REDn Scientific System User Guide

Version 4.4

January 2017
# Contents

<table>
<thead>
<tr>
<th>Part 1</th>
<th>Welcome</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Contacting SMI</td>
<td>3</td>
</tr>
<tr>
<td>1.2</td>
<td>Copyright and Trademarks</td>
<td>4</td>
</tr>
<tr>
<td>1.3</td>
<td>Product Liability</td>
<td>5</td>
</tr>
<tr>
<td>1.4</td>
<td>Precautions</td>
<td>6</td>
</tr>
<tr>
<td>1.5</td>
<td>Declaration of Conformity</td>
<td>10</td>
</tr>
<tr>
<td>1.6</td>
<td>Product Maintenance</td>
<td>11</td>
</tr>
<tr>
<td>1.7</td>
<td>Document Conventions</td>
<td>12</td>
</tr>
<tr>
<td>1.8</td>
<td>Glossary</td>
<td>13</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part 2</th>
<th>System Overview</th>
<th>17</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>System Requirements</td>
<td>19</td>
</tr>
<tr>
<td>2.2</td>
<td>REDn Scientific Eye Tracker</td>
<td>23</td>
</tr>
<tr>
<td>2.3</td>
<td>iViewRED Software</td>
<td>25</td>
</tr>
<tr>
<td>2.4</td>
<td>Accessories</td>
<td>27</td>
</tr>
<tr>
<td>2.5</td>
<td>Optimal Conditions</td>
<td>28</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part 3</th>
<th>iViewRED Software Overview</th>
<th>29</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Geometry Tab</td>
<td>30</td>
</tr>
<tr>
<td>3.2</td>
<td>Calibration Tab</td>
<td>36</td>
</tr>
<tr>
<td>3.3</td>
<td>Settings Tab</td>
<td>41</td>
</tr>
<tr>
<td>3.4</td>
<td>Info Tab</td>
<td>43</td>
</tr>
<tr>
<td>3.5</td>
<td>Profile Selector</td>
<td>45</td>
</tr>
<tr>
<td>3.6</td>
<td>Eye Tracking Monitor</td>
<td>48</td>
</tr>
<tr>
<td>Part</td>
<td>Section</td>
<td>Page</td>
</tr>
<tr>
<td>--------</td>
<td>---------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>3.7</td>
<td>Status Indicators</td>
<td>50</td>
</tr>
<tr>
<td>Part 4</td>
<td>Getting Started</td>
<td>53</td>
</tr>
<tr>
<td>Part 5</td>
<td>Installing iViewRED Software</td>
<td>59</td>
</tr>
<tr>
<td>5.1</td>
<td>Obtaining the Installation Package</td>
<td>60</td>
</tr>
<tr>
<td>5.2</td>
<td>Installing the Required Software</td>
<td>61</td>
</tr>
<tr>
<td>Part 6</td>
<td>Running iViewRED</td>
<td>63</td>
</tr>
<tr>
<td>Part 7</td>
<td>Mounting the Eye Tracker</td>
<td>67</td>
</tr>
<tr>
<td>7.1</td>
<td>Mounting Guides</td>
<td>68</td>
</tr>
<tr>
<td>7.2</td>
<td>Mounting Instructions</td>
<td>69</td>
</tr>
<tr>
<td>Part 8</td>
<td>Managing Profiles</td>
<td>75</td>
</tr>
<tr>
<td>8.1</td>
<td>Creating and Modify Profiles</td>
<td>76</td>
</tr>
<tr>
<td>8.2</td>
<td>Selecting Profiles</td>
<td>78</td>
</tr>
<tr>
<td>8.3</td>
<td>Deleting Profiles</td>
<td>79</td>
</tr>
<tr>
<td>Part 9</td>
<td>Setting Geometry Measurements</td>
<td>81</td>
</tr>
<tr>
<td>9.1</td>
<td>Using Multiple Displays</td>
<td>82</td>
</tr>
<tr>
<td>9.2</td>
<td>Selecting Type of Display</td>
<td>84</td>
</tr>
<tr>
<td>9.3</td>
<td>Required Measurement Values</td>
<td>85</td>
</tr>
<tr>
<td>9.4</td>
<td>Automatically Detecting Measurement Settings</td>
<td>86</td>
</tr>
<tr>
<td>9.5</td>
<td>Manually Entering Measurement Settings</td>
<td>88</td>
</tr>
<tr>
<td>9.6</td>
<td>Setting Depth and Height</td>
<td>90</td>
</tr>
<tr>
<td>9.7</td>
<td>Setting RED Angle</td>
<td>94</td>
</tr>
<tr>
<td>9.8</td>
<td>Setting Screen Width and Height</td>
<td>95</td>
</tr>
</tbody>
</table>
## Contents

<table>
<thead>
<tr>
<th>Part 10</th>
<th>Positioning the Participant</th>
<th>97</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.1</td>
<td>Optimal Participant Position</td>
<td>98</td>
</tr>
<tr>
<td>10.2</td>
<td>Eye Tracking Monitor</td>
<td>99</td>
</tr>
<tr>
<td>Part 11</td>
<td>Performing a Calibration</td>
<td>105</td>
</tr>
<tr>
<td>11.1</td>
<td>Running a Calibration</td>
<td>106</td>
</tr>
<tr>
<td>11.2</td>
<td>Calibration Methods</td>
<td>110</td>
</tr>
<tr>
<td>11.2.1</td>
<td>0 Point Calibration</td>
<td>110</td>
</tr>
<tr>
<td>11.2.2</td>
<td>1 Point Calibration</td>
<td>111</td>
</tr>
<tr>
<td>11.2.3</td>
<td>2 Point Calibration</td>
<td>113</td>
</tr>
<tr>
<td>11.2.4</td>
<td>5 Point Calibration</td>
<td>114</td>
</tr>
<tr>
<td>11.2.5</td>
<td>9 Point Calibration</td>
<td>115</td>
</tr>
<tr>
<td>11.2.6</td>
<td>13 Point Calibration</td>
<td>116</td>
</tr>
<tr>
<td>11.3</td>
<td>Setting Animation Speed</td>
<td>117</td>
</tr>
<tr>
<td>11.4</td>
<td>Accepting Calibration Points</td>
<td>117</td>
</tr>
<tr>
<td>11.4.1</td>
<td>Using Smart Calibration</td>
<td>118</td>
</tr>
<tr>
<td>11.5</td>
<td>Setting Calibration Point Styles</td>
<td>119</td>
</tr>
<tr>
<td>11.6</td>
<td>Running a Validation</td>
<td>121</td>
</tr>
<tr>
<td>11.7</td>
<td>Understanding the Results</td>
<td>124</td>
</tr>
<tr>
<td>11.8</td>
<td>Recalibrating on a Point</td>
<td>126</td>
</tr>
<tr>
<td>Part 12</td>
<td>Setting the Calibration Area</td>
<td>129</td>
</tr>
<tr>
<td>Part 13</td>
<td>Using Live Gaze View</td>
<td>135</td>
</tr>
<tr>
<td>Part 14</td>
<td>Setting the Tracking Mode</td>
<td>139</td>
</tr>
</tbody>
</table>
Part 15  Additional Information  141

15.1  Shutting Down iViewRED  142
15.2  Troubleshooting  143
15.3  Logfile recording  146
15.4  Showing Eye Images  148
15.5  Removing the Mounting Bracket  150
15.6  Checking for Software Updates  150
15.7  iViewRED Software Structure  151
15.8  Interfacing with other Applications  153
   15.8.1  Interfacing with SMI Experiment Center  153
      15.8.1.1  Working in a Dual PC configuration  154
   15.8.2  Interfacing with Third Party Applications  154
      15.8.2.1  Application Running on iViewRED PC  155
      15.8.2.2  Working in a Dual PC configuration  156
15.9  Evaluating Eye Tracking Data  158
   15.9.1  Evaluation with SMI Experiment Suite  158
   15.9.2  Working with the iView Data File  159
15.10  Working with TTL Triggers  159

Part 16  License Agreement and Warranty  163

Part 17  About SMI  173

Index  175
Welcome
1. Welcome

Together with the optional SMI Experiment Suite™, the REDn Scientific System provides a comprehensive toolbox for a broad range of scientific studies such as neuroscience, psychology, psychiatry and psycholinguistics.

This User Guide provides detailed instructions on the use of the REDn Scientific System. This system includes the REDn Scientific Eye Tracker and the iViewRED software, which is used to configure and run the REDn Scientific Eye Tracker.

Document Information

Document Version: 1.2
Release Date: January 2017
Software Version: 4.4

Copyright © 2017 SensoMotoric Instruments (SMI). All other product names are copyright of their respective owners.

For rights and responsibilities of the use of this product, see Product Liability.

For more information, visit our home page: www.smivision.com.

Please read this User Guide carefully to ensure best results. See Precautions.
1.1 Contacting SMI

International Headquarters

SensoMotoric Instruments GmbH (SMI)
Warthestr. 21
14513 Teltow
Germany

Phone: +49 (0) 3328 - 3955 - 510
Fax: +49 (0) 3328 - 3955 - 599
e-mail: sales@smi.de
Web: www.smivision.com

SensoMotoric Instruments, Inc.

236 Lewis Wharf
Boston, MA 02110
United States of America

5 3rd Street
San Francisco, CA 94103
United States of America

Phone: +1 (617) 557 0010
Fax: +1 (617) 507 8319
e-mail: sales@smivision.com
Web: www.smivision.com
1.2 Copyright and Trademarks

The SOFTWARE is owned by SensoMotoric Instruments GmbH or its suppliers and is protected by the Federal Republic of Germany copyright laws and international treaty provisions. Therefore, you must treat the SOFTWARE like any other copyrighted material except that you may either:

1. Make one copy of the SOFTWARE solely for backup or archival purposes or

2. Transfer the software to a single hard disk provided you keep the original solely for backup or archival purposes.

You may not copy the written materials accompanying the SOFTWARE.

The user is not entitled to allow a third party to use the software simultaneously without written approval of SensoMotoric Instruments GmbH. Independent branch offices or subsidiary companies are also understood to be a third party in this sense. SensoMotoric Instruments GmbH and/or its supplying firm remain the owners of the delivered software, even if it is altered.

The following trademarks are owned by their respective companies:

- iViewRED™, Experiment Center™, BeGaze™ and SensoMotoric Instruments™ are trademarks of SensoMotoric Instruments GmbH.

- Microsoft® and Windows® are registered trademarks of Microsoft Corporation in the United States and other countries.
• Intel and Intel Core are trademarks of Intel Corporation or its subsidiaries in the U.S. and/or other countries.

1.3 Product Liability

_SensoMotoric Instruments GmbH_ (SMI) does not assume liability for resultant damages to property or personal injury if the product has been misused in any way or damaged by improper use or failure to observe these operating instructions. In addition, any unauthorized modifications or repairs of the device will render the warranty null and void!

Make sure the presented visual stimuli or the environment in which you conduct your study does not harm or injure your participants. _SensoMotoric Instruments GmbH_ (SMI) is in no way responsible for the experiments you develop, execute, and analyze. Furthermore, do not offend your participant's cultural background, age or psychological condition.
1.4 Precautions

General Precautions

Read the following carefully before using this product:

- The REDn Scientific Eye Tracker is a sophisticated measurement device. Please handle it with care in order not to damage any of its internal components.

- When the REDn Scientific Eye Tracker is not in use, power it off by unplugging it from the USB port and safely storing it in its case.

- Do not scratch the shield (front face) of the REDn Scientific Eye Tracker.

- Keep the REDn Scientific Eye Tracker away from heat sources.

- No part of the product may be modified or rebuilt.

- Any usage other than described in this manual is not permitted.

The REDn Scientific Eye Tracker may warm up to 55°C / 130°F during prolonged operation.

Magnet Precautions

Neodymium magnets (Rare Earth magnets) are used in this device to connect it to the Mounting Bracket. This allows the REDn Scientific Eye Tracker to be easily disconnected and safely stored in its case while the Mounting Bracket stays attached to the Laptop Display or Desktop.
Monitor. However, because these type of magnets are extremely strong, please read the following precautions.

- Neodymium magnets are not the same as standard magnets. This type of magnet can cause injury if not used properly.

- Neodymium magnets have strong magnetic fields and are likely to cause damage to magnetic media devices. Therefore, keep the REDn Scientific Eye Tracker away from magnetic media such as hard drives, memory sticks, credit cards, magnetic ID cards, or other magnetic media. KEEP THE DEVICE IN ITS STORAGE CASE WHEN NOT IN USE.

- While connecting the REDn Scientific Eye Tracker to the Mounting Bracket, the two attracting magnets have enormous strength and can severely pinch your fingers if they come between the magnets when they are connecting together.

- Gently connect the REDn Scientific Eye Tracker to the Mounting Bracket. Neodymium magnets are prone to cracking if connected too quickly or if the device is dropped.

- Metal items, such as keys, knives, or tools may cause the magnet to shatter, if placed near enough to the magnets to cause them to connect with the magnets.

- Do not leave the REDn Scientific Eye Tracker near an open flame or a heat source. Aside from destroying the device, the neodymium magnets may ignite, burn and create toxic fumes.
Do not handle the *REDn Scientific Eye Tracker* when eating. In the unlikely event that the magnets come in contact with food, the metal compounds in the magnets may be toxic when ingested.

Neodymium magnets should NEVER be used near a person who uses medical aids such as a pacemaker. The magnet can cause the medical aid to malfunction. Individuals with pacemakers or internal medical devices should use caution when handling the *REDn Scientific Eye Tracker* and the mounting bracket. Magnetic fields may affect the operation of these devices. Consult your physician and the manufacturer of your medical device to determine its susceptibility to static magnetic fields prior to handling the *REDn Scientific Eye Tracker* and the Mounting Bracket. All of our magnetic products should be kept at a safe distance from individuals with these devices.

**Keep Out of Reach of Children**

NEODYMIUM MAGNETS (RARE-EARTH) MAGNETS SHOULD BE KEPT OUT OF REACH OF CHILDREN. RARE-EARTH MAGNETS ARE NOT TOYS.

Children should not be allowed to handle or play with rare-earth magnets. Small magnets pose a choking hazard. Children and adults should not ingest magnets or place magnets in any body orifice such as the ear, nose or mouth. Ingestion of magnets is very hazardous. If magnets are ingested or aspirated into the lungs,
immediate medical attention is required. Swallowed magnets can stick together across intestines causing serious infections and death. Seek immediate medical attention if magnets are swallowed or inhaled. Children under 3 should not handle magnets, in any case.

Transportation

The International Air Transport Association (IATA) Dangerous Goods Regulations provide guidelines for the identification, classification, and testing of potentially hazardous materials offered for transports by air. IATA Packing Instruction 902 defines the acceptance criteria and provides packaging guidelines for magnetized material. These instructions should be consulted prior to transporting magnetic material by air. These regulations also apply to magnets built in to products such as the Eye Tracker and Mounting Bracket.
1.5 Declaration of Conformity

SMI products are for use in office environments and bear the CE mark to indicate compliance with the health and safety requirements according to European Directives. For individual product declarations please refer to sales@smivision.de.

All SMI eye tracking equipment has been tested and found to comply with the limits for Class B digital devices, pursuant to Part 15 of the FCC Rules and EMC directive 2004/108/EC, and conforms to the low-voltage directive 2006/95/EC.
1.6 Product Maintenance

To keep the REDn Scientific Eye Tracker in good working order, we highly recommend that you:

- Regularly clean the shield (front face) of the device using the supplied microfiber cloth.
- After using the device, store it safely in the provided case.
- Do not leave the device exposed to direct sunlight, even when not in use. Store it in the case.
- Keep liquids and other contaminants away from the device. Do not allow liquids of any kind to near or on the device to prevent permanent damage.

If the REDn Scientific Eye Tracker becomes damaged, we highly recommend that you:

- Immediately unplug it from the USB port.
- Do not use the device until it has been repaired or replaced.

Do not attempt to repair the REDn Scientific Eye Tracker by yourself. There are no user-serviceable parts in the device. Servicing, adjustment or repair should only be done by a certified distributor or by SensoMotoric Instruments GmbH (SMI).
1.7 Document Conventions

The following conventions are used in this document.

*Italic* Indicates filenames and file extensions and, in some cases, product names.

*Bold* Used for user interface buttons, selections, check boxes, application windows and screen names.

*Underlined* In the PDF and Online Help version of this manual, indicates references to a related topic in this manual or to internet addresses.

Note icon to indicate additional information.

Warning icon to indicate reader should pay careful attention to the information.

Reference (See Also) icon indicating a related topic.
1.8 Glossary

*BeGaze™*

Software developed by SMI for analyzing eye tracking data.

*CAlibration*

The process of adapting iViewRED's internal eye model to the unique eye characteristics of a participant.

*Calibration point*

A point or circle displayed on a screen for a short duration. Used during calibration.

*Display, Monitor*

Generally referring to the same device, but in this document a Display refers to a Laptop screen, while Monitor refers to a Desktop PC screen.

*Experiment Center™*

Developed by SMI, this software is an easy to operate experiment creation, planning and execution environment. It is specially designed for eye tracking studies.

*Experiment Suite™*

Suite of software developed by SMI that includes *Experiment Center™* and *BeGaze™*. 
**Fixation**

Period of time during which the eyes remain relatively still and the gaze is maintained on a single location.

**Gaze**

The direction in which the person is looking.

**Head Box**

The volume in which the participant can move during the experiment, and where tracking is possible, is determined by tracking range and operating distance.

**Monocular Left Tracking Mode**

Tracks only on the left eye channel.

**Monocular Right Tracking Mode**

Tracks only on the right eye channel.

**Operator**

Person who is responsible for running the experiment. Also see **Participant**.

**Operating Distance**

Distance between the participant and the cameras on the eye tracker where tracking is possible.
Participant

Person performing an experiment run by the Operator.

Reference Point

A mark on the Mounting Bracket used to align the eye tracker with the center point of the screen.

Sampling Frequency

The number of eye tracking data samples obtained in one second.

SMI

SensoMotoric Instruments GmbH.

Smart Binocular Tracking Mode

Tracking mode where both eyes are tracked. Tracking continues when one eye is closed or cannot be tracked.

Smart Calibration

With Smart Calibration enabled, the calibration process waits for required fixations for two seconds. If fixation on one calibration point is found unreliable (e.g. when the user was not really fixating that point or closing the eyes), the data from this point will not be used to establish the calibration model. The model will instead be based on data from successful calibration points.

Smart Tracking Mode
Tracking mode where iViewRED uses the calibration results to intelligently decide whether to use one or both eyes for tracking.

*Stimulus Display*

The display used for presenting the experimental stimuli to the participant during the experiment.

*Tracking Mode*

Setting which determines how the eye tracker will track the participant's eyes.

*Tracking Range*

Characterizes the surface of the plane in which eyes are detected by the eye tracker.

*Validation*

Uses a new set of points to verify the accuracy of the calibration results.
System Overview

Chapter
2. System Overview

The SMI REDn Scientific System provides a comprehensive set of tools for performing fixation based studies. With its extra large head box and superior robustness, it provides outstanding accuracy and precision. Furthermore, it allows for easy interfacing with biometric data collection systems.

The REDn Scientific System consists of the ultra-light USB powered, fully portable REDn Scientific Eye Tracker and the iViewRED software to configure the REDn Scientific Eye Tracker for use with a participant as well as a dedicated, SMI-certified Laptop configured for use with the REDn Scientific Eye Tracker.

SMI Experiment Suite™ is available as a recommended complementary software package for experiment design and analysis.

See also Experiment Center™ and BeGaze™ User Guides.
2.1 System Requirements

You can install and run *iViewRED* on a PC of your choice. However, you must be aware that the quality of the recording cannot be guaranteed on your own PC, as it would be the case on SMI’s certified RED PCs.

In this section we provide guidelines and hardware requirements for using *iViewRED* on your PC. SMI, of course, cannot guarantee that a particular Laptop or Desktop PC running a supported version of Microsoft® Windows® will be sufficient. It is possible that other hardware components or software on a particular PC may interfere with the functioning of *iViewRED* software. In short, if you plan on using *iViewRED* on a PC other than an SMI-provided PC, it is possible that the recording output may be a lower quality.

The following instructions in this section are guidelines only on how to set up your PC.

Requirements

**Operating system:**

- Windows® 7 (32 or 64 bit)
- Windows® 8 (32 or 64 bit)
- Windows® 8.1 (32 or 64 bit)
- Windows® 10 (32 or 64 bit)

**Operating system Language:**

*iViewRED* has been tested to run with English and German language Windows® operating systems. *iViewRED* is not guaranteed to work with other languages.
**Disk Space:** 300 MB free space for *iViewRED*. Additional disk space is required for data recording and analysis.

**CPU:** Quad-core Intel® Core™ i5 or i7 processors of 3rd generation or later (e.g. Intel® Core™ i5 3xxx or Intel® Core™ i7 3xxx)

**USB:** USB 3.0 port required.

---

It is possible that your PC does not support USB 3.0 or that the USB chipset on your PC may not be compatible with the Eye Tracker. A USB 3.0 Add-On Card may add SuperSpeed USB 3.0 capability to your PC. Please contact SMI for latest recommendations.

---

**PC Configuration Recommendations**

Depending on your use case, we highly recommend that you configure your PC based on the following specifications.

**User Account Rights:** Administrator rights are required for installing *iViewRED*.

**Standby Mode:** Disable the Standby Mode.

**Screen Saver:** Disable the screen saver.
### Power Options:
Disable any function that will power-down the PC after a period of inactivity.

### Display:
Set to **Never turn off**.

### Sleep:
Set to **Never put the computer to sleep**.

### Power Plan:
Set to **High Performance**.

### Closing the Lid:
Set to **Do nothing**.

### Windows® Updates:
During recording sessions only: Set to **Never Check for Updates**.

### Antivirus Software:
Add *iViewRED* to exception list. Contact SMI for Antivirus Software recommendations. During recording sessions only. Turn off scheduled updates. Deactivate virus scanning.

### USB Devices:
Do not use any other USB devices on the same USB controller as the *REDn Scientific Eye Tracker* during the recording.

### Other Software / Applications:
Do not use additional applications that consume CPU or USB resources on the PC, since they
might have an impact on the eye tracker performance.

**Firewall and Networking:** Adapt the firewall and network settings so that *iViewRED* can run properly.

**Write Access:** Ensure the operator has write access to the repository directory. Do not try to write to a folder for which you do not have write access.
2.2 REDn Scientific Eye Tracker

The REDn Scientific Eye Tracker is a light, scientific-grade mobile device that can be used inside or outside a lab and in environments familiar to participants. It is connected to a USB 3.0 port on the Laptop or PC running iViewRED, which also provides a power supply to the device.

The device is mounted just below the screen on a Laptop Display or Desktop Monitor and can be easily removed for storage in the provided protective case.

The REDn Scientific Eye Tracker requires a USB 3.0 Port.

Technical Specifications

- **Sampling frequency:** 30 Hz and 60 Hz
- **Eye tracking mode:** Smart Binocular, Monocular Left, Monocular Right and Smart Tracking
- **Gaze position accuracy:** 0.4°
- **Spatial resolution (RMS):** 0.05° (human)
- **Calibration:** 0, 1, 2, 5, 9, 13 Points. Smart Calibration technology.
- **Operating distance:** 40 cm to 100 cm
Tracking range: 50 cm x 30 cm at 65 cm distance

Interfacing: 8 TTL

Operator feedback: Eye Images, Eye Tracking Monitor

Interface setup: Use with Desktop Monitor (10” to 27”) or Laptop Display

Operating system: Windows® 7 (32 or 64 bit)  
Windows® 8 (32 or 64 bit)  
Windows® 8.1 (32 or 64 bit)  
Windows® 10 (32 or 64 bit)

PC Interface / power: USB 3.0 / Power over USB

Blink recovery time: 16 ms @ 60 Hz

Dimensions (W x H x D): 30 cm x 2 cm x 2 cm

Weight: 75 g

Software compatibility: SMI Experiment Suite, free SMI Software Development Kit (SDK) and all software building on the SDK. SMI SDK allows integration with popular stimulus software (for example, MATLAB, PST E-Prime®, Python, NBS Presentation®) and custom applications written in, for example, C/C++ and .NET.
Eyewear compatibility: Works robustly with most glasses and lenses

Norm compliance: CE Declaration of Conformity

See also Mounting the Eye Tracker.

2.3 iViewRED Software

iViewRED is the controller software for the REDn Scientific Eye Tracker. It is available as a free download from the SMI website and installed prior to connecting the REDn Scientific Eye Tracker to the PC and mounting it.
For an overview of iViewRED, see iViewRED Software Overview.

For installation instructions, see Installing iViewRED Software.
2.4 Accessories

The *REDn Scientific System* includes the following accessories:

- A sturdy carrying case to protect the *REDn Scientific Eye Tracker* and its accessories.

- A dedicated USB 3.0 cable.

- A Mounting Bracket with a 20° angle. Additional Mounting Brackets are available as an option with a 15° angle and a 25° angle.

- Set of Mounting Strips to attach the *REDn Scientific Eye Tracker* to either a Laptop Display or Desktop Monitor.

- Positioning triangle for mounting the *REDn Scientific Eye Tracker*.

- Grease Removal Pads to clean the mounting surface prior to mounting the *REDn Scientific Eye Tracker*.

- Microfiber cleaning cloth to clean the face of the *REDn Scientific Eye Tracker*.

- SMI-certified *REDn Scientific* Laptop in Flight Case.
2.5 Optimal Conditions

To ensure optimal operating conditions throughout the experiment, we recommend:

- Participant should sit in the center of the Head Box area so that the participant has flexibility of movement during the experiment.

- Minimize any interference from direct sunlight on the REDn Scientific Eye Tracker.

- Do not use the REDn Scientific Eye Tracker in conditions where the participant's pupils would dilate and contract frequently, such as bright lights switching on and off frequently.

- Do not cover or block the REDn Scientific Eye Tracker when it is powered up and is connected to a PC or Laptop running iViewRED.

- For best results, the brightness of the background color for the calibration process should be similar to the average brightness of the stimuli shown during the experiment.
iViewRED Software Overview
3. iViewRED Software Overview

The iViewRED is the controller software that is used with the REDn Scientific Eye Tracker. This software is designed to allow an operator to quickly prepare the REDn Scientific Eye Tracker for experimentation.

3.1 Geometry Tab

The Geometry tab is shown by default when iViewRED starts. A set of measurement fields are provided for entering the geometry measurements for either a Laptop Display or a Desktop Monitor and the relative position of the REDn Scientific Eye Tracker to the display. This can be done manually or assisted automatically.

These measurements are required to ensure optimal mapping of the eye tracking data to the stimulus display.
Geometry Tab showing the Laptop settings
Geometry Tab showing Desktop Monitor settings
Tab Options:

Select Display: Selection is possible only if two displays are connected to a single PC (or an additional display is connected to the Laptop). Select the display to which the REDn Scientific Eye Tracker is mounted.

1-2 Button: Shown only if a second display is connected to the Laptop or Display. When clicked, identifiers are shown on the displays to indicate which is Display 1 and Display 2, as defined by the Windows® operating system.

Type of Display: Changes the Geometry tab to the respective fields of the selected display type.

Use Default Settings: Automatically detects Screen width and Screen height of the Display and sets the Depth and Height measurements to the default values of the SMI supplied laptop.

Setup Guide: Dims the screen and displays a vertical line at the center point of the screen for use when mounting the REDn Scientific Eye Tracker to the
frame of the Desktop Monitor or Laptop Display.

**Depth:**
Horizontal Distance [in mm] from the screen to the front edge of *REDn Scientific Eye Tracker* at the center point. This center point can be located using the Setup Guide. See *Measurement Settings*.

**Height:**
Vertical Distance [in mm] from the upper edge of the lower section of the screen frame to the top side of the *REDn Scientific Eye Tracker* at the center point. This center point can be located using the Setup Guide. See *Measurement Settings*.

**Screen Width:**
Width of the screen [in mm], not including the frame.

**Screen Height:**
Height of the screen [in mm], not including the frame.

**RED Angle [degree]:**
Angle of the Mounting Bracket that is used to connect the *REDn Scientific Eye Tracker* to the Desktop Monitor or Laptop Display. Selections include 15°, 20° and 25°. Ensure you select the correct value.
See Setting Geometry Measurements.
3.2 Calibration Tab

The **Calibration** tab is used to trigger the calibration process during which *iViewRED*'s internal eye model is adapted to the participant's unique eye characteristics. It is also used to perform an independent validation of the calibration results. You can furthermore configure the calibration point settings on this tab and display **Live Gaze View**.
Tab Options:

**Calibration Method:** Select from 0, 1, 2, 5, 9 or 13 Point. This sets the number of points that the participant must observe during calibration.

**Animation Speed:** Select from Normal or Fast. This is the speed of the animation between calibration points.

**Accept Points:** Select from Automatically, Semi-Automatically or Manually:

- **Automatically:** Calibration points are displayed sequentially without requiring confirmation by the operator or participant.

- **Semi-Automatically:** The first calibration point needs to be confirmed by the operator or participant manually by pressing the Space Bar.

- **Manually:** Each calibration point needs to be accepted manually by the operator or participant by pressing Space Bar.
**Smart Calibration:**
Smart Calibration is checked by default in iViewRED. See also *Smart Calibration* in the Glossary.

**Target Size:**
Sets the size of the calibration target on the Calibration screen.

**Target Shape:**
Select from Image or Disc:

When Disc is selected, the Target Color option appears.

When Image is selected, the Target File option appears to select an image from the PC or network drive. You can adjust the image for different use cases, for example, using engaging and captivating drawings for infant experiments.

**Target Color:**
Appears when Target Shape is set to Circle. Opens an Available Colors popup window to select from a range of grayscale colors. **This is only adjustable if you disable Auto Color function.**

**Target File:**
Appears when Target Shape is set to Image. Browse to an image to use as a calibration point.
Auto Color: When selected, an average gray level of the current screen content is used as the background color of the Calibration screen.

Background Color: Select from a set of grayscale colors for the background of the Calibration screen. Default is gray. **This is only adjustable if you disable Auto Color function.**

Calibration Results: Displays the results of the Calibration and the optional Validation. It shows for each eye the ratio of accepted calibration points to the number of points. It also shows accuracy values that indicate the deviation between target points and estimated gaze position. When **Smart Tracking Mode** is used, the calibration results indicate if either or both of the eyes have been selected for tracking based on the calibration data.

Default Values: Resets the Calibration tab to original settings.

Live Gaze View: When clicked, the screen is dimmed with the exception of a moving bright area, which corresponds to the movement of
the participant's gaze. Live Gaze View mode can be ended by pressing the **Live Gaze View** button again or by pressing the ESC key. This feature is available only after a calibration has been performed successfully.

**Calibration Area:**

This settings is for Advanced Users only. Changes are not normally required to these settings. After clicking the button, the **Calibration Area** will be shown in full screen mode. You can then change the location of each calibration point separately.

**Calibrate:**

Starts the calibration.

**Validate:**

Starts the validation. This is done after the calibration has been run.
3.3 Settings Tab

The Settings tab displays the Eye Tracking Monitor and settings for the Sampling Frequency, Tracking Mode and TTL Recording. Eye Images can also be displayed.

![Settings tab](image)

**Tab Options:**

**Sampling Frequency:** Select from **30** or **60** Hz sampling rate.
Tracking Mode: Select from Smart Binocular, Monocular Left, Monocular Right and Smart Tracking.

Show Tracking: Displays the Eye Tracking Monitor in a larger size for easy viewing. Checked by default

Show Eye Images: Hidden by default. The eye images can be displayed by right-clicking on the Eye Tracking Monitor.

See Setting Tracking Mode and Showing Eye Images.
3.4 Info Tab

The **Info** tab shows the system information. You can also check for software updates (Internet access required), launch the Online Help, and contact SMI for support requests (Internet access required).

**Tab Options:**

**System Information:** Lists the key operating parameters of the system. This information can be copied to the Clipboard for pasting into an email.
Check for updates: Sends a request to the SMI Updates server for the latest software updates (Internet access required). If a new version is available, it will be installed.


Contact SMI: Use to send an email to SMI for support requests. It launches the default email application (Internet access required).

See Checking for Software Updates.
3.5 Profile Selector

Settings made for a specific system or experiment can be saved to a profile. This can be useful when studies are run sometimes with a Laptop Display and sometimes with a Desktop Monitor. Profiles are also useful when different tracking and calibration settings are used in different experiments. In this way you can always use the same profile, and therefore the same settings, for the same experiments.

Profiles cannot be used across different PCs or Laptops.
Select Profile Options:

Select Profile: A profile includes all the defined settings made in all the tabs. If two or more profiles have been created, you can select a specific profile from the dropdown list.

Save: After making changes to any of the settings, you can save these settings to the currently selected profile.

Save as: After making changes to any of the settings, you can save these settings to a new profile.

Add: You can create a new profile, which will save any settings made to this new profile.

Remove: If you do not need a profile, you can remove it. All settings saved to this profile will be lost.

Profiles which are marked with an * behind the name contain unsaved profile changes.
See Managing Profiles.
3.6 Eye Tracking Monitor

The **Eye Tracking Monitor** helps the operator to find the optimum position for the participant to sit in front of the *REDn Scientific Eye Tracker*. Before running a calibration or an experiment, it is strongly recommended that the participant is sitting in this optimum position.

A larger Eye Tracking Monitor is provided on the **Settings** tab.
Features:

**Arrows:** When the participant is not sitting in an optimum position, arrows are shown to guide the participant. These include move left, move right, move closer to the screen, move away from the screen.

**Distance Values:** A distance value is also displayed to indicate how near (or far) a participant is from the REDn Scientific Eye Tracker.

See [Positioning the Participant](#).
3.7 Status Indicators

The operating status of the *iViewRED* software is indicated through the use of icons in the Windows® Taskbar and in the software’s title bar.

**Status Indicators:**

- **Not Connected:** Indicates the *REDn Scientific Eye Tracker* has not connected with the *iViewRED* software. This can be due to the USB cable on the Eye Tracker not connected with the USB port or the software has lost connection with the Eye Tracker. Check connections and/or restart *iViewRED*.

- **Connecting:** Indicates *iViewRED* is attempting to establish a connection with the *REDn Scientific Eye Tracker* via USB.

- **Running:** Indicates the *iViewRED* has established a connection with the *REDn Scientific Eye Tracker*.

See [Running iViewRED](#).
Chapter

Getting Started
4. Getting Started

Follow these steps to get started using the REDn Scientific System. Detailed instructions are provided in later sections of this User Guide.

1. Preparation:

   a. Download and run the *iViewRED* Installation Package, which is available at [www.smivision.com/software/](http://www.smivision.com/software/).

   b. After *iViewRED* has been installed, run the application.

   c. Connect the *REDn Scientific Eye Tracker* to an available USB port on the PC or Laptop.

   The *REDn Scientific Eye Tracker* requires a USB 3.0 port.

   d. The **Geometry** tab will be displayed in *iViewRED*.

   e. On the **Geometry** tab, select the type of display used from the **Display Type** dropdown menu. Select **Laptop Display** or **Desktop Monitor**.

   f. On the **Geometry** tab, click **Setup Guide**. This will display a vertical line on the screen in the exact horizontal center of the selected screen. It is used to correctly mount the *REDn Scientific Eye Tracker* on a Laptop Display or Desktop Monitor.

2. Mount the *REDn Scientific Eye Tracker*:
a. Select a Mounting Bracket from the available Mounting Brackets. The 20° Mounting Bracket is provided as standard. A 15° and 25° Mounting Bracket are available from SMI.

b. Insert the Mounting Strip into the Mounting Bracket.

c. Remove the protective cover from the Mounting Strip.

d. Horizontally align the Mounting Bracket with the vertical Setup Guide displayed on the screen. You can use the Reference Point on the Mounting Bracket (the Reference Point is a small indentation on the top side of the Mounting Bracket) for alignment.

e. Vertically align the top of the Mounting Bracket exactly with the upper edge of the lower frame of the screen.

   Ensure the Mounting Bracket is right side up before attaching. The Reference Point is on the top side of the Mounting Bracket and the Mounting Bracket is angled upwards.

f. Press and hold the Mounting Bracket against the frame for a few moments to ensure adhesion.

   Once the Mounting Strip has been attached, it cannot be easily removed. Ensure that the device has been attached in the correct position.

g. Connect the REDn Scientific Eye Tracker to the Mounting Bracket using the magnetic slots.
The USB cable connector should be on the right side of the device and the Reference Point on the Mounting Bracket should be facing upwards.
3. Set Geometry Measurements:

a. If a second Display or Monitor is connected to the Desktop PC or Laptop, click the 1-2 button on the Geometry tab to show the Display 1 and Display 2 identifiers. Select from the Select Display dropdown menu the Display or Monitor on which the REDn Scientific Eye Tracker is mounted.

b. Click Use Default Settings to obtain measurements for Screen Width and Screen Height. If the REDn Scientific Eye Tracker is mounted to the SMI-supplied laptop, and mounting instructions were followed precisely, the Depth and Height measures for REDn Scientific Eye Tracker positioning are given by the default values. Select the angle of the Mounting Bracket.

If top of the Mounting Bracket could not be aligned to the upper edge of the lower frame of the Display or if a Display other than that of the SMI-supplied Laptop is used, then you will have to manually enter the geometry measurements.

4. Position the Participant

a. Ensure the participant is sitting in an optimal position. See Positioning the Participant

b. Use the Eye Tracking Monitor to position the participant in the center of the Head Box.

5. Perform Calibration:
a. On the **Calibration** tab, set the calibration method, speed and other options as required.

b. Perform a Calibration.

---

Performing a Validation is optional.

---

6. **Create a Profile:**

   a. Save your default Geometry and Calibration settings for easy recovery for future experiments.

   b. Either add the changes to the existing profile by clicking the **Save** button or create a new profile to save these settings by clicking **New**.

7. **The REDn Scientific Eye Tracker is ready.**
Installing iViewRED Software
5. Installing iViewRED Software

The Installation Package for iViewRED software is available as a free download on the Software Downloads area of the SMI website. This Installation Package also includes the required drivers.

If the REDn Scientific Eye Tracker has been shipped with the SMI Laptop, then all required software is already installed. You should, however, check for software updates. See Checking for Software Updates.

5.1 Obtaining the Installation Package

To obtain the iViewRED software Installation Package:


2. Click the download link for the iViewRED Installer SMI iViewRED.msi.

3. On the File Download dialog, click Save File to download the installer to your PC or Laptop.
5.2 Installing the Required Software

Before installing *iViewRED*, ensure the *REDn Scientific Eye Tracker* is disconnected from the Laptop or PC.

To install the required software:

1. Run the *iViewRED Installer* SMI *iViewRED.msi*.

2. When the **Prerequisites Installer** dialog appears, click **Install** to begin.

   The **Prerequisites Installer** lists the software required to run *iViewRED*, which includes the Microsoft® .NET Framework 4.0 Client. If the .NET Framework is already installed, only the *iViewRED Installer* will be shown.

3. If the .NET Framework 4.0 Client needs to be installed, you will be asked to confirm the installation of this software. An Installation Wizard will download the Microsoft® .NET Framework 4.0 Client. Depending on the internet connection speed, this may take a few minutes.

   a. In the **.NET Framework Setup** dialog, accept the terms and conditions and click **Install** to continue.

   b. The .NET Framework 4.0 Client will be installed.

   c. Click **Finish** to complete the installation.

4. The **iViewRED Setup Wizard** will appear. Click **Next**.
5. Accept the **License Agreement** and click **Install**.

6. **iViewRED** will now be installed.

7. Click **Finish** to dismiss the dialog.
Running iViewRED
6. Running iViewRED

If the REDn Scientific Eye Tracker has not yet been mounted, see Mounting the Eye Tracker.

To run iViewRED:

1. Attach the REDn Scientific Eye Tracker to the Mounting Bracket, which is attached to the Laptop Display or Desktop Monitor.

2. Connect the REDn Scientific Eye Tracker to a USB 3.0 port on your Laptop or Desktop PC.

3. Start iViewRED.

4. The Startup screen will appear and iViewRED will immediately begin attempting to connect to the REDn Scientific Eye Tracker.
5. When connected, a set of LEDs on the front panel of the REDn Scientific Eye Tracker will be illuminated. This indicates the cameras are switched on and is sending data.

If iViewRED could not connect to the REDn Scientific Eye Tracker a status message will appear: **No device detected. Please make sure the device is plugged in.** The status indicator will change to **Not Connected.** In this case, ensure the device is properly connected to a USB 3.0 port. See **Troubleshooting.**
6. When connected, the default screen of *iViewRED* will appear showing the **Geometry** tab and the status indicator will change to **Running**.
Mounting the Eye Tracker
7. Mounting the Eye Tracker

Mounting the *REDn Scientific Eye Tracker* is simple and takes only a few minutes. It is designed to be mounted on the lower frame of a Desktop Monitor or Laptop Display.

7.1 Mounting Guides

Mounting guides have been provided to assist you in mounting the device.

- **Reference Point** - This physical mark on the Mounting Bracket is located at the exact center of the bracket for alignment with the Setup Guide.

- **Setup Guide** - This is a vertical line displayed at the exact vertical center of the screen for alignment with the Reference Point on the Mounting Bracket. It is displayed by clicking **Setup Guide** on the **Geometry** tab of *iViewRED*. 
7.2 Mounting Instructions

The mounting instructions provided in this section are relevant to both Laptop Displays or Desktop Monitors.

Before proceeding, ensure *iViewRED* has been installed. If not see Installing *iViewRED* Software.

To mount the *REDn Scientific Eye Tracker* on a Laptop Display or a Desktop Monitor follow these steps:

1. **Connect the *REDn Scientific Eye Tracker* to a USB 3.0 port with the supplied USB cable.**
a. Insert the USB cable to the connector on the REDn Scientific Eye Tracker, being careful not to damage the connectors.

b. Connect the USB cable to an available USB 3.0 port.

c. Start iViewRED.

d. iViewRED will attempt to connect to the REDn Scientific Eye Tracker.

e. Once connected, the LEDs on the REDn Scientific Eye Tracker will illuminate.

2. Attach the Mounting Bracket to the Laptop Display or Desktop Monitor.

a. With iViewRED running, click Setup Guide on the Geometry tab to display the vertical Setup Guide. This blue line is displayed at the exact vertical center of the screen.
b. Connect the magnetic Mounting Strip to the back of the Mounting Bracket.

c. Remove the protective cover from the Mounting Strip.
d. Horizontally align the Mounting Bracket: Using the Reference Point on the Mounting Bracket, carefully align the Mounting Bracket to the vertical Setup Guide displayed on the screen. Ensure that the Reference Point is facing upwards.

e. Vertically align the Mounting Bracket: Carefully align the top of the Mounting Bracket to the upper edge of the bottom frame of the screen.

f. Firmly press and hold the Mounting Bracket to the frame at that position for a few moments to ensure adhesion.

g. Your setup should look like this.

3. Connect the REDn Scientific Eye Tracker to the Mounting Bracket.

a. The REDn Scientific Eye Tracker can only be connected to the Mounting Bracket in one direction. This ensures the cameras on
the device are in the correct orientation and that the USB cable is on the right side of the device.

Attach the eye tracker to the Mounting Bracket.

b. Attach the REDn Scientific Eye Tracker to the Mounting Bracket using the magnet connectors.

For important information about the magnets, see Precautions.
Chapter 8

Managing Profiles
8. Managing Profiles

A profile stores all the values set in iViewRED. A default profile is provided which contains the most commonly used settings. You can save changes to this default profile or you can create a unique profile that saves settings made for specific conditions or participants. You can then easily switch between profiles without having to re-enter these settings.

8.1 Creating and Modify Profiles

Create a Profile

To create a profile:

1. In the Select Profile area, click New to open the Creating a new profile dialog.
2. Enter a profile name in the Name field, and click OK.

3. Any settings made can be saved to this profile by clicking Save.

Modify a Profile

To modify some settings of an existing profile you can use the option Save as... . All current profile settings will be copied to a new profile. Please refer to the following steps:
1. Select the profile you want to modify and make all changes you want to submit.

2. Click on the Save as... button in the Select Profile area. A new window called Saving profile as... appears.

3. Enter a new profile name in the Name field and click OK.

Profiles which are marked with a * behind the name contain unsaved profile changes. If you want to keep the changed settings, please use the Save button in the Select Profile area.

If you create a new profile or close the application and the current selected profile contains unsaved changes, you have to confirm if you want to save or discard these changes. A Confirmation dialog will appear when ever there are changes to the profile which are not saved.

8.2 Selecting Profiles

To select a profile:
1. From the **Select Profile** field, click the down-arrow to open a list of available saved profiles.

![Select profile](image)

2. Select one of the saved profiles.

3. The settings stored in the selected profile will be automatically loaded into the application.

### 8.3 Deleting Profiles

Profiles no longer needed can be deleted.
When a profile is deleted, the settings saved in the profile will be lost.

To delete a profile:

1. In the **Select Profile** field, click the down-arrow to open a list of available saved profiles.

2. Select a saved profile from the list and click **Remove**.
Chapter 9
Setting Geometry Measurements
9. Setting Geometry Measurements

The **Geometry** tab is used to set geometry measurement that provide to **iViewRED** the actual position of the **REDn Scientific Eye Tracker** mounted on the Stimulus Display. These settings are important for optimal mapping of the eye tracking data to the Stimulus Display.

### 9.1 Using Multiple Displays

If a second monitor is attached to your Desktop PC or Laptop, you must select which of the two displays will be used by the **REDn Scientific Eye Tracker**.

To select the display used by the **REDn Scientific Eye Tracker**:

1. Run **iViewRED**.
2. Select the **Geometry** tab.
3. The **Select Display** dropdown menu will show **Display 1** and **Display 2** and the **1-2** button will appear.
4. Click the **1-2** button to show the Display Identifiers. In the following example, *iViewRED* is shown on Display 1, which can be used by the operator. The *REDn Scientific Eye Tracker* is mounted on Display 2 which is used by the participant.

5. Choose from the **Select Display** dropdown list the display on which the *REDn Scientific Eye Tracker* is mounted. In this example, you would select **Display 2**.
9.2 Selecting Type of Display

The Geometry tab provides a set of fields for entering geometry measurements for Laptop Displays or Desktop Monitors used with the REDn Scientific Eye Tracker. Therefore, before you enter those measurements, you need to select the type of display.

To select the type of display:

- Select Laptop Display or Desktop Monitor from the Type of Display dropdown menu:

The following shows the Laptop Display settings.

![Geometry tab for Laptop Display Settings]
The following shows the Desktop Monitor settings.

Geometry tab for Desktop Monitor Settings

9.3 Required Measurement Values

A set of measurement values are required by iViewRED for the software to know the actual position of the REDn Scientific Eye Tracker. These values provide an optimal mapping of the eye tracking data to the stimulus display. This can be done manually or assisted automatically.

See Automatically Detecting Measurement Settings and Manually Entering Measurement Settings.
The following provides a general illustration of the measurements required by *iViewRED*.

**9.4 Automatically Detecting Measurement Settings**

*iViewRED* provides an automatic detection of screen measurement settings. This is done through the *Use Default Settings* button on the *Geometry* tab.

Automatic detection of *Screen Width* and *Height* works for the vast majority of monitors on a single PC setup.

However, *Depth* and *Height* values as provided with the *Use Default Settings* function are the default positioning values of the *REDn Scientific Eye Tracker* on the SMI-supplied Laptop if mounting
instructions have been followed precisely. When using a different monitor or laptop, or adjustments to the default mounting were made, these settings should be manually adjusted.

Using Automatic Detection

To automatically detect measurement settings:

1. On the Geometry tab, select the type of display from the Select Display dropdown.

2. If you have not done so already, create a new profile, such as "Experiment Laptop". See Creating Profiles.

3. If a second display is connected to the PC or Laptop, use the 1-2 button and select from the Select Display dropdown the display that will be used with the REDn Scientific Eye Tracker. See Using Multiple Displays.

4. Click Use Default Settings.

5. iViewRED will detect the measurement values and load these values into the fields.

6. Select from 15, 20 or 25 to enter the angle value of the Mounting Bracket into the RED Angle [Degree] field. See Setting RED Angle.

Use Default Settings works on most systems. Some systems may be incompatible with Windows® standard interfaces. In this case, a manual check and correction of the settings is recommended.
9.5 Manually Entering Measurement Settings

When to Manually Enter Measurement Settings

In cases where it is not advisable to use automatically detected measurement settings, you will need to manually determine and enter these measurement settings into iViewRED. This cases include:

- The REDn Scientific Eye Tracker could not be aligned correctly with the upper edge of the lower frame of the Display screen.

- The frame thickness of your Display's frame is different from the thickness of the SMI provided Laptop's Display frame.

- You are using a Dual PC setup or a Display for which screen parameters cannot be detected.

For a description of the measurement values, see Required Measurement Values.
Using Manual Settings

To manually enter the measurement settings:

1. On the **Geometry** tab, select the type of display from the **Select Display** dropdown.

2. If you have not done so already, create a new profile, such as "Experiment Laptop". See **Creating Profiles**.

3. If a second display is connected to the PC or Laptop, use the 1-2 button and select from the **Select Display** dropdown display that will be used with the *REDn Scientific Eye Tracker*. See **Using Multiple Displays**.

4. Determine the **Depth** measurement and enter the measurement in the **Depth [mm]** field. See **Setting Depth and Height**.

5. Determine the **Height** measurement and enter the measurement in the **Height [mm]** field. See **Setting Depth and Height**.

6. Determine the **Screen Width** and **Height** measurements and enter these measurements in the **Screen Width [mm]** and **Screen Height [mm]** fields. See **Setting Screen Width and Height**.

7. Select from **15, 20 or 25** to enter the angle value of the Mounting Bracket into the **RED Angle [Degree]** field. See **Setting RED Angle**.
9.6 Setting Depth and Height

Obtaining the Depth Measurement

To obtain the depth measurement:

1. Run *iViewRED* and click **Setup Guide** on the **Geometry** tab.

2. Place the Triangle against the screen along the Setup Guide and on top of the *REDn Scientific Eye Tracker*.

3. Measure the depth from the screen to the front corner of the *REDn Scientific Eye Tracker*. The **Depth** measurement in this example is approximately 22 mm.

4. Enter the **Depth** measurement in the **Geometry** tab.
Setting Geometry Measurements

Depth [mm] field

- Depth [mm]: 23
- Height [mm]: -1
- Screen width [mm]: 344
- Screen height [mm]: 194
- RED Angle: 20
Obtaining the Height Measurement

To obtain the height measurement:

1. Run iViewRED and click Setup Guide on the Geometry tab.

2. Place the Triangle as shown in the following image. The Triangle is placed on top of the display lower frame at the screen and aligned to the vertical line displayed by the Setup Guide. The distance you want to obtain is the height from the Triangle to the front top of the REDn Scientific Eye Tracker.

3. Enter the Height measurement in the Geometry tab.
9.7 Setting RED Angle

The RED angle is determined by the angle of the Mounting Bracket used to connect the REDn Scientific Eye Tracker to the Desktop Monitor or Laptop Display.

- Select from the RED Angle dropdown menu 15, 20 or 25.

The standard Mounting Bracket supplied is the 20° bracket. Other Mounting Brackets available from SMI include a 15° Mounting Bracket and a 25° Mounting Bracket.
9.8 Setting Screen Width and Height

These two measurements are the dimensions of the display area of the screen as illustrated below.

You can use **Use Default Settings** to obtain the screen width and height. This works for most displays in a single PC setup.

These values are entered in the **Geometry** tab.
Interface to set Screen Height and Width
Positioning the Participant

Chapter 10
10. Positioning the Participant

Before running a calibration, the operator needs to assist the participant to find a sitting position that is comfortable and yet allows the participant to be tracked by the REDn Scientific Eye Tracker. iViewRED helps the operator to find that position through the use of an Eye Tracking Monitor.

10.1 Optimal Participant Position

Here are some recommendations for locating the optimal participant position:

- Ensure the participant is sitting comfortably.

- Ensure the participant is sitting approximately centered in front of the REDn Scientific Eye Tracker and directly facing the screen. This location can be found using the Eye Tracking Monitor.

- Ensure the participant is positioned at a distance away from the screen that is roughly in the center of the operating distance of the REDn Scientific Eye Tracker. This distance can be found using the Eye Tracking Monitor.

See also Optimal Conditions
10.2 Eye Tracking Monitor

The **Eye Tracking Monitor** is located in the upper area of *iViewRED*.

![Eye Tracking Monitor Diagram]

The **Settings** tab provides a larger **Eye Tracking Monitor**, when **Show Tracking** is selected.
Distance Measurement

To indicate how far (or near) a participant is from the REDn Scientific Eye Tracker, the Eye Tracking Monitor provides a distance measurement at all times. In the example below, the participant is 52 cm away from the screen.
Eye Tracking Monitor - Distance

Eye Tracking Monitor Arrows

When a participant is within the optimum sitting position, the Eye Tracking Monitor will be displayed without arrows. However, when the participant begins to move towards the edges of the Head Box, the Eye Tracking Monitor provides arrows to assist the participant to move back towards the optimum position.

The participant can still be tracked when the arrows appear. They simply serve as guides to help position the participant to remain within the optimal location.

- **Arrow Directions** - When the participant is not sitting in an optimum position, arrows are shown to guide the participant. These include move left, move right, move closer to the screen, move away from the screen. In the example below, the participant should move to the right and away from the screen.
- **Arrow Colors** - The color of the arrows indicate a progression from close to optimum to close to out of tracking range. These colors are Orange, Yellow, and Red:

![Eye Tracking Monitor - Arrows](image)

Orange indicating close to optimum
Yellow indicating moving away from optimum

Red indicating moving out of trackable range
Performing a Calibration
11. Performing a Calibration

When a calibration is performed, the participant observes a series of calibration points sequentially displayed on the screen. The calibration can then be validated (optional) using a similar procedure on independent points.

11.1 Running a Calibration

When clicking Calibrate in the Calibration tab, iViewRED goes briefly into full screen mode and a series of target shapes are displayed in succession in each of the areas of the screen as defined by the Calibration Method.

Calibration can be canceled at any time by using the Esc (Escape) key.

To run a calibration:

1. Ensure the measurement values of the Laptop Display or the Desktop Monitor are set in the Geometry tab. See Setting Geometry Measurements.

2. Select the Calibration tab.

3. If required, set the calibration method, calibration speed, Smart Calibration and method of accepting calibration points.

4. Click Calibrate to begin.
5. *iViewRED* goes into full screen mode and displays the **Calibration** screen with an initial focus point in the center of the screen.

![Initial focus point](image)

6. After a few moments, and depending on the settings for **Animation Speed** and **Calibration Method**, one or more focus points will be displayed in succession on the screen. Depending on the settings for **Accept Points**, you may need to press the **Space Bar** to continue. The participant must focus on each point as it is displayed. The following shows five target points distributed across the screen.
The participant must keep their eye gaze focused on these points. If the results are unusual or inadequate, run the calibration again while ensuring the participant keeps a focus on each point as it appears.

7. When the calibration is completed, *iViewRED* exits full screen mode and returns to the **Calibration** tab.

8. The results of the calibration are saved to the participant profile. In the **Calibration Monitor**, the results of the calibration is displayed.
For an explanation of the results of the calibration, see Understanding the Results.

9. The calibration can be then validated, as described in Running a Validation.
11.2 Calibration Methods

Calibration methods with a higher number of calibration points may improve the results but require the participant to focus their attention for a longer time. The decision to use a higher or lower number of calibration points should consider how long a particular participant can concentrate and how well they can focus.

In most cases, a 5 Point calibration will provide the best trade-off between duration of calibration and results.

See also Calibration in the Glossary

The REDn Scientific Eye Tracker provides six calibration methods:

- 0 Point Calibration
- 1 Point Calibration
- 2 Point Calibration
- 5 Point Calibration
- 9 Point Calibration
- 13 Point Calibration

11.2.1 0 Point Calibration

0 Point calibration method does not establish an individual model of the
participant's eye characteristics. In this case, a calibration is performed automatically without displaying the **Calibration** window. Gaze data will be immediately calculated after the calibration button has been clicked.

0 Point calibration is not recommended for highest accuracy, but it is suitable for participants who have difficulty achieving a successful calibration.

Use 0 Point or 1 Point calibration only if using a higher number of calibration points is not adequate.

### 11.2.2 1 Point Calibration

1 Point calibration method has an improved accuracy over 0 Point calibration.

In this mode, a single calibration point is shown in the center of the screen.
1 Point Calibration method

This calibration mode is suitable for participants who have difficulty achieving a successful calibration with more than one calibration point.

Use 0 Point or 1 Point calibration only if using a higher number of calibration points is not adequate.
11.2.3 2 Point Calibration

2 Point calibration method is quick and easy to perform.
11.2.4 5 Point Calibration

5 Point calibration method is the recommended method for most use cases.

This mode is a good balance between fast and comprehensive calibration and is suitable for data recordings where a more robust level of accuracy is required.
11.2.5 9 Point Calibration

9 Point calibration method has a very high accuracy level. The participant, however, must be able to stay focused for a longer duration of the calibration process.

![9 Point Calibration Mode](image)
11.2.6 13 Point Calibration

13 Point calibration method has a very high level of accuracy. However, due to the number of calibration points, the participant must be able to stay focused for an extended duration of the calibration process.

13 Point Calibration Mode
11.3 Setting Animation Speed

If a participant cannot follow the points shown on the screen, you can increase the amount of time of the animation between calibration points by selecting a slower animation speed.

*iViewRED* provides two animation speeds: **Normal** and **Fast**. These options are selected from the **Animation Speed** dropdown box on the **Calibration** tab.

11.4 Accepting Calibration Points

*iViewRED* provides three options for accepting calibration points: **Manually**, **Semi-automatically** and **Automatically**. These options are selected from the **Accept Points** dropdown in the **Calibration** tab. Calibration points can be accepted either by the operator or by the participant.

- **Manually**: Each calibration point is accepted manually by pressing the **Space Bar**.

- **Semi-Automatically**: The first calibration point is accepted manually by pressing the **Space Bar**. On subsequent calibration points, calibration points are accepted automatically.

- **Automatically**: In this mode, all calibration points are accepted automatically. This mode assumes that the participant is gazing at the calibration points while they are presented. For that, willingness of cooperation by the participant is required.
If **Smart Calibration** is enabled and the eye gaze of a participant cannot be tracked, the current calibration point will be dropped. If **Smart Calibration** is not active, iViewRED will wait until a fixation can be detected before advancing to the next calibration point. See [Using Smart Calibration](#).

### 11.4.1 Using Smart Calibration

When **Smart Calibration** is enabled, the calibration process waits two seconds for a fixation. If the data of one point is found unreliable (for example, the participant did not fixate on a point), then the data for this point will be dropped and this point will not be used to calculate gaze estimation parameters. This helps the calibration by removing bad fixations containing significant errors.

**Smart Calibration** is enabled in the **Calibration** tab.
When using **Smart Calibration** in combination with automatic acceptance of calibration points, a timeout of two seconds is provided for each point. If the system is unable to track the eyes in that time, data from that calibration point is discarded.

### 11.5 Setting Calibration Point Styles

You can customize the calibration point styles to suit your environment and needs of the participants. The following shows the default calibration point style.
Customize the calibration using the following options:

- **Target Size** - Adjust the calibration point size for different use cases. For experienced participants a smaller target size may improve the calibration results. However, for inexperienced participants a bigger target size can improve the success rate.

- **Target Shape** - You can use either a disc or you can choose any image suitable for your needs. When Image is selected, the **Target File** option appears to select an image from the PC or network drive.

- **Auto Color** - The background color of the **Calibration** screen is set automatically using an average gray level of the current screen content.

- **Target Color** - When you select **Disc** for a target shape, you can then set the color of the calibration point using the **Available Colors** popup window to select from a range of grayscale colors.
• **Background Color** - If **Auto Color** is deselected, you can select from a set of grayscale colors for the background of the **Calibration** screen. The default color is gray.

The background color should be similar to the color of the stimuli used in the experiment to maintain the same level of brightness. Changing the brightness causes the participant's pupils to change, which can affect the calibration.

### 11.6 Running a Validation

The calibration can be validated (optional) with the same participant using a procedure similar to that used during the calibration process.

To run a validation:

1. After running a calibration, and with the same participant, click **Validate** on the **Calibration** tab.
2. *iViewRED* goes into full screen mode and displays the **Validation** screen.

3. The participant must focus on each of the validation points as they are displayed sequentially.
4. Validation will begin immediately without any initial focus point.

5. When the validation is complete, iViewRED exits full screen mode and returns to the Calibration tab.

6. The results of the validation will be displayed in the Validation Monitor.
11.7 Understanding the Results

After a calibration has been performed, iViewRED returns to the Calibration tab. The results of the calibration are displayed in this tab.

For each eye, the ratio of accepted calibration points to the number of shown calibration points is displayed. The accuracy of the gaze is indicated by the value shown:

- The lower the value, the better the results.
The results also indicate if either both of the eyes were used during calibration.

![Good calibration results](image)

The results of a calibration have two parts:

- **Left Usage and Right Usage** - For each eye, the ratio of accepted calibration points to the number of shown calibration points is displayed.

- **Accuracy (X/Y) Left Eye and Right Eye** - The accuracy of the gaze is indicated by the value shown. The lower the value, the better the results.

**Blue and Green indicators**
• **Blue dot** - indicates the right eye.

• **Green dot** - Indicates the left eye.

### 11.8 Recalibrating on a Point

Recalibration on a calibration point can be done if the calibration results indicate that the participant did not focus sufficiently on an individual calibration point.

When a calibration point has been recalibrated, the entire calibration will then be adapted afterwards in one of the following ways:

- The data from the selected point will be replaced with new data from the recalibrated point.

- The data from the previously missing point will be included in the calibration model.

Recalibration can only be done after a calibration has been performed, and only if no calibration settings were changed or if another tab was selected. If another tab was selected or if the calibration settings were changed, the display will be turned to **Calibration Point Setting** mode and recalibration is no longer possible.

To recalibrate on a specific calibration point:

1. Using the mouse, move over the point to be recalibrated.

2. A floating hint will appear - **Click to recalibrate**.
3. Click on the hint and follow the process as in running a 1 Point calibration. See Running a Calibration.

4. The new data will be merged with the previous calibration and the entire calibration will then be adapted as described above.
Setting the Calibration Area
12. Setting the Calibration Area

The default positions of the calibration points are optimized to gain best performance over the full screen area. If you use only a part of the screen, you may want to consider moving the calibration points to this certain area.

⚠️ Changing the position of calibration points has a severe impact on accuracy.

The **Calibration Area** can be reset for all calibration methods, except 0 Point and 1 Point calibration.

To set the calibration area:

1. From the **Calibration** tab, select the number of calibration points from **Calibration Method**.

2. Click **Calibration Area**.
3. When changing the position of a calibration point, the accuracy of the calibration may be affected. Specific guidelines are provided in this section for the placement of calibration points. Refer to these sections before making any changes. Click **OK** to accept the warning.
For positioning of calibration points, refer to the respective sections below for each calibration method.

4. The application will go into full screen mode with the target points showing in each quadrant.
5. Adjust the position of the target points and click OK.

6. If necessary, any changes made can be reset to default by clicking Default values.

7. When done, click OK to return to the Calibration tab.

For best results across the screen, the calibration points shall cover the whole area of the screen. The calibration point coordinates should be distributed equally along the x and y axis.

When resetting a 2 Point Calibration, calibration points MUST BE placed on a diagonal from the top left corner to the bottom right corner in the stimulus area.

For all other Calibration Methods it is generally recommended, but not mandatory, to place the calibration points in the same layout as in the default layout.
Using Live Gaze View
13. Using Live Gaze View

Live Gaze View can be used to show the area on the screen at which the participant is gazing.

Run a calibration before using this Live Gaze View for best performance.

To use Live Gaze View:

1. On the Calibration tab, click Live Gaze View.

2. The Live Gaze View button turns red while this mode is activate.

3. The entire screen dims except the area on the screen to which the participant attends. This area is shown as a lit circle, as in a
flashlight shining into a dark area. The refresh rate of the Live Gaze View is determined by screen refresh rate.

Live Gaze View

4. Exit by clicking the **Live Gaze View** button.
Chapter 14

Setting the Tracking Mode
### 14. Setting the Tracking Mode

iViewRED provides four tracking modes that can improve the eye tracking of participants with various eye characteristics. This can be eye conditions such as "lazy eyes" or having a glass eye. It can also assist tracking of participants wearing glasses or contact lenses.

- **Smart Binocular** - Both eyes are tracked. Tracking continues if one eye is temporarily closed.

- **Monocular Left** - Only the left eye is tracked. This is useful if the participant has a right glass eye or if the right eye has characteristics that make it undesirable to track for the purposes of the experiment; for example, this is useful if the vision of the right eye of the participant is much weaker than the left eye.

- **Monocular Right** - Only the right eye is tracked. This is useful if the participant has a left glass eye or if the left eye has characteristics that prevents it from being tracked; for example, this is useful if the vision of the left eye of the participant is much weaker than the right eye.

- **Smart Tracking** - Based on the calibration results, the software intelligently decides whether to use one or both eyes for tracking. This ensures the best data quality in settings where highest robustness is required, for example, when participants might have severe vision impairments on one eye. Recommended only for calibrations using five and more points.
Chapter 15

Additional Information
15. Additional Information

This section includes additional topics for the REDn Scientific Eye Tracker.

15.1 Shutting Down iViewRED

To shut down iViewRED:

1. Click the red close ("X") icon in the top right corner of the window.

2. A dialog window will appear, asking for confirmation. Click Yes to finally shut down the application.

3. iViewRED will now shut down.

4. Disconnect the REDn Scientific Eye Tracker from the USB port and safely store the device in its Carrying Case.

Note: When shutting down the iViewRED software all other applications which are also connected to the eye tracking server will lose their connection.
15.2 Troubleshooting

Certain background processes and services require substantial system resources during execution. While this does not affect the system during idle times, those background processes may disturb a running eye tracking experiment. If you notice a degradation in system responsiveness, you may consider the following points:

- Disable the background scan function of your virus scanner. This function scans newly started executables and various file formats while they are read in from the hard disk drive. Use the on-demand virus scan function instead.

- Make sure no CPU consuming screen saver is automatically activated during a running experiment. It is best to completely switch off the screen saver during an experiment.

- You may also deactivate any auto-update functions. While background downloading of files does not normally use too much system resources, confirmation dialogs and update notices may disturb an experiment.

- Check the power configuration settings when using a Notebook PC. In the Windows® Control Panel, select the Performance and Maintenance category. Start the Power Options applet and select the "Presentation" entry in the Power Schemes list.

- Disable the USB selective suspend settings on a Desktop PC. This prevents the USB port from suspending during the usage of iViewRED. To disable this setting in Windows® 7:

  a. Select Control Panel > Hardware and Sound > Power Options.
b. In the **Power Options** window, select **Change Power Settings** from the **Preferred Plan** area, and then select **Change plan settings**.

c. In the **Changes settings for the plan** window, select **Change Advanced Power Settings**.

d. In the **Power Options** dialog, click the plus sign next to **USB Settings**, then click the plus sign next to **USB selective suspend setting**.
e. Click **Setting** and then choose **Disabled** from the dropdown list.

f. Click **OK** to close the dialog.

*iViewRED does not start*

It is not sufficient to simply copy the *iViewRED* application directory to another PC. You must use the *iViewRED* Installation package. This ensures, for example, that the required Microsoft® .NET Framework Version 4.0 or above is installed properly.

You cannot start *iViewRED* from a network share / network drive because of .NET security restrictions.

*I am getting an error message*

*iViewRED* has several error states:

- **Not Connected** - This is indicated by the symbol in the application title bar. Ensure that the *REDn Scientific Eye Tracker* is connected to the USB port. If the *REDn Scientific Eye Tracker* is connected and you are still getting a **Not Connected** status, the USB port may not be functioning or you are using the wrong USB port (USB 2.0 instead of USB 3.0 for example). In this case, ensure you are using the correct USB port or try another USB port or disconnect any unneeded USB devices.

- **License expired!** - This error message indicates that you are working with a time limited (loaner or demo) Eye Tracking device and its time
limit has expired. Please contact your SMI sales representative to discuss further options.

Can I use the REDn Scientific Eye Tracker with other USB connected devices?

The REDn Scientific Eye Tracker is a high performance USB device that requires a certain amount of available bandwidth from the USB port. When other high performance USB devices are plugged into USB ports such as USB drives, webcams, WIFI adapters, the available bandwidth of USB may become insufficient.

The REDn Scientific Eye Tracker also draws the power it needs from the USB port. If some other USB device is absorbing current above the USB specification, this may also lead to problems. Try disconnecting unneeded USB devices.

See also the description for setting Power Options above.

15.3 Logfile recording

The iViewRED software will automatically detect software and hardware error conditions. They are recorded into logfiles stored on the hard drive. In case you want to contact the SMI support team to report an issue you might be asked to send these log files to SMI for further analysis.

The logfiles are recorded to the installation folder of iViewRED. Typically this is:
Collect all current logfiles in a single file

Use **Collect log files** from the Info tab of **iViewRED** to save all logfiles in a single file.
15.4 Showing Eye Images

Eye images from the REDn Scientific Eye Tracker can be shown on the Settings tab. These images are hidden by default.

To show eye images:

1. Right-click on the Eye Tracking Monitor in the Settings tab.

2. The processed eye images from the REDn Scientific Eye Tracker will be displayed.
3. Right-click on the Eye Images and click Hide eye images to return to the Eye Tracking Monitor.
15.5 Removing the Mounting Bracket

The magnet used to hold the Mounting Bracket to the Magnetic Strip is very strong. When the Magnetic Strip is not firmly glued to a surface, removing the Mounting Bracket from the Magnetic Strip is not easy. You can detach the Mounting Bracket from the Magnetic Strip by inserting a pin the detachment hole provided on the Mounting Bracket.

15.6 Checking for Software Updates

To update iViewRED:

1. On the Info tab, click Check for Updates.
2. If no current updates are available, no executable will be downloaded.

3. If a newer version is available, an executable will be downloaded. Save it to your local drive for installation.

4. Install the update as described in Installing iViewRED Software.

15.7 iViewRED Software Structure

iViewRED includes a Server and a Client. As a structure, iViewRED consists of an Application Layer, a Driver and Service Layer, and a
Physical Layer. Each layer provides status messages to the Windows® operating system.

**Application Layer**

This is the top layer and consists of the *iViewRED* application and additional application software such as the *SMI Experiment Suite 360°*, or other 3rd party applications.

Application software accesses the *REDn Scientific Eye Tracker* through an exposed API (Application Programming Interface) provided in the Driver and Service Layer.

For further information consult the SDK User Guide.

**Driver and Service Layer**

This layer consists of a server and the USB Driver provided by the Windows™ operating system.

It provides an API through which applications in the top layer communicate with the *REDn Scientific Eye Tracker*. The server provides the kernel which processes information from the *REDn Scientific Eye Tracker* and
sends the resulting coordinates to the application layer via the API.

When iViewRED is running, the Connected status indicator icon is provided in the Windows™ Taskbar.

**Physical Layer**

This layer consists primarily of the REDn Scientific Eye Tracker. It communicates with iViewRED via USB.

### 15.8 Interfacing with other Applications

If you wish for another application, such as stimulus presentation software, to interact with iViewRED, both applications need to be interfacing properly.

Interfacing differs whether you are working with Experiment Center or a third party application. It also differs depending on whether your application runs on the same PC as iViewRED or if you are working in a Dual PC configuration.

#### 15.8.1 Interfacing with SMI Experiment Center

Interfacing with SMI Experiment Center™ is particularly simple. Before running a designed study, iViewRED needs to be started and the REDn Scientific Eye Tracker connected to the PC, then data acquisition can start.
Before running a study in *Experiment Center™*, make sure that tracking mode and sampling rate selection in *iViewRED* as well as the Geometry Settings have been adjusted to the setup and experimental needs.

When using *Experiment Center™* and *iViewRED* on the same PC, be sure that **Use One PC Setup** is checked in *Experiment Center™*’s **Global Setting** dialog.

Consult the *Experiment Center™* User Guide for further information.

### 15.8.1.1 Working in a Dual PC configuration

It is possible to use *Experiment Center™* and *iViewRED* on different PCs. In this case, after each recording the IDF file is automatically transferred from the *iViewRED* PC to the Stimulus PC running *Experiment Center™*.

To establish a connection, go to *Experiment Center™*’s **Global Settings** dialog. Uncheck **Use One PC Setup**. Enter the IP address and port found in the Info tab of *iViewRED* in the respective fields for the **iView X System** in *Experiment Center™*.

A firewall may block the communication. Consult *Experiment Center™*’s User Guide on how to unblock the firewall and for further information.

### 15.8.2 Interfacing with Third Party Applications

If third party application is running on the *iViewRED* PC (the PC that the *REDn Scientific Eye Tracker* is connected to), the programs can be connected using the **localhost address**. See Application Running on *iViewRED PC*. 
When *iViewRED* is running on a PC different from the PC that the application is running on, a network connection needs to be established. See Application Running on Second PC (Dual PC Setup).

### 15.8.2.1 Application Running on iViewRED PC

When *iViewRED* and the application interacting with *iViewRED* are running on the same PC, the connection can be automatically initialized if the application uses the SDK command `iV_ConnectLocal`. In this case, no further settings are required.

If the application uses the SDK command `iV_Connect`, a network connection will need to be established. In this case, locate the part of your application where a network communication can be configured. In an existing application, this would use the command

```
iV_Connect(SendIPAddress, SendPort, RecvIPAddress, ReceivePort).
```

When both applications are running on the same PC, use a localhost network connection. Typically, this is realized using the IP address 127.0.0.1 for both `SendIPAddress` and `RecvIPAddress`. You can find IP Address and Port of the *iViewRED* PC on the Info Tab. These will need to be inserted for `SendIPAddress` and `SendPort`. `RecvIPAddress` and `ReceivePort` are determined by the PC running your application.
For further information, consult the SDK User Guide or the User Guide of the application you are using.

15.8.2.2 Working in a Dual PC configuration

When *iViewRED* and the application interacting with *iViewRED* are running on two different PCs, the connection will need to be established physically with a hardware ethernet network connection. In addition, the application interacting with *iViewRED* will need to be configured for communication.
Locate the part of your application where the network communication can be configured. If you are writing your own application use the command `iV_Connect(SendIPAddress, SendPort, RecvIPAddress, ReceivePort)`.

You can find IP Address and Port of the iViewRED PC on the Info Tab. These will need to be inserted for `SendIPAddress` and `SendPort`. `RecvIPAddress` and `ReceivePort` are determined by the PC running your application.

![Image of System Information](image-url)

**IP Address and Port**
For further information, consult the SDK User Guide or the User Guide of the application you are using.

15.9 Evaluating Eye Tracking Data

The fastest way to conduct and analyze eye tracking experiments is by using SMI's comprehensive software package *Experiment Suite™*. Eye tracking data is saved in a binary iView Data File (IDF) format. Also when working with other applications, this data can be analyzed with SMI's *BeGaze™* analysis software, or processed with SMI's *IDF Converter* tool for custom evaluation purposes.

15.9.1 Evaluation with SMI Experiment Suite

For most eye tracking experiments, the combination of using SMI *Experiment Center™* for experiment design and execution and *BeGaze™* for analysis provides powerful and easy to use opportunities. Refer to *Experiment Center™* and *BeGaze™* User Guides for further information.

When using Experiment Center for running the eye tracking study, make sure that the proper geometry and tracking modes for the experiment are selected in *iViewRED*.

Also when working with other applications, the generated IDF file can be analyzed with SMI's *BeGaze™* analysis software. When *BeGaze™* loads IDF files, it can automatically separate the data stream into single trials. *BeGaze™* uses messages of a defined format to achieve this trial separation. When designing an experiment where later trial separation in *BeGaze™* is desired, use the SDK command

iV_SendImageMessage(ImagePath) at the point of the experiment when the trial separation is desired. Refer to the SDK User Guide for further information.
15.9.2 Working with the iView Data File

The IDF file can be loaded either in BeGaze or into the IDF Converter, which exports various kinds of data, such as pupil size and position, messages, trigger status and gaze position and into ASCII readable text for custom evaluation.

The IDF Converter is part of the iTools package which can be downloaded from the SMI web page.

15.10 Working with TTL Triggers

iViewRED is capable of receiving up to 8 TTL signals on 8 lines at the same time through Parallel Input. You can enable the TTL Recording at the Settings tab throughout the TTL Recording drop down menu. The drop down menu contains all LPT ports on the PC that are supported for TTL recording. If no LPT port is available the list only contains the Off entry.
A trigger signal is an electrical low-voltage TTL signal. There are two possible states, trigger HIGH (5 V) and trigger LOW (0 V). The duration of a trigger signal should be at least 1.5 samples long, depending on the used sample rate. For a 60 Hz sampling rate, a minimum trigger duration of 25 ms is recommended.

Trigger signals will be time stamped and recorded in the IDF file. In the IDF export, trigger signals are available as a Trigger column if **Show Trigger** is selected in the Export Options. Trigger signals can be represented either as hexadecimal or decimal values.

When working with TTL signals, make sure that an LPT port is installed on your PC. Up to eight lines of the LPT port can be used as input on Pins 1 and 10 - 16. Pins 1, 14 and 16 can only be used on ECP-ready LPT ports.
The other channels are ignored. Usually LPT connectors use grounding switch, which means that the input channels are HIGH by default. It is recommended to use the falling edge of the trigger signal.

For further information, consult the SDK User Guide.
License Agreement and Warranty
16. License Agreement and Warranty

IMPORTANT – PLEASE READ CAREFULLY: This license agreement (“Agreement”) is an agreement between you (either an individual or Your Company, “Licensee”) and SensoMotoric Instruments Gesellschaft für innovative Sensorik mbH, Warthestraße 21, 14513 Teltow, Germany (“SMI”). The “Licensed Materials” provided to Licensee subject to this Agreement include the software programs SMI has granted Licensee access to (the “Software”) and any “online”, electronic or written documentation associated with the Software, or any portion thereof (the “Documentation”), as well as any updates or upgrades to the Software and Documentation, if any, or any portion thereof, provided to Licensee at SMI’s sole discretion. The application of conflicting general terms and conditions of Licensee shall be excluded. This applies irrespective of whether or not such terms and conditions have been expressly rejected by SMI or whether SMI, having knowledge of such conflicting terms and conditions, has accepted or effects contractual performance without reservation.

If you do not agree with these provisions, do not install, download or use the Licensed Materials. If you have already paid for the Licensed Materials, please return them for a full refund to your supplier.

1) License. Subject to the terms of this Agreement, SMI hereby grants and Licensee accepts a non-exclusive permanent license without the right to sublicense for the use of the Licensed Materials only for Licensee’s business operations and only by one (1) concurrent user. Licensee may use the Licensed Materials as necessary for trouble shooting provided that, despite a written request by Licensee, SMI has not offered to rectify the defect within a reasonable period of time and on reasonable terms. Licensee may make one (1) copy of the Software in machine readable form for
backup purposes only; every notice on the original will be replicated on the copy. Installation of the Software is Licensee’s sole responsibility. The use of all third party software provided as part of or with the Software (“Third Party Software”) is exclusively governed by the terms and conditions of the respective third party license agreements executed directly between Licensee and the third party, which will be displayed for you to read and accept prior to using the Licensed Materials and/or which you can find in the system folder “Licenses”. The Licensed Materials may be protected by technical means as explained in the user manual, if any. Usage data of the Software, which do not include any personal data, are automatically transmitted in order to support SMI’s efforts to continuously improve, update and further develop SMI software. Licensee may sell or give away the Software to a third party on a permanent basis provided that (i) such third party agrees vis-à-vis SMI to comply with the terms of this Agreement defining the scope of the licensed use, (ii) any Software purchased by Licensee embedded into a device will be handed over by Licensee to the third party only in its original physical fixation on the device (including any updates or upgrades, if any), (iii) Licensee ceases any own use of the Software, (iv) Licensee deletes all own copies of the Software, unless handed over to the third party, including any backup copy, and (v) Licensee provides to SMI a written confirmation documenting compliance with the aforementioned requirements upon request. Licensee is not entitled to rent, lease or otherwise make available the Software to third parties on a non-permanent commercial basis (including as part of any software as a service or application service provider offering), except with the prior written consent of SMI.

2) **Rights in Licensed Materials.** With the exception of Third Party Software and the limited license rights granted to Licensee under this Agreement, title to and ownership in the Licensed Materials and
all proprietary rights with respect to the Licensed Materials remain exclusively with SMI and/or its licensors.

3) **Confidentiality.** Licensed Materials are proprietary to SMI and constitute SMI trade and business secrets. Licensee shall maintain Licensed Materials in confidence and prevent their disclosure using at least the same degree of care it uses for its own trade and business secrets, but in no event less than a reasonable degree of care. Licensee shall not disclose Licensed Materials or any part thereof to anyone for any purpose, other than to its employees and sub-contractors, if any, for the purpose of exercising the rights expressly granted under this Agreement, provided they have in writing agreed to confidentiality obligations at least equivalent to the obligations stated herein. The foregoing does not apply to information that (i) is or becomes generally known or available to the public without any breach of the confidentiality obligation by Licensee, (ii) was already known to Licensee prior to the disclosure by SMI, or (iii) was rightfully acquired by Licensee from a third party without a breach of a confidentiality obligation towards SMI. In case of a dispute, Licensee has the burden of proof that the Licensed Materials and/or any portion thereof fall under one of these exceptions. Should Licensee be legally compelled to disclose any Licensed Materials to a third party, such as pursuant to a mandatory order by a court or authority or any comparable action, Licensee shall, to the extent permitted under applicable law, inform SMI without undue delay and undertake all possible measures to safeguard secrecy.

4) **No Reverse Engineering.** Licensee shall not, and shall not allow any third party to, decompile, disassemble or otherwise reverse engineer or by any means whatsoever attempt to reconstruct or discover any source code or underlying ideas, algorithms, file
formats or programming or interoperability interfaces of the Software or of any files contained or generated using the Software.

5) **Warranty.**

a. If Licensed Materials show a defect during the limitation period specified in Sec. 5 d), which already existed at the time of transfer of risk, SMI will, at its own option and discretion, either provide Licensee with a corrected version of such defective Licensed Material or replace the Licensed Material with a non-defective version (“Repeat Performance”). Where considered reasonable, SMI may also render Repeat Performance by revealing adequate and reasonable ways to work around the effects of the defect. In case of defects in title [Rechtsmängel], SMI may render Repeat Performance also by procuring for Licensee the right to continue to use the Licensed Materials or by replacing or amending the Licensed Materials (without limiting their quality or functionality) so that they no longer infringe third party rights.

b. Licensed Materials are defective, if they do not conform to SMI’s specification.

c. Licensee’s claims for defects are excluded:
   i. for insignificant divergences from the written agreement between SMI and Licensee, if any, or SMI’s specification;
   ii. for insignificant impairments of usability;
   iii. for damages caused after the transfer of risk by external influences such as fire, water, currency surge, etc., improper installation, operation, use or maintenance, use in fields of application and environmental conditions other than those expressly specified by SMI, use in combination with other products not approved by SMI for this purpose, excessive stress or normal wear and tear;
   iv. for defects of the Software, which cannot be reproduced;
v. for defects resulting from Licensee’s or a third party’s modifications of Licensed Materials;
vi. in as far as Licensee has not notified SMI of apparent defects within five (5) business days of delivery and of hidden defects within five (5) business days of discovery.

d. The limitation period for warranty claims is twelve (12) months. This does not apply for claims for damages in cases of injury to life, body or health, fraudulently concealed defects, intent, gross negligence and if a guarantee as to the condition of the Licensed Materials [Beschaffenheitsgarantie] has been given; these claims shall become time-barred within the limitation periods defined by applicable law or, in case a guarantee has been given, within the limitation period stipulated in such guarantee, if any. Repeat Performance does not restart the limitation period; the remainder of the original limitation period shall run from return of the corrected version of the Licensed Material. The same shall apply in case of a replacement of the Licensed Materials.

e. Licensee has to always first provide SMI the opportunity for Repeat Performance within a reasonable period of time. Repeat Performance does not constitute acceptance of a legal obligation.

f. If the Repeat Performance fails even within an additional period of time of reasonable length to be granted by Licensee, Licensee shall, notwithstanding its claims under Sections 6 and 7, if any, be entitled to rescind the Agreement or to claim a reasonable price reduction in accordance with applicable law.

g. If the analysis of an alleged defect shows that it is not covered by the above warranty, SMI may charge for the failure analysis and correction of the defect, if any, at SMI’s then applicable rates.

6) Liability Limitations.
   a. SMI shall be liable without limitation for damages caused by willful intent or gross negligence.
b. SMI shall further only be liable for damages caused by slight negligence [einfache Fahrlässigkeit] if such are due to a material breach of duty, which endangers the achievement of the objective of the Agreement, or to a failure to comply with duties, the very discharge of which is an essential prerequisite for the proper performance of the Agreement and on the observance of which Licensee may rely.

c. In cases of Section 6 b), the liability is limited to the damage, which is typical for contracts like this Agreement and which could have been foreseen.

d. For damages caused by the gross negligence of an agent [Erfüllungsgehilfe] or an employee of SMI, who is not a statutory representative [gesetzlicher Vertreter], officer or executive of SMI, SMI’s liability is also limited to the damage, which is typical for contracts like this Agreement and which could have been foreseen.

e. In cases of Sections 6 b) and d), SMI’s liability is limited to a maximum amount of EURO 500,000, respectively EURO 100,000 for financial losses.

f. Licensee’s claims for damages caused by slight negligence or caused by the gross negligence of an agent [Erfüllungsgehilfe] or an employee of SMI, who is not a statutory representative [gesetzlicher Vertreter], officer or executive of SMI, which are not based on defects and thus not subject to time-barring in accordance with Sec. 5 d) are time-barred at the latest two (2) years from the point in time Licensee became aware of the damage and regardless of Licensee’s awareness at the latest three (3) years after the damaging event.

g. With the exception of claims for damages in the event of (i) an injury to life, body or health, (ii) liability under the Product Liability Act [Produkthaftungsgesetz], (iii) defects after having given a guarantee for the condition of the Licensed Materials [Beschaffenheitsgarantie] (in which case the liability terms and limitation period under the guarantee, if any, shall apply), and (iv)
fraudulently concealed defects, the above limitations of liability shall apply to all claims for damages, irrespective of their legal basis, including but not limited to all claims based on breach of contract or tort.

h. The above limitations of liability also apply in case of Licensee’s claims for damages against SMI’s employees, statutory representatives [gesetzliche Vertreter] or agents [Erfüllungsgehilfen].

7) SMI Indemnity. Subject to SMI being liable according to Section 6 and excluding claims for which Licensee is obligated to defend or indemnify SMI under Section 8, SMI will defend or settle any claim brought against Licensee to the extent such claim is based on a claim that Licensed Materials, used within the scope of the license granted in this Agreement, infringe any valid copyright and will pay the cost of any final settlement or judgment attributable to such claim, provided (i) Licensee has given prompt notice to SMI of such claim, (ii) Licensee has not recognized an infringement of the third party’s copyright, and (iii) the defense and the settlement negotiations are reserved for SMI to the largest extent possible under applicable law with Licensee’s full cooperation and support. If Licensee discontinues the use of Licensed Materials for damage reduction or other important reasons, Licensee is obligated to point out to the third party that the discontinuation of use does not constitute an acknowledgement of a copyright infringement. SMI shall have no obligation to defend (or any other liability) to the extent any claim involves a Software release other than the current, unaltered release made available to Licensee, if such would have avoided infringement, or use of the Software in combination with non-SMI programs or data, unless the infringement would also incur without such combination.

8) Licensee Indemnity. Licensee will defend and indemnify SMI, and hold it harmless from all costs, including attorney’s fees, arising
from any claim that may be made against SMI by any third party as a result of Licensee’s use of Licensed Materials, excluding claims for which SMI is obligated to defend or indemnify Licensee under Section 7.

9) **Export Restriction.** Licensee will not remove or export from Germany or from the country Licensed Materials were originally shipped to by SMI or re-export from anywhere any part of the Licensed Materials or any direct product of the Software except in compliance with all applicable export laws and regulations, including without limitation, those of the U.S. Department of Commerce.

10) **Non-Waiver; Severability; Non-Assignment.** The delay or failure of either party to exercise any right provided in this Agreement shall not be deemed a waiver. If any provision of this Agreement is held invalid, all others shall remain in force. Except as expressly set forth in this Agreement, Licensee may not, in whole or in part, assign or otherwise transfer this Agreement or any of its rights or obligations hereunder.

11) **Entire Agreement; Written Form Requirement.** Unless otherwise specified herein, SMI’s General Terms and Conditions for the Supply of Products and Services available at [http://www.smivision.com/en/gaze-and-eye-tracking-systems/support/documents-download.html](http://www.smivision.com/en/gaze-and-eye-tracking-systems/support/documents-download.html) or attached hereto apply. Any supplementary agreements or modifications hereto must be made in writing. This also applies to any waiver of this requirement of written form.

12) **Notices.** All notices under the Agreement must be in writing and shall be delivered by hand or by overnight courier.
13) **Applicable Law and Jurisdiction.** German law applies with the exception of its conflict of laws rules. The application of the United Nations Convention on Contracts for the International Sale of Goods (CISG) is expressly excluded. The courts of Berlin, Germany, shall have exclusive jurisdiction for any action brought under or in connection with this Agreement.

Copyright 2017 SensoMotoric Instruments GmbH
About SMI
17. About SMI

SensoMotoric Instruments (SMI) is a world leader in dedicated computer vision applications, developing and marketing eye and gaze tracking systems and OEM solutions for a wide range of applications.

Founded in 1991 as a spin-off from academic research, SMI was the first company to offer a commercial, vision-based 3D eye tracking solution. We now have over 20 years of experience in developing application-specific solutions in close collaboration with our clients.

We serve our customers around the globe from our offices in Teltow, near Berlin, Germany and Boston, USA, backed by a network of trusted local partners in many countries.

Our products combine a maximum of performance and usability with the highest possible quality, resulting in high-value solutions for our customers. Our major fields of expertise are:

- Eye & gaze tracking systems in research and industry
- High speed image processing, and
- Eye tracking and registration solutions in ophthalmology.

More than 5,000 of our systems installed worldwide are testimony to our continuing success in providing innovative products and outstanding services to the market. While SMI has won several awards, the largest reward for us each year is our trusted business relationships with academia and industry.
Index

- . . -
.NET Framework
  Setup 61

- 1 -
1-2 Button 30

- A -
  Accept Points
    Automatically 36
    Manually 36
    Semi-Automatically 36
  Accuracy
    in Calibration results 124
  Arrows
    In Eye Tracking Monitor 98
  Automatically Accepting Points
    Setting 117

- B -
  BeGaze™ 18, 158

- C -
  Calibration
    About 106
    Results explained 124
    Running 106
  Calibration Area
    Setting 36, 130
  Calibration Method 106, 130
    0 Point 36, 110
    1 Point 36, 111
    13 Point 36, 116
    2 Point 36, 113
    5 Point 36, 114
    9 Point 36, 115
    Overview 110
    Calibration results 36
    Explained 36, 124
  Calibration Speed
    Fast 36, 117
    Normal 36, 117
    Setting 36
  Calibration tab
    Accept Points 36, 117
    Auto Color 36
    Background Color 36
    Calibrate 36, 106
    Calibration Area... 130
    Calibration Method 36
    Calibration results area 36
    Calibration Speed 36, 117
    Default Values 36
    Live Gaze View 36, 136
    Smart Calibration 36, 118
    Target Color 36
    Target Shape 36
    Target Size 36
    Validate 36
    Validation 121
  Check for Updates 150
  Contacting SMI 3
  Copyrights 4

- D -
  Declaration of Conformity 10
  Default Values, resetting to 36
  Depth 30
Desktop Monitor 90
  Selecting 84
Detect Settings Automatically 30
Display measurements
  Screen Height 82, 95
  Screen Width 82, 95
Distance measurement
  in Eye Tracking Monitor 98
Document Conventions 12
Downloading Installation Package 60
Dual PC Setup 154, 156

- E -
Error messages
  Could not connect to Eye Tracker 64
  Firmware outdated 143
  Not connected 143
Experiment
  Optimal conditions for 28
Experiment Center 18, 153, 154
Experiment Suite™ 18
Eye Images
  Hiding 41, 148
  Showing 41, 148
Eye Tracker
  Maintenance of 11
Eye Tracking Monitor
  Arrows 48, 98
  Distance Values 48, 98
  Eye Images 148
  in Settings tab 41
  Optimum participant position 48

- G -
Geometry tab 90
  1-2 Button 30, 82, 90
  About 82
  Depth 30, 90
  Detect Settings Automatically 30, 90
  Height 30, 90
  Screen Height 30, 95
  Screen Width 30, 95
  Select Display 30, 82, 90
  Setup Guide 30, 69
  Type of Display 30, 84, 90
Getting Started 54
Glossary 13

- H -
Height 30, 90

- I -
IDF 158
Info tab
  Check for Updates 43
  Contact SMI 43
  Open User Manual 43
  System Information 43
  Updating iView RED 150
Installation Package
  Downloading 60
Installation Wizard 61
Installer
  Running 61
- L -
Laptop Display 90
  Selecting 84
License Agreement 164
Live Gaze View
  Using 36, 136
log files logfile log files 146

- M -
Magnets
  Use of 6
Maintenance
  of Eye Tracker 11
Manually Accepting Points 36
Manually Setting Measurements 90
Minimize software
  How to 142
Monitor measurements 90
  Screen Height 95
  Screen Width 95
Monitor, Size Requirement 19
Monocular Left
  Setting 41, 140
Monocular Right
  Setting 41, 140
Mounting
  Eye tracker 69
    Running iView RED before 64
Mounting Bracket 69
Mounting Guides 69
Mounting Strip, attaching 69
Multiple displays
  Using 82

- N -
Network drive
  Cannot start Eye Tracker from 143
New Profile 76
Not connected, error message 143

- O -
Operating system
  Requirements 19

- P -
Participant
  Optimal Participant Position 98
PC hardware
  Requirements 19
Power options
  and CPU power consumption 143
Precautions
  General 6
  Magnet 6
Prerequisites Installer dialog 61
Product Liability 5
Profile
  About 76
  Deleting 79
  Managing 76
  New 76
  Selecting 78

- R -
Recalibrating
  On a point 126
RED Angle 94
Reference Point
  Using to mount Eye Tracker 68
Removing Profile 79

- S -

Sampling Frequency
Setting 41
Screen Height 30, 95
Screen Width 30, 95
SDK 23
Select Display 30, 82
Select Profile 76, 78, 79
Semi-Automatically
Accepting points 36
Setting 90
Calibration Area 130
Calibration speed 117
Geometry Measurements 82
RED Angle 94
RED position 90
Screen Height 95
Screen Width 95
Type of Display 90
Settings tab
Eye Tracking Monitor 41
Sampling Frequency 41
Show Eye Images 41
Show Tracking 41
Tracking Mode 41
Setup Guide 30
Using to mount Eye Tracker 68
Show Tracking 98
Enabling 41
Showing Eye Images 148
Shutting down
How to 142
Single PC Setup 153, 155

Smart Binocular
Setting 41, 140
Smart Calibration
And Automatic Acceptance 118
Enabling 36
Selection 118
Smart Tracking
Setting 41, 140

SMI
About 174
Contacting 3

Software structure
Application Layer 151
Driver and Service Layer 151
Physical Layer 151

Status Indicators
Connecting 50
Not Connected 50
Running 50

System Information 43

System requirements
Monitor size 19
Operating system 19
PC hardware 19
USB port used 19

- T -

Target Color
Setting 36
Target File
Selecting 36
Target point
Recalibrating 126
Target points
Resetting location of 130
Target Shape
   Setting 36

Target Size
   Setting 36

Technical support
   iView RED 43
       Requesting 43

Tracking Mode
   Monocular Left 140
   Monocular Right 140
   Setting 140
   Smart Binocular 140
   Smart Tracking 140

Trademarks 4

Troubleshooting 143

TTL Trigger 159

Type of Display 30
   Desktop Monitor 84
   Laptop Display 84

- U -

Updating iView RED 150

Usage
   in Calibration results 124

USB connected devices
   Using with Eye Tracker 19, 143

- V -

Validate
   Running 36, 121

- W -

Warnings
   and Magnets 6

Warranty 164