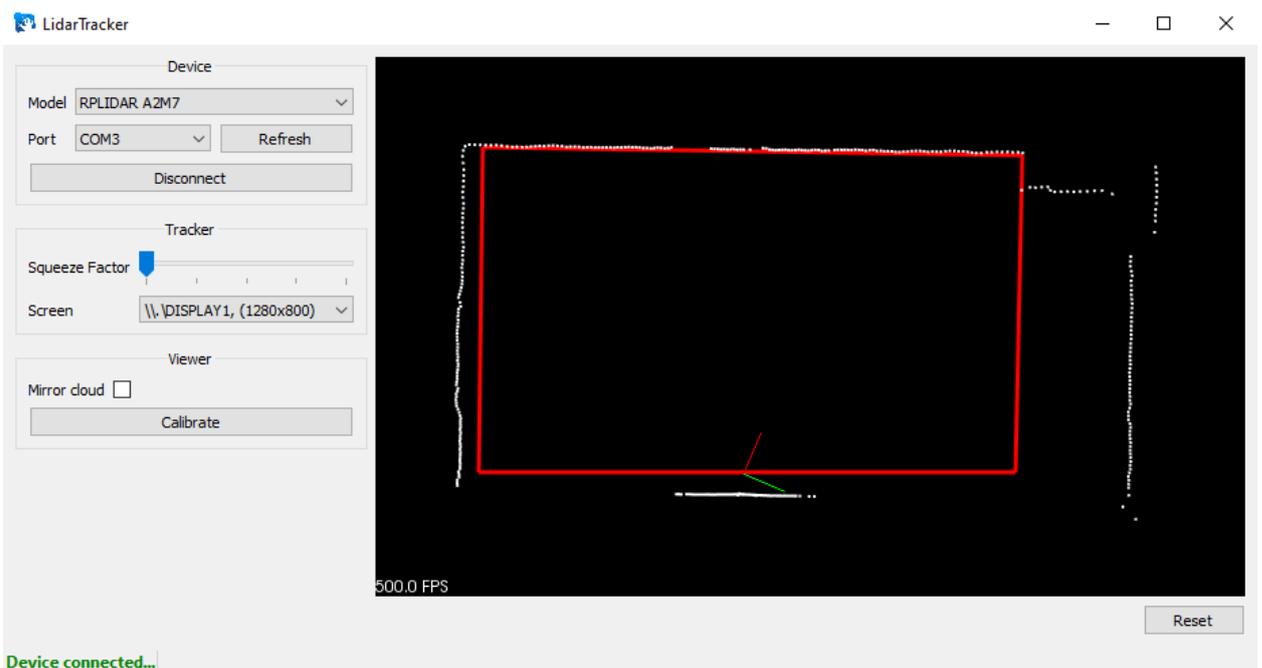
Pic. 32 Set the lower right corner of the projection. Completing the calibration process

At the end of the calibration, the program will display a red polygon, which represents the position of the projection on the "terrain map" recorded by the sensor. Any interaction with the "terrain map" inside this polygon will be perceived by the program as interaction with the interactive system, for example, if you put your hand by analogy with Pic. 22, the program will display the set of points corresponding to the touch with any color other than white (Pic. 33).
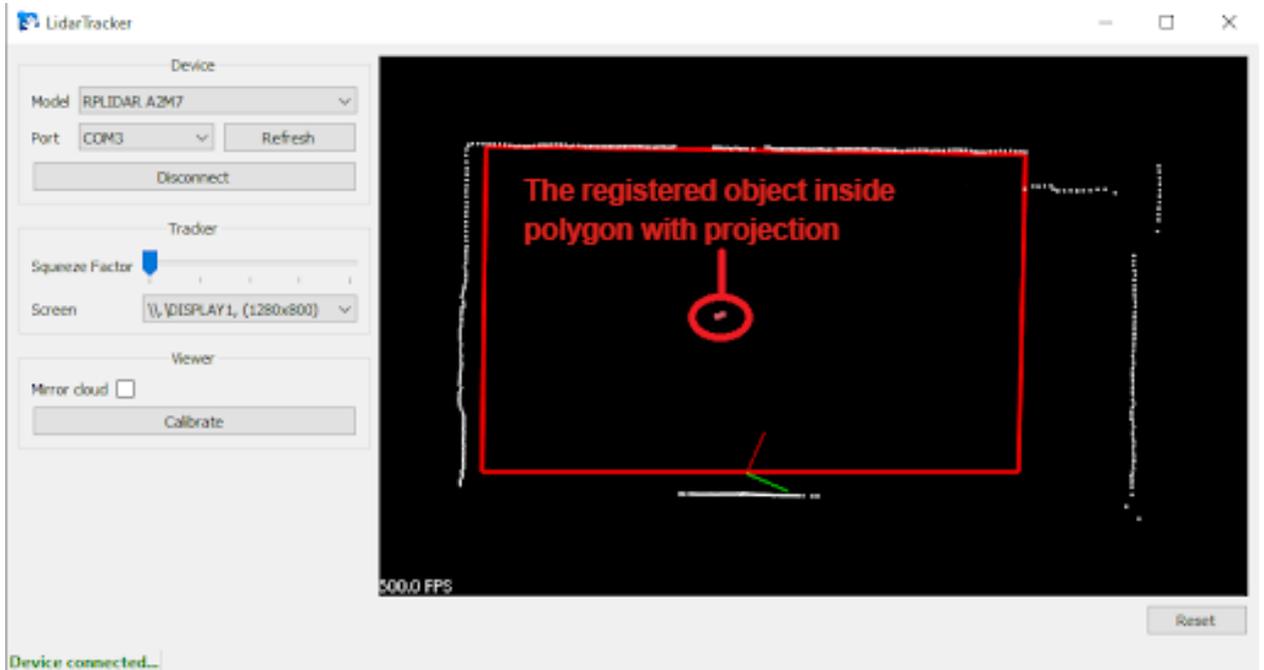

Pic. 33 Display interaction with the interactive system inside the polygon with projection

Important: Inside the polygon, with the projection, there should be no foreign objects (electric boards, interior items), which can be perceived by the sensor as interaction with the interactive system and become the result of false positives. If dots other than white are registered inside the polygon, it means that the interactive system is triggered in this place.

The final step in the list of available screens Screen \\.\DISPLAY1, (1280x800) is to select the projector on which to display interactive effects. If the wrong screen is selected, there may be response drifts when processing touches to the projection.

2.2.5. Eliminating false positives on projection edges

A collision may occur when a part of multiple points from the ceiling, floor, or side walls registered by the sensor gets inside the polygon with the projection (Pic. 34).
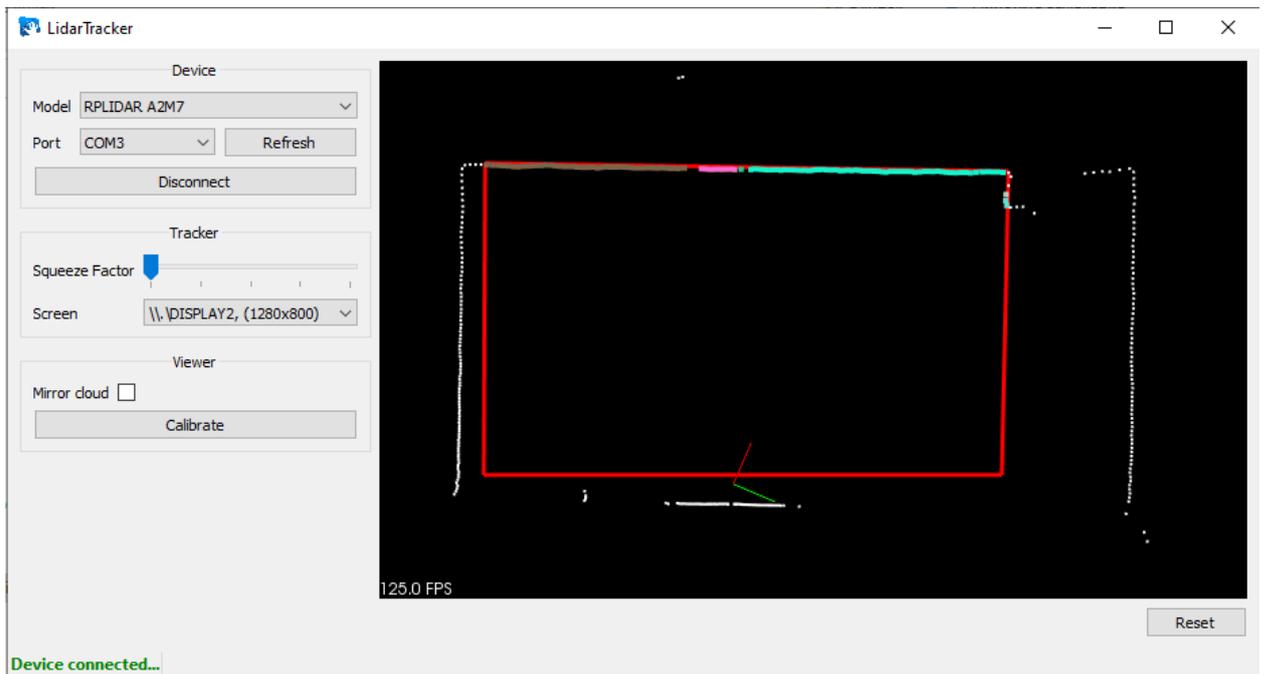
Pic. 34 Registering part of the space at the edges of the projection as an interaction with the interactive system

It is necessary to eliminate this effect with the slider . It is necessary to move the slider to the right until the undesirable effect is eliminated (the "terrain map" points on the edges of the polygon should stop being colored and become white) and stop increasing the value of the slider exactly at the moment when the effect is eliminated. If the value of the slider is large, "dead" zones may appear in the area of all four projection edges, where touches will not be registered. Note the small value of the slider in Pic. 35, sufficient to eliminate the described effect.
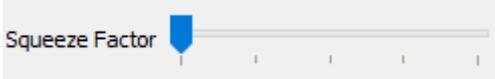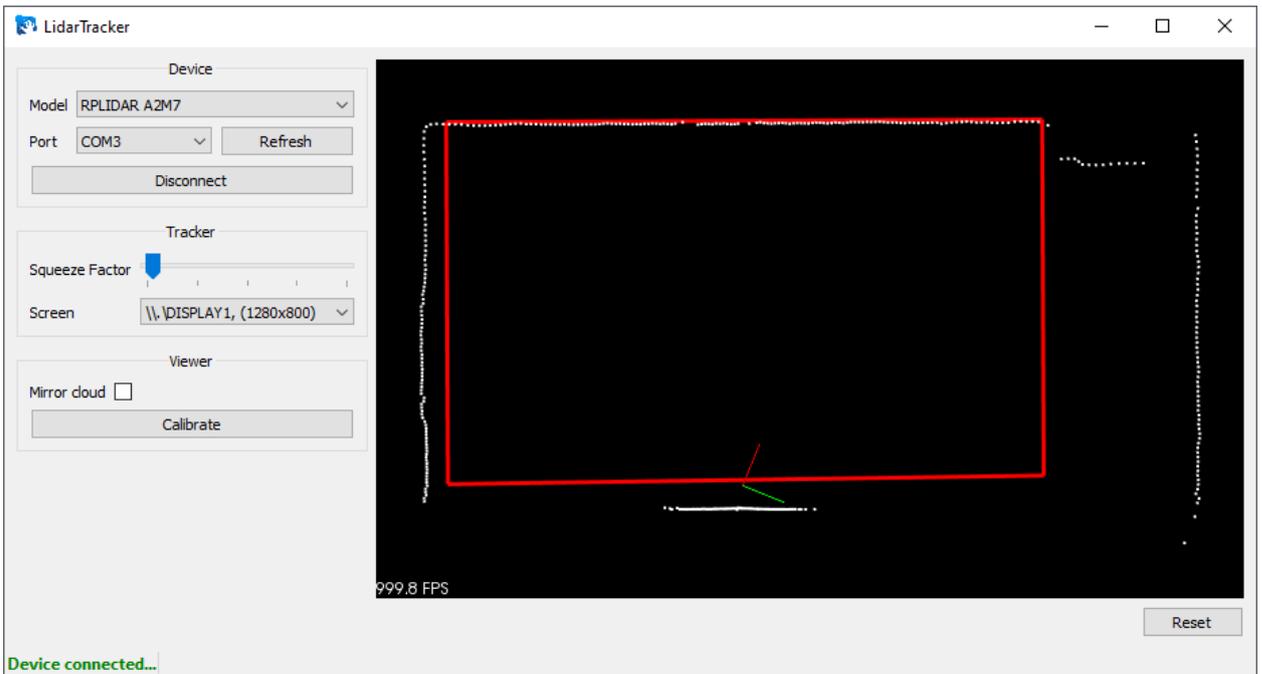
Pic. 35 The result of eliminating the effect of false interaction with the interactive system at the edges of the projection

2.2.6. Completing the program setup

After you have passed the above configuration steps, you should **terminate the program** by clicking on the cross in the upper right corner of the main program window $\times$, or using the context menu of the program in the system tray (Pic. 36). After finishing the program will save all the settings. Further, when you work with the game menu, the program will start and stop automatically.

Pic. 36 Ending a program via the system tray menu

The presence of the program icon in the system tray indicates that the program is still running.