CaptoGlove™ Ver. 1.0

USER MANUAL

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WELCOME TO CAPTOGLOVE

Your new CaptoGlove is the result of more than 5 years of continuous development and passion that the team behind it has put and keeps putting every day in this project. We poured our hearts into making your new CaptoGlove, giving it the best quality in terms of materials used and engineering currently available on the market.

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FCC WARNING

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

NOTE 1: Any changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio and television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help

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REGISTRATION

You can register an account to participate to CaptoGlove's forum by sending an email to support@captoglove.us with your first name, last name and order number.

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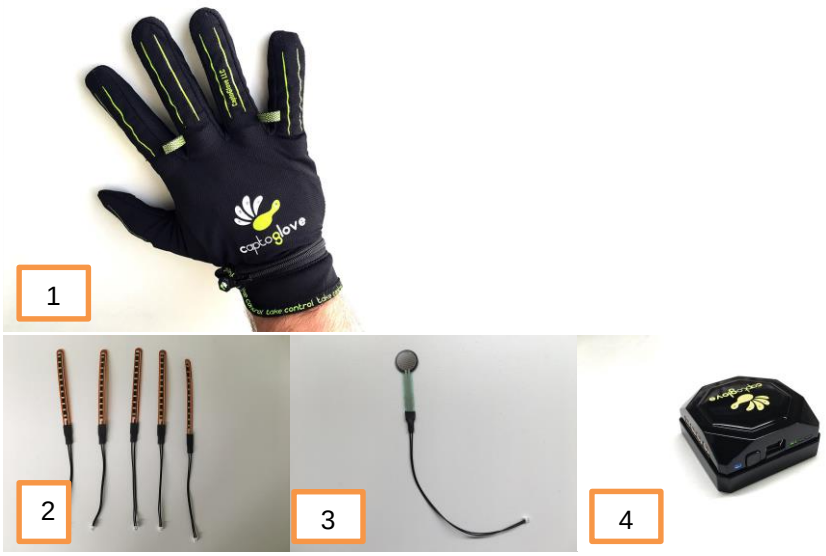
CAPTOGLOVE SYSTEM OVERVIEW

General

CaptoGlove satisfies the requirement of flexibility needed to interact with your technology whether your aim is to play a game or run any other type of application.
CaptoGlove can currently be connected to Windows 8-10 PCs and will soon connect to iOS, Mac and Android devices.
CaptoGlove can virtually communicate with any Bluetooth Low Energy device provided that an integration with such devices exists or a specific configuration set up is available.

Every CaptoGlove is composed of:

1. 1 textile glove
2. 5 bending sensors;
3. 1 or more pressure sensors;
4. 1 CaptoSensor.



CaptoGlove's travel bag includes:

- 1 or 2 CaptoGlove;
- 1 or 2 mini USB – USB cables;
- 1 or 2 CaptoSensor (Optional).

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Wearing CaptoGlove

A simple but effective way to preserve your CaptoGlove integrity is to wear and undress it accurately. In order not to damage the sensors inside it, CaptoGlove should be removed using the specific rings. In this way, the likelihood of having malfunctioning sensors during CaptoGlove's life will be significantly reduced. Also, after having worn it, verify that all the bending and pressure sensors are correctly inserted and in the correct position. This will provide the best accuracy for fingers tracking. Also, CaptoSensor should be positioned under the CaptoGlove logo on the textile and a bit moved toward the thumb to enable enough cable length for the Thumb sensor connector. You can find a video on that at https://youtu.be/SUEzTqjYIUk.

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CaptoSensor Usage Conditions

Every CaptoSensor contains a rechargeable lithium-polymer battery. Lithium-polymer batteries have high energy densities and can be dangerous if not used and cared for properly. CaptoSensor has been designed to include multiple levels of battery safety assurance. Their circuitry includes smart charging circuitry with thermal management to prevent over-charging the battery. The battery pack itself also includes protection circuitry to prevent over-charge, over-voltage, over-current, and over-discharge conditions.

Most battery issues arise from improper handling of batteries, and particularly from the continued use of damaged batteries.

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CaptoSensor Overview

The CaptoSensor is a miniature, high-precision, high-reliability, Attitude and Heading Reference System (AHRS). The Attitude and Heading Reference System (AHRS) uses triaxial gyroscope, accelerometer, compass and single-axial barometer sensors in conjunction with advanced on-board filtering and processing algorithms to determine orientation relative to an absolute reference orientation in real-time (10DOF).
Orientation can be returned in absolute terms or relative to a designated reference orientation. The CaptoSensor system also utilizes a dynamic sensor confidence algorithm that ensures optimal accuracy and precision across a wide range of operating conditions.

1. **Bluetooth Connectivity –** The CaptoSensor connects via Bluetooth Low Energy to the PC or to any other desired device if compatible. The Bluetooth Low Energy and the 500 mAh battery allows for more than 10-hour continuous usage.
2. **USB Connector**– The CaptoSensor can also be connected to a computer using a mini USB – USB cable. The USB connector charges the battery and provides for both power and communication signals. When connected via USB, the unit is powered and the battery will begin recharging even if the CaptoSensor is turned off. The connection via cable is required to update the firmware. If the battery is below a certain level of power, when the cable is connected, push the button to turn on and activate recharging of CaptoSensor;
3. **Push Power Switch**– CaptoSensor can be switched on and off when powered from the internal battery by using the power switch. To turn the CaptoSensor on simply click the power button. To turn it off hold the button for 3 seconds and then release it. Holding the button for 6 seconds will reset the Bluetooth connection and a white light will appear for some seconds;
4. **Input Connection Holes** – The CaptoSensor includes up to 10 inputs operated by the bending and pushing sensors. The input buttons can be used in conjunction with the orientation sensing capabilities of the device;
5. **Indicator LEDs**– The CaptoSensor includes an RGB LED that can be used for visual status feedback such as successful connection to controlled device or for enabled/disabled emulation.
   It also has 3 green LEDs that are used to give information about battery charging status and charge level.

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Bending Sensors

The bending sensors are placed on the top part of each finger, in correspondence of the green lines.
For a proper functioning, check that they are correctly positioned inside CaptoGlove.

The bending sensors can be triggered either when the finger closes or when it opens. The user can set the modality he/she prefers through the Suite configuration application. Bending sensors, moreover, can trigger up to two keys per sensor. It is possible to choose two thresholds at which a key is enabled.

Pushing sensors

The pushing sensors are placed on the palm side of user's hand. For a proper functioning, be sure that they are positioned in correspondence of the fingertips. The standard installation is in the pocket for Thumb's fingertip.

It is possible to assign, to each one of the pushing sensors, a function that can be triggered in different ways. The pushing sensors, in fact, can work in "pressing mode" i.e. the function assigned to a sensor is triggered every time a certain (customizable) level of pressure is applied to the sensor or they can work in "release mode" i.e. they are activated every time the sensor has been released. Pushing sensors, can trigger up to two keys per sensor. It is possible to choose two threshold levels at which different keys are enabled. These settings can be customized through the Suite configuration app. See below for a more detailed description.

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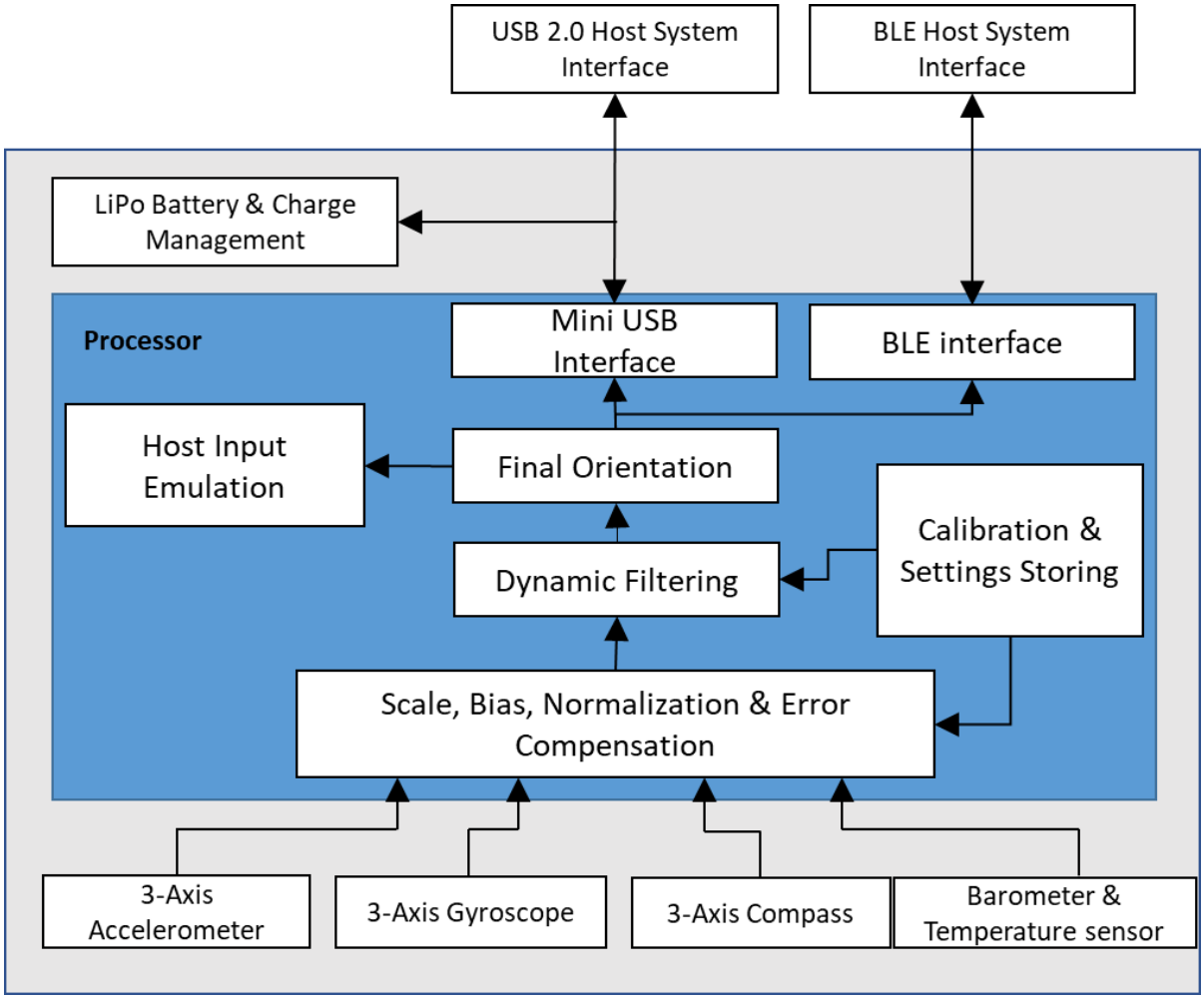
Wireless Sensor Block Diagram



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Assembling

Sometimes it may be necessary to remove all or some of the electrical components inside CaptoGlove, for instance if the user wants to wash it or if he/she needs to add some sensors. Please refer to the images below to visualize how such components are disposed inside the fabric.

CaptoGlove Textile Details

CaptoGlove's textile is made of two layers between which the electrical components such as the fingers sensors and the CaptoSensor lay. These components are therefore not visible from the outside, but are accessible by opening the zipper on CaptoGlove's wrist.

On the back side of the CaptoGlove's hand, inside the pocket, there is a velcro tape that keeps the CaptoSensor fixed. There are also some internal loops placed at the base of each finger that help the bending sensors stay in position as well as on the thumb for its pressure sensor.

On the side instead, close to the thumb finger there are two internal holes that allow the cable of the thumb pressure sensor reach the CaptoSensor and connect to it.

Refer to the following image for a graphical description of these details.

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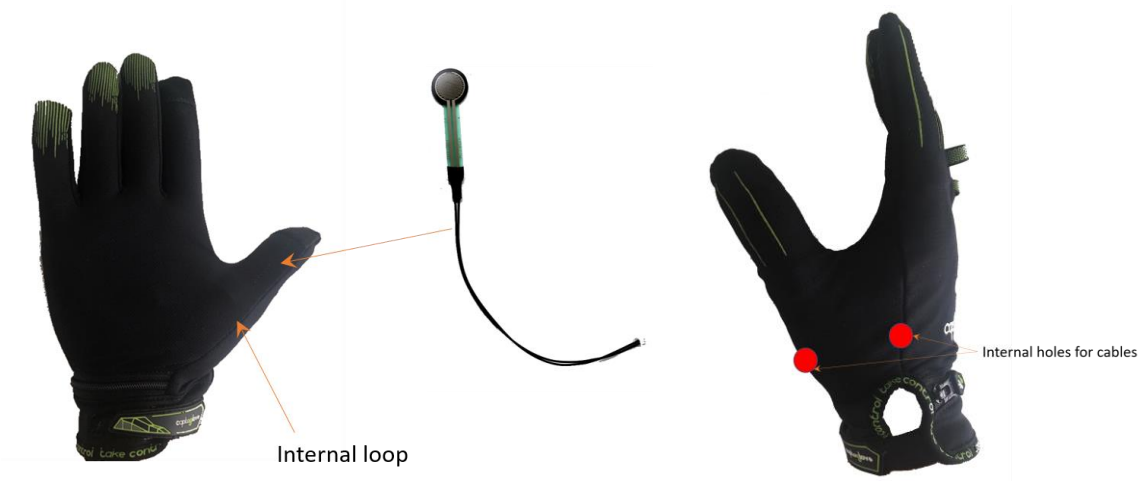

Instructions to remove electrical components inside CaptoGlove

This section contains a brief explanation on how to remove all the electrical parts from CaptoGlove. For a good understanding on how the sensors are placed inside CaptoGlove, please have a look at the following video https://youtu.be/0Epttra-rKE.

Proceed as follows:

- As first step unzip the zipper on CaptoGlove's wrist. You will access an internal pocket where the CaptoSensor is placed;
- Detach the sensors from the CaptoSensor by pulling them and paying attention not to damage the connectors;
- Once all the sensors have been detached remove the CaptoSensor from the velcro tape;
- **The pressure sensors are accessible from the palm of CaptoGlove, while the bending sensors are accessible from the backside;**
- At this point keeping the palm of CaptoGlove upwards, proceed in removing the pressure sensor from the thumb finger: pull gently the cable to make the white connector go through the holes and reach CaptoGlove's palm. Once the cable has gone through the holes, remove the sensor by pulling it upwards respect to the internal loop.
- After having removed the pressure sensor you can proceed removing the bending sensors by gently pulling them.

Instructions to assemble the electrical components inside CaptoGlove

This section contains a brief explanation on how to assemble all CaptoGlove's electrical parts.
The video at https://youtu.be/0Epttra-rKE explains how to assemble the sensors inside CaptoGlove and ***gives a good understanding on how CaptoGlove is made internally***.

Proceed as follows:

- Open the zipper and place CaptoGlove with the palm upwards;
- Insert the pressure sensor along the thumb finger by keeping the black part on the tip of the sensor downwards;
- Once the sensor has been well inserted, make the cable go under the loop at the base of the thumb finger;

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- Make the cable go through the two holes shown in the above image and reach the backside of the hand;
- Turn CaptoGlove on the backside;
- Take the bending sensor labeled n. 1 on the connector pin and insert it in the same hole where the cable of the pressure sensor exits, making the electrical circuits of the sensor face upwards;
- Insert the bending sensor in the designated area indicated by the green lines, making sure that the sensor passes beneath the internal loop;
- Proceed inserting the rest of the bending sensor using the n.3 for the index finger, n.5 for the medium finger, n. 7 for the ring finger and n. 9 for the little finger, paying attention that the side with the circuits is facing upwards;
- Place the CaptoSensor on the velcro tape with the side with the button orientated towards the zipper;
- Use the schema in the following section to connect the finger sensors to the CaptoSensor.

Connecting the finger sensors to CaptoSensor

The sensors are labeled with a small number written on the pin of each one of them that indicates to what connector on the CaptoSensor it should be connected. The position of the connectors on the CaptoSensor changes according to what CaptoGlove the user is using: left or right.

The schema used is as follows: odd numbers for bending sensors and even numbers for pushing sensors. In particular:

Bending:	**Pushing:**
1 – Thumb	2 – Thumb
3 – Index	4 – Index
5 – Middle	6 – Middle
7 – Ring	8 – Ring
9 – Pinkie	10 - Pinkie

Left CaptoGlove

Right CaptoGlove

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CAPTOGLOVE USAGE

To start using CaptoGlove download the CaptoGlove Suite from the download area at https://www.captoglove.com/downloads.
To participate in the technical forum, send an email to support@captoglove.us with first name, last name and order number of the purchase.

Basic Usage

There are few basic operations the user should get familiar with before starting using CaptoGlove.

Turn CaptoGlove On/Off

To turn CaptoGlove on and off the user must access the CaptoSensor inside it. Every CaptoSensor has a main button to turn it on or off. In order to turn it on, simply click the button once. If instead you want to turn it off hold the button for 3 seconds and release it. At this link https://youtu.be/OEln0BK1tWM you can find a video that shows how to do it.

Pair CaptoGlove to the PC

When using CaptoGlove for the first time or after having unpaired it from the PC, it is necessary to pair it to the PC.
A brief tutorial on YouTube shows how to pair CaptoGlove with a Windows PC, https://youtu.be/ByUQ0F9Sj34:

- Step 1: Turn CaptoGlove on
- Step 2: Hold the button for 6 seconds until the white light appears
- Step 3: On your PC open the Bluetooth settings and add CaptoGlove
- Step 4: Turn the CaptoGlove off and on again, open the Suite and connect. Alternatively, just restart Windows.

Windows terminology at regard can be misleading. Windows uses the word “Paired” to indicate a device that is known, but which is not necessarily connected (generally shown when the sensor is off and already paired). The word “Connected” is used when the PC and CaptoGlove are ready to exchange data over the Bluetooth connection (generally when sensor is on and already paired). As an example, it is possible to think of it as a phonebook: when a number is registered in the phonebook than it is “paired”. When a phone call with that number is ongoing, then the number is connected. If the number is deleted from the phonebook than it is unpaired.

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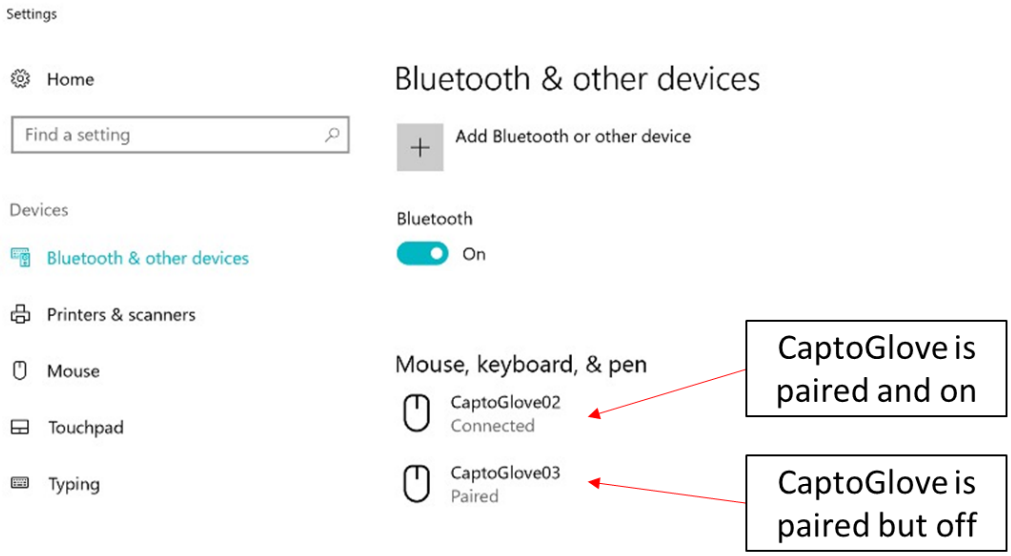

Unpair CaptoGlove from PC

Sometimes it may be necessary to unpair CaptoGlove from the PC to connect it to another one or to reset the Bluetooth connection. A short video on how to do it can be seen at https://youtu.be/5Q3YFdsKbf4:

- Step 1: Hold the button for 6 seconds to reset CaptoGlove's Bluetooth connection
- Step 2: select “remove device” from the Bluetooth settings on PC

Connect CaptoGlove to the PC Suite

To configure the way CaptoGlove works, it is necessary to connect it to the Pc Suite. A short tutorial on how to do it can be found at https://youtu.be/h6XfzHjgCd4:

- Step 1: Click on the green button to scan for a paired CaptoGlove
- Step 2: On the left choose the device you want to use
- Step 3: Click Connect

Troubleshooting while connecting to the Suite

Sometime, while trying to connect to the CaptoGlove, the Suite can get stuck on an orange exclamation mark. This means that it is not able to communicate with the CaptoGlove properly. Make sure that the CaptoGlove is on and try one of the following solutions:

1. Restart the Suite
2. Close the Suite, unpair CaptoGlove, pair it again, open the Suite and connect.
3. Restart Windows

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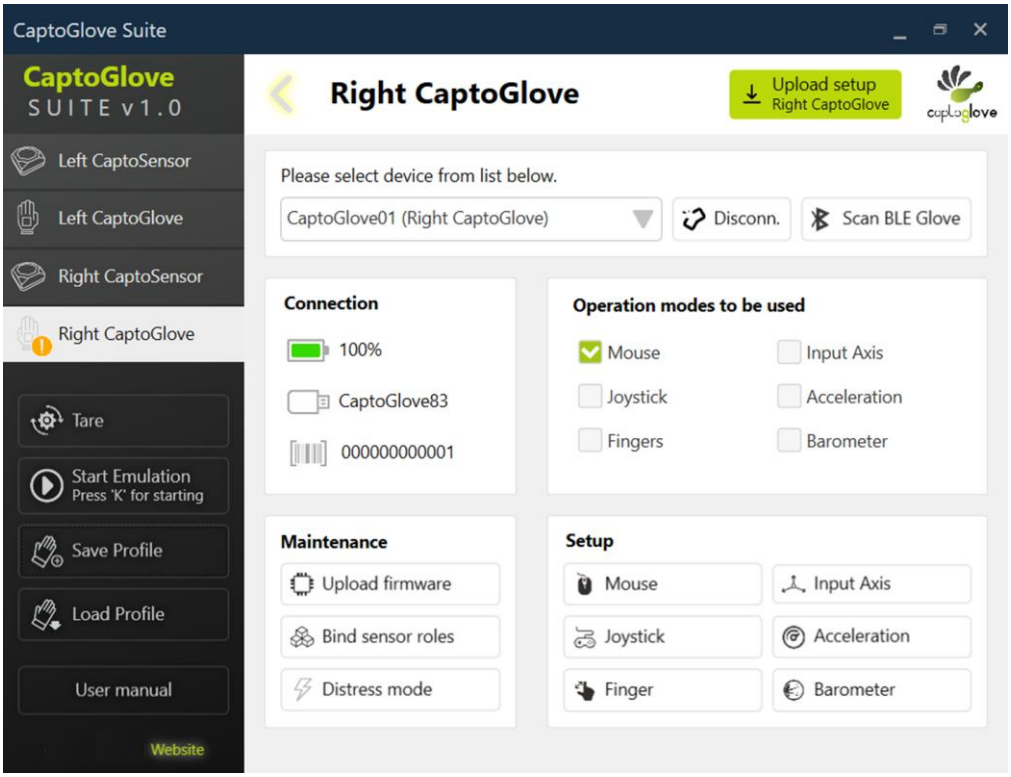

Update CaptoGlove Firmware

In order to keep CaptoGlove always updated with the new improvements and features, you may be required to update the firmware. Before starting the upload of the firmware remember to **connect the board via USB cable** and **unpair it from the associated Bluetooth devices**.
See this link https://youtu.be/k7dP5yQ96lI for a video tutorial on how to do it:

- Step 1: Press the Upload Firmware and connect CaptoGlove via USB
- Step 2: Select the file to upload
- Step 3: Press the Upload Firmware button and wait until completed

Refer to the Maintanance section below for more information.

PC Suite

The CaptoGlove Suite is a simple but very powerful user interface that allows CaptoGlove's functionalities to fit the most demanding user or experience.

NB: the CaptoGlove Suite may need to be added to the antivirus' exception list.

CaptoGlove's potential is extremely wide. When connected to the PC it can emulate mouse, joystick/gamepad and keyboard. Thanks to its sensors and their high precision it can perceive the great majority of user's hand and fingers movements. Each one of these movements can be translated into one of the standard inputs sent by traditional controllers (mouse, keyboard, joystick/gamepad).

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The suite displays also information about battery level, firmware version, serial number and manages firmware updates.

Start using CaptoGlove

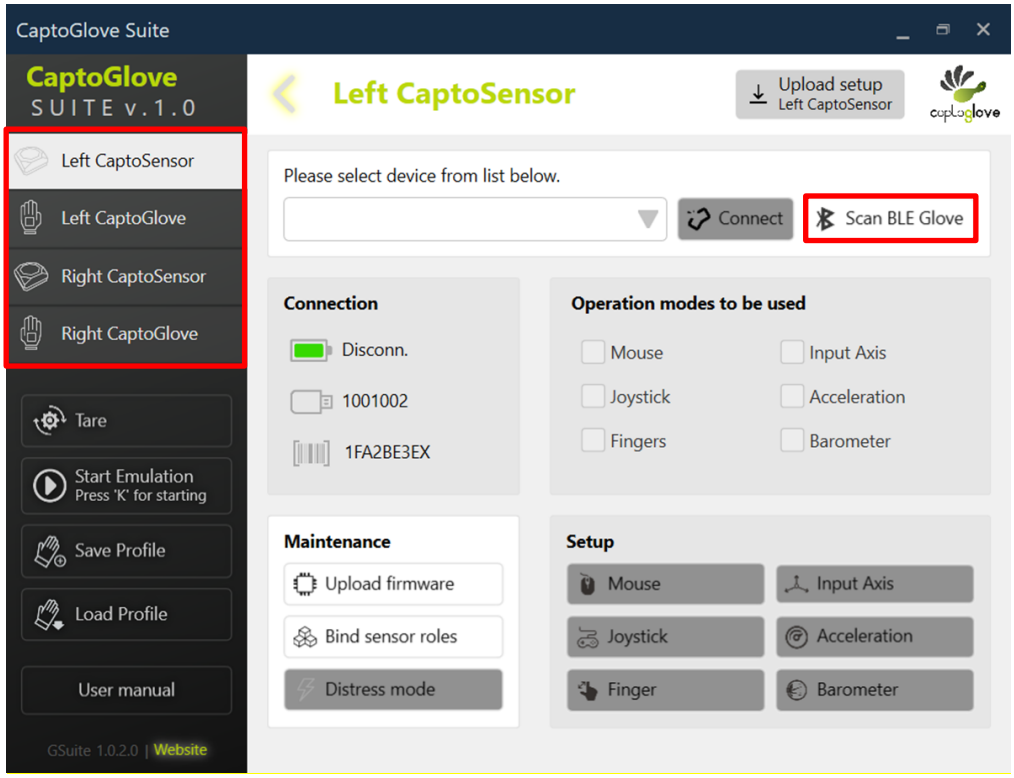
Once the CaptoGlove Suite has been downloaded and installed, it is possible to enter the configuration set up and customize the way CaptoGlove (CaptoSensor) works. A more detailed description of the operations listed above is presented here, with the help of the images of the CaptoGlove Suite.

Pair CaptoGlove with PC

Connect CaptoGlove (or CaptoSensor) to the PC via Bluetooth. To do so, turn on CaptoGlove (CaptoSensor) and open the Bluetooth settings on the PC. Push for more than 6 seconds the button on the CaptoSensor until the light becomes white. A CaptoGlove (CaptoSensor) entry will appear, ready to be paired. Pair it with the PC.

Connect CaptoGlove to the PC Suite

Once the PC and CaptoGlove (CaptoSensor) have been paired, launch the CaptoGlove Suite, select the device you want to use on the left and click on “Scan BLE Glove”.



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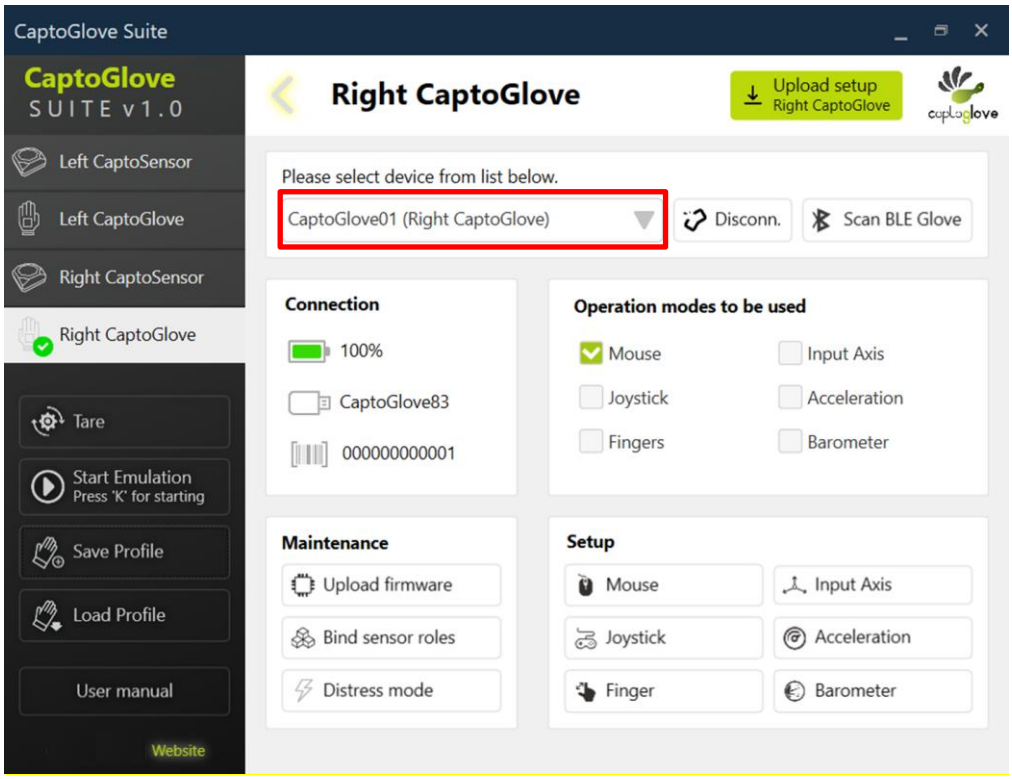
After having clicked on “Scan BLE Glove”, all the paired CapoGlove will be shown in the drop-down menu. Select the one you want to use and click on “Connect”. After few seconds, the CaptoGlove will be connected to the Suite and it will become active.

NB: Not all “Operations modes” and the options in the “setup” are active in current version of the Suite. They will be available in the near future.



Customize your settings

After having connected CaptoGlove to the Suite, it is possible to customize the way the user wants it to work, by choosing its operation modes and more specific settings relative to each mode in the setup section. The first settings that will appear are the one contained within CaptoSensor.

After having made any modification, the Suite will display the button in the top right corner red-colored. It is the Suite warning to save the new configuration in order to apply it to the CaptoGlove (or CaptoSensor). The configuration will be stored on the CaptoGlove itself.

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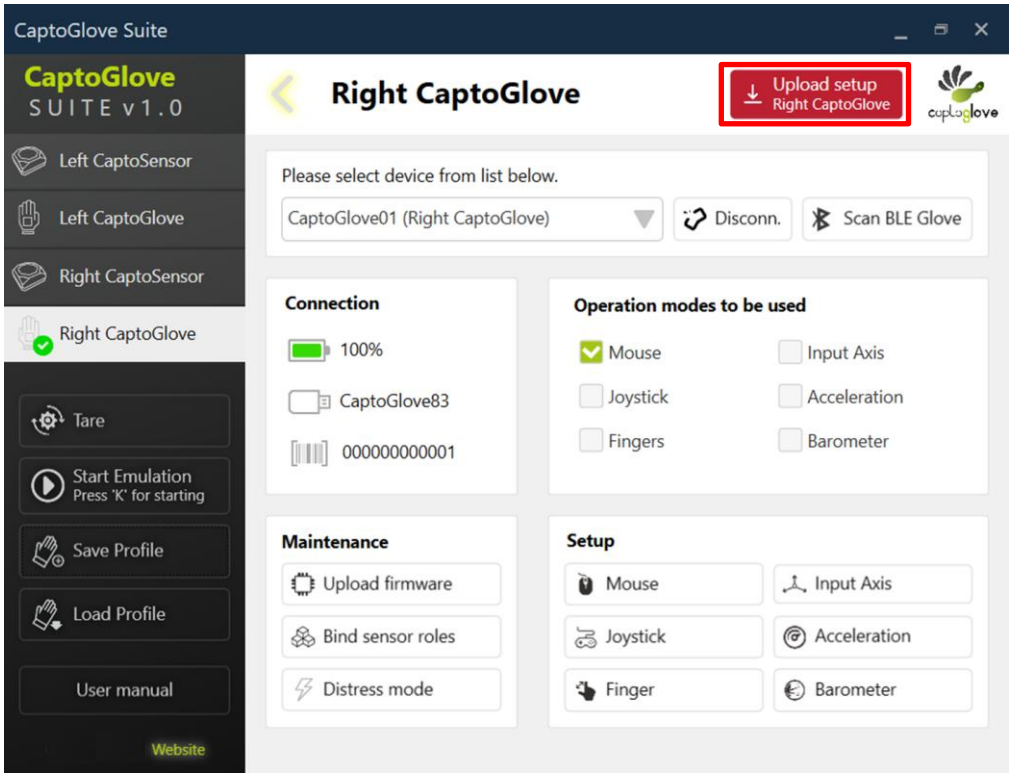

Advanced Customization

The Suite allows for a customization granularity of an incredible high level. In this section, further customizations options will be presented.

NB: As stated above, some of the functionalities described below are not yet enabled in current version of the Suite and will be available in the near future.

Operation Modes

In the "Operation modes" section of the Suite, it is possible to set the functionalities that you want to activate. The CaptoSensor can emulate mouse or joystick inputs, moreover it is possible to choose to activate finger inputs, axis movements, acceleration and barometer options.

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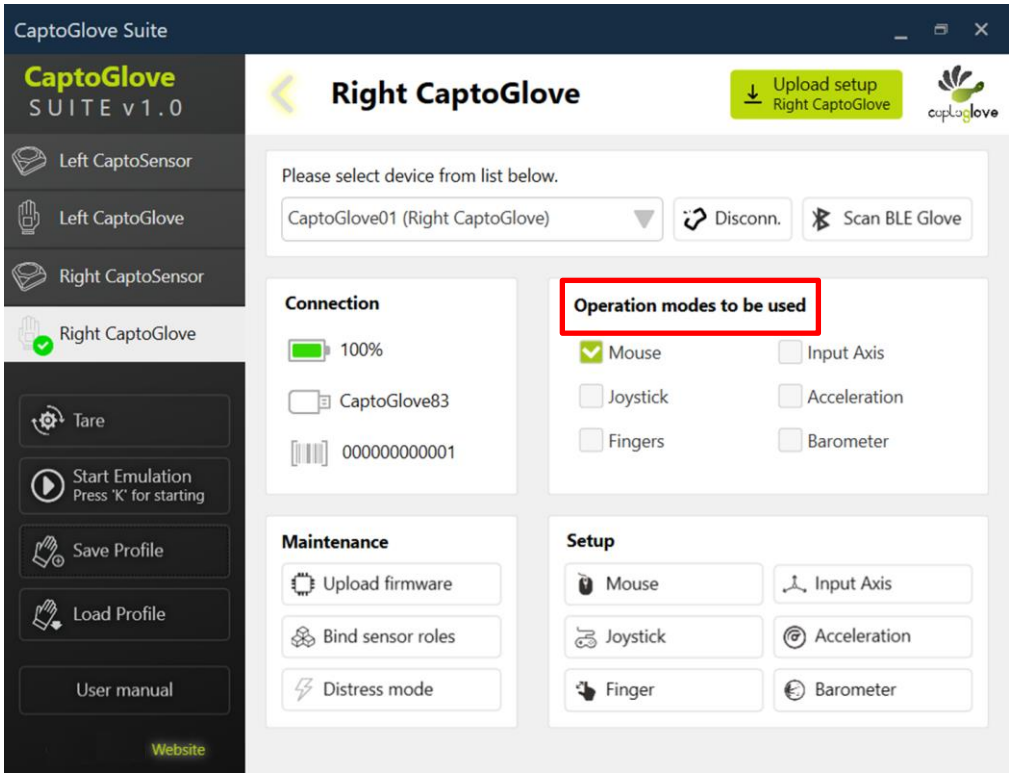

Setup

In the “Setup” section it is possible to enter very specific settings for

- Mouse emulation
- Joystick emulation
- Fingers sensors
- Input axis
- Acceleration
- Barometer

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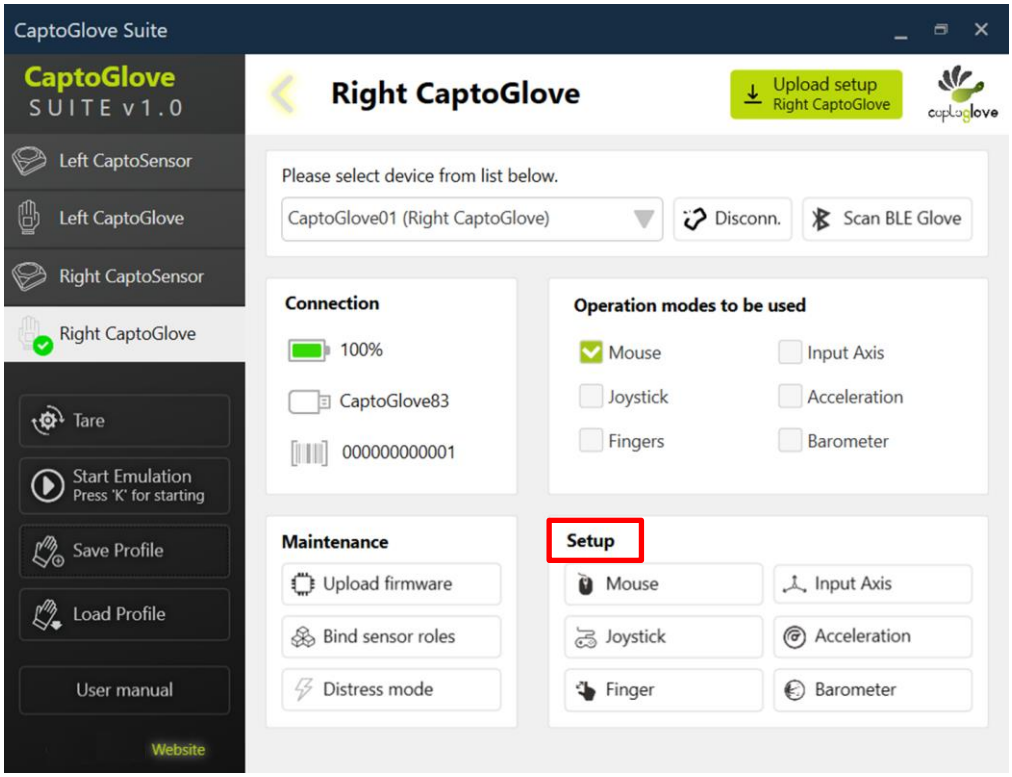
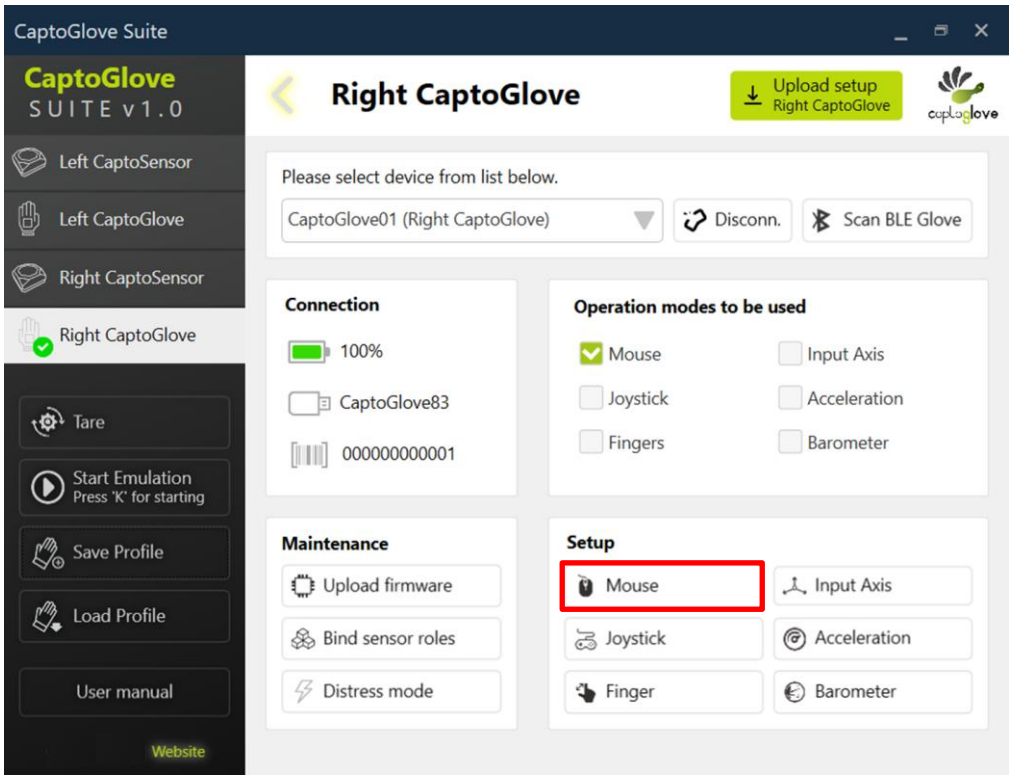


Mouse emulation

By clicking on "Mouse" in the Setup section it is possible to configure how the CaptoSensor inside CaptoGlove (or an external CaptoSensor) will emulate the mouse.



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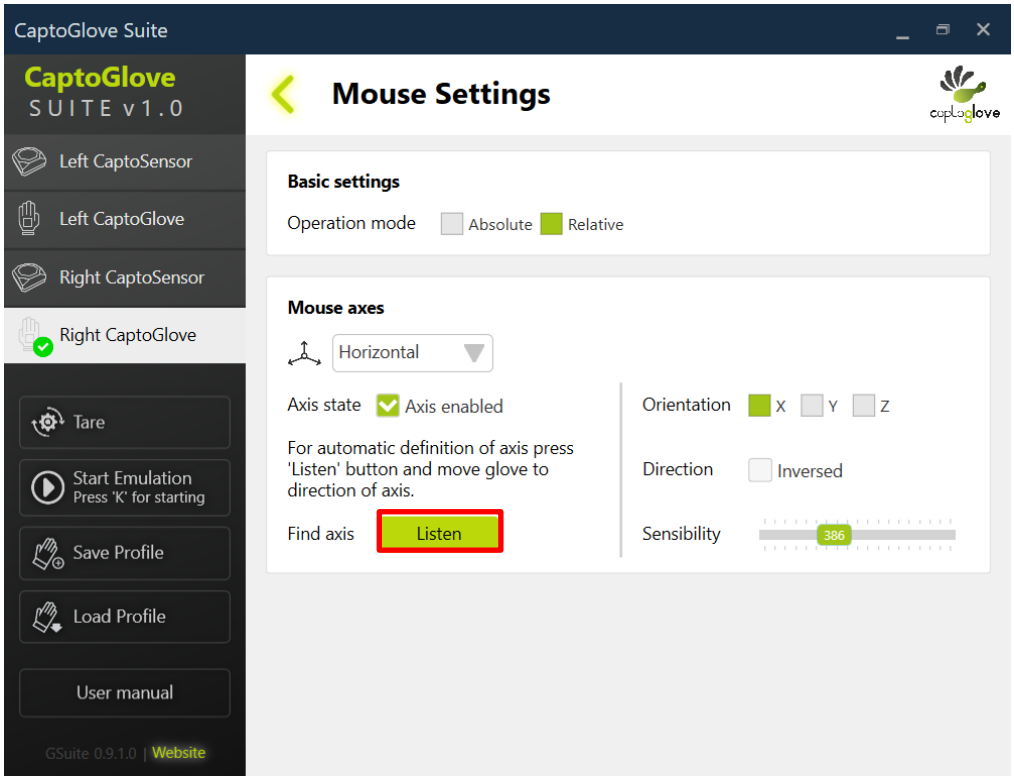
It is possible to choose between “Absolute” or “Relative” operation modes. This means that the mouse position can be calculated in respect to a fix point in the space or respect to its previous position. Some games need to be adjusted in terms of sensibility of the mouse within internal game options for a correct behavior of the Absolute mode.

The absolute mode delivers a more precise experience, in particular for a full 360 degrees turning experience. However, should the game not support Absolute mouse, by correctly setting the sensibility of the Relative mouse mode it is possible to achieve a great level of precision. **The primary mode and most flexible one is the Relative mode.**

Through the “Mouse axes” section it is possible to choose along which axis the mouse will move when the user moves his hand in a specific direction.

The orientation for the “Horizontal” or “Vertical” direction can be chosen manually selecting the “X”, “Y”, “Z” axis or through the “Listen” button. By pressing the “Listen” button in fact, the user can move his/her hand in a desired direction and the Suite will automatically detect it.



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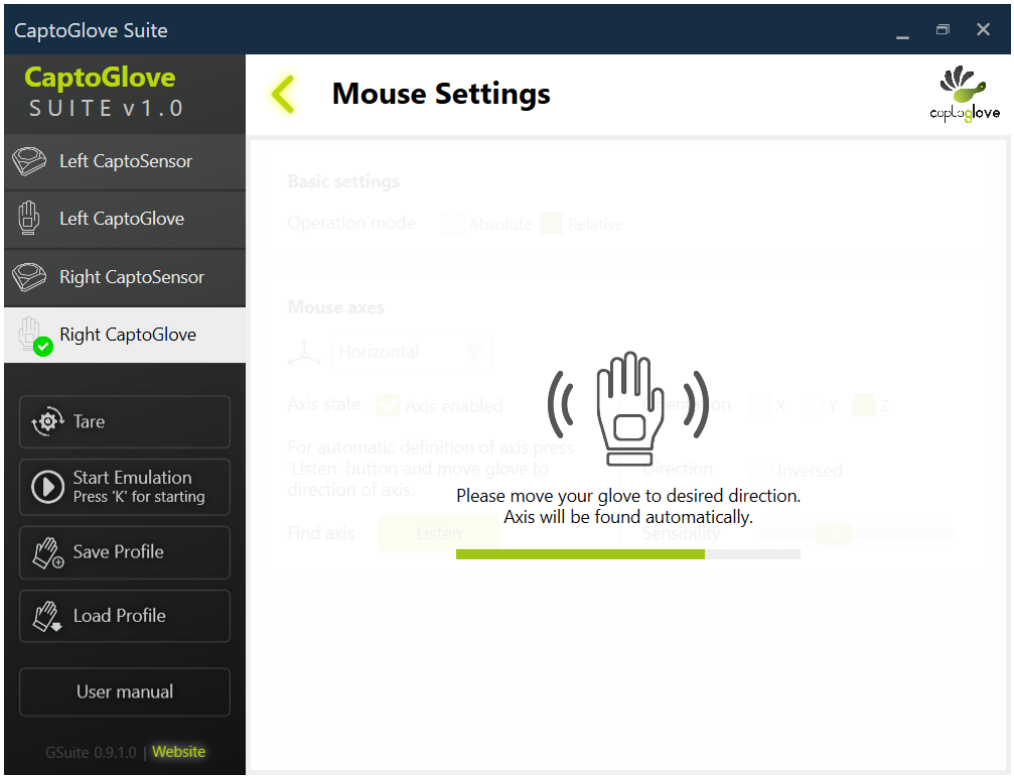

Through the "Sensitivity" bar moreover, it is possible to choose how sensitive mouse movements will be compared to the movements of one's hand. If the sensitivity bar is set on a low value the user will need to perform wider movement. If, instead, the sensitivity is set on a high value, the movements needed to move the mouse will be narrower.

NB: Each application and game has its internal mouse sensibility settings that may be required to be set.

The "inversed" check box allows to invert the direction of the mouse for the chosen axis.
The following link shows how to set up the mouse options in current version of the Suite: https://youtu.be/0RHpGXCn9hA.

Joystick Emulation
In an analogues way to the mouse configuration, it is possible to configure the joystick emulation.

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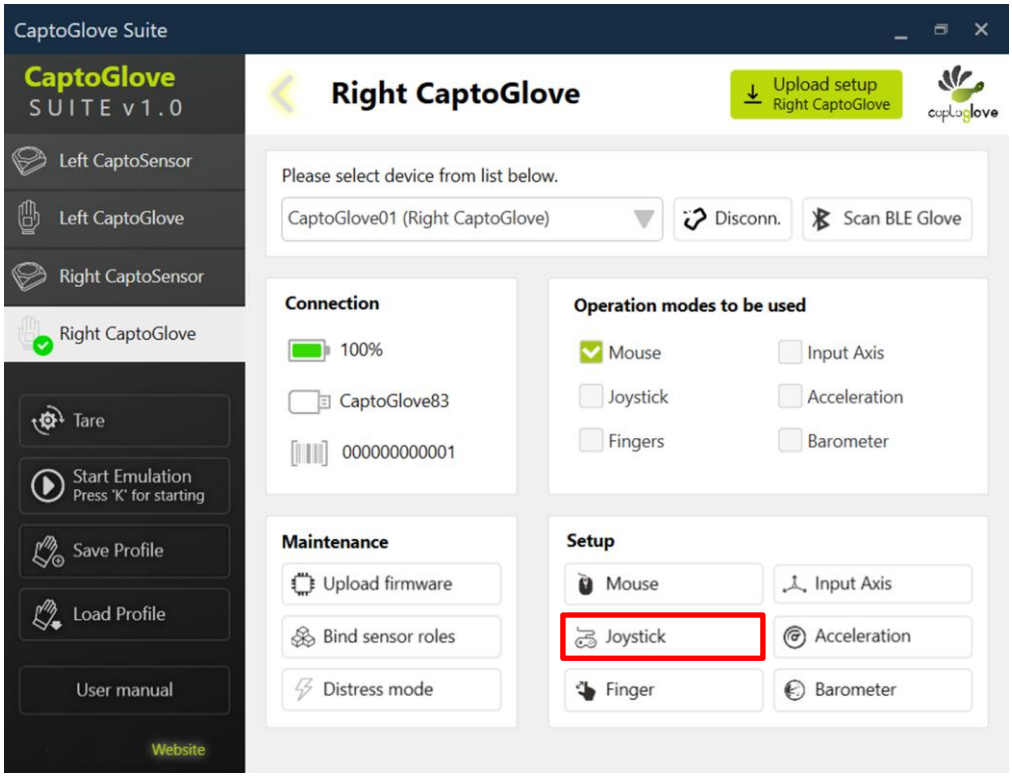

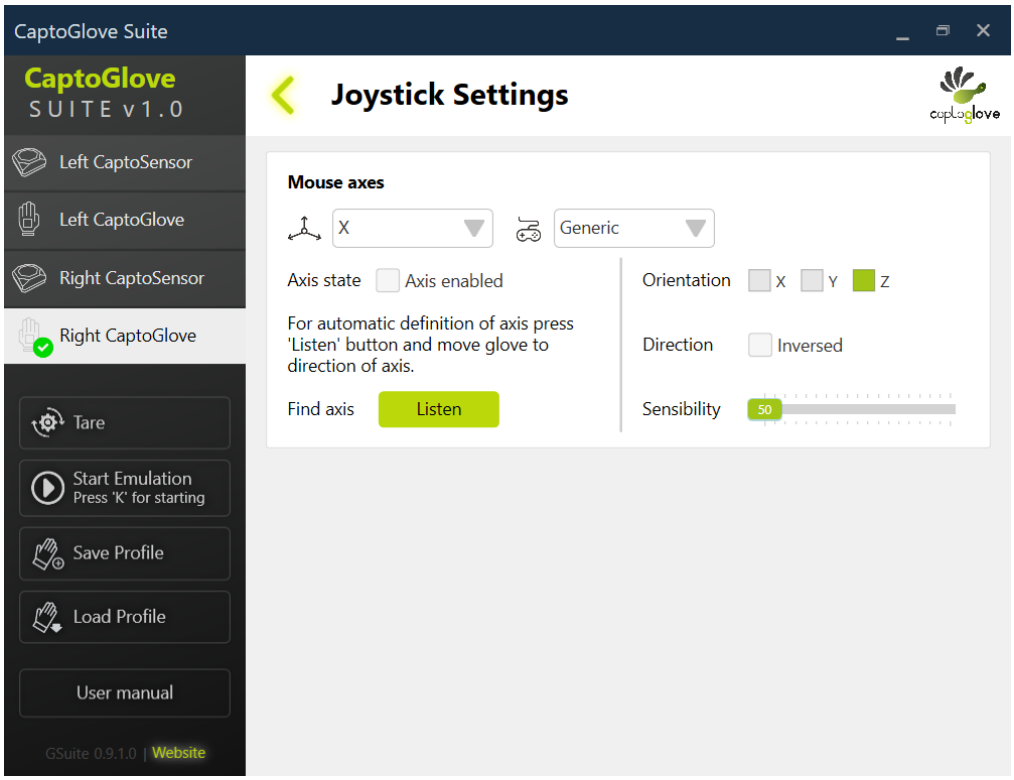

It is possible, in fact, to choose (as for the mouse) an orientation for each axis of the joystick; invert their direction through the “Inversed” check box and select the desired sensitivity.
By clicking on the “Listen” button it is possible to detect the desired orientation automatically by moving the user’s hand. The Suite will in fact detect the axis along which the hand is moving and assign it automatically to the selected joystick axis.

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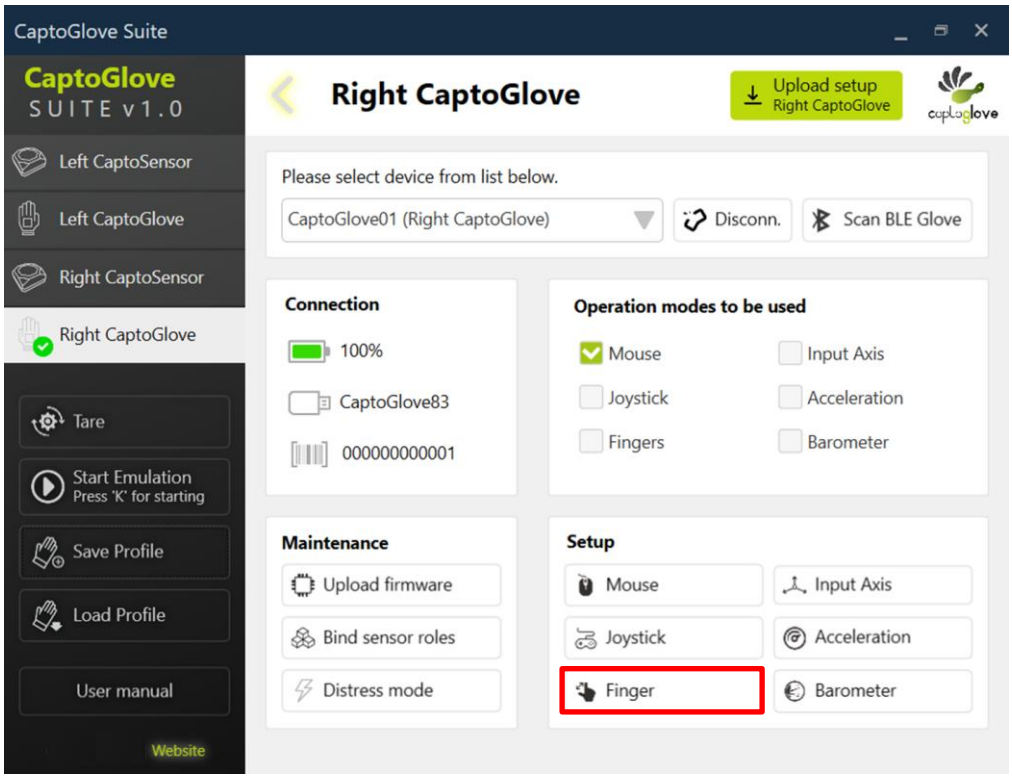
Fingers Sensors



In the “Finger” settings it is possible to configure each sensor’s behavior. There is a scroll-down menu to select the finger sensor to configure.

The “Calibrate” button allows to set the maximum range of movements that the user can or wants to perform with the selected finger. Clicking on the “Calibrate” button in fact, the Suite will “listen” for the movements of the finger and detect the range accordingly. On the right side of the window, a progress bar displays the current detected force applied to the sensor.

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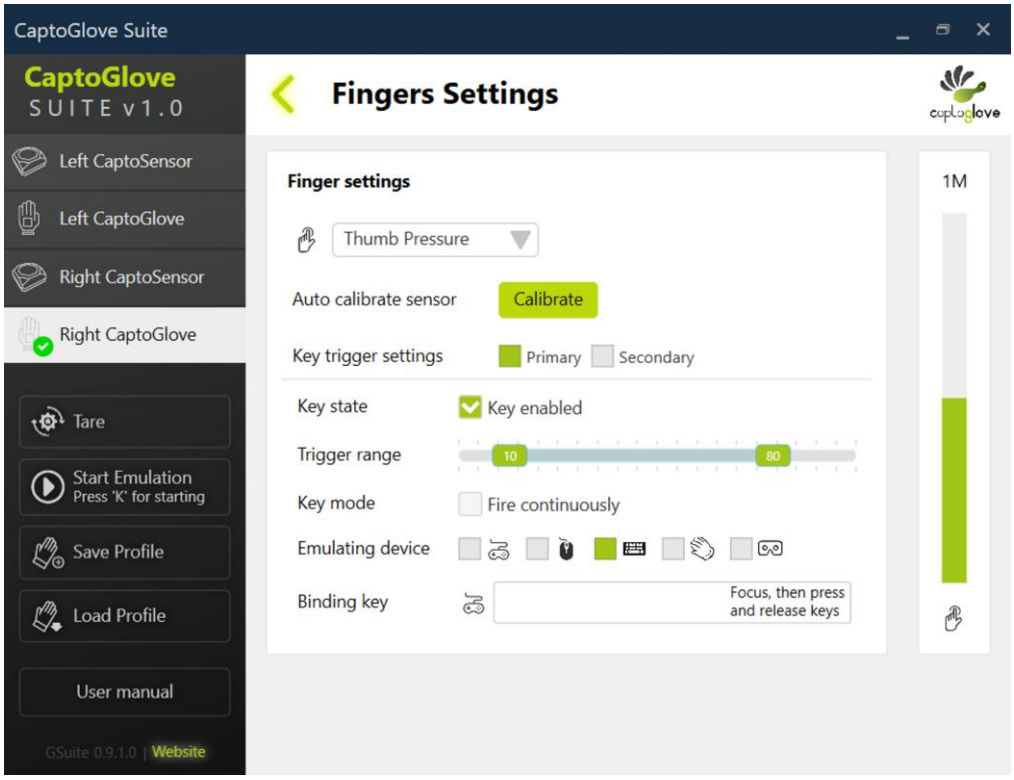

The finger sensors can be configured to activate two different keys: “Primary” and “Secondary”. Using the “Trigger range” bar, moreover, it is possible to choose the range of the sensor’s force where the chosen key will be activated.

The “Key mode” option allows to have a continuous mode, i.e. if the sensor remains in the activation range, it will continuously repeat the chosen key instead of striking it only once.
The “Emulating device” option allows the user to choose which kind of input to send when the sensor is activated. By selecting one of the options, the corresponding possible inputs will appear in the “Binding key” field.

If, for instance, the user chooses mouse as emulating device, “Right Button”, “Left Button” and “Middle Button” will appear as possible keys to assign to the current sensor. The hand image refers to CaptoGlove native commands (to be implemented) and the visor for VR controller inputs (to be implemented).

Input Axis
With CaptoGlove it is possible to send an input to the PC when a certain angle is detected on one of the Yaw, Pitch or Roll axis. Clicking on “Input Axis”, the characteristic customization window will appear. From this window, it is possible to select what is the axis that the user wants to use to activate the chosen input.
The “Listen” button can be used to automatically detect what axis the user wants to use, by moving his/her hand in the desired direction.

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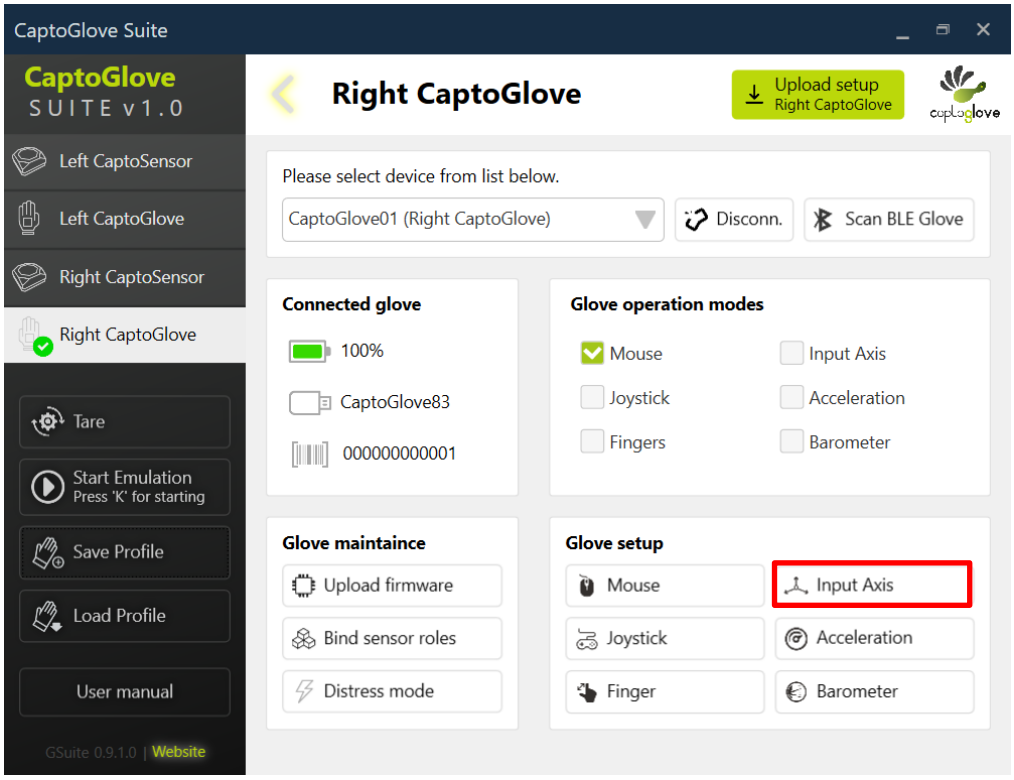
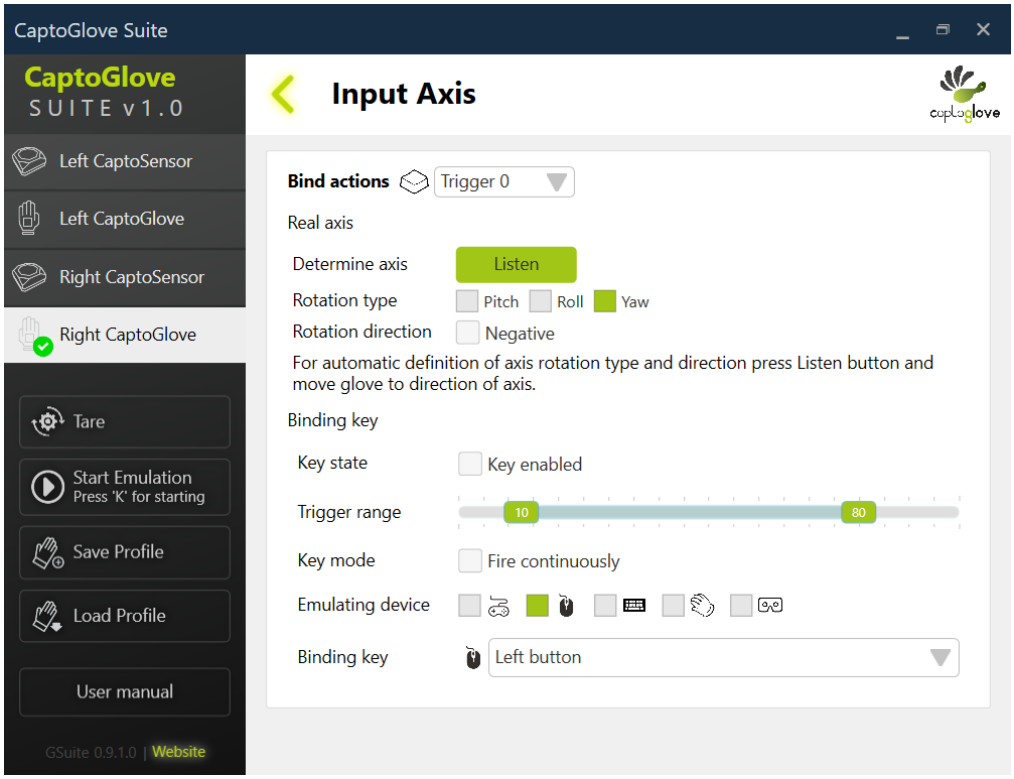


As in the other setup settings, also in the "Input Axis" it is possible to choose what kind of input to use by selecting the *Emulating Device* and the *Binding Key*.



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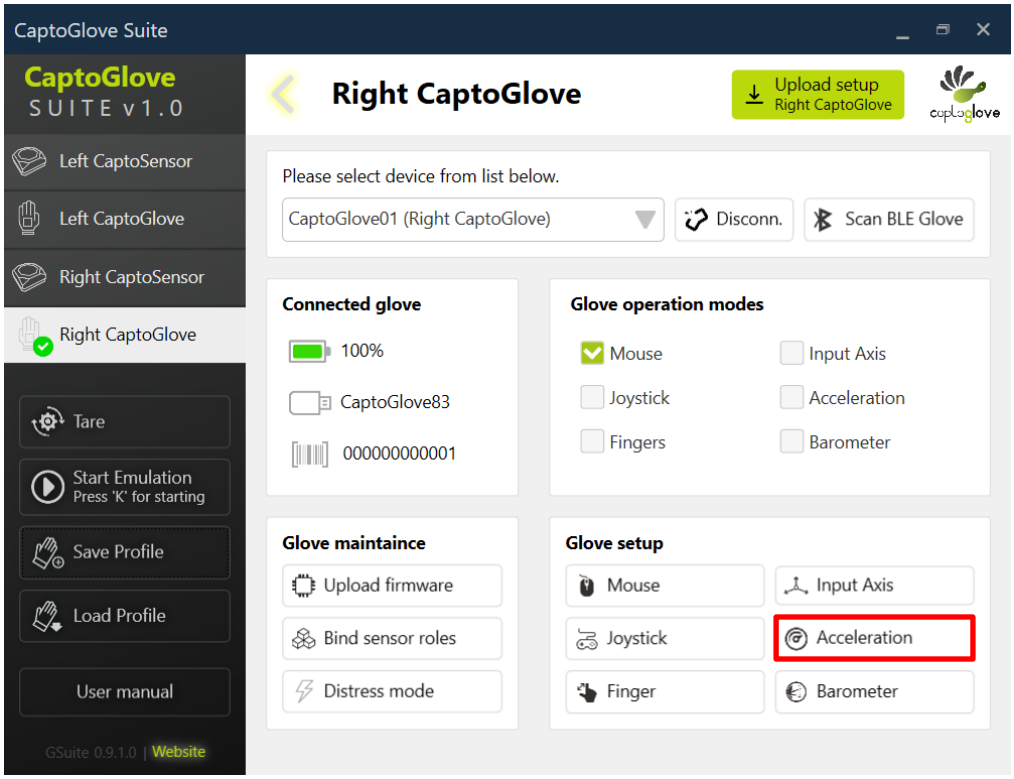
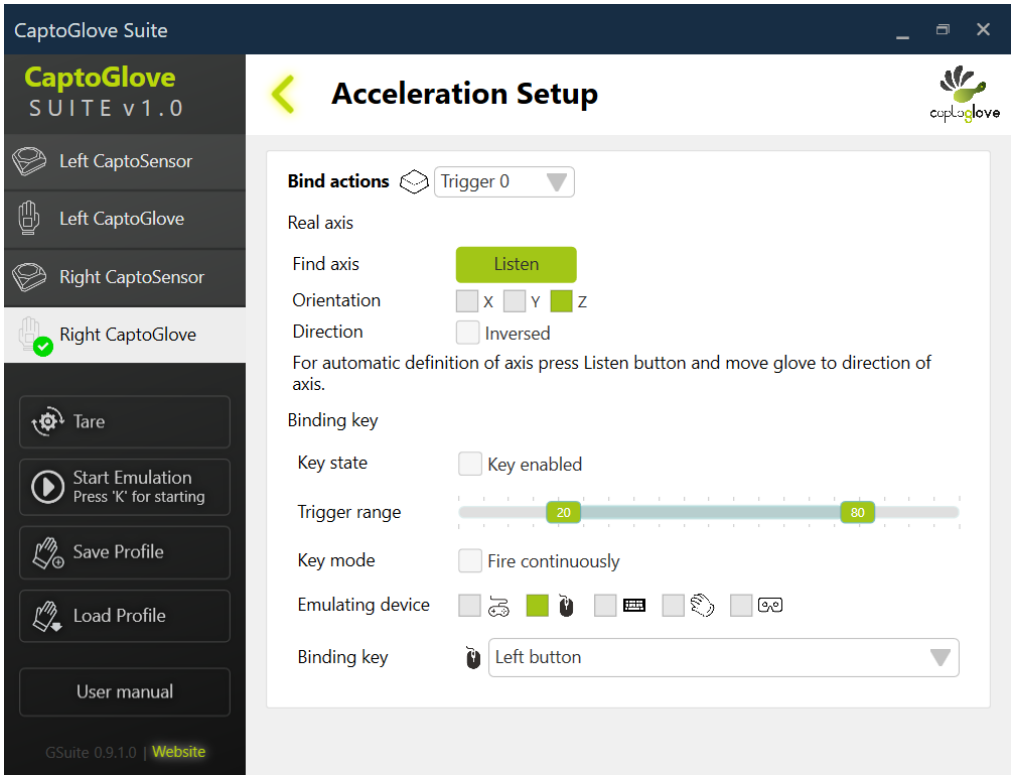
Acceleration

The Acceleration function allows the user to select an axis on which a certain acceleration must be detected. When such acceleration is detected on the chosen axis, CaptoGlove (CaptoSensor) will send an input to the PC according to the *Emulated Device* and its *Binding Key.*





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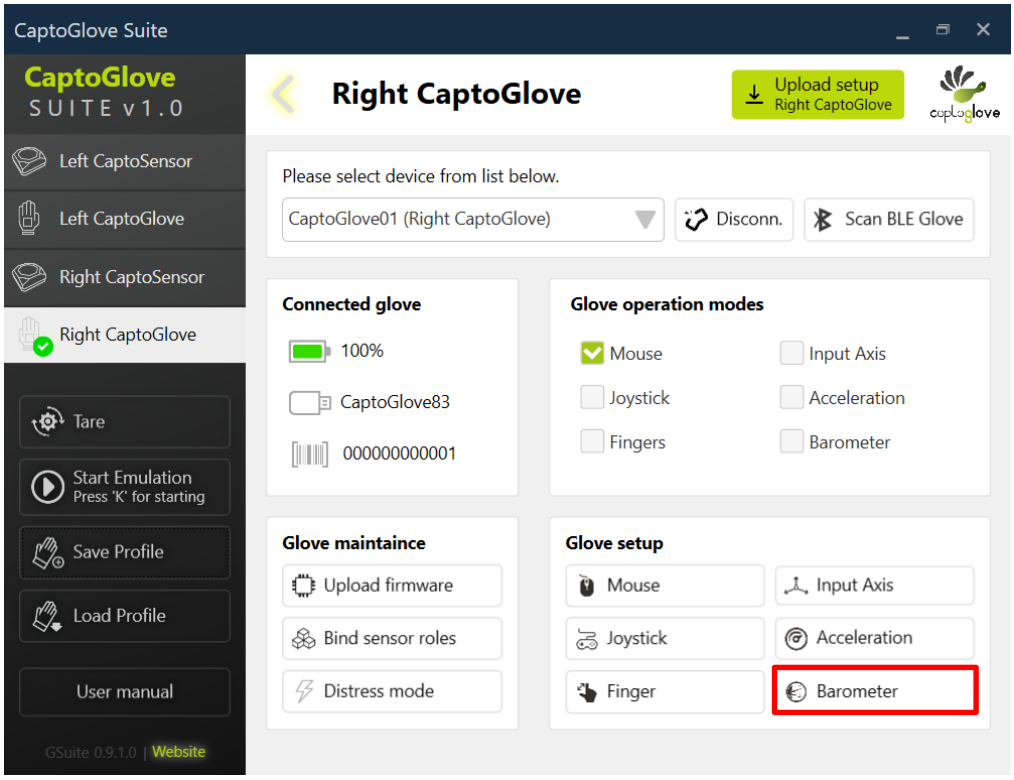
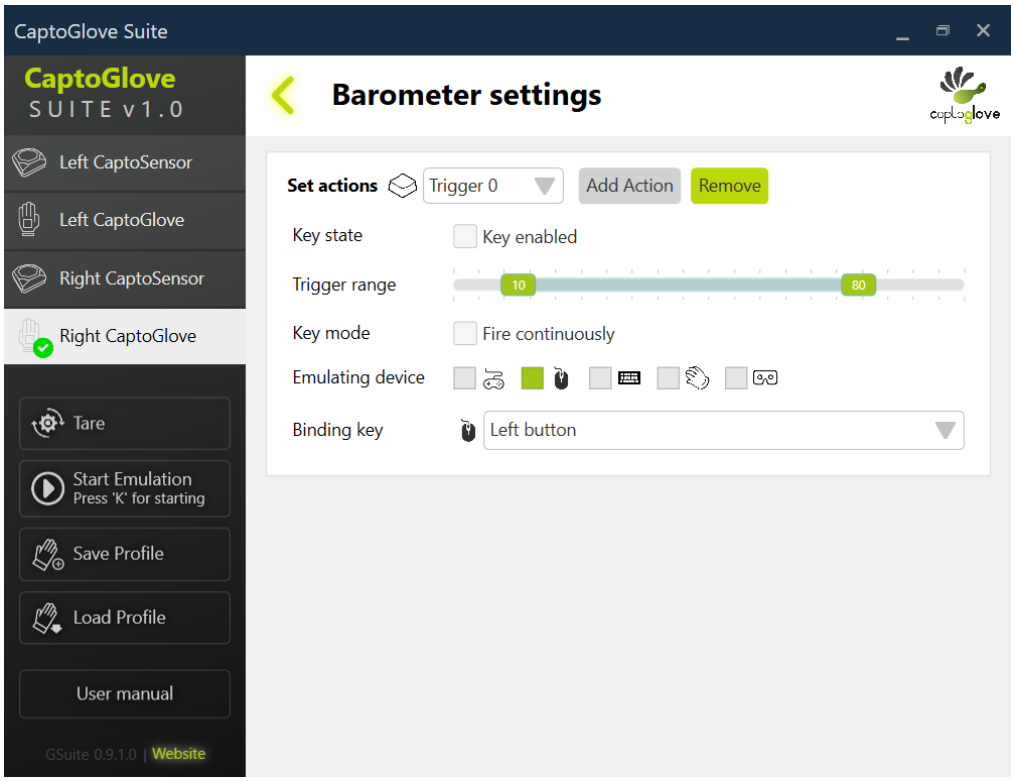
Barometer

In an equivalent way to what is done for the accelerometer can be done for the barometer function. The user can choose an input function that can be triggered when his/her hand or the CaptoSensor is at a certain height. There can be more than one trigger each of which can be activate at a different height.





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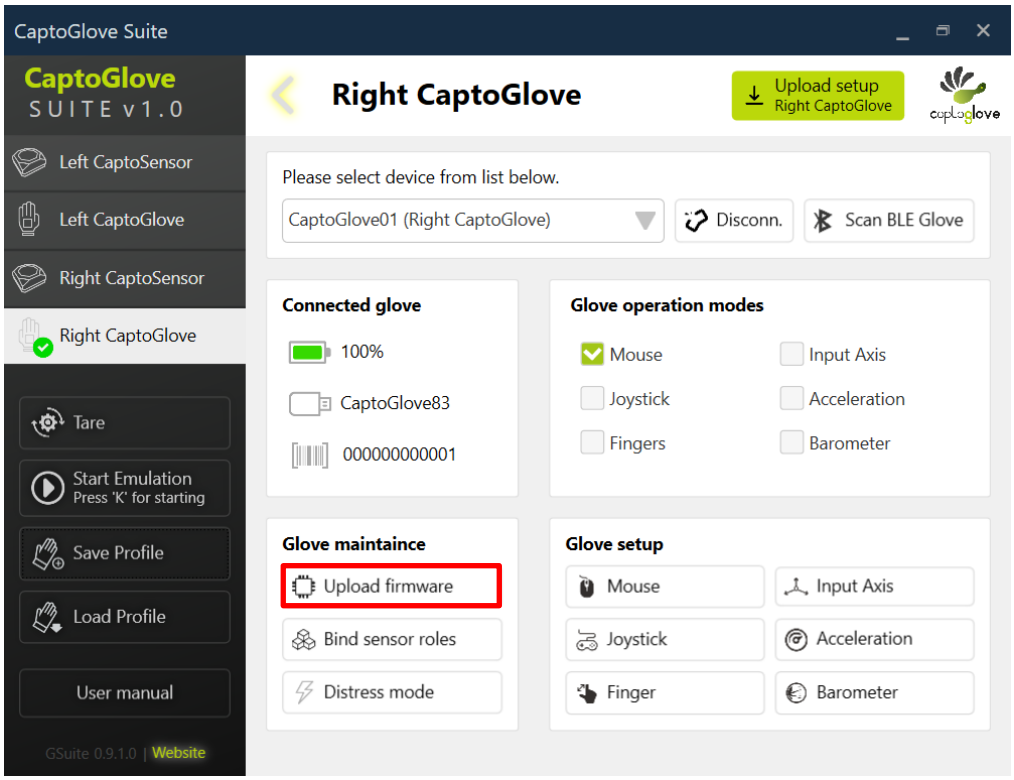
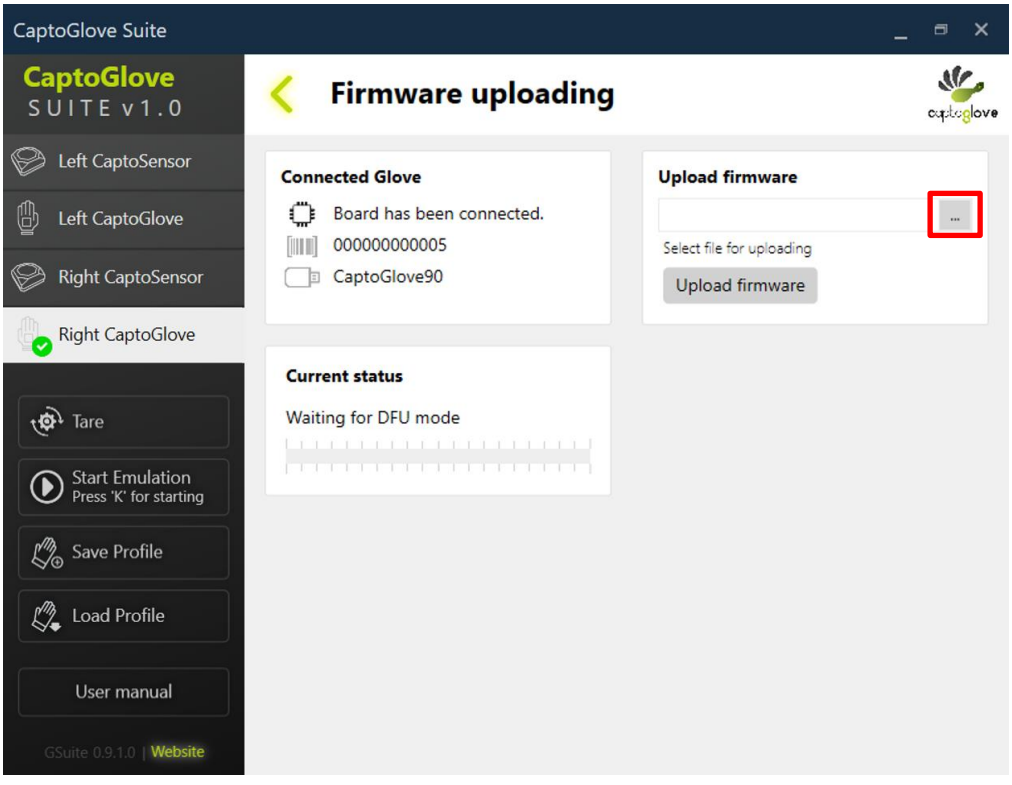
Maintenance

Upload firmware

The Suite allows to upload the firmware on CaptoGlove to keep it always updated and expand its features with new ones. Follow the procedure described below or visit the YouTube tutorial at this link https://youtu.be/k7dP5yQ96lI for instructions.





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To upload a new firmware, follow these instructions:

- Unpair CaptoGlove
- Connect CaptoGlove to the PC via USB
- Click on Upload firmware in the main window of the Suite
- Click on the three-dot symbol and choose the file to upload
- Click on Upload firmware and wait until the upload has been completed

In case there are issues in reconnecting to the Suite soon after having uploaded the firmware:

- Unpair CaptoGlove from the PC and wait 10 seconds
- Close the Suite
- Turn on CaptoGlove
- Pair it to the PC
- Turn the CaptoGlove off and on again, open the Suite and connect. Alternatively, just restart Windows.

Tare

Once the user has chosen all the settings he/she wants to apply to CaptoGlove, he/she can tare CaptoGlove clicking on the "Tare" button. The whole procedure requires generally few seconds and should be done before starting a new game session. All the connected CaptoGlove and CaptoSensor will be tared once "Tare" is pressed. The optimal position to tare CaptGlove is on a plane surface even if the CaptoSensor remains inside the textile. Make sure the CaptoGlove is perfectly flat on a plane surface. Here is a video that shows how it is done on the Suite: https://youtu.be/pEmMeR_fpPs

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Start Emulation

After the tare process has been completed, in order to start the emulation, the user can simply click on the "Start Emulation" button. At this point CaptoGlove (or CaptoSensor) will be activated.

Profiles

CaptoGlove allows for an incredible high number of configurations that can fit numerous purposes. For this reason and because each application may require a specific configuration, it is possible to save each profile in a separate file. In order to load a saved profile, the user can click on the "Load Profile" button and choose the profile he/she desires. Since profiles are configuration files, they can be easily shared or downloaded from different sources as for instance between friends or at CaptoGlove's downloads section at https://www.captoglove.com/downloads.

To see how to work with profiles and how to create one, have a look at these two videos https://youtu.be/nx8RtIQ_v3A, https://youtu.be/7sk-s97ZUzA.

SDKs

CaptoGlove can be integrated in specific applications. In order to do so, SDKs for Unity 3D, Unreal, iOS, Android and Windows C++ libraries will be delivered for free.

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