Peltihamsteri project

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User manual

Syncster 1.0.0 & Touchster 1.5

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Contents

Figures

1 What is Syncster?

Syncster is an application for the Windows 10 platform that collects data from multiple devices and synchronizes data from those devices into one CSV file. An application called Touchster was developed for extracting touch data from Android devices. Syncster and Touchster were developed by a group of programmers as part of the course *Student Software Project* at the University of Jyväskylä during spring of 2019. The applications were developed for the driving simulator laboratory of University of Jyväskylä for research purposes.

Syncster can gather and synchronize data from the following devices:

1) Eepsoft driving simulator (version 20150311d),
2) Wearable Sensing DSI-24 EEG device and DSI-Streamer (version 1.08.28),
3) Dikablis Professional eye tracking glasses and D-Lab (version 3.52),
4) Android mobile devices and Touchster.

Instructions for all devices and their Syncster modules can be found in Chapter 2. Chapter 3 entails instructions for setting up a study in Syncster, and Chapter 4 describes how to record with Syncster. In Chapter 5 we guide the user through importing D-Lab data to a recording and exporting one or multiple recordings.

2 Syncster's device modules

All Syncster devices work in a different way. In the chapter, specific information about each device is given.

To ensure Syncster's performance, **all devices must use different port numbers**. If devices and PCs are part of a network that restricts TCP/UDP traffic, user must first manually create firewall rules that allow ports to send or receive TCP/UDP traffic. It should be enough to create these rules on the PC running Syncster.

To make sure you get the best and most accurate recording results it is recommended to use a stable Internet connection or local area network (LAN). Of all the devices, the eye tracker is the only one that can connect again if the connection disconnects, while other devices must be reconnected again from Syncster.

2.1 Driving simulator (Eepsoft)

The following things should be known before recording:

1) Use the script `peltihamsteri_udp.lua` (name might be different if various versions of the script are used) when launching Eepsoft. Make sure it is in the same folder as `t.exe`.
2) Figure out the IP address of the PC running Syncster and replace the IP address of the script with it.
3) Make sure *Command extra* is selected in Simu starter. Add parameter *-dofile peltihamsteri_udp.lua* in it (change parameter according to script's name).
4) Choose a port number (default is `5596`) and replace the port number of the script with it.
5) On Syncster's *Devices* tab, input the settings of driving simulator by carrying out the following steps:
    a. Select device to be used in study.
    b. Make sure to use the same port number that was used in the script `peltihamsteri_udp.lua`.
    c. Select the data you want to gather. To select all data, use the *Select all data* button. Figure 1 gives an example of module settings.

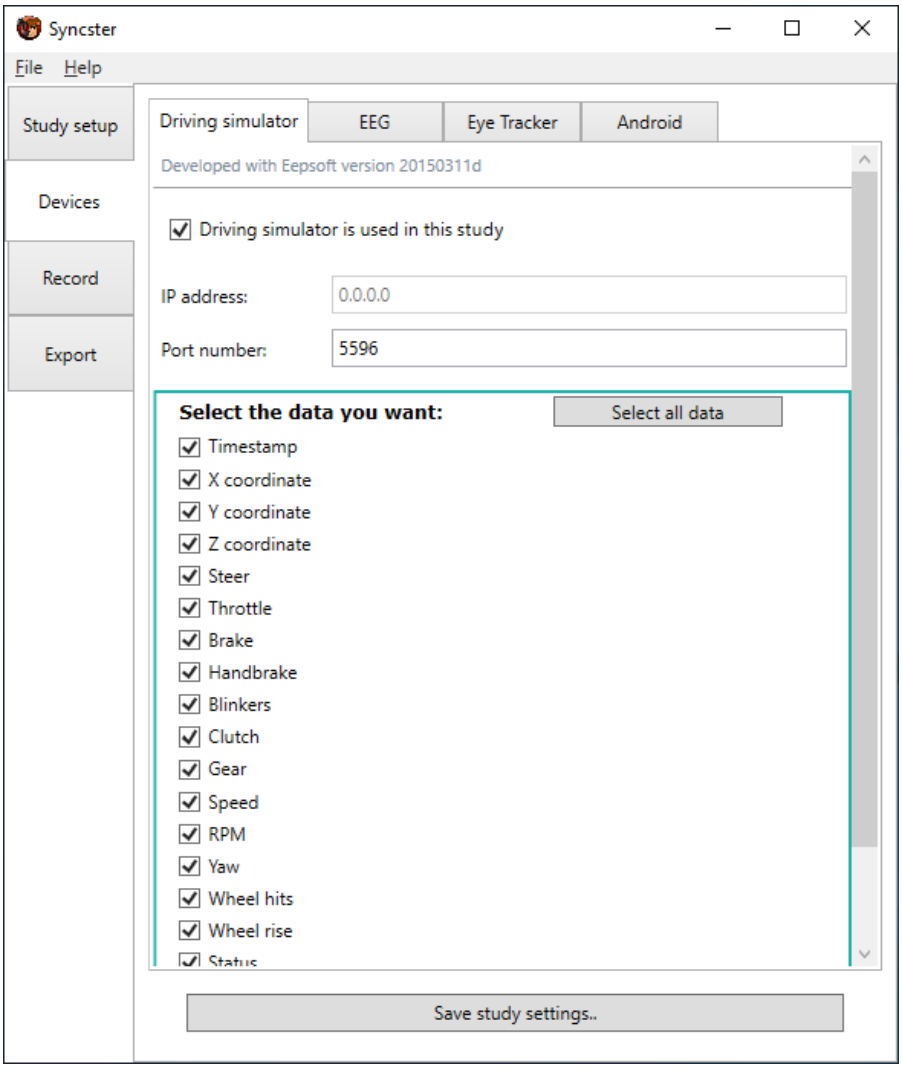

Figure 1. Driving simulator module settings example.

Recommended procedure when using the device:

1) Launch driving simulator's software with `peltihamsteri_udp.lua`.
2) Connect devices from Syncster.
3) Start recording from Syncster.
4) Start driving.

   Recording process…

5) Stop recording from Syncster.
6) Disconnect devices from Syncster.
7) Close Eepsoft.

NB: Driving simulator sends data with UDP, so the procedure doesn't need to be followed to the letter, if you know what you are doing. Just make sure to start the recording before driving begins, so that the data will all be gathered.

2.2 Dikablis Professional eye tracking glasses

The following things should be known before recording:

1) Eye tracking glasses should be in use and streaming data to D-Lab.
2) D-Lab has a *Relay* function (under screen layout) which can send data in real-time via TCP/IP. Drag the data you would like to send from the *Recording Devices* window and drop on to the *Relay* window.
3) Configure the settings in D-Lab's *Relay* window in order to send from a specified IP address and port number. Check boxes *Send Column Headers* and *Send Timestamps*.
4) On Syncster's *Devices* tab, input Eye Tracker's settings by carrying out the following steps:
    a. Select device to be used in study.
    b. Make sure to use the same values in Syncster's *IP address* and *Port number* text fields of the Eye Tracker module that are used in D-Lab.
5) You can open multiple relays from D-Lab. Different relays need different port numbers to work. Syncster supports two D-Lab relays. To activate the second port check *Eye tracker port 2 is used in this study* checkbox and fill *Port number 2* text field with the same port number that is used in the second relay of D-Lab. Figure 2 gives an example of module settings.
6) For more information check *D-Lab Manual version 3.0.*

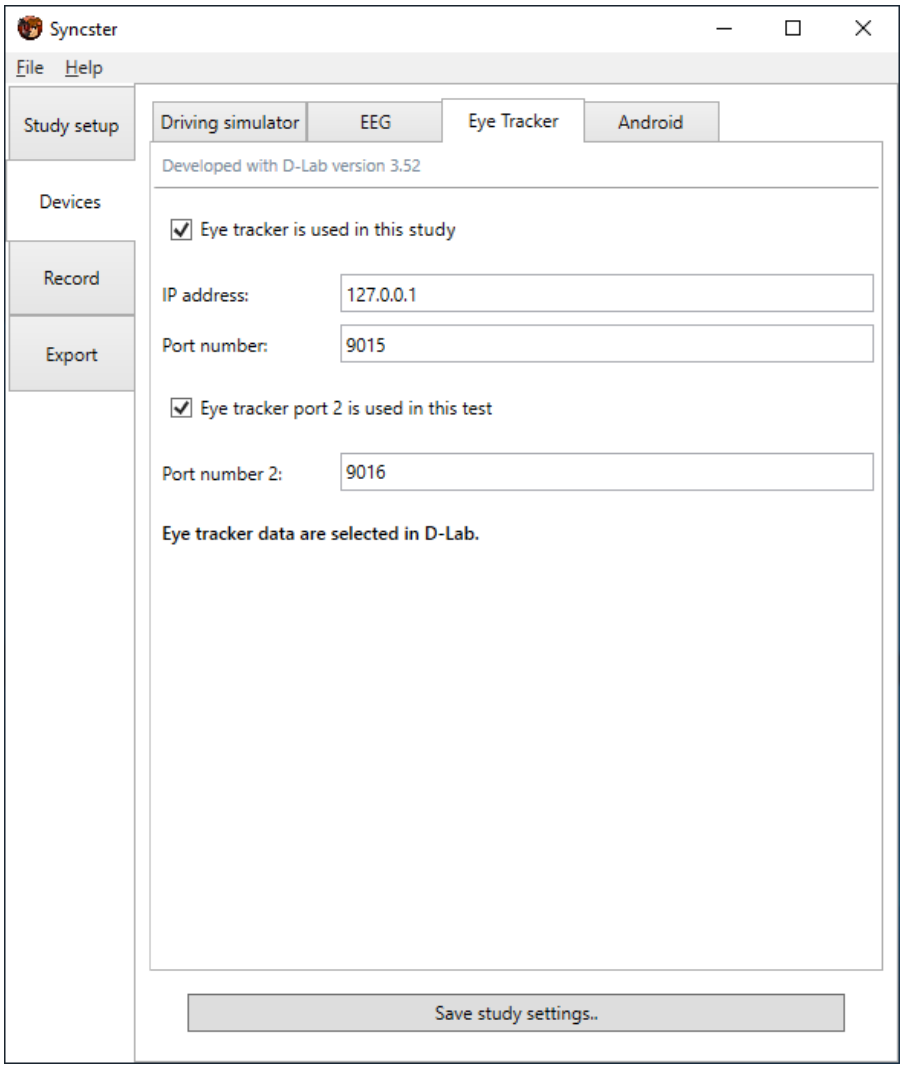

Figure 2. Eye tracker module settings example.

Recommended procedure when using the device:

1) Launch D-Lab and make it stream data.
2) Connect devices from Syncster.
3) Start recording from D-Lab.
4) Start recording from Syncster.

   Recording process…

5) Stop recording from Syncster.
6) Stop recording from D-Lab.

2.3 DSI-24 EEG headset

The following things should be known before recording:

1) Syncster and DSI-Streamer must be running on the same PC.
2) EEG should be in use and streaming data to DSI-Streamer. For more information, check *Wearing Sensible DSI-24 EEG Headset User Manual version 0.8.*
3) To stream EEG data to Syncster, you must select *Activate TCP/IP Socket* in DSI-Streamer's *TCP IP* tab.
4) On Syncster's *Devices* tab, input EEG's settings by carrying out the following steps:
    a. Select device to be used in study.
    b. Make sure to use the same port number that was used in DSI-Streamer's *Client Inport* field.
    c. Select the data you want to gather. To select all data, use *Select all data* button. Figure 3 gives an example of module settings.

Recommended procedure when using the device:

1) Launch DSI-Streamer and make it stream data.
2) Connect devices from Syncster.
3) Start recording from Syncster.

    Recording process…
4) Stop recording from Syncster.
5) Close DSI-Streamer.

NB: If DSI-Streamer happens to crash or Syncster's EEG module loses connection when you are recording, you have two options: you can either continue recording without further EEG data, or stop the recording and start a new one. The EEG module does not know how to reconnect. In case of DSI-Streamer crashing and resetting its relative timestamp, the module would not be able to reliably calculate timestamps.

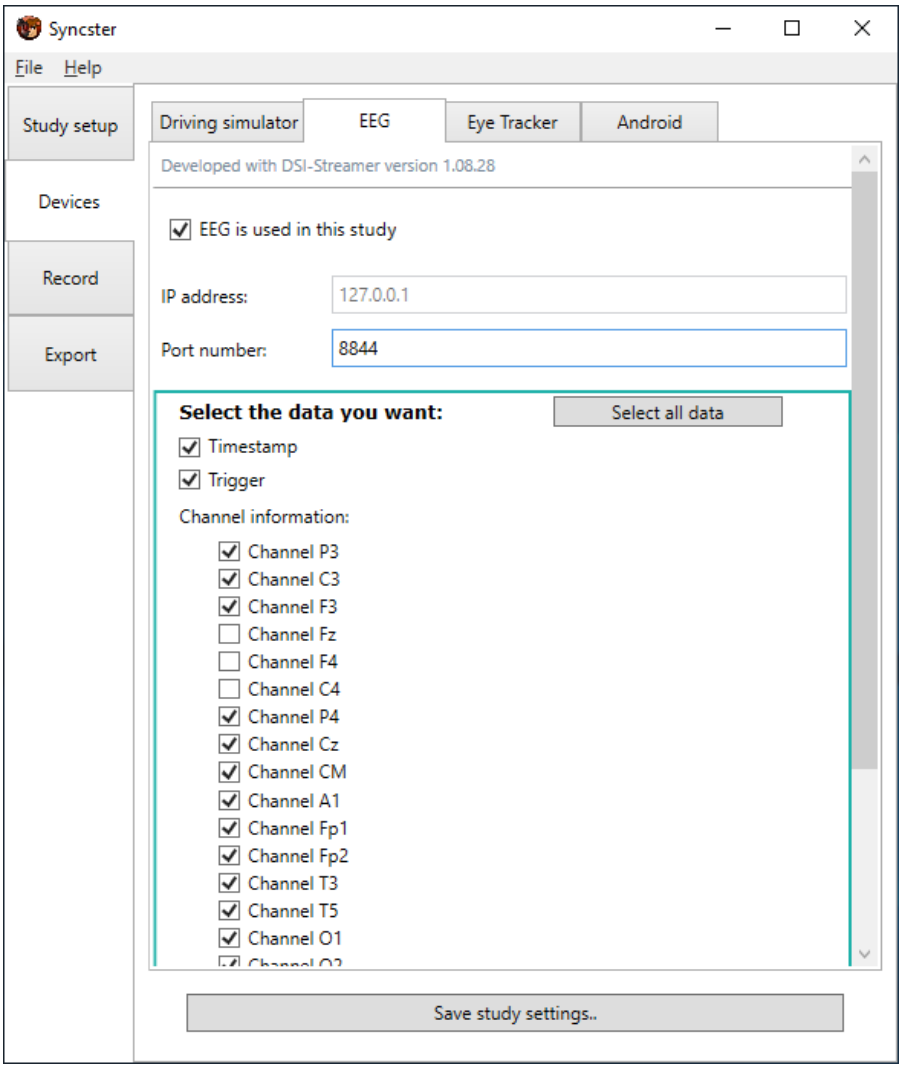

Figure 3. EEG module settings example.

2.4 Touchster (Android device)

The following things should be known before recording:

1) If your PC running Syncster is connected to university's internet, your Android device running Touchster must also be connected to university's internet. Otherwise the university's firewall will block the connection.
2) On Syncster's *Devices* tab, input Android's settings by carrying out the following steps:
    a. Select device to be used in study.
    b. Choose a port number. Figure 4 gives an example of module settings.

3) When launching Touchster for the first time, it will look like the left view in Figure 5. Touchster will save the values that are in the *IP address* and *port number* text fields when you close the app. The saved values are available in the text fields in your subsequent launches of Touchster.

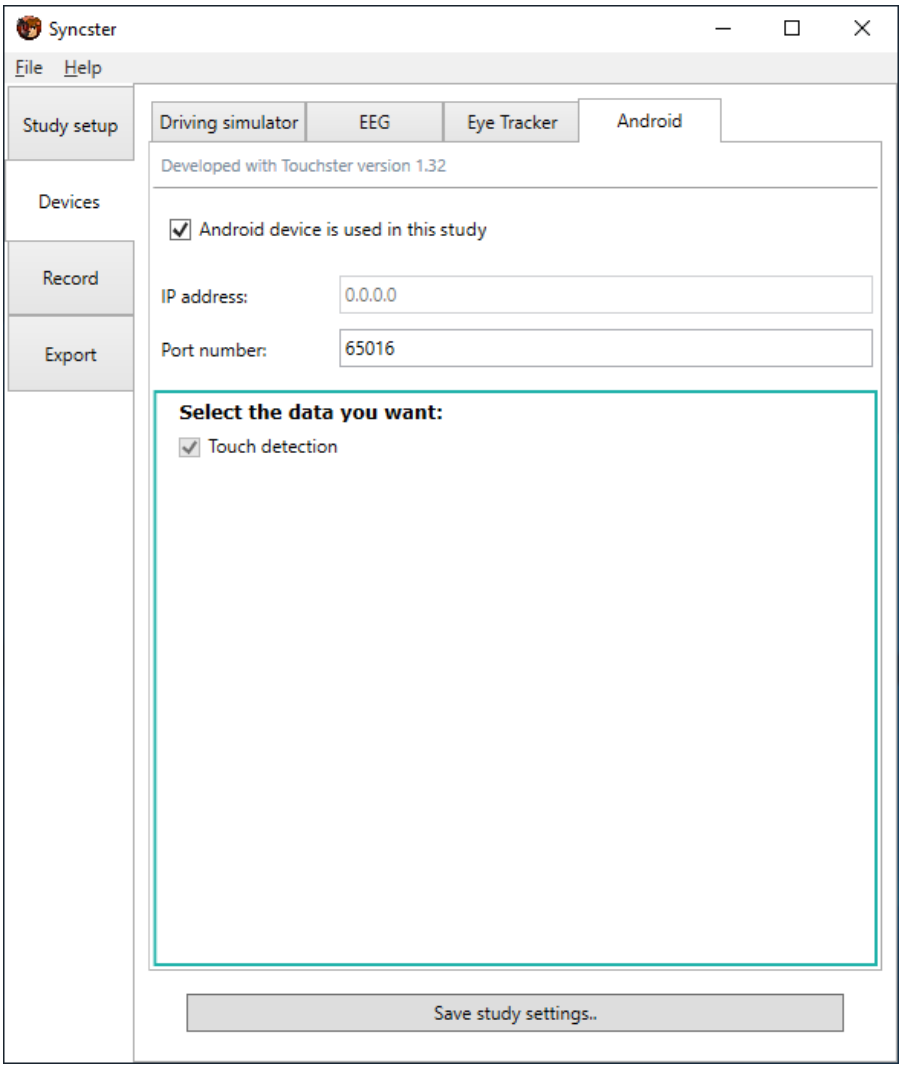

Figure 4. Android module settings example.

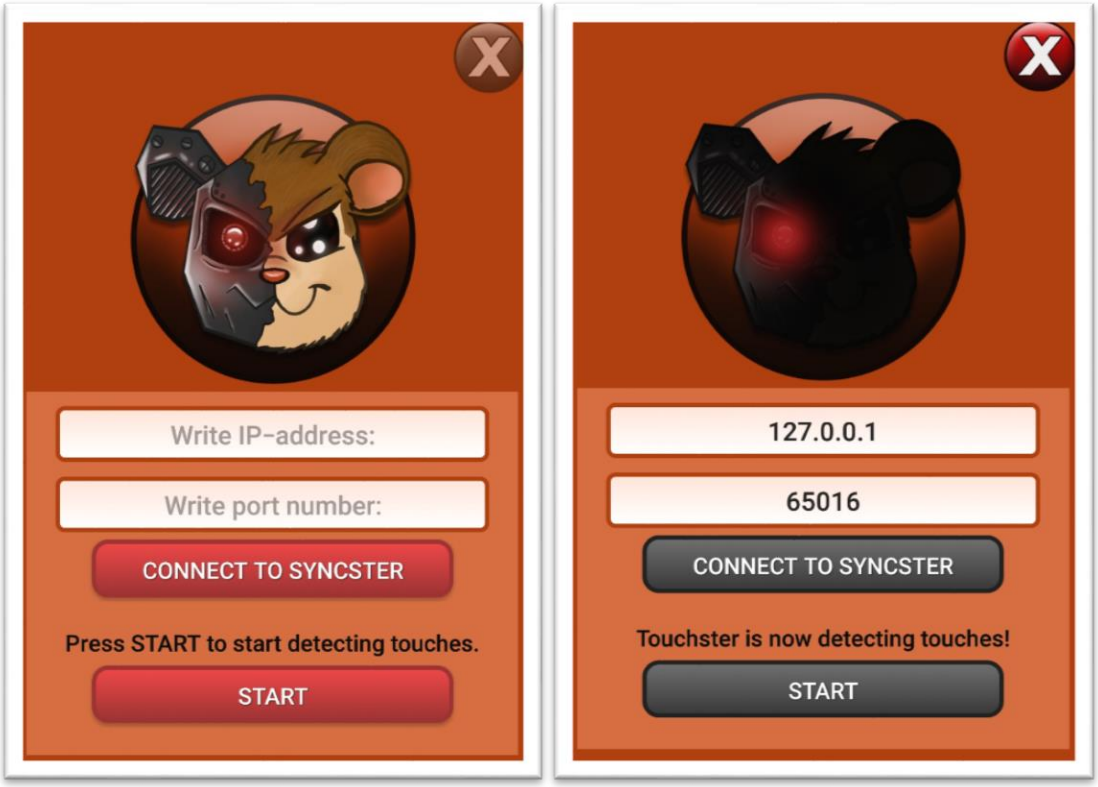

Figure 5. Touchster's default (left) and working (right) states.

4) Connecting to Syncster requires you to write the IP address of the Syncster PC and a port number to the text fields of Touchster. Make sure to use the same port number that was used in the port number of Syncster's Android tab (for example in Figure 4, the port number would be `65016`).
5) Connect devices in Syncster. If Touchster cannot connect:
    a. check that the IP address and port number are correct and
    b. check that the port number is opened in PC's firewall rules.
6) You can start detecting touch data by pressing the *Start* button. Starting touch detection will be different with different Android devices:
    a. If your Android version is 8.0.0 or higher, you need to give Touchster a permission to draw over other apps (without the permission Touchster will show a message saying *Touchster needs permission to draw overlay!*). Go to the application settings of the device and look for Touchster. From there you can give Touchster permission to draw over other apps.

b. If your Android version is between 6.0 – 7.1, you need to give Touchster a permission to draw over other apps. Your device will ask for this permission automatically when you press *Start*.
c. If your Android version is lower than 6.0, Touchster doesn't need permissions.

7) After you have connected to Syncster and started detecting touches, Touchster should look like the right view in Figure 5. At this point both *Connect to Syncster* and *Start* button are inactive.
8) After you are done using Touchster, you can reset it by pressing the reset button located in the top right corner. Pressing the button will open a window (see Figure 6), which asks your permission to reset Touchster. Resetting disconnects Touchster from Syncster, stops detecting touch data and deactivates the reset button.

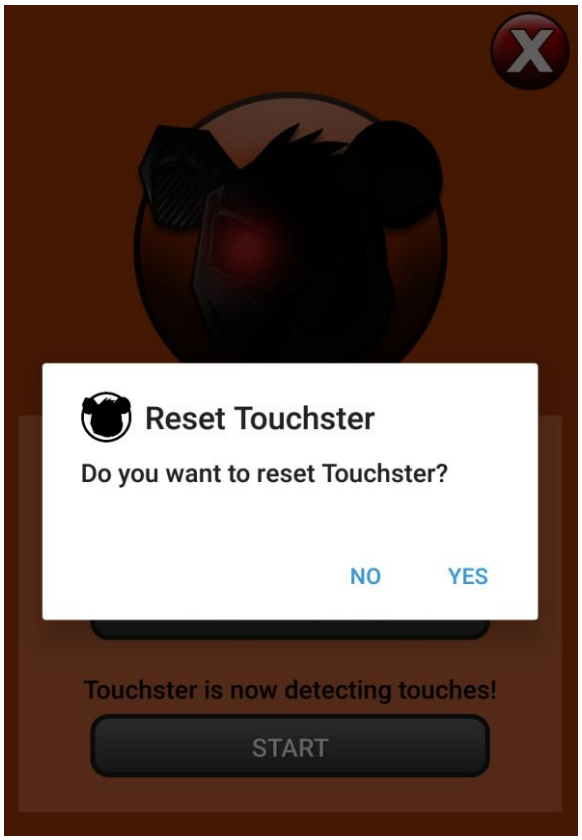

Figure 6. Resetting Touchster.

Recommended procedure when using the device:

1) Connect devices from Syncster.
2) Connect Touchster to Syncster.
3) Start detecting touches from Touchster.
4) Start recording from Syncster.

   Recording process*…*
5) Stop recording from Syncster.
6) Reset Touchster.
7) Disconnect devices from Syncster.

NB: Connect Touchster to Syncster after you have pressed *Connect devices* button in Syncster. Touchster's device module in Syncster won't actively show heartbeats. Heartbeats show up only when user touches device's screen. It is recommended that before you start recording with Syncster, check that heartbeats are coming to make sure the connection is formed.

It is recommended that you reset Touchster before you disconnect devices from Syncster. Disconnecting before resetting doesn't break anything, but Touchster can't visually indicate that it isn't connected anymore to Syncster. It will stay in the state presented in the right view of Figure 5.

3 Setting up a study

In the chapter we go through step-by-step instructions on how to set up a study in Syncster. Sections 3.1 – 3.4 tell how to make and save study settings. Lastly section 3.5 presents Syncster's menu bar and its activities.

3.1 Text field validation

Many of Syncster's text fields have an ability to check if their content is valid. If you try to use characters that are not allowed, the text and border color of the text field

will turn red to inform that the content is invalid. You cannot start recording if there are text fields with invalid content in them that are needed in the recording process. The fields include all text fields in *Study setup* tab and *IP address* and *port number* text fields from the devices that are used. It is recommended to fill all required information correctly to avoid unnecessary confusion when trying to start recording. Figure 7 shows an example of text field that has invalid content in it.

Figure 7. Example of characters that are not allowed.

3.2 Study details and result folder

Before recording you need to set up *Study details* and *Result folder* in the *Study setup* tab. *Result folder* can be selected by pressing *Open* button on the Result folder section (point 2 in Figure 8). All recordings will be saved into this folder, so it is important that it holds enough space. If the result folder runs out of space, the recording process will fail and you will lose data. You also need to have write access to the result folder.

Every recording session requires a study name and at least one task that will be performed. Specify a study name by writing it on the *Study name* text field (point 3 in Figure 8). Create a new task name by writing it on the *Add a task name* text field. After writing a task name you need to add it to tasks by pressing *Add* button next to text field (point 4 in Figure 8). Alternatively, pressing the *Enter* key adds the task. Multiple task names can be added at once by separating the tasks with a semicolon (e.g. `task1;task2`). After adding, the tasks will be shown in *Task names* list above. You can create as many tasks as is needed. A task can be removed by selecting a task, right-clicking it to open the context menu and selecting *Remove*.

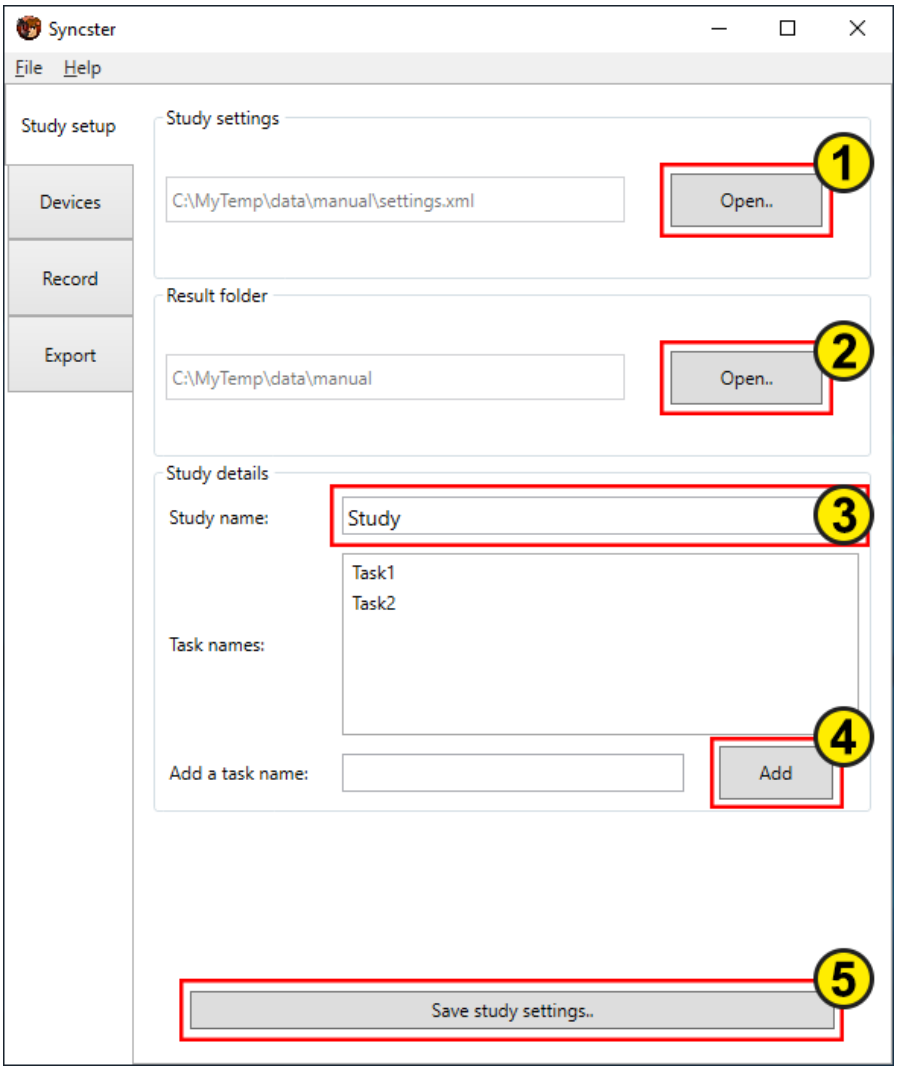

Figure 8. Study setup.

3.3 Selecting devices

To select devices, you need to go to the *Devices* tab. From there you can find all devices that Syncster supports. Each device has its own tab (see Figures 1-4).

You can select a device by checking the *<device name> is used in this study* checkbox. Then you can select what data you want and fill the text fields for *IP address* and *port number*. Some IP addresses cannot be changed (i.e. driving simulator and EEG). All data for used devices must be filled before you can start recording. Every device has different types of data that you can choose to have in your recording. You can choose as much data as you want in your recording. Currently, Syncster does not stop you

from recording with no data selected, so be sure to make at least one data selection. You can find more information about devices and how to set them up in Chapter 2.

3.4 Saving and using study settings

The fastest way to fill all information before recording is to use a settings file that you have created earlier. To save your settings, press the *Save study settings* button that can be found on the bottom of *Study setup* and *Devices* tabs (point 5 in Figure 8). This will open a dialog that allows you to name your file and choose a directory. You need to have write access to the directory.

You can open a settings file in the *Study setup* tab's *Study settings* section. Press *Open* button to find and use a settings file (point 1 in Figure 8). Syncster will automatically fill all study setup and devices information present in the settings file. After this you can still edit current settings as much as you like. Currently there is no way of clearing all settings in Syncster. If you wish to start anew, you should restart Syncster.

3.5 Menu bar

You can open and save study settings from the menu bar's *File* menu by clicking *Open study settings* and *Save study settings*. You can also exit from Syncster by clicking *Exit* from the *File* menu.

Menu bar also has a *Help* menu that includes *Help*, *Device status help* and *About* menu items. *Help* opens Syncster's instruction manual (you probably have already found that because you are reading the document).

Device status help opens a window that explains the device status colors used in the *Record* tab. From these colors, *Paused* isn't used in Syncster's current modules.

About opens a little window that shows the application name and the last month the application was modified.

4 Recording

The chapter presents the recording process in Syncster. We outline things to do before recording, as well as starting and stopping the recording.

4.1 Before recording

Once you have filled all obligatory setup information and chosen at least one device, you can start recording with Syncster. To start recording you need to go to the *Record* tab (see Figure 9). The most significant area here is the *Device names, heartbeats, and statuses* section. Devices that you have chosen earlier are highlighted here with a sea green border. The heartbeat shows different number values when Syncster is receiving data from the device. Essentially a heartbeat tells you how many rows of data has been received in the last 500 milliseconds. A status ellipse indicates the current state of the device module. Grey color indicates that the device is not yet connected. Figure 9 shows an example where we have selected some devices, but we haven't connected them yet.

You can launch Syncster's selected device modules by pressing the *Connect devices* button. If there are obvious mistakes in the settings of a selected device module, Syncster should show a message box that tells which piece of information is incorrect. Go back to the *Devices* tab, correct the mistakes, and retry pressing the *Connect devices* button. Device's status color shows green when Syncster has launched the module successfully. Be aware that some devices won't start showing heartbeat right away. For example, driving simulator will show heartbeat only when you are driving in the simulator. Also, Android will show heartbeat only when device's screen is touched.

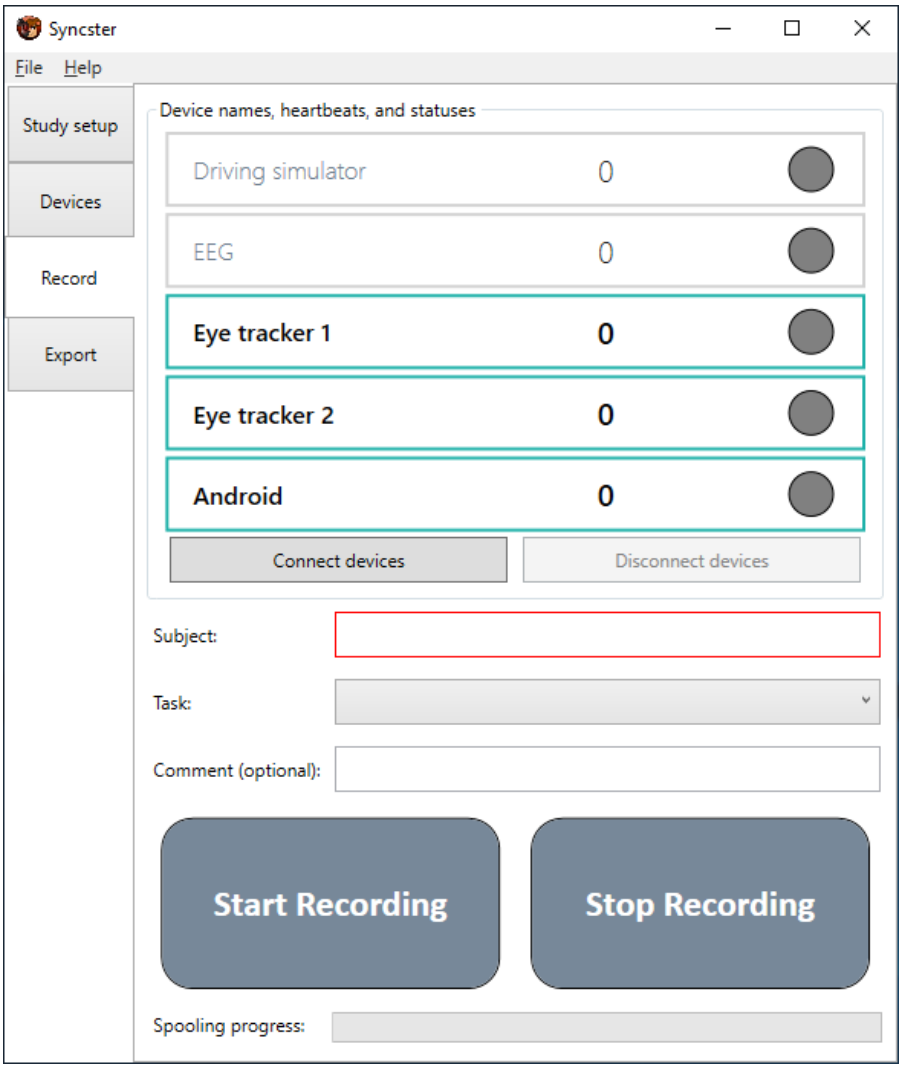

Figure 9. Devices before connecting.

Next you need to fill the *Subject* text field and select a task from the *Task* dropdown menu. Below these, there is also an optional *Comment* text field, where you can write a comment describing the recording. You can write a comment before you start recording or while the recording is going on. You cannot write a comment after you have stopped recording, because Syncster will use the comment text as a part of the ID of the recording when recording is stopped. *Comment* text field also has a validation check which its content must pass before the comment can be used. If the comment is not valid when recording stops, Syncster will not use the comment or might only use a portion of it.

Figure 10 shows an example where devices have been connected successfully. All devices are sending data, because heartbeats are showing a number other than zero. *Subject* text field and *Task* are also filled.

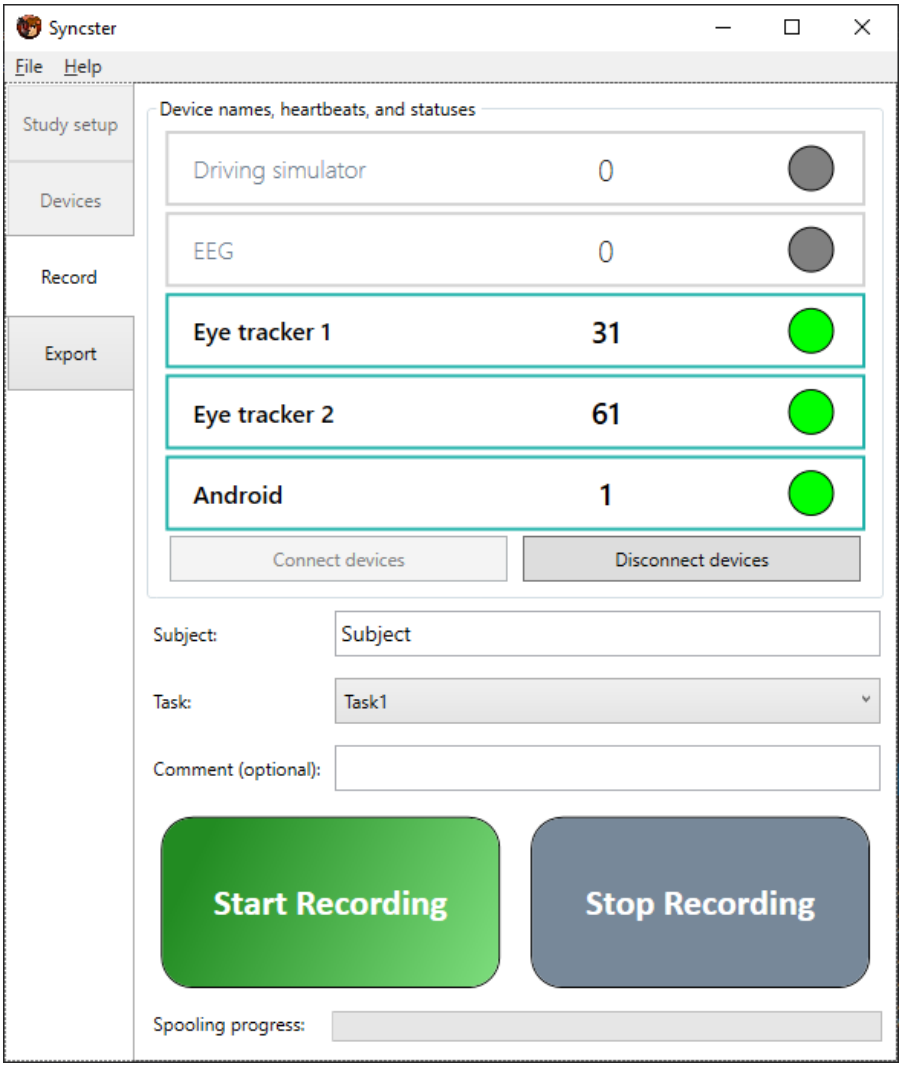

Figure 10. Devices are connected.

4.2 Starting and stopping recording

After all required information has been filled, *Start Recording* button will change its appearance from grey to green (see Figure 10). You can start recording by pressing the button. If the appearance of the button won't change to active, disconnect the devices and check for possible validation errors from earlier tabs. Remember to check each device's own tab.

Figure 11 shows an example where recording has been started. When the devices have been connected, you cannot go to *Study setup* and *Devices* tabs. During recording you cannot modify the subject or select a different task. You can still write a comment about the recording to make it more recognizable or to add some information of how the recording advanced.

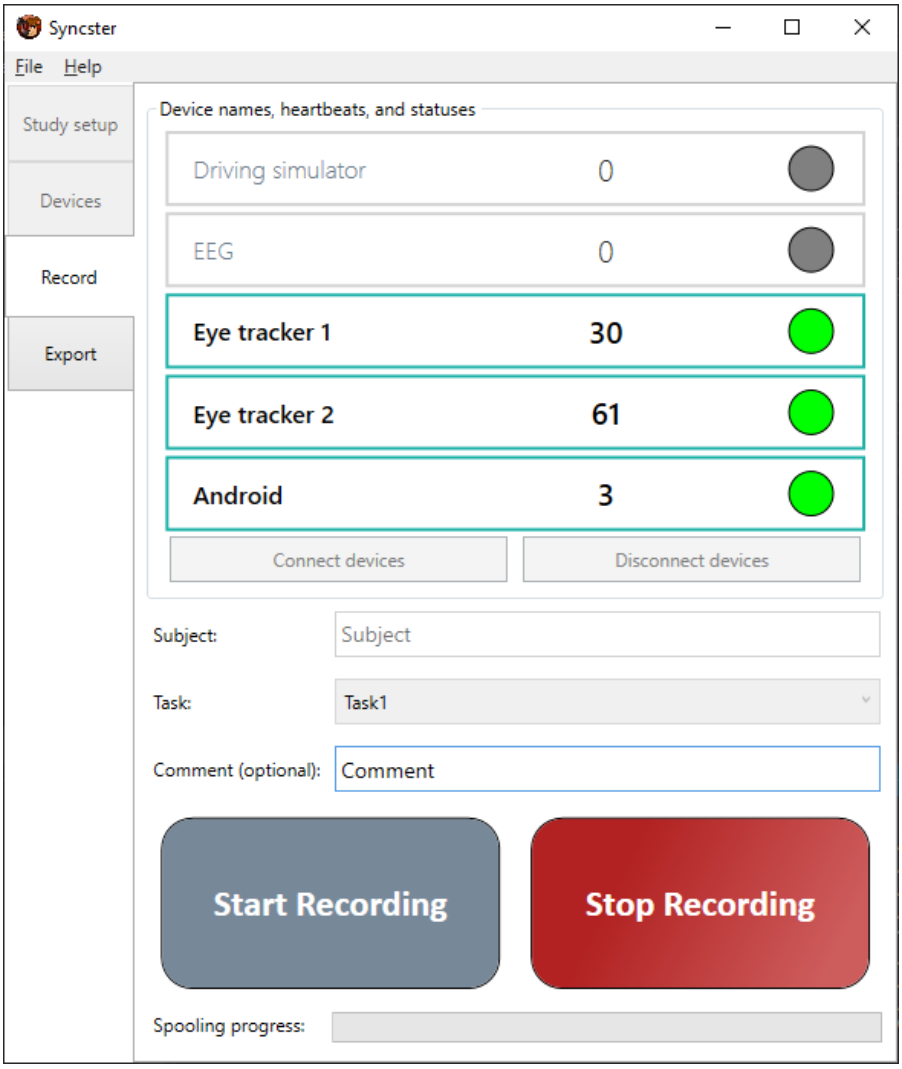

Figure 11. Syncster is recording.

When you are done with recording, press the *Stop Recording* button. Syncster will automatically start writing temporary files from each recorded device. Depending on the length of your recording and devices used, the process might take time from a couple of seconds to multiple minutes. You can follow the progress of the process from the *Spooling progress* bar, which is in the bottom of the *Record* tab. Syncster will

inform you when the temporary files have been created. Figure 12 shows an example where recording has been stopped and Syncster has finished creating temporary files.

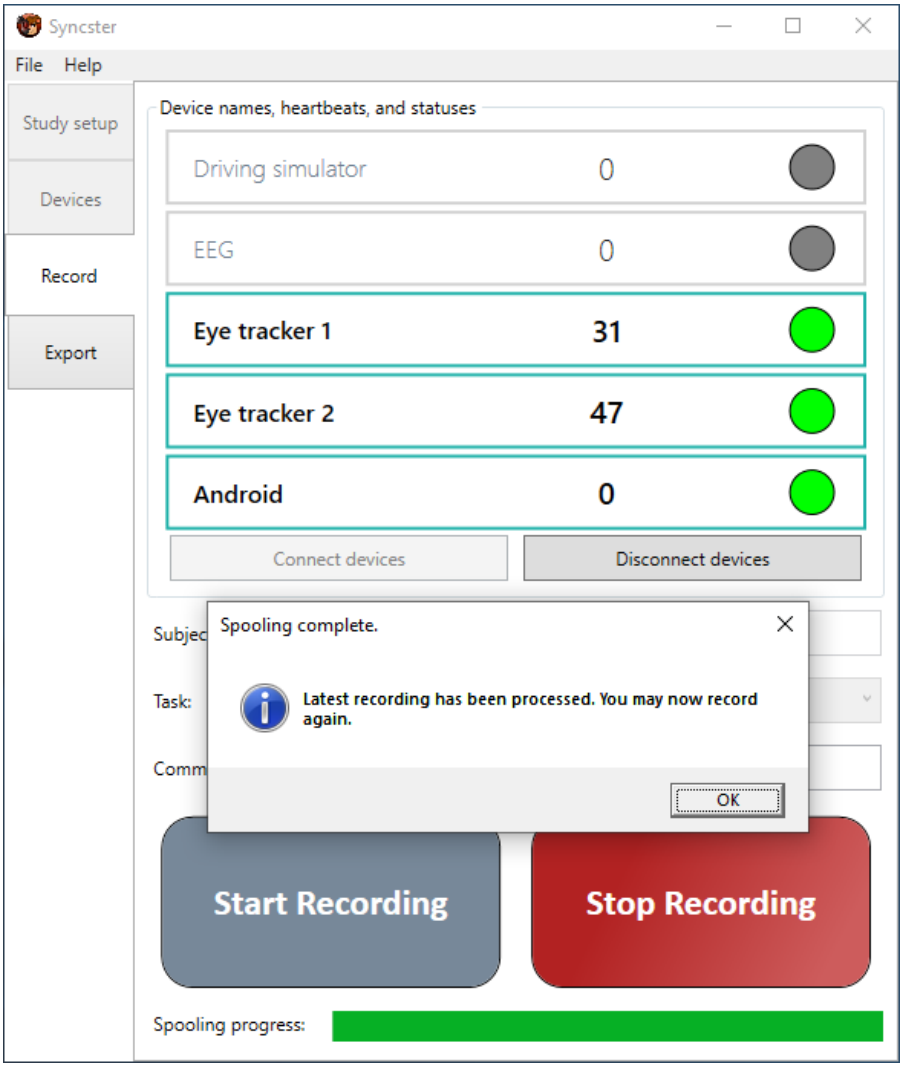

Figure 12. Syncster has stopped recording.

5 Importing and exporting

The chapter presents the exporting in Syncster. We describe how to import D-Lab data to your recordings, the exporting process, and ways to export. Lastly, important remarks about exporting are disclosed.

5.1 Importing D-Lab data

Some data cannot be gathered in real time. At the moment Syncster only supports importing eye tracker software's (D-Lab) data, which is recorded at the same time Syncster is recording. To import D-Lab's data to Syncster, first select a recording from the grid and then press the *Import new source* button located in the *Current selection* section (point 8 in Figure 15). Find a file you want to import and open it. Syncster opens an *Import D-Lab data* window (see Figure 13).

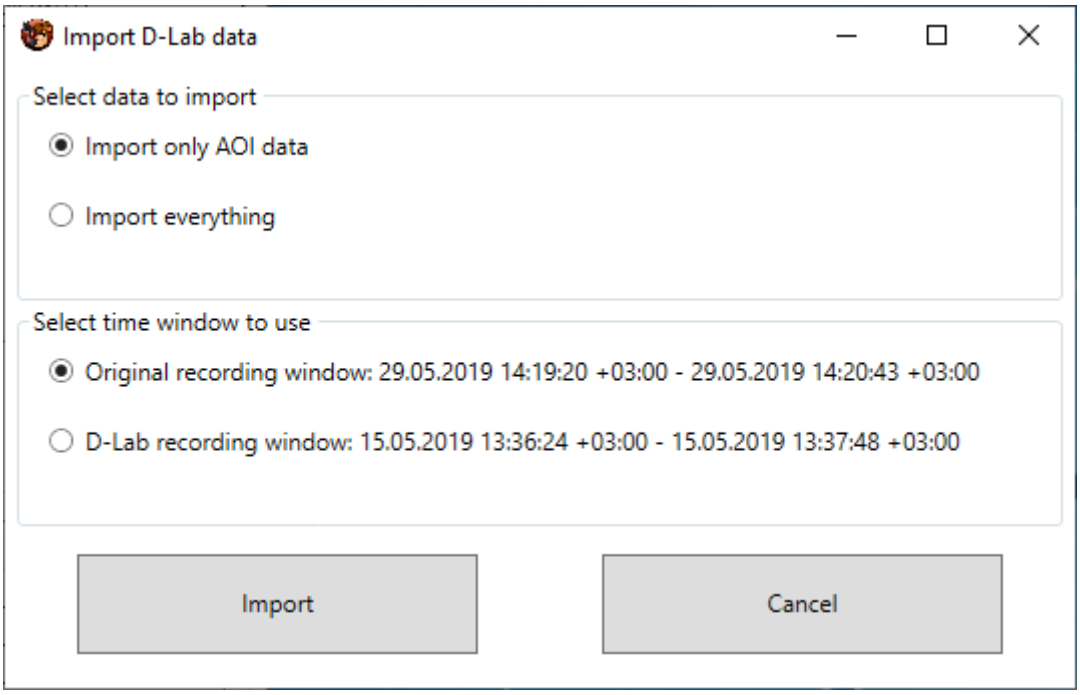

Figure 13. *Import D-Lab data* window.

Syncster will ask you if you want to import only Area-Of-Interest data of all the data. You also need to select whether you want to use the recording time window that Syncster used, or the time window that D-Lab provides. Assuming that D-Lab's recording is longer than Syncster's, using D-Lab's recording window will add rows that only have D-Lab data in them to the start and end of your exported CSV file. To start importing, press *Import*. After this D-Lab's data is imported and you can start exporting as described in Sections 5.2 and 5.3. You can see the exported D-Lab data in recording's *Current selection* area (see Figure 14).

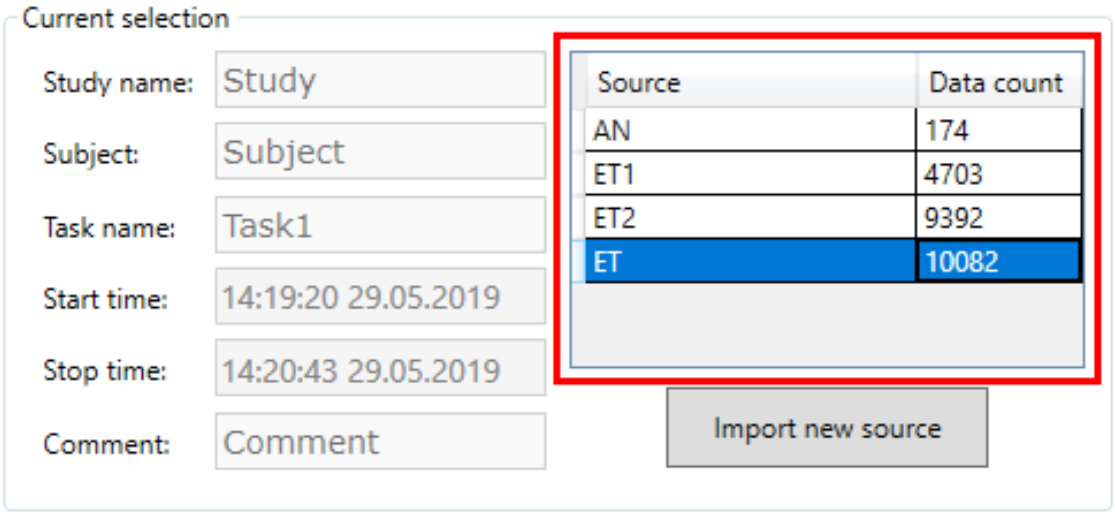

Figure 14. Imported D-Lab data highlighted.

5.2 Exporting process

The exporting process creates one CSV file per recording that includes all recorded device data. The file can be then opened in other programs like Excel for further use. To start exporting you need to go to the *Export* tab (see Figure 15).

First pick a folder where your temporary files are. If you are exporting right after recording, Syncster will automatically use the result folder that you have chosen before recording. However, if you open Syncster just to export earlier files, you need to pick the right folder. To do this, press *Change folder* button located in the top of *Export* tab (point 1 in Figure 15).

After picking the right folder, Syncster will list all recordings it holds. These are visible for the user in a data grid located in the middle of *Export* tab. You can arrange recordings by pressing *Study name, Subject, Task name, Start time, Duration* and *Comment* fields on top of the grid (point 2 in Figure 15). You can select a recording by pressing its row in the grid. Syncster will show its information in the *Current selection* section. Here you can see what devices were used in the recording and how much data each device provided (point 7 in Figure 15).

5.3 Ways to export

Syncster offers two ways to export recordings:

1. Export one recording by choosing it from the grid and pressing the *Export selected* button (point 3 in Figure 15). The option allows you to choose your own file name and save directory, but Syncster will offer a default file name. Press *Save* to start the exporting process.
2. Export all recordings from the grid by pressing the *Export all* button (point 4 in Figure 15). This option won't allow you to choose file names, but uses the default file name Syncster provides. You can choose a save directory for all CSV files that will be created. Press *Save* to start the exporting process.

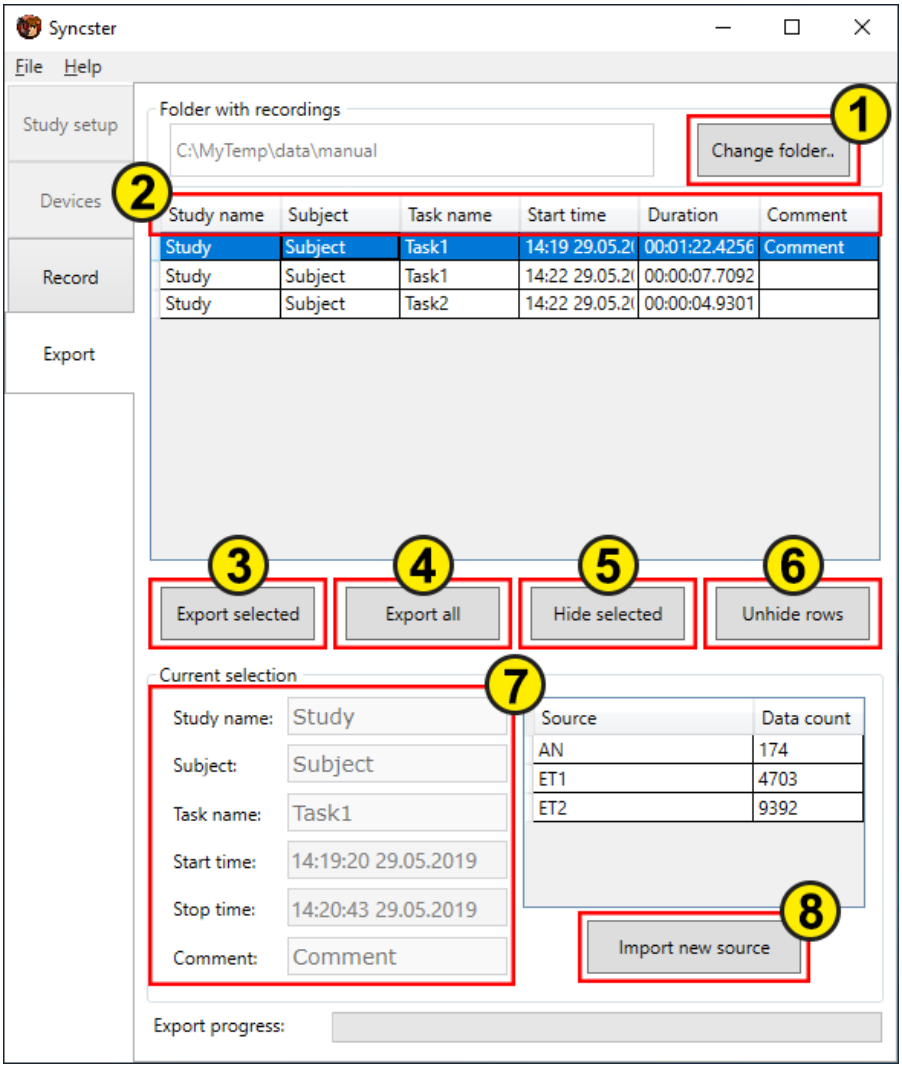

Figure 15. Export tab.

You can hide an unwanted recording by choosing it from the grid and pressing the *Hide selected* button (point 5 in Figure 15). You can unhide all hidden rows by pressing the *Unhide rows* button (point 6 in Figure 15).

You can follow the progress of exporting from the *Export progress* bar, which is in the bottom of the *Export* tab. Syncster will inform you when the exporting is done. Notice that you need to have write access to the folder you are exporting to. Figure 16 shows an example where Syncster has exported all visible recordings. The ensuing message box tells the user if any of the exports have failed.

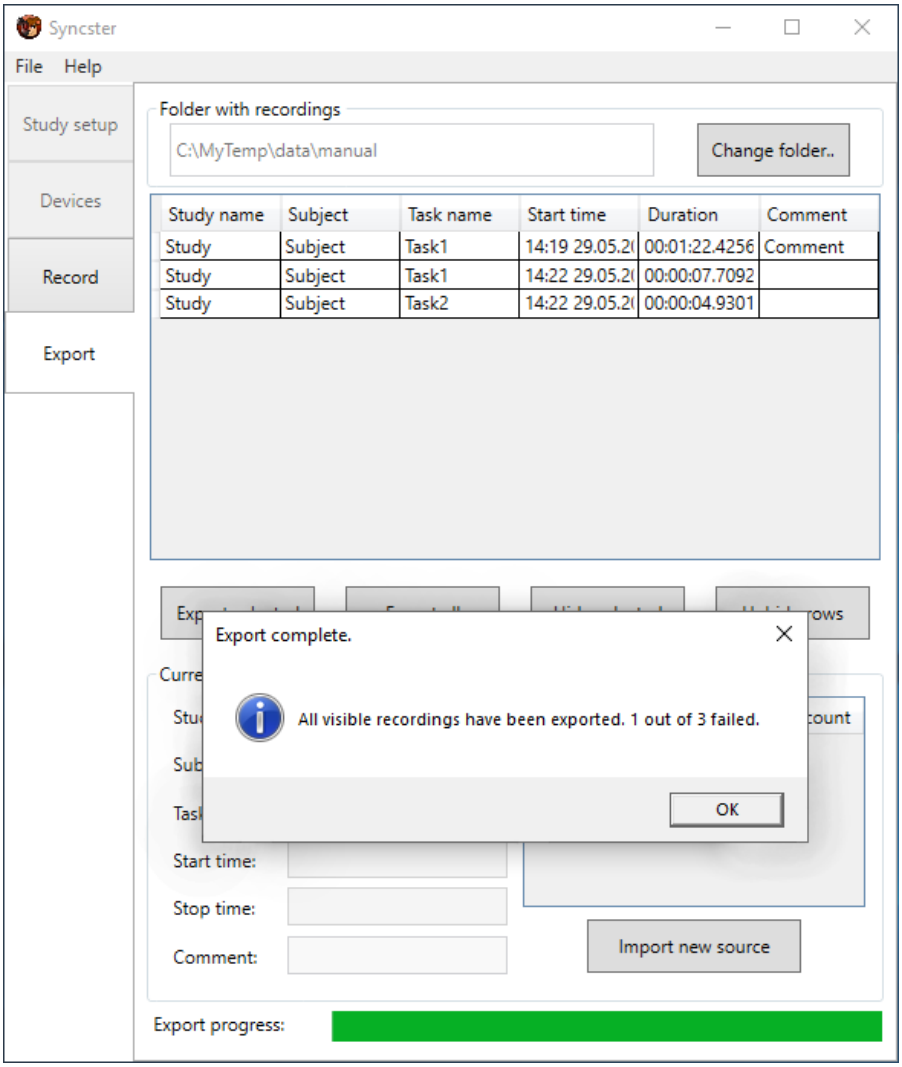

Figure 16. Syncster has finished the exporting process.

5.4 Remarks about exporting

The exporting process can be demanding for a PC. For example, with a very large recording, the process requires a lot of memory (e.g. 700 000 rows of data will take about 9 GB of RAM).

Multiple different recordings can be exported at the same time by starting a new export when the last one has not yet finished. However, *Export progress* bar will not show progress correctly. Syncster will still open a message box to inform the user when each exporting process is done.

We have identified a few situations during an export process that probably will not result in a CSV file that includes all wanted data. Therefore, we **do not recommend** that you:

1) export the same recording multiple times at the same time by pressing the *Export selected* button repeatedly. Doing this might put Syncster into a lock state, and there is no real way of knowing whether any of the exportings have been successful.
2) export all recordings multiple times at the same time by pressing the *Export all* button repeatedly. Doing this might put Syncster into a lock state, and there is no real way of knowing whether any of the exportings have been successful.
3) import D-Lab data to a recording while you are exporting it.
4) export a recording while you are importing D-Lab data to it.