Eye Control Professional Module

Eye Controlled Interaction (ECI) Application

User Guide

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Ergoneers
Ergonomic Engineers

Content

1. First Steps

1.1 Scope of Supply

Concerning the scope of supply following parts are enclosed in your package of the Eye Control Professional Module:

- CD for the Installation of the Dikablis Software
- License - USB flash drive
- CD for the Installation of the Eye Controlled Interaction (ECI)

Please note, that the ECI Application can only be operated in connection with the Dikablis Recorder Version 2.5 or higher.

Remark for new customers: The license for the clearing of the ECI Professional Module is contained in your Dikablis Recording Flash Drive. The Dikablis Software (containing the ECI Professional Plugin) is already installed on the included Dikablis computer.

Remark for old customers: The extended license to your Dikablis Recording license includes the Eye Control Professional Module. In this case you do not receive a new License-USB Flash Drive.

1.2 System Requirements

The ECI Application is executable on those Windows computers that match the following minimal requirements:

- Windows XP, Windows 7 operating system, 32bit as well as 64bit possible
- 2GHz processor
- 1GB working memory

Software Requirements:

- Dikablis Recorder 2.5

1.3 Installation

To install the ECI application, proceed as follows:

1. Insert the included ECI-Installation-CD into the hard drive of your computer. The installation application will start automatically and display the window that is represented by Figure 1: Installation of Eye Controlled Interaction Module. Press “Install” to start the Installation.

2. It is possible that different dialogue boxes appear during the installation, that require affirmation (especially with Windows 7). Please confirm to proceed with the installation process.

3. After a successful installation a confirmation window will be depicted. Please reboot your computer afterwards.

4. In the *programs* menu of your computer an Ergoneers directory will be established, which contains links to the installed software.

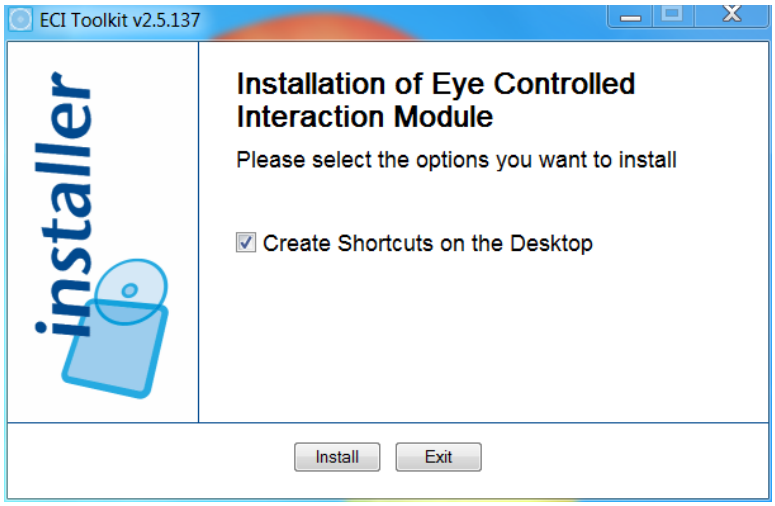

Figure 1: Installation of Eye Controlled Interaction Module

To uninstall the ECI application open the Control Panel of your computer and use the administration of programs which is integrated into your operating system for the uninstallation of applications.

2. Outline

The ECI application in conjunction with the Dikablis Eye Control Professional Module provides you with the possibility to identify glance behavior onto a predefined Area of Interest (AOI) in real time, during the recording of the gaze data. Thus you can already know during the trial where the participant is looking at. Hence you can operate other systems in real-time, e.g. to test the effect of a warning display in a combined instrument when the gaze of the participant focusses on the information display in the center console.

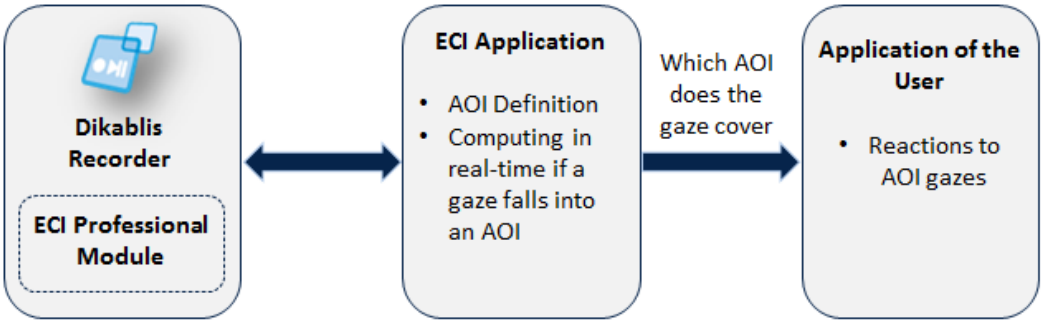

Figure 2: Overview - Eye Control Professional Module

In Figure 2: Overview - Eye Control Professional Module the interaction between the Dikablis Recorder, the ECI application and the user application, which applies the outcomes of the ECI Module, is being characterized. The three applications can also be installed on different computers. The IP-addresses and the ports, through which the communication of the applications takes place, can be set up as described in section 3.1. We recommend carrying out the user application (the third element in Figure 2: Overview - Eye Control Professional Module) not on the Dikablis computer but on another one to avoid, that the recording of the gaze data is being influenced negatively in some sort of manner.

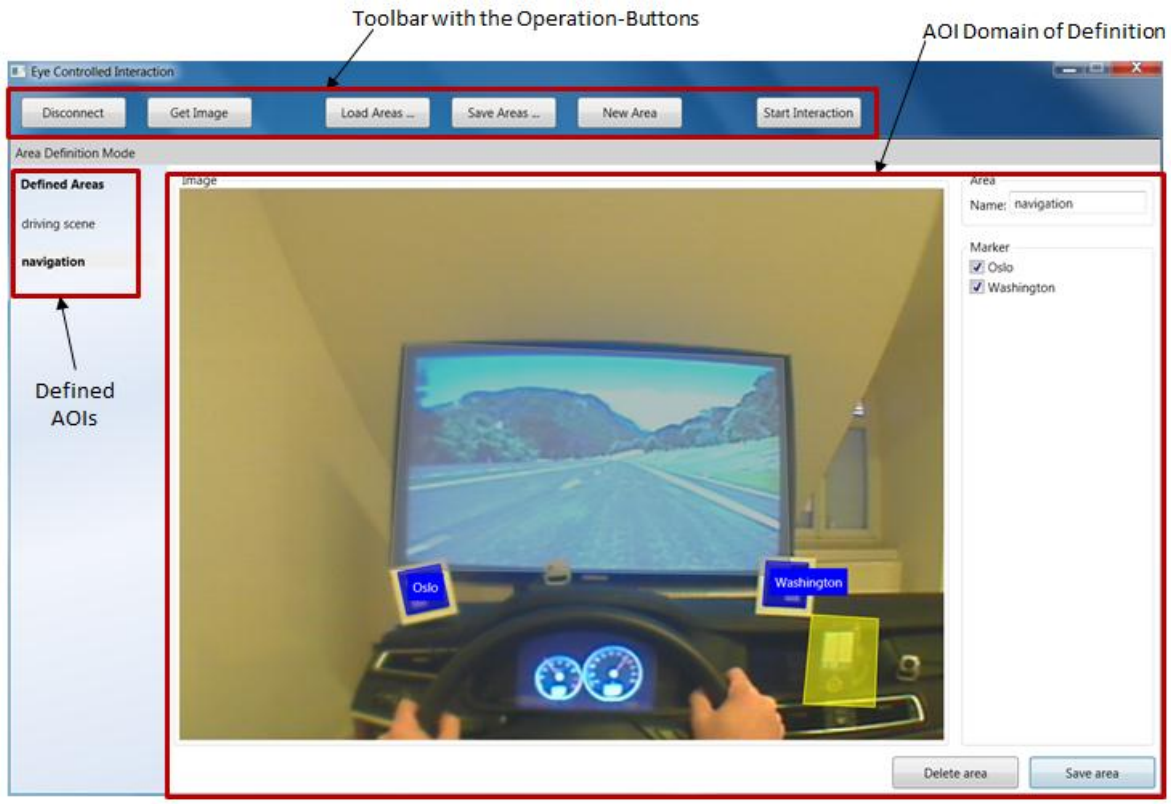

Figure 3: ECI Main Window

This manual describes the functionality of the ECI application. It is composed of the ECI Main Window, that is represented by Figure 3: ECI Main Window and contains the following subitems:

Toolbar with the Operation-Buttons:

- Configuration of the connection with Dikablis and of the connection for the transmission of the outcomes
- Getting the current frame of the field video from the Dikablis Recorder
- Saving defined AOIs
- Loading defined AOIs
- Defining new Areas of Interest (AOI)
- Starting/stopping an interaction and thereby a calculation, which AOI is being regarded

Defined AOIs:

- Listing of all currently defined AOIs

AOI Domain of Definition

- Here new AOIs can be defined and existing AOIs can be changed

Preview Area (Figure 4)

- During the interaction (determination, which AOI catches the gaze) here the AOIs as well as the visual focus are being displayed in real-time. If the gaze falls onto a certain AOI, this AOI will be highlighted.

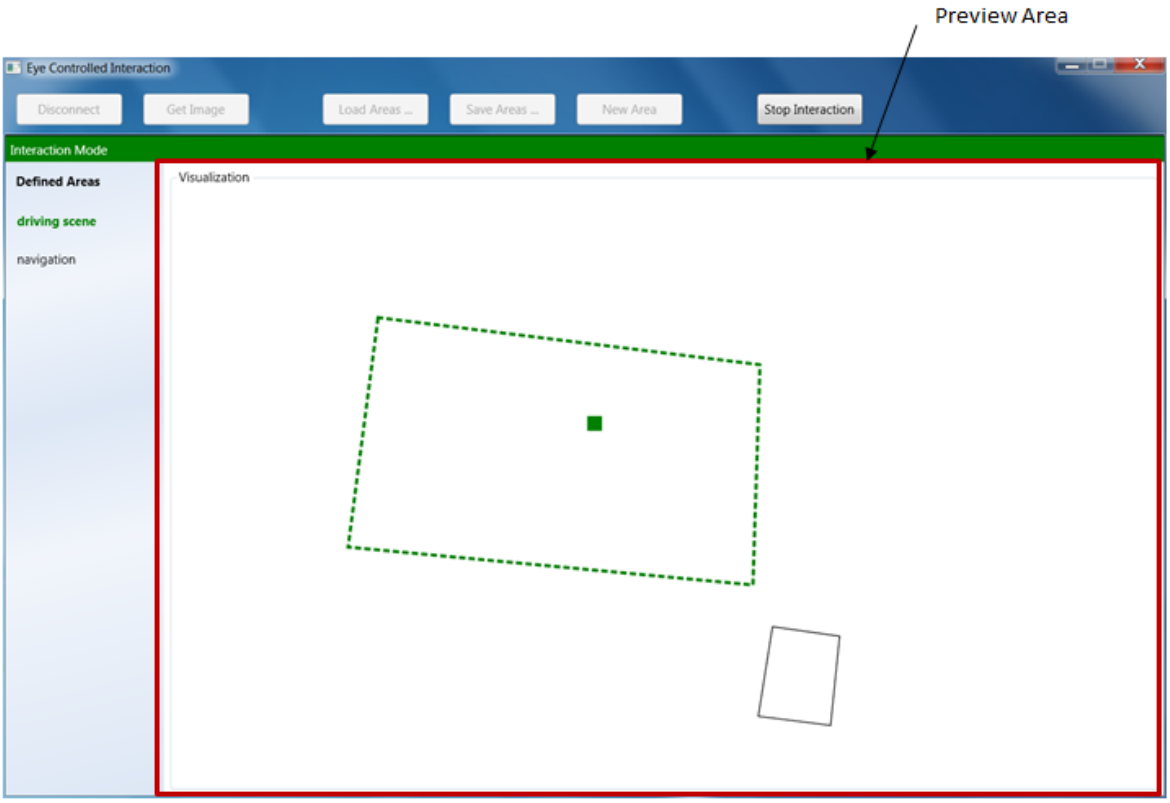

Figure 4: ECI Main Window during Interaction

In the following chapter all functionalities of the ECI application are being described in detail.

3. Identifying Glances over AOIs in Real-Time

3.1 Establishing the Connection (Dikablis and Transmission of Outcomes)

After the start of the ECI Application first a connection to the Dikablis Recorder has to be established. Furthermore you can specify where the calculated data shall be sent by the ECI Application. To do so proceed as follows:

1. First start the Dikablis Recorder.
2. Start the ECI Application and press the “Connect” Button in the ECI Toolbar.
3. The configuration options will be displayed as represented in Figure 5: Configuration Options.
4. Enter the IP-address of the computer, on which Dikablis runs as well as the port for the communication with the Dikablis Recorder in the left column. The default configuration is valid when the Recorder and the ECI application run on the same computer. If this is not the case, enter the IP-address of that computer, on which the Dikablis Recorder runs.
   It is recommended not to change the number of the port. However, in case this should be necessary, please note that you have to change the port for the Dikablis communication also in the settings of the Dikablis Recorder ECI Plugin. To do so change the port in the file DikablisRecorder.EciCommunicationPlugin.settings.xml. You will find this file in the directory of the Dikablis Recorder.

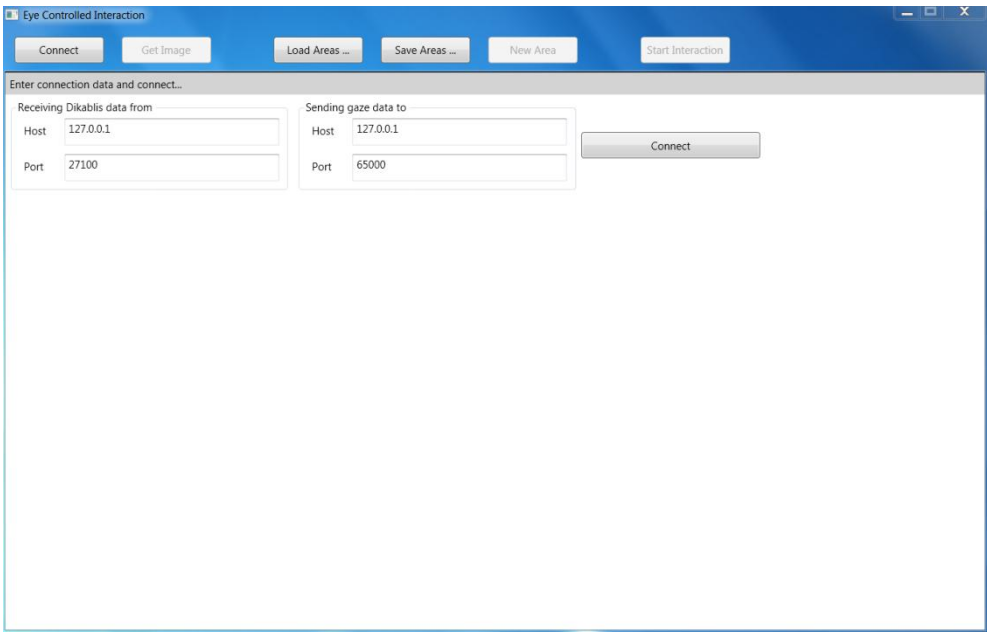

Figure 5: Configuration Options

5. In the right column you determine to which computer and through which port the Outcome-data of the ECI application get sent. The communication is carried out through UDP.
6. Press “Connect“ to establish the connections.

To cancel an existing connection press the “Disconnect” Button.

3.2 Requesting a current frame from the Dikablis Recorder field video

Please note, that this function is only executable, when the Dikablis Recorder records data!

To define a specific AOI an image of the Dikablis Field Camera is necessary, in which the AOI as well as the markers, that are to be linked to this AOI, are visible.

1. Direct the person, who wears the Head Unit, to adjust his vision together with the position of his head towards the AOI.
2. Start the recording with the Dikablis Recorder.
3. In the ECI Application press the “Get Image“ Button.
4. The current frame of the Dikablis Field Camera will be shown in the ECI Application and the identified markers are being highlighted as Figure 6: Identified and Highlighted Markers illustrates.
5. Check if the desired AOI is visible and if the markers could be identified by the program. When this is the case you can now define AOIs (Figure 6: Identified and Highlighted Markers), otherwise modify the position of the participants´ head and request a new image.

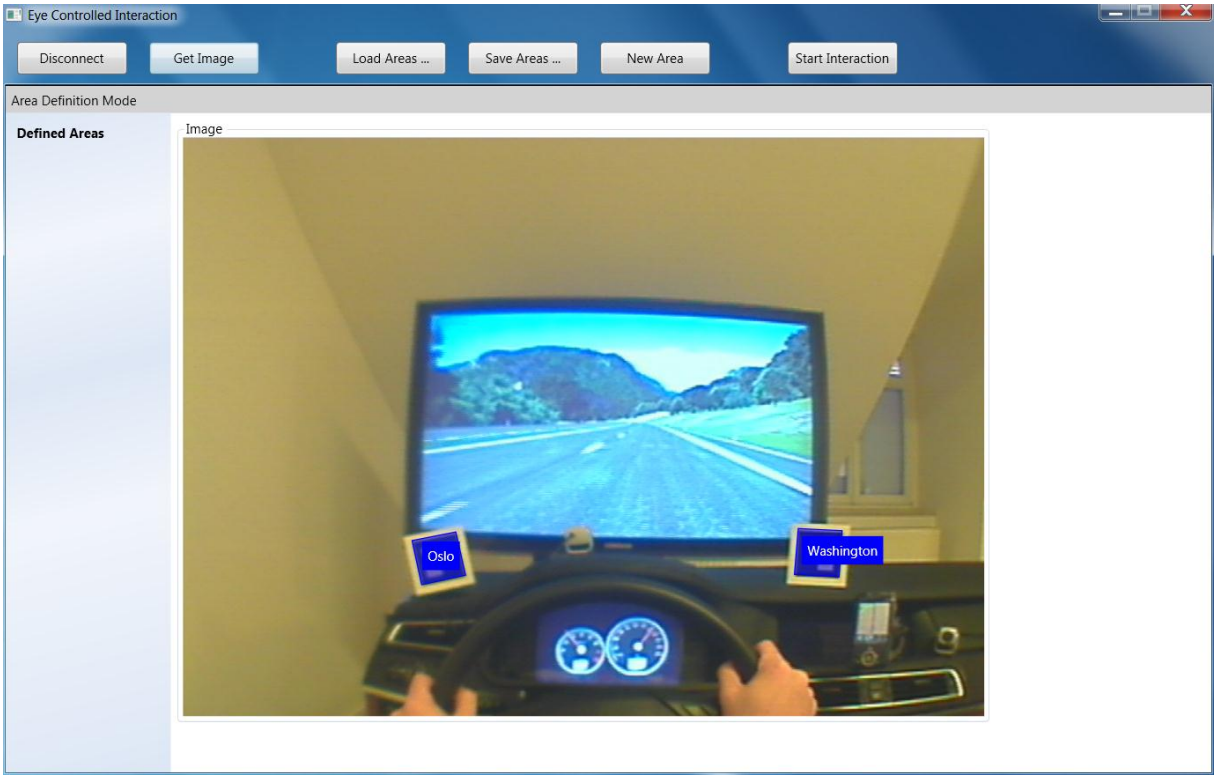

Figure 6: Identified and Highlighted Markers

3.3 Defining AOIs

After you have received an image, which is suitable for the AOI definition by pressing the “Get Image” Button you can define AOIs as follows:

1. Press the “New Area“ Button.
2. The ECI Application switches to the AOI Definition Mode as Figure 7: Marker detected, AOI defined illustrates.
3. In the Image Section you can now draw in the AOI as a polygon with concave and convex angles by using the mouse. The mouse keys correspond to the following functions:
    - Left-click: fixes a corner point of the AOI.
    - Right-click: Ends the drawing in of the AOI and closes down the area.
    - In a completely drawn AOI a left-click on a corner point or an AOI edge enables the readjustment of the edge or the corner. By keeping down the left mouse key the item can be moved freely to change the profile of the AOI.
    - By double-clicking the right mouse key the AOI is being deleted.
4. In the “Area“ Section in the “Name“ Field you enter the name of the AOI. This has to be unambiguous. Two AOIs cannot be named equally.
5. Afterwards choose those markers, to which the AOI is to be linked. To do so consider the following aspects:
    - Every AOI has to be linked to at least one marker.
    - The AOI only connects to the selected markers.
    - For every frame of the gaze video all selected markers, that could get identified, get united into a combined marker. This facilitates the tracking of the AOI. Details concerning combined markers can be found in [1].
6. Press the “Save Areas“ Button to save the AOI.
7. The new, defined AOI is being shown in the left division “Defined Areas”.

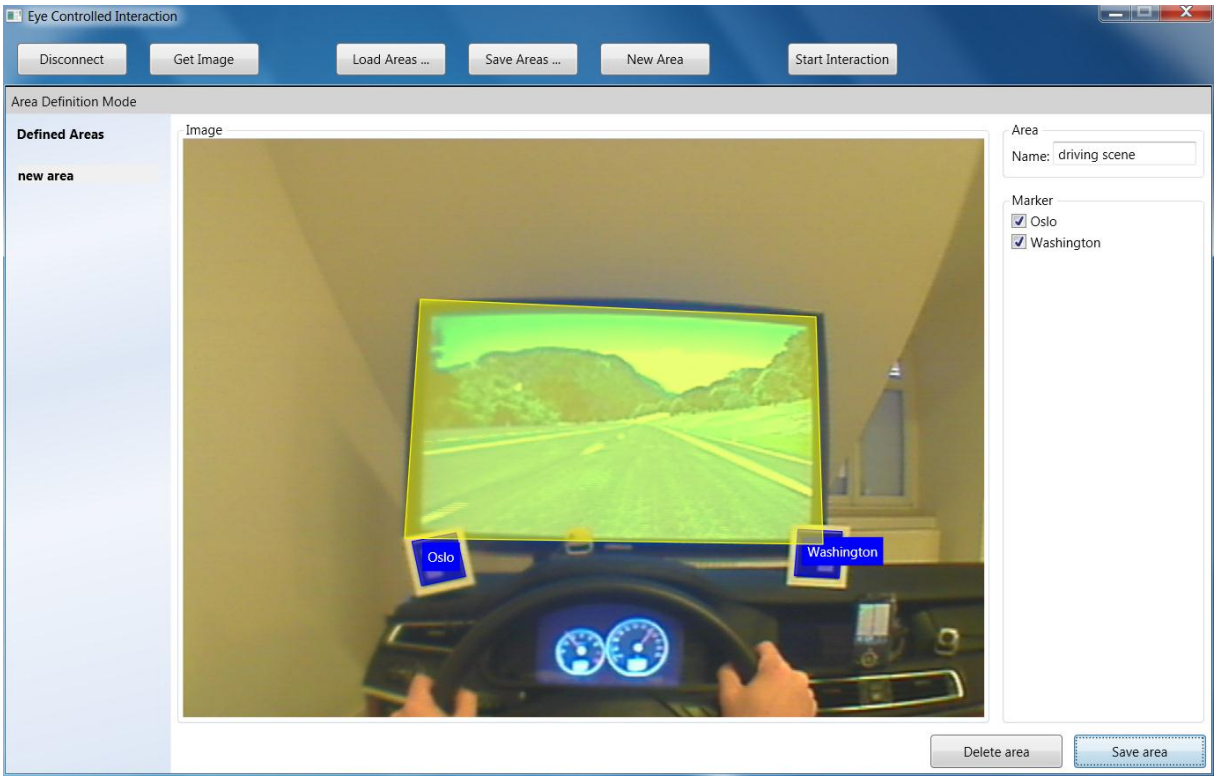

Figure 7: Marker detected, AOI defined

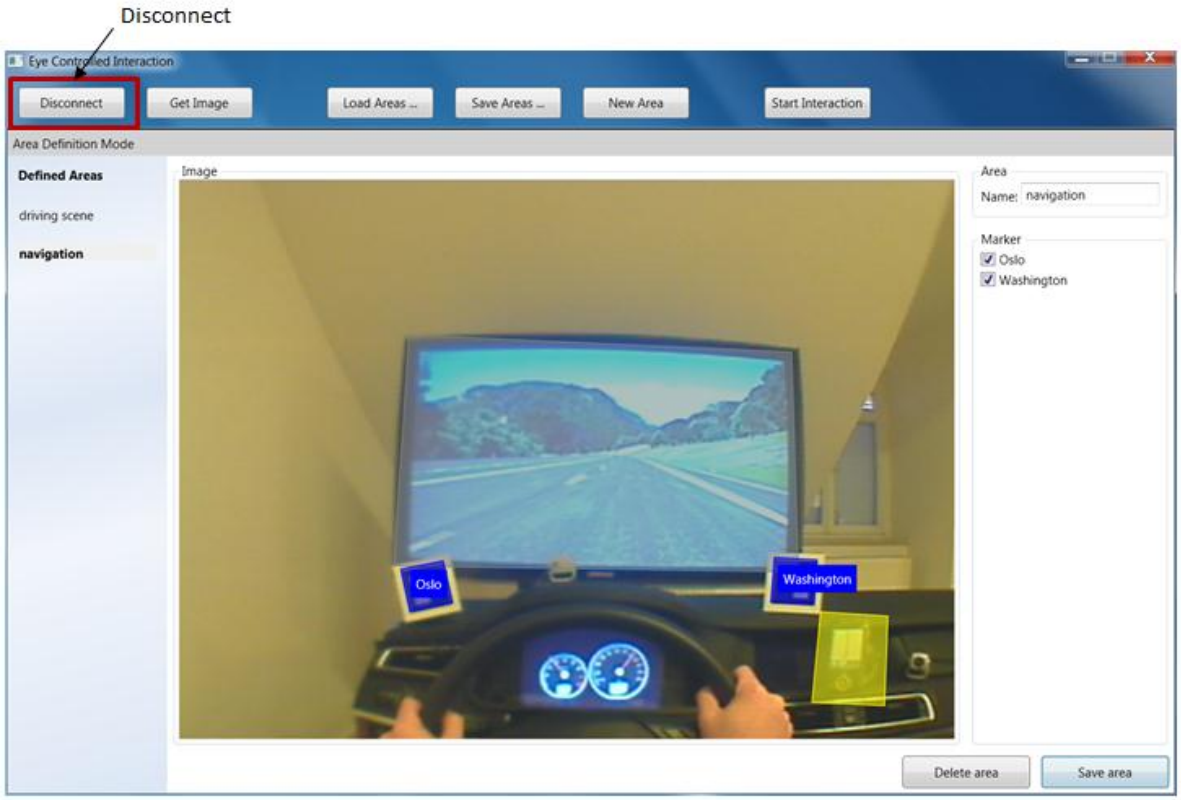

Figure 8: Marker detected, AOI defined

You can define multiple AOIs in one image. To do so proceed as follows (Figure 8):

1. Choose an AOI in the “Defined Areas“ Division.

2. The AOI and the corresponding image are being displayed.
3. To define a new AOI in the same image press the “New Area” Button and proceed as is characterized above.

To define AOIs in different images you have to retrieve an appropriate image for every AOI concerning this definition by pressing the “Get Image” Button and defining the AOI afterwards.

3.4 Deletion of AOIs

To delete already existing AOIs consider the following steps:

1. Select the AOI which is to be deleted in the “Defined Area“ Division.
2. The AOI is being displayed.
3. In the lower right division within the AOI Definition Window press the “Delete Area” Button to delete this AOI

3.5 Editing AOIs

The profile, the name as well as the linkage to the markers can be altered for a defined AOI.

1. Select the AOI, that is to be changed in the “Defined Areas“ Division.
2. The AOI will be depicted and can now be changed as described in section 3.3.
3. Confirm the changes with the “Save Area“ Button. When you do not save, the modifications are being dismissed.

3.6 Saving defined AOIs

It is possible to save the defined AOIs to be able to use them again in the course of the survey. In this manner it is sufficient to define the AOIs once before the survey begins and to apply these definitions to every participant within the survey. To save defined AOIs proceed as follows:

1. Press the “Save Areas…“ Button.
2. In the now opening dialogue box specify the path and the file name, whereto the file with the AOI definitions are to be saved. Confirm within the dialogue box.
3. The AOI definitions are being saved in the specified file and can now be retrieved at a future point in time.

3.7 Loading defined AOIs

To restore saved AOIs proceed as follows:

1. Press the “Load Areas“ Button.
2. In the now opening dialogue box select the file, which contains the saved AOIS and confirm within the dialogue box.
3. The AOIs will be loaded and displayed in the “Defined Areas“ Division.

3.8 Starting the Interaction

Please note, that this function is only executable, when the Dikablis Recorder records data!

The ECI Application can determine in real-time on which AOI the gaze of the participant falls at specific moments. This is only possible when AOIs are already defined and when the Dikablis Recorder records data. To start the real-time-calculation proceed as follows:

1. Press the “Start Interaction“ Button.
2. The application switches to the Interaction Mode as Figure 9 illustrates. In the Preview Window every currently visible AOI as well as the viewing spot are being plotted. When the gaze falls into an AOI this AOI gets highlighted.

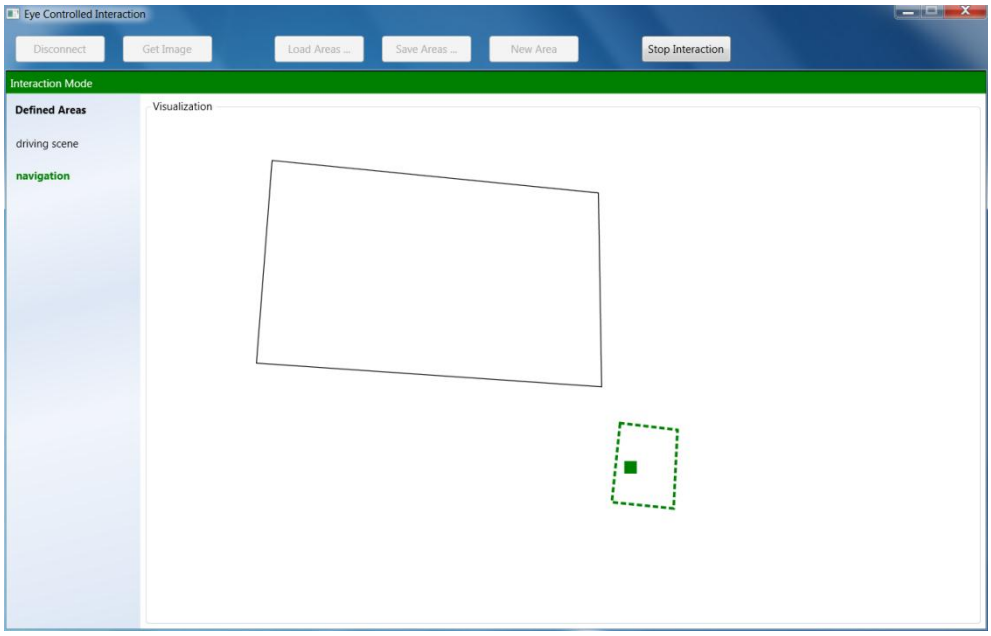

Figure 9: Interaction Mode

To stop the interaction press the “Stop Interaction“ Button.

3.9 Output of the Module

The ECI module processes each frame of the Dikablis field video and detects the markers in it. Further, the gaze point in the coordinate system of each detected marker is computed. The module also calculates if the fixation point is with an area of interest or not. All this information is transmitted on the fly over UDP to the IP address and port number configured in the configuration options (see Figure 9).

The data transmitted for each frame is a text string with a fixed structure. Within the string the single values are separated by a tabulator character (“\t”). In case that some values are missing the string may contain one or more consecutive tabulators. The data string contains following values:

Value	Description	Range
Index	Frame number, same as the index in the Dikablis journal file	Consecutively numbered, starting with 0; unsigned int
Timestamp	Timestamp of the frame, same as the Dikablis timestamp in the journal file	Time in millisecons; unsigned int
Eye_valid	1 if the pupil was detected, 0 if not	0 or 1
eye_x	x coordinate of the gaze point in the image of the eye camera	x: 0 to 384 y: 0 to 288
eye_y	y coordinate of the gaze point in the image of the eye camera	x: 0 to 384 y: 0 to 288
field_x	x coordinate of the gaze point in the image of the field camera	x: 0 to 768 y: 0 to 576
field_y	y coordinate of the gaze point in the image of the field camera	x: 0 to 768 y: 0 to 576
Number_of_Markers	Number of detected markers in the current frame	0 to 16
The gaze point coordinates in the coordinate system of each detected marker. If the marker is not detected, the values are empty.		
Gaze_point_relative_to_Marker0_x	x coordinate of the gaze point in the coordinate system of marker 0	Depending of the size of the marker and the used lens; length of marker edge is the unit in the coordinate system
Gaze_point_relative_to_Marker0_y	y coordinate of the gaze point in the coordinate system of marker 0	Depending of the size of the marker and the used lens; length of marker edge is the unit in the coordinate system
Gaze_point_relative_to_Marker1…	coordinates of the gaze point in the coordinate system of marker 1	As above
Gaze_point_relative_to_Marker2…	coordinates of the gaze point in the coordinate system of marker 1	As above
…	…	

Gaze_point_relative_to_Marker15…	coordinates of the gaze point in the coordinate system of marker 15	As above
The following part contains for each of the 16 possible markers the coordinates of the marker, if it was detected, in the field image. For not detected markers the values are empty.		
Marker0_upper_left_x	x coord. of the upper left marker corner	x: 0 to 768 y: 0 to 576
Marker0_upper_left_y	y coord. of the upper left marker corner	x: 0 to 768 y: 0 to 576
Marker0_upper_right_x	x coord. of the upper right marker corner	x: 0 to 768 y: 0 to 576
Marker0_upper_right_y	y coord. of the upper right marker corner	x: 0 to 768 y: 0 to 576
Marker0_lower_right_x	x coord. of the lower right marker corner	x: 0 to 768 y: 0 to 576
Marker0_lower_right_y	y coord. of the lower right marker corner	x: 0 to 768 y: 0 to 576
Marker0_lower_left_x	x coord. of the lower left marker corner	x: 0 to 768 y: 0 to 576
Marker0_lower_left_y	y coord. of the lower left marker corner	x: 0 to 768 y: 0 to 576
Marker1…	Coordinates of marker 1	As above
Marker2…	Coordinates of marker 2	As above
…		
Marker15…	Coordinates of marker 15	As above
AOI Name	Name of the AOI	String
Glance inside AOI	0 if the glance is outside the above AOI, 1 if inside *Last two rows are repeated for all defined AOIs	0 or 1

Table 1: Structure of data stream

As an example for the output with the information if the glance is within an AOI or not:

134	… Driving sequence	0	Satnav	1
135	… Driving sequence	0	Satnav	1
136	… Driving sequence	1	Satnav	0
137	… Driving sequence	1	Satnav	0
138	… Driving sequence	1	Satnav	0

4. References

[1] D-Lab V2.5 Manual