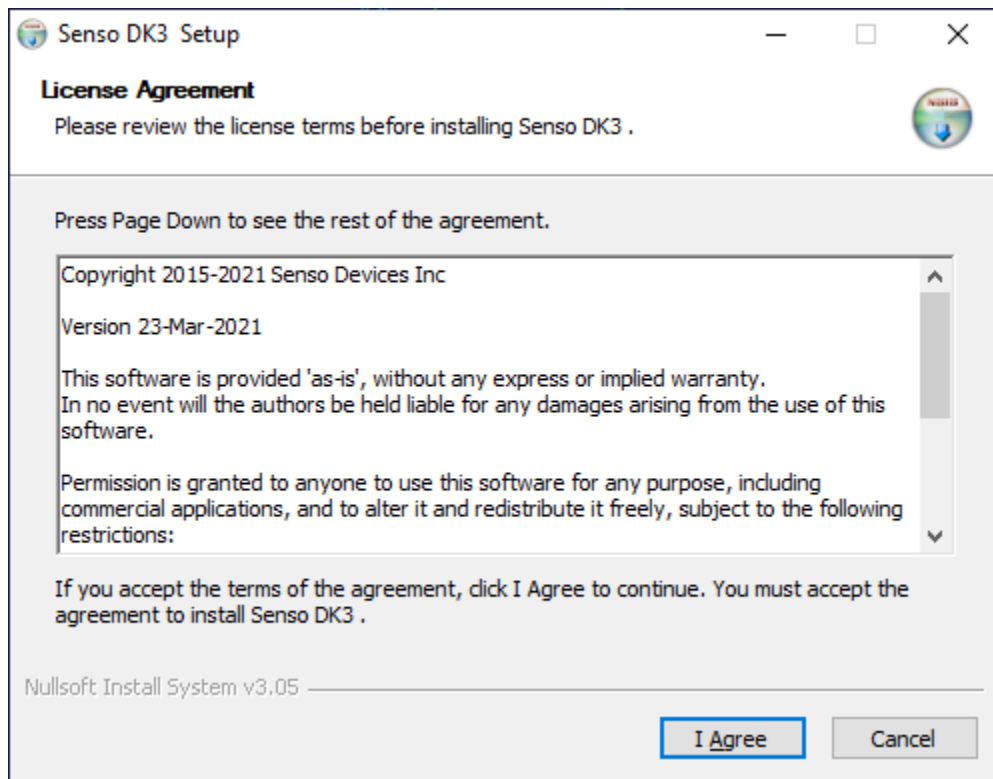


1. Quick start

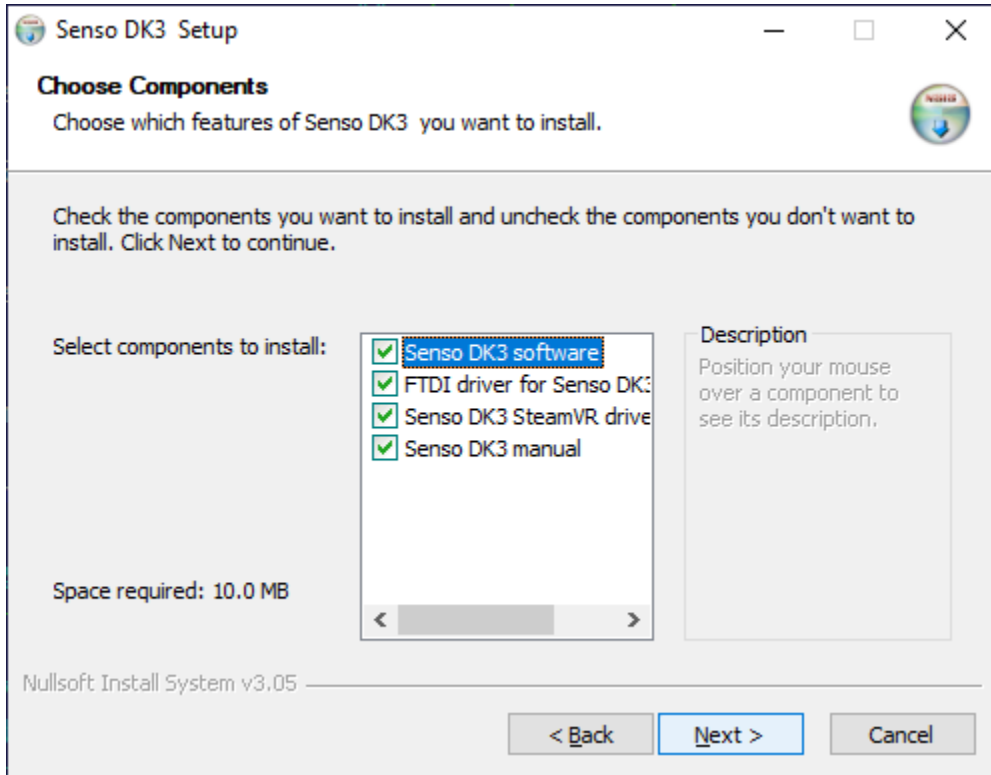
Download and install DK3 setup file (dk3_setup.exe) from our partners website.

<https://senso.me/download>

Launch dk3_setup.exe

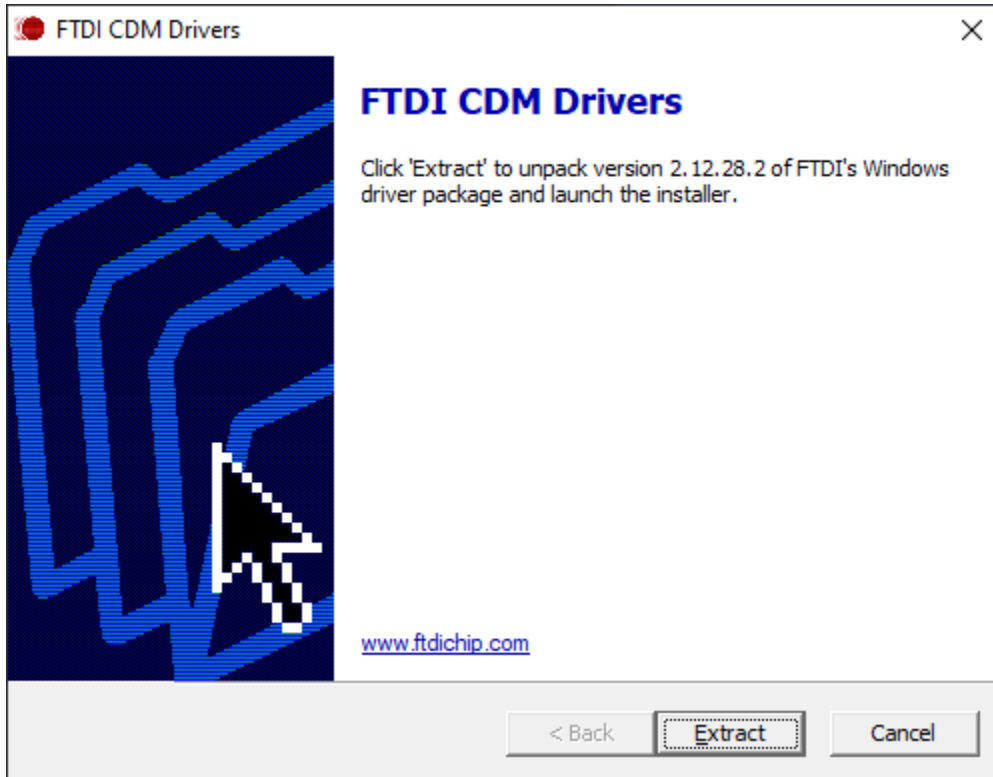


Proceed by pressing 'I Agree'

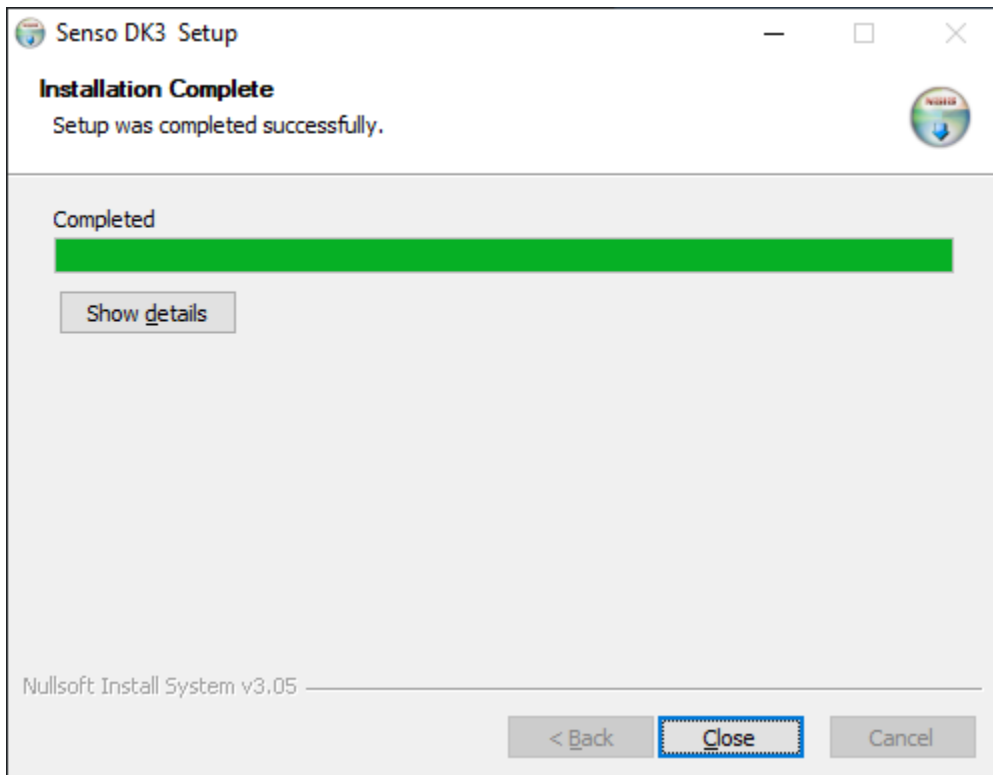


Proceed by pressing 'Next' until the end.

You also may need to install FTDI driver (some versions of Windows 10 don't require this driver, but there is no down side, so install it anyways)



Close the installation window



Before the next step make sure that 11Dvr Glove has been charged for at least 45 minutes via any kind of USB charger (using the USB port of your computer may require more time for the charging process).

Get New Pic*



Insert the DK3 RF adapters into the USB ports of your computer or laptop.

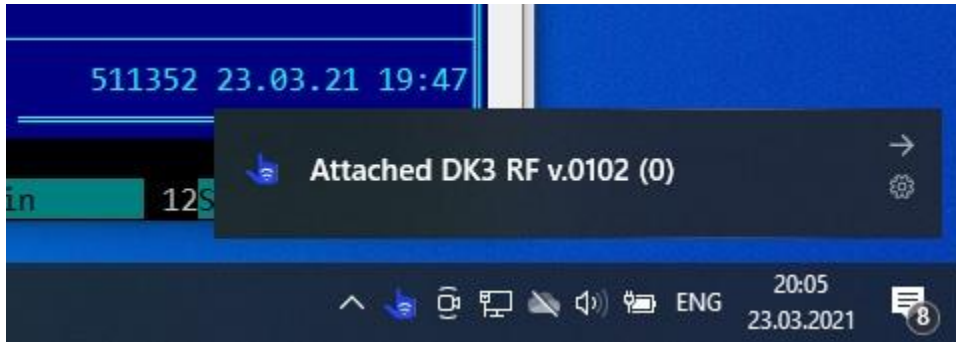
Though one adapter is enough to work with both 11Dvr Gloves, it is strongly recommended that you use both of them.

The radio dongles use MIMO technology and using two adapters with some distance between each other can help increase the strength of the connection. to make connection.

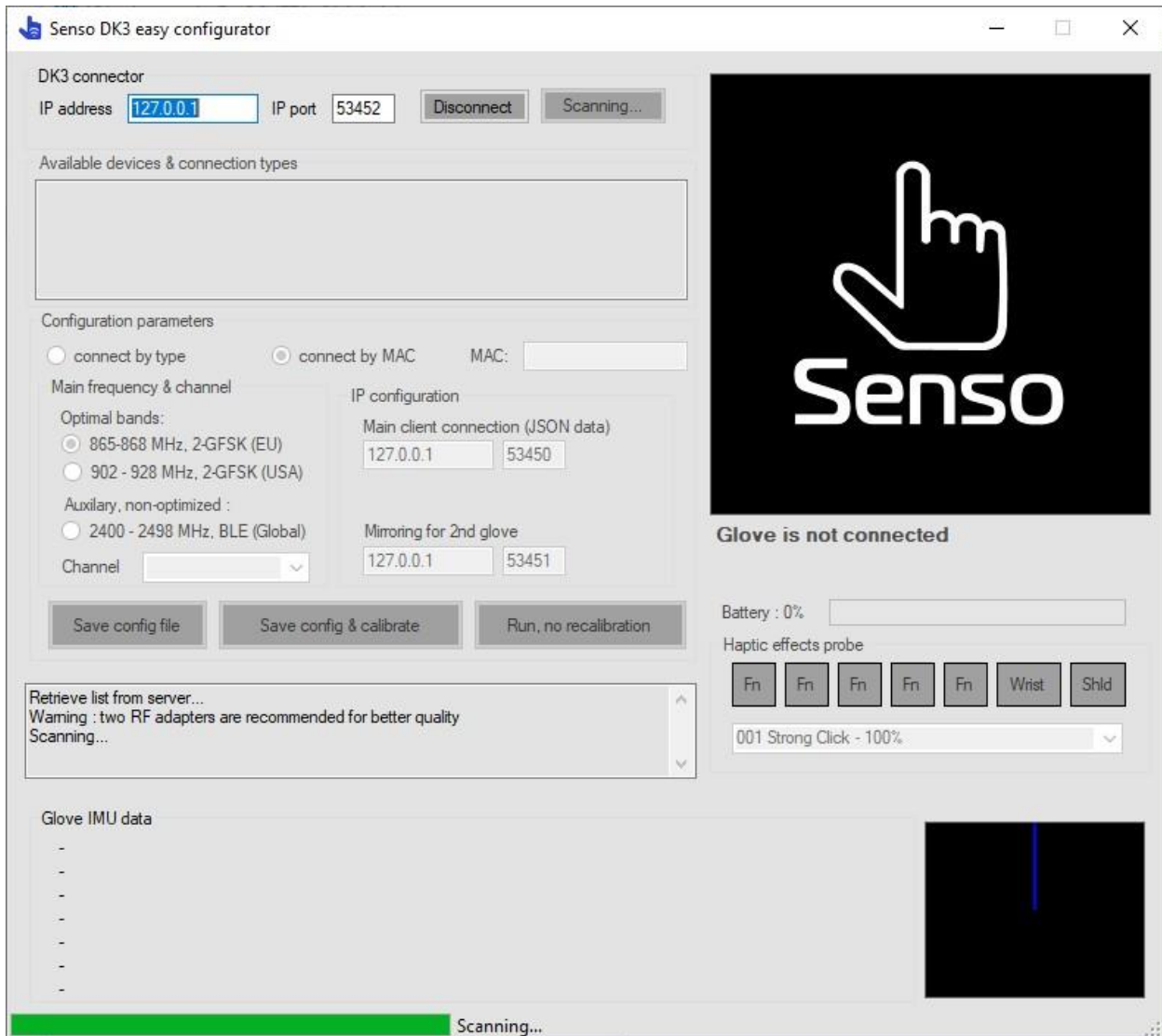
New Picture*



At this step you should see blue icon in the system tray which shows active state of the RF adapters

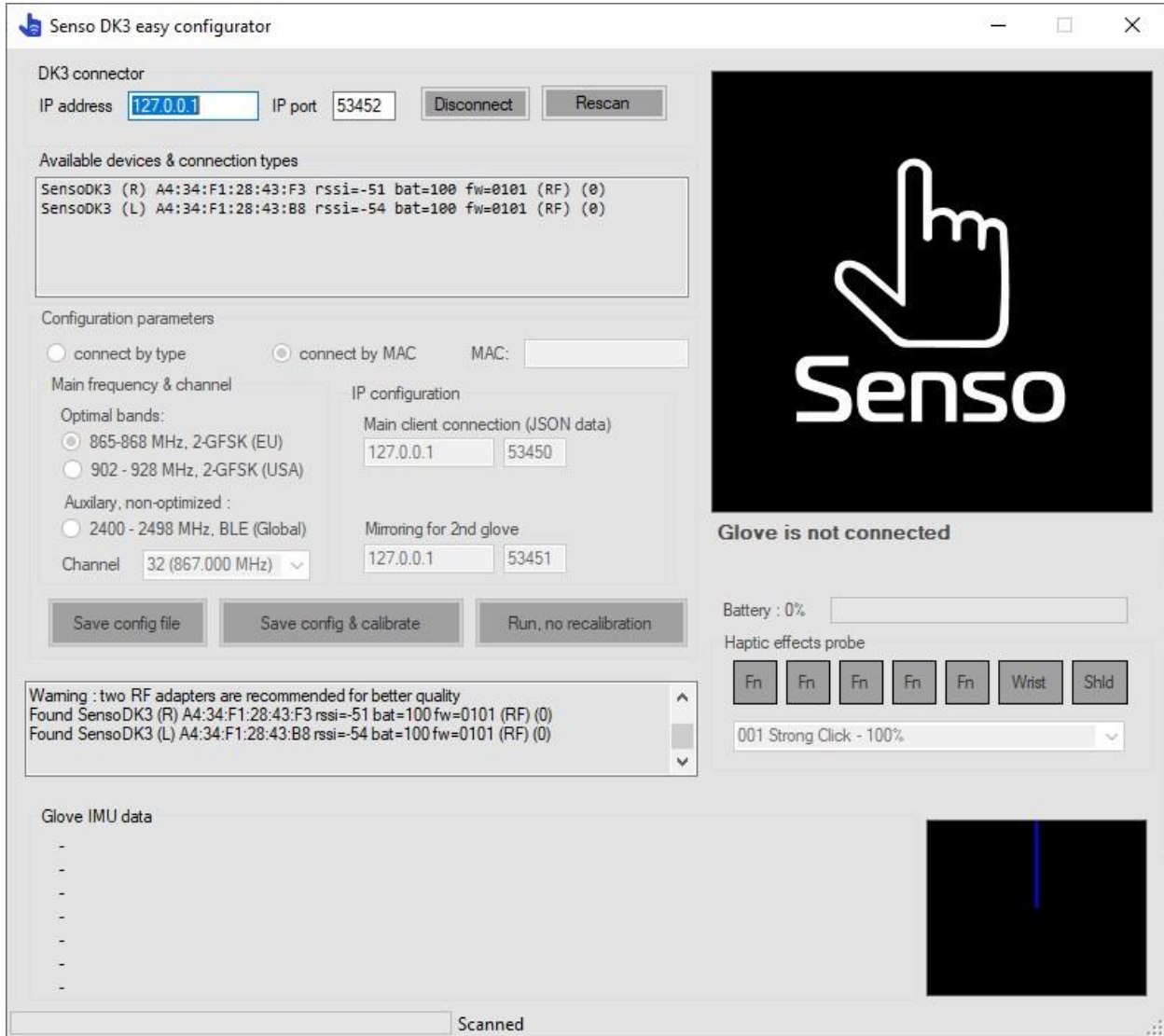


Launch DK3_GUI.exe



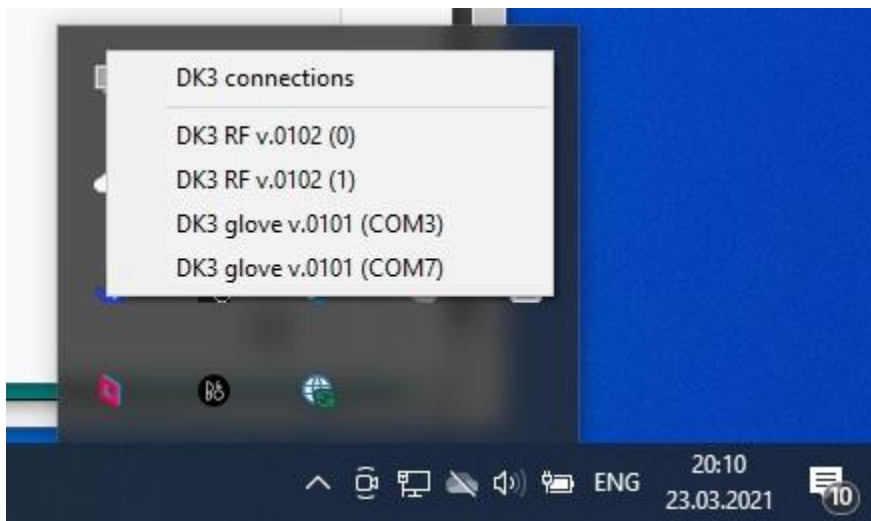
This GUI is the easiest way to find and configure the DK3 gloves.

After the launch it will scan and show all DK3 devices nearby.

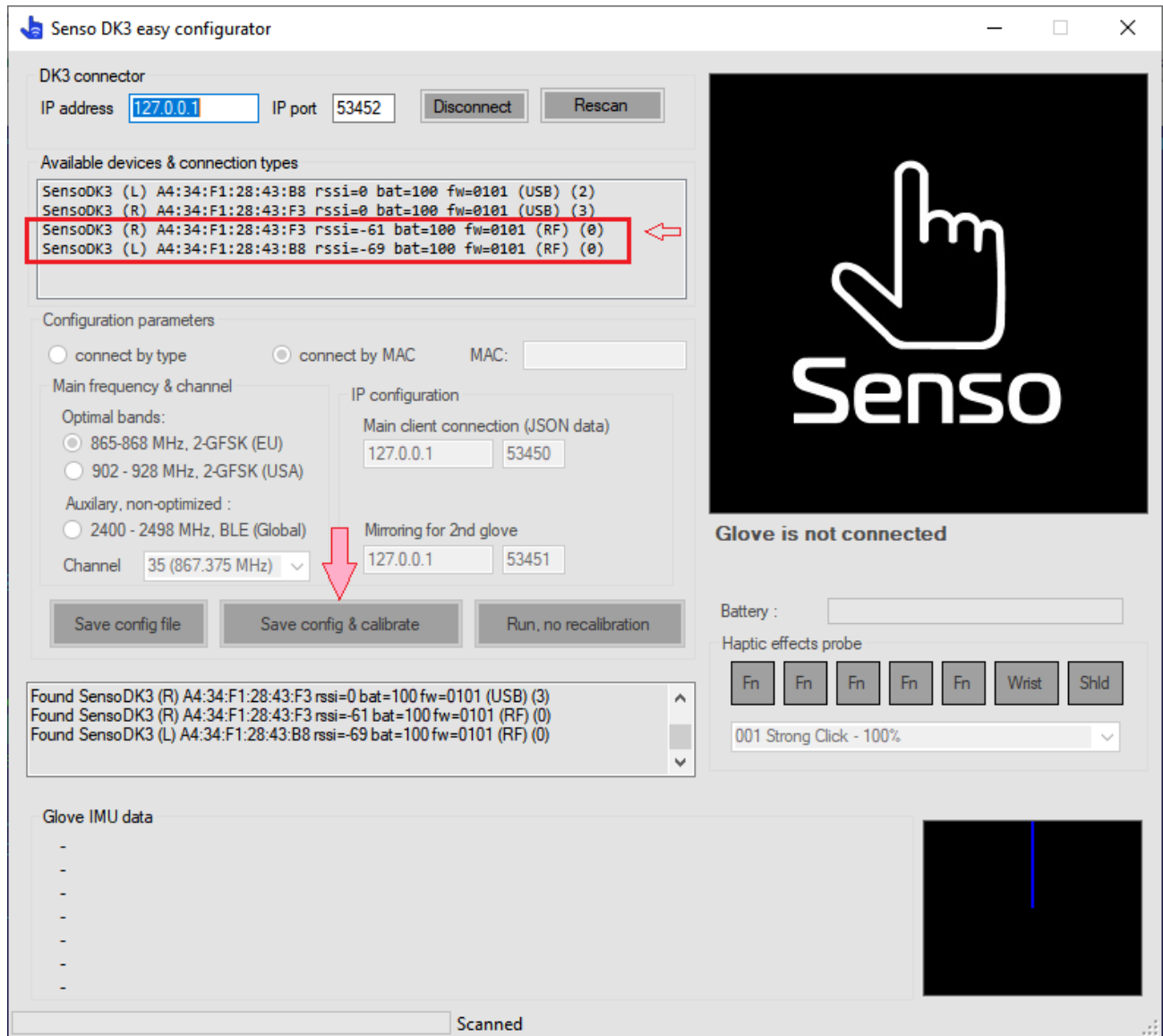


In case, you don't see devices in the list, please ensure that the gloves are charged, and are within close proximity of the RF adapters.

If you connect gloves to your computer via USB for charging you will probably see additional strings in system tray and in the GUI interface



The 11Dvr Gloves can use both RF or USB connectivity, but the most useful way is to use RF connectivity.



Here are three RF options you can choose - ISM band 865 (European Union), 902-928 (US / North America) or universal worldwide band 2400 which is available everywhere but **not** recommended due to performance issues and interference with other devices or WiFi networks.

Choose the proper option suitable for your location. You can also choose radio channel (random by default)

Now it's time to put 11Dvr Gloves on and calibrate them.



The calibrating procedure is needed to detect the position of built in sensors, with accordance to the fabric of the glove, and the anatomy of the hand.

Place your hand at flat surface **with all fingers together including thumb**, then click '**Save config & calibrate**' (or just double click at the selected glove in the list).

After several seconds you will see the first-time calibration procedure. Here you will need to follow three simple steps.

Senso DK3 easy configurator

DK3 connector
 IP address IP port

Available devices & connection types

SensoDK3 (R)	A4:34:F1:28:43:F3	rsssi=-64	bat=100	fw=0101	(RF)	(0)
SensoDK3 (L)	A4:34:F1:28:43:88	rsssi=-67	bat=98	fw=0101	(RF)	(0)

Configuration parameters

connect by type connect by MAC MAC:

Main frequency & channel

Optimal bands:

865-868 MHz, 2-GFSK (EU)
 902 - 928 MHz, 2-GFSK (USA)

Auxiliary, non-optimized :

2400 - 2498 MHz, BLE (Global)

Channel


IP configuration

Main client connection (JSON data)

client : connected

Mirroring for 2nd glove

SteamVR driver configured
 Launch "Senso_DK3_processing.exe /ini=C:\nsis_senso\config_data\configuration_A4_34_F1_28_43_B8.ini"

Place palm on the table and stay calm
 rsssi=-57/-60, temp=28 C, Vb=4.139V Vp=3.976V (69/69)
 mag=[-175,-126, 186] grv=[-0.8,-3.0, 9.3] lia=[0.0, 0.0, 0.0]
 Battery : 100% 

Haptic effects probe

001 Strong Click - 100%

Glove IMU data

	Central	wrist	Thumb_1	Fn1	Fn2	Fn3	Fn4	Thumb_2	Shoulder
A0:	-173	301	-776	-485	-693	-161	-1022	-329	0
A1:	-616	-275	1502	526	405	307	80	1188	0
A2:	1892	-2106	1080	2001	1921	2038	1770	1509	0
G3:	-156.5	6.6	-14.3	-2.9	-5.9	2.1	0.4	-25.1	0.0
G4:	44.3	-4.6	18.6	17.2	1.2	6.4	14.3	-0.5	0.0
G5:	0.1	-11.7	-9.3	-3.1	-5.4	-1.5	6.8	-1.3	0.0

Scanned

Please place your palm on the table for around 5 – 10 seconds (make sure it's flat as depicted on picture) and wait for the next step.

Senso DK3 easy configurator

DK3 connector
 IP address: IP port:

Available devices & connection types

SensoDK3 (R)	A4:34:F1:28:43:F3	rsssi=-64	bat=100	fw=0101	(RF)	(0)
SensoDK3 (L)	A4:34:F1:28:43:88	rsssi=-67	bat=98	fw=0101	(RF)	(0)

Configuration parameters

connect by type connect by MAC MAC:

Main frequency & channel

Optimal bands:

865-868 MHz, 2-GFSK (EU)
 902 - 928 MHz, 2-GFSK (USA)

Auxiliary, non-optimized :

2400 - 2498 MHz, BLE (Global)

Channel:


IP configuration

Main client connection (JSON data)

client : **connected**

Mirroring for 2nd glove

SteamVR driver configured
 Launch "Senso_DK3_processing.exe /ini=C:\nsis_senso\config_data\configuration_A4_34_F1_28_43_B8.ini"

Raise your hand as shown on picture
 rsssi=-53/-55, temp=30 C, Vb=4.136V Vp=3.976V (64/64)
 mag=[-168,-117, 182] grv=[-0.6,-2.8, 9.4] lia=[0.0, 0.0,-0.1]
 Battery : 100% 

Haptic effects probe

001 Strong Click - 100%

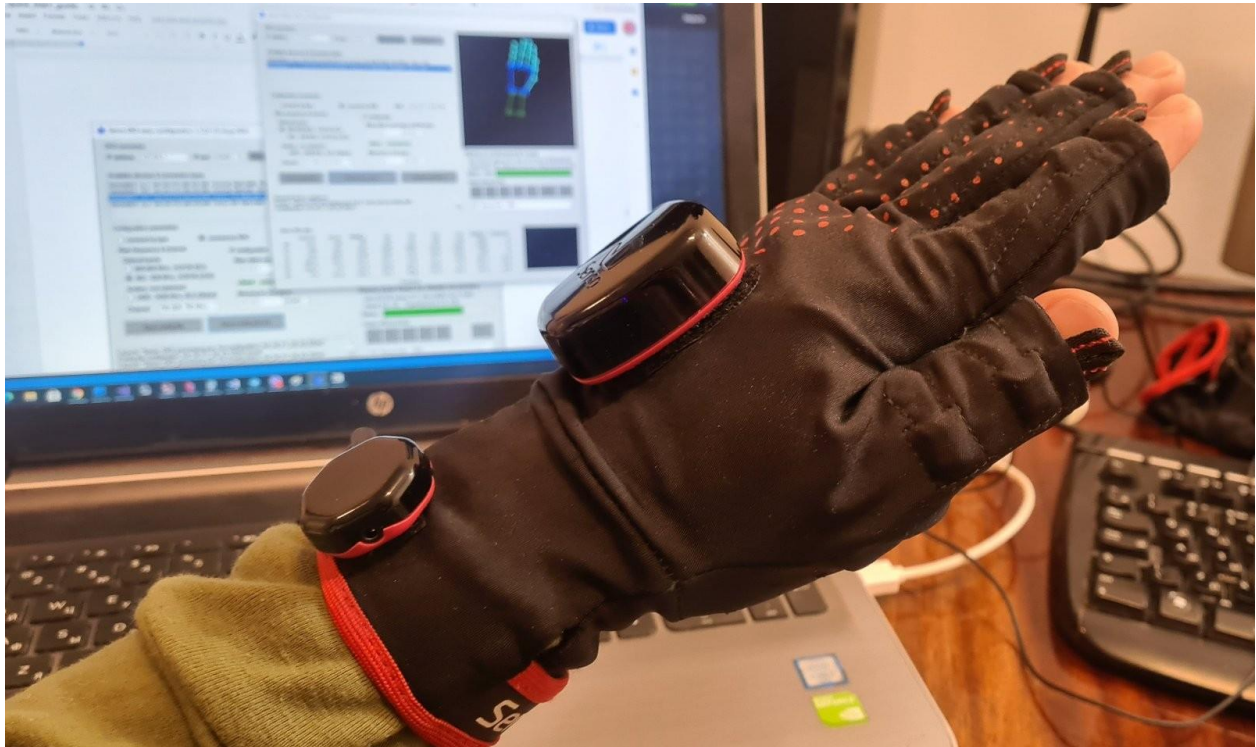
Glove IMU data

	Central	wrist	Thumb_1	Fn1	Fn2	Fn3	Fn4	Thumb_2	Shoulder
A0:	-116	316	-767	-426	-642	-168	-897	-296	0
A1:	-565	-203	1541	588	461	335	25	1228	0
A2:	1912	-2121	1001	2056	1907	2044	1839	1484	0
G3:	-143.2	8.1	-12.9	-3.3	-0.7	-7.6	-4.5	-16.1	0.0
G4:	29.8	0.8	0.4	9.3	-0.5	-3.4	-7.2	-5.3	0.0
G5:	-0.1	-18.8	-2.9	-4.4	-1.7	-5.5	-3.6	1.5	0.0

Scanned

Next, raise your hand gradually, without any rotation, and with all the sensors along one line. You have now completed the calibration procedure.

Extra notes: Try not to make any random movements during the calibration process. Also please remember to keep your fingers together, as depicted.



If everything is done correctly, you will see this screen.

Senso DK3 easy configurator

DK3 connector
 IP address: 127.0.0.1 IP port: 53452 [Disconnect] [Rescan]

Available devices & connection types

SensoDK3 (R)	A4:34:F1:28:43:F3	rssi=-64	bat=100	fw=0101	(RF)	(0)
SensoDK3 (L)	A4:34:F1:28:43:B8	rssi=-67	bat=98	fw=0101	(RF)	(0)

Configuration parameters

connect by type connect by MAC MAC: A4:34:F1:28:43:B8

Main frequency & channel

Optimal bands:

865-868 MHz, 2-GFSK (EU)

902 - 928 MHz, 2-GFSK (USA)

Auxiliary, non-optimized :

2400 - 2498 MHz, BLE (Global)

Channel: 21 (865.625 MHz)

IP configuration

Main client connection (JSON data)
 127.0.0.1 53451

client : **connected**

Mirroring for 2nd glove
 127.0.0.1 53450

[Save config file] [Disconnect glove] [Disconnect glove]

SteamVR driver configured
 Launch "Senso_DK3_processing.exe /ini=C:\nsis_senso\config_data\configuration_A4_34_F1_28_43_B8.ini"

Glove is connected & ready
 rssi=-53/-55, temp=35 C, Vb=4.103V Vp=3.952V (66/66)
 mag=[-205,-137, 183] grv=[4.1,-3.7, 8.1] lia=[0.0,-0.0,-0.0]
 Battery : 100%

Haptic effects probe

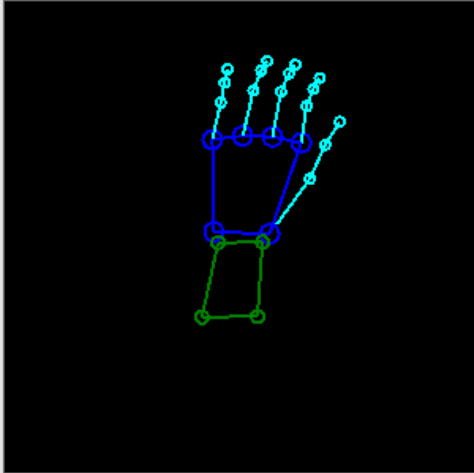
[Fn] [Fn] [Fn] [Fn] [Fn] [Wrist] [Shld]

001 Strong Click - 100%

Glove IMU data

	Central	wrist	Thumb_1	Fn1	Fn2	Fn3	Fn4	Thumb_2	Shoulder
A0:	840	-37	-95	-732	-1070	-652	-1441	359	0
A1:	-754	-596	1566	388	424	437	-186	1373	0
A2:	1647	-2016	1202	1963	1706	1843	1437	1338	0
G3:	-185.3	-39.8	-21.1	46.3	37.8	6.5	-11.3	-19.9	0.0
G4:	-230.8	33.7	17.5	11.7	-9.7	-14.6	7.8	18.8	0.0
G5:	53.3	-9.6	-7.2	4.9	5.3	11.1	20.8	6.7	0.0

Scanned



Now the 11Dvr glove is ready to use.

Click 'Disconnect glove' and repeat the same procedure for the other VR glove.

Now that the 11Dvr gloves are calibrated and you can check that everything is working correctly by pressing the 'Run, no calibration' button. Simply put your hands in the same flat position before clicking it, otherwise the 11Dvr Glove will start from a different pose and it will restore proper position during future movements.

If you accidentally calibrate the 11Dvr Glove, in a position other than the horizontal flat pose, or if something wrong happens during tracking, The 11Dvr Glove will eventually return itself to the natural pose, but you can save the time by doing these movements:

- Try to wave the 11Dvr Glove up and down, imagine you are smacking an imaginary table
- Try to wave the 11Dvr Glove in another position, for example imagine you are giving someone a handshake

If you have SteamVR installed on your computer, you do not need to do anything else - the drivers will work immediately after restarting SteamVR.

2. Using the 11Dvr Gloves with SteamVR.

As a SteamVR controller, the 11Dvr Glove DK3 uses, not only the skeleton of the hand, but the bindings and render models of the controller. It is possible to use any model, but for sake of compatibility, the pre-default state is a simulation of the Valve Index controller which supports precise hand and finger tracking features.

All the configuration settings for the 11Dvr Gloves can be tuned in configuration files - including haptics, gesture recognition and positioning.

We recommend you to watch [demo video](#) from our partners website to see how to use the gestures with the 11Dvr Glovers.

As a brief introduction, here is a list of possible gestures, defined in configuration files.

1. Calibration pose (to correct the direction of the hand)



Place your hand in a horizontal position, as shown in the photo.
After about 1 second, in the case of a successful recognition of this gesture, there will be a continuous vibration. You can define the proper position at any time.
End of this gesture is changing pose to any other.

2. Click "System" button



This pose with hand directed up is a simulation of the event "click system" = /input/system/click

3. Button "B"



Quickly move your thumb down (please do not bend it). This will simulate `/input/b/click`.

4. Button "A"



As for "B" - move your thumb quickly down, with a slight bend.
This will result in `/input/a/click`.

5. Trigger



Bend your index finger.

As a result, value `/input/trigger/value` will be changed from 0 to 1 (click / shot in games)

6. Grip



Bend your middle finger.

As a result, `/input/grip/force` value will be changed from 0 to 1.

Usually it is used for grabbing and squeezing in games.

7. Moving hand farther



Result will be changing the position of the hand.
This gesture can be used to interact with objects located far from the typical reach.

8. Moving hand close



Opposite gesture, to make the hand close to the observer.

9. Thumbstick



Move your thumb quickly down and 'click' it onto your index finger which is slightly bent. Will result in switching the thumbstick on, and changing its values. As confirmation of the switching state from off to on, there will be pulsing of vibration for thumb.

Then you can change the position of the thumb, to change X and Y values of the thumbstick.

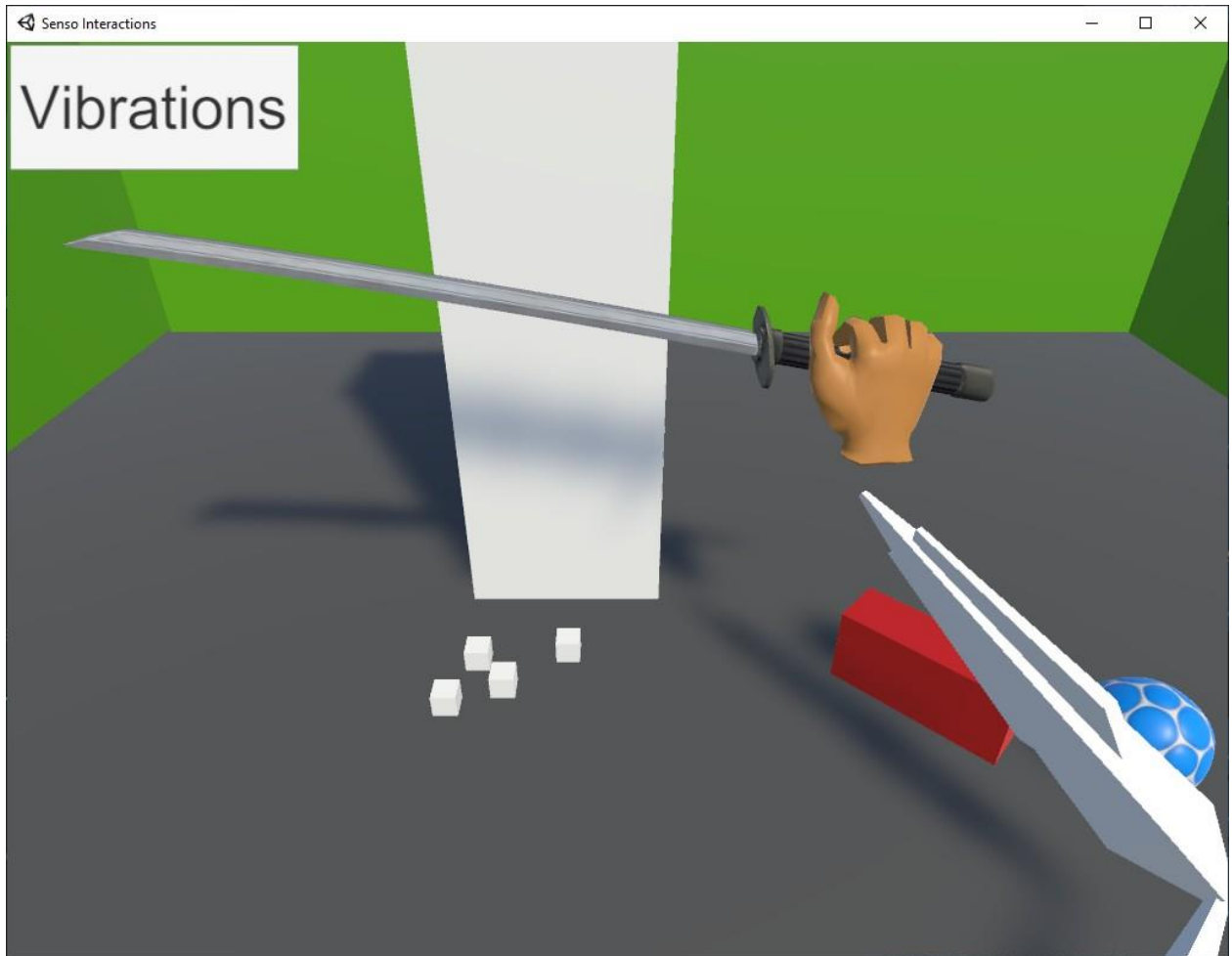


To end this gesture just move up your thumb, or relax your index finger. See videos on the of our partners site for more details ([demo video](#)).

If you're not planning to use 11Dvr Gloves in any other way than in the SteamVR environment, further reading of this manual will not be useful for you.

3. Short information for developers

In case if you prefer to use 11Dvr Glove directly without SteamVR for your Unity / Unreal software, as working example you can download and unpack SensoInteractionsDemo.exe Launch SensoInteractions.exe and check it with **right** glove



All the time while your VR glove is connected and works you can see additional console application

```
C:\nsis_senso\Senso_DK3_processing.exe
FPS 95/ 95 rssi=-48
FPS 94/ 94 rssi=-45
FPS 96/ 97 rssi=-45
FPS 94/ 94 rssi=-45
FPS 96/ 96 rssi=-45
FPS 95/ 97 rssi=-45
FPS 99/ 99 rssi=-45
FPS 96/ 97 rssi=-45
FPS 93/ 96 rssi=-44
FPS 98/ 98 rssi=-44
FPS 98/ 99 rssi=-46
FPS 94/ 97 rssi=-46
FPS 93/ 94 rssi=-43
FPS 97/ 99 rssi=-44
FPS 95/ 98 rssi=-46
FPS 95/ 97 rssi=-45
FPS 97/ 98 rssi=-46
FPS 92/ 96 rssi=-46
Glove is connected (0)
FPS 0/ 1 rssi=-46
Glove is connected (0)
FPS 2/ 8 rssi=-45
FPS 99/101 rssi=-45
FPS 93/ 94 rssi=-44
FPS 97/ 99 rssi=-44
FPS 34/ 36 rssi=-43
FPS 92/ 94 rssi=-43
FPS 98/ 98 rssi=-43
FPS 17/ 17 rssi=-43
```

This application, `Senso_DK3_processing.exe`, and connector `Senso_DK3_connector.exe` are necessary for working with VR gloves.

`Senso_DK3_GUI.exe` itself is a useful tool for visualisation and first time quick start but it isn't necessary and, probably, in your projects you'll not use it but rather prefer to start everything manually from your project.

After first time calibration procedures you'll have additional files in your `Senso_DK3` directory `configuration_A4_34_F1_28_43_D0.ini` and `calibration_a4_34_f1_28_43_d0.dat` (these letters and numbers depends on MAC address of your glove)

Anytime you need to work with VR glove you just have to launch `Senso_DK3_processing.exe` with parameters like

`Senso_DK3_processing.exe /ini=configuration_A4_34_F1_28_43_D0.ini`
(make sure that `Senso_DK3_connector.exe` is working and visible in the system tray).
For disconnecting VR glove put it into standby mode and close `Senso_DK3_processing.exe`

All the parameters are configurable via config file or keywords, so you can choose freely IP addresses and ports, bands and other parameters.

3. Technical manual

The 11Dvr DK3 glove has six Bosch BMI160 sensors for fingers (one per each finger and two for thumb), main central sensor Bosch BNO055, 5 LRA vibration motors and Texas Instruments haptic controller DRV2605.

Wrist module is a separate part which has Bosch BMX055 IMU sensor, one LRA vibration motor and DRV2605 as well.

Wrist module provides USB 2.0 connectivity which can be used for transferring data from and to the glove as well as via radio interface, and also can be used for firmware update.

For the radio transport the 11Dvr Glove uses TI CC1350 MCU which is capable of supporting almost any sub 1GHz frequency, including 863-868, 902-928 and 2400-2500 ISM bands.

For the discovering and broadcasting purposes the 11Dvr Glove uses BLE 4.0 channels 37,38,39 in BLE packets format, therefore the glove can be visible as any other Bluetooth device but without possibility to connect over BLE transport.

For transferring data after connection handshake on channels 37-39 the 11Dvr Glove uses sub-1GHz configurable channels (863-868 or 902-928 bands depending on country).

Check local regulations to use proper bands in your area.

ISM 2400 band is also available for use but not recommended due to poor quality of the signal and interference with other devices like WiFi.

Software pack consists of three main components

- Senso_DK3_GUI.exe
- Senso_DK3_processing.exe
- Senso_DK3_connector.exe

Senso_DK3_connector.exe is a low-level transport part which provides connectivity via USB or radio interfaces.

Is it possible to run Senso_DK3_connector on one computer and other modules on another because all of them use IP/UDP transport for connection to each other.

Senso_DK3_processing is the main computation module which receives all low-level data from Senso_DK3_connector and transforms it into JSON data packets. It allows multi clients connectivity, so many applications can work with the same glove at the same time.

Senso_DK3_GUI is a tool for quick start configuration processes and raw visualisation & basic haptic tests.

For proper working Senso_DK3_processing requires configuration file with all necessary parameters including glove address (or type), USB or radio transport, ISM band and channel etc.

An alternative solution is to launch Senso_DK3_processing with proper keywords in the command line, though the configuration file is more detailed.

Several Senso_DK3_processing can be launched at the same time in order to use several VR gloves (right and left, for example)

Each Senso_DK3_processing instance should be configured with different IP ports because no application can share the same IP/port pair with others, therefore users software should connect to each Senso_DK3_processing instance.

As an alternative it's also possible to configure one Senso_DK3_processing instance as a data collector and route other Senso_DK3_processing instances to this one. It allows having one connection point.

Before using a VR glove it requires fast calibration procedures. It can be done every time or just once.

Radio interface is provided by RF USB adapters. Each adapter can be used as part of the whole mesh network or standalone.

Available options are these :

- one adapter with two (or more) gloves

Pros : using just one RF channel for all gloves, less equipment

Cons : less FPS per each glove, blind radio spots.

- one adapter per each glove

Pros : best FPS per each glove

Cons : requires RF channels for each glove, separated by 1MHz interval at least

- two adapters for one or two gloves

Pros : one RF channel for all gloves, best radio quality (software MIMO), less blind RF spots

Cons : less FPS per each glove

We recommend the last option for best radio coverage.

All these options can be configured with the configuration file of Senso_DK3_processing module.

In theory it is possible to build a big mesh network with many RF adapters to cover huge areas and seamless connectivity.

Typical distance of good reception quality is about 3-5 meters but it depends on circumstances.

For sub-1GHz bands it is possible to assign several radio channels simultaneously with real time switching between them.

4. Examples

Senso_DK3_processing.exe /ini=configuration_A4_34_F1_28_43_D0.ini

Launch Senso_DK3_processing with configuration file "configuration_A4_34_F1_28_43_D0.ini"

Example of configuration file

```
-----  
MAC A4:34:F1:28:43:D0  
#usb  
server 127.0.0.1 53452 0  
server 127.0.0.1 53452 1  
client 127.0.0.1 53450  
SET_RF 902 FSK 10000 30 50  
SET_CH 198 198 198 198  
SET_TM 4 -70 -99 0  
save_calibration 1  
debug 1  
-----
```

These parameters are doing these things :

- connection will be with Senso DK3 glove with MAC address A4:34:F1:28:43:D0
- it uses Senso_DK3_connector running on localhost (127.0.0.1) port 53452 (default value)
- it uses up to two RF adapters at the same time for best MIMO connectivity (two lines server 127.0.0.1 53452 0 and server 127.0.0.1 53452 1 where 0 and 1 are index of RF adapters on computer)
- it accepts incoming connection on port 53450 (default for Senso Unity/Unreal plugins)
- it uses base frequency 902 MHz and 2-GFSK coding scheme
- It uses channel 198 for all slots which gives result frequency $902 + 0.125 * 198 = 926.75$ MHz
- save_calibration 1 will perform calibration procedure just one time and save calibration data into file. To perform calibration procedure again, just remove calibration*.dat file in working directory.
- debug 1 is basic printout (set more for more details)

Example of configuration file for USB connectivity

```
-----  
MAC A4:34:F1:28:43:D0
```

```
usb
server 127.0.0.1 53452 0
server 127.0.0.1 53452 1
client 127.0.0.1 53450
save_calibration 1
debug 1
-----
```

Example of configuration files for two gloves

```
configuration_A4_34_F1_28_43_D0.ini
-----
```

```
name SensoDK3
MAC A4:34:F1:28:43:D0
#usb
server 127.0.0.1 53452 0
server 127.0.0.1 53452 1
client 127.0.0.1 53450
mirror 127.0.0.1 53451
hand right
SET_RF 902 FSK 10000 30 50
SET_CH 198 198 198 198
SET_TM 4 -70 -99 0
save_calibration 1
debug 1
```

```
configuration_A4_34_F1_28_43_E0.ini
-----
```

```
name SensoDK3
MAC A4:34:F1:28:43:E0
#usb
server 127.0.0.1 53452 0
server 127.0.0.1 53452 1
client 127.0.0.1 53451
mirror 127.0.0.1 53450
hand left
SET_RF 902 FSK 10000 30 50
SET_CH 198 198 198 198
SET_TM 4 -70 -99 0
save_calibration 1
debug 1
```

Parameter mirror is used to route traffic between two instances, so the user's application can connect to any of the 53450 or 53451 ports and have all the data for all gloves at the same time.