K2RULALite User manual

Contents

References

Please, in your research results, cite the software tool according to the following reference:

"Manghisi, V. M., Uva, A. E., Fiorentino, M., Bevilacqua, V., Trotta, G. F., & Monno, G. (2017). Real time RULA assessment using Kinect v2 sensor. Applied ergonomics, 65, 481-491."

Bib Tex:

```
@article{manghisi2017real,
title={Real time RULA assessment using Kinect v2 sensor},
author={Manghisi, Vito Modesto and Uva, Antonio Emmanuele and Fiorentino, Michele and
Bevilacqua, Vitoantonio and Trotta, Gianpaolo Francesco and Monno, Giuseppe},
journal={Applied ergonomics},
volume={65},
pages={481--491},
year={2017},
publisher={Elsevier}
}
```

Prerequisites

Using the software and the Kinect V2 sensor requires the following HW Specifications:

1.   Processor 64-bit (x64)
2.   4 GB RAM memory (or greater)
3.   3.1 GHz Dual-core CPU (2 logical cores per physical core)
4.   USB 3.0 dedicated controller for Windows v2 sensor
5.   DX11 compatible graphics card
6.   Kinect v2 sensor, with its power supply and USB cable

Using the software and the Kinect V2 sensor requires the following SW Specifications:

1.   64-bit Operating System Windows 8, 8.1, 10

User interface

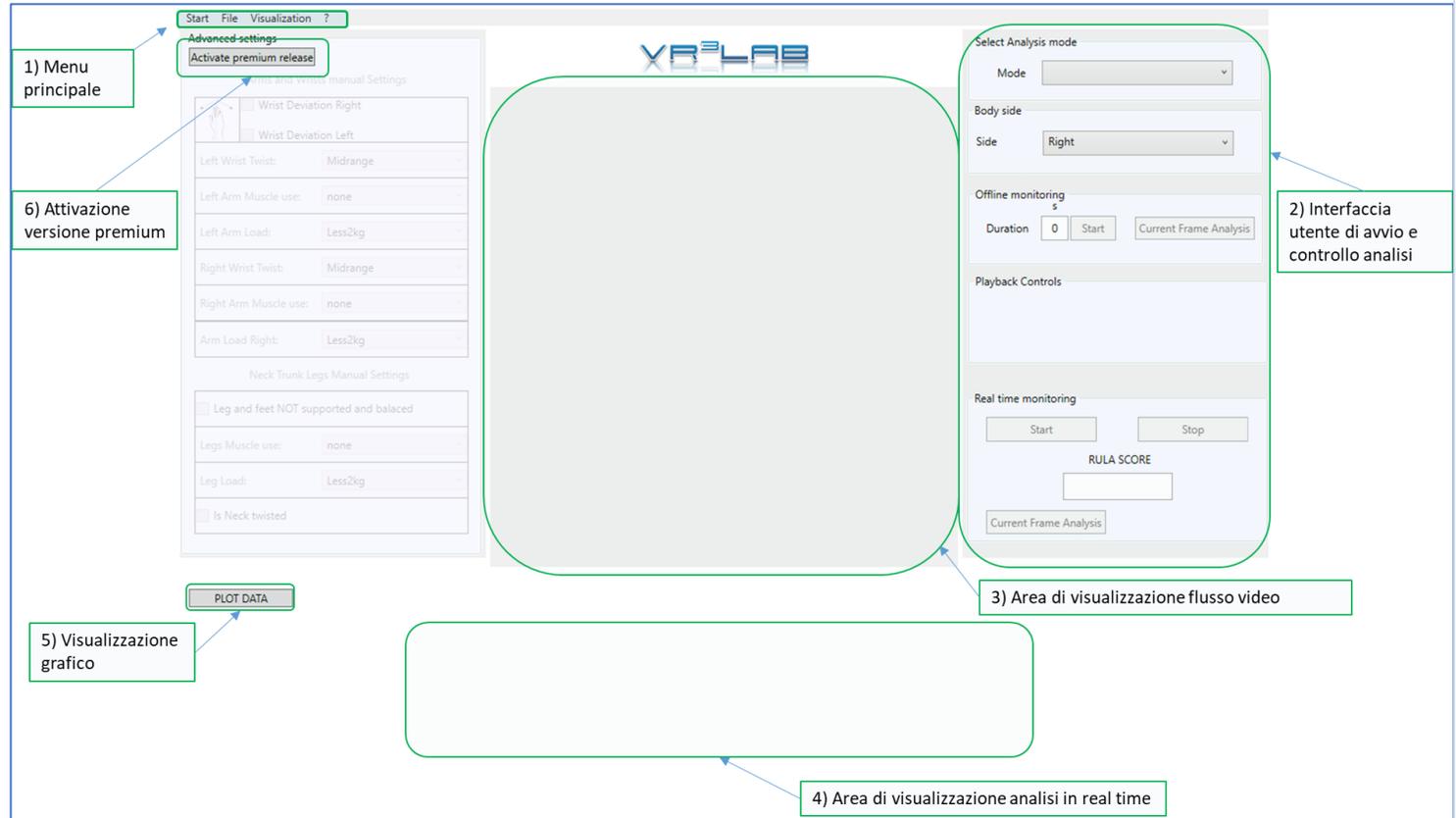The application starts displaying the General Use interface.

Figure 1: General user Interface

The user interface is divided into 6 main areas:

1. [Main Menu](#)
2. [User interface for analysis management](#)
3. [Video Stream Display Area](#)
4. [Real Time Analysis display area](#)
5. [Graphic score-trend display area](#)
6. [Activate Premium release](#)

1) Main Menu

The main menu gives you access to the four sub-menus:

- Menu Start
- Menu File
- Menu Visualization
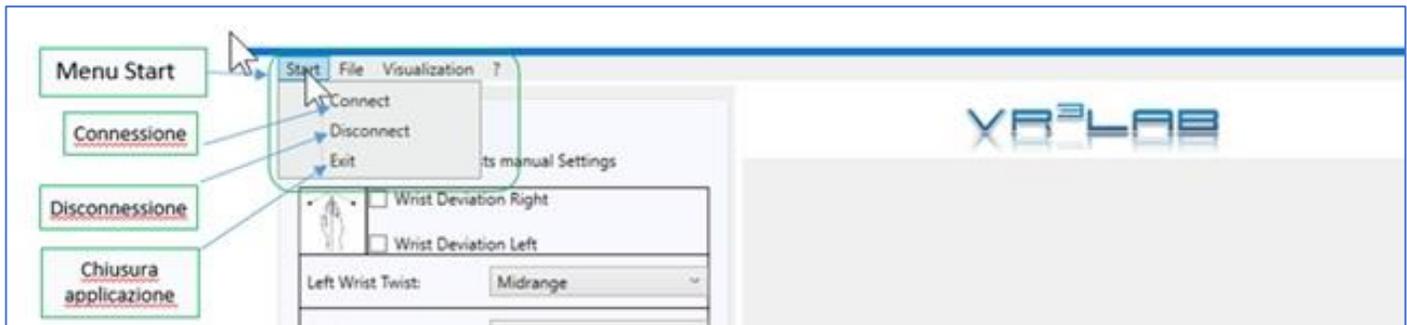- Menu ? (Help- Info)

Menu Start

Figure 2: Menu start

Through this menu you can connect and disconnect the sensor and exit the application):

1.   Connect: Connects the sensor (when the application starts if the sensor is already plugged it is connected by default to the application)
2.   Disconnect: Disconnects the sensor from the application
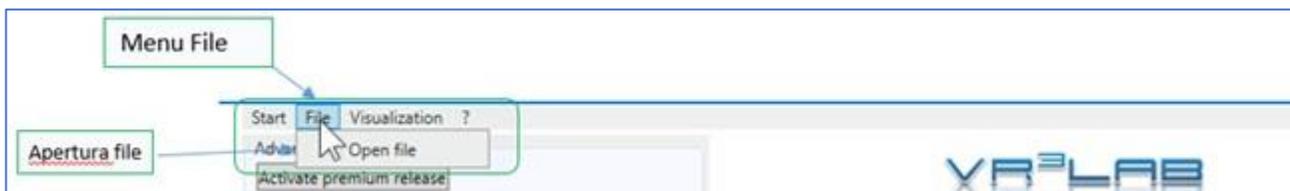3.   Exit: Closes the application

Menu File

Figure 3: Menu file

Through this menu you can select a previously recorded file, by clicking on the Open file you open the file selection window.
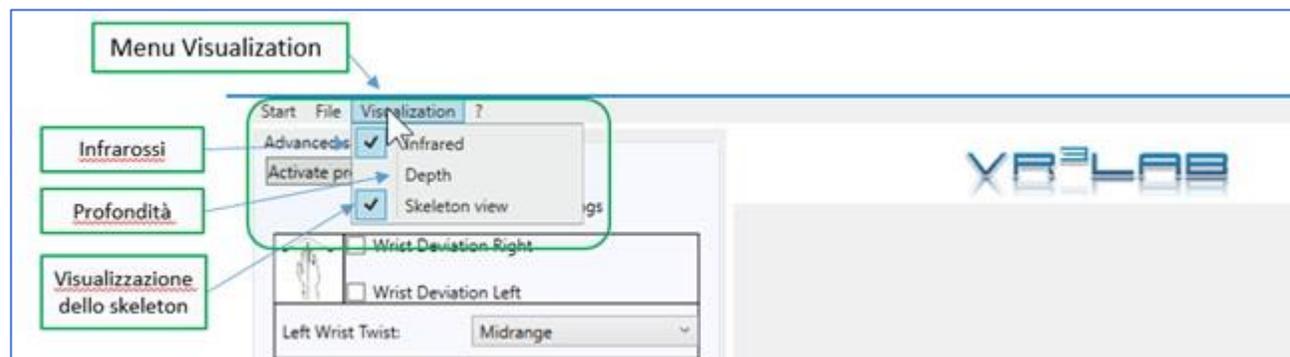
Menu Visualization

Figure 4: Menu visualization

Through this menu you can select the type of display for the video stream. The available options are:

1. Infrared: Displays the scanned image from the infrared sensor
2. Depth: Displays the image as a depth map
3. Skeleton view: Overlaps the video displaying the skeleton of the observed subject
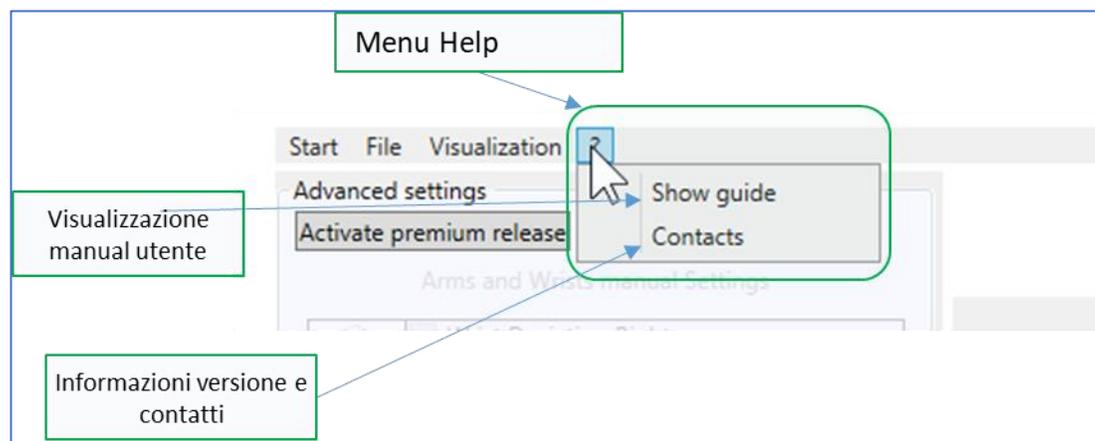
Menu ?

Figure 5: Help-menu

Through this menu you can open this user manual or have information about the installed software version and the useful contacts:

1. Show guide: Opens this user manual;
2. Contacts: Gives the software version and useful contacts.
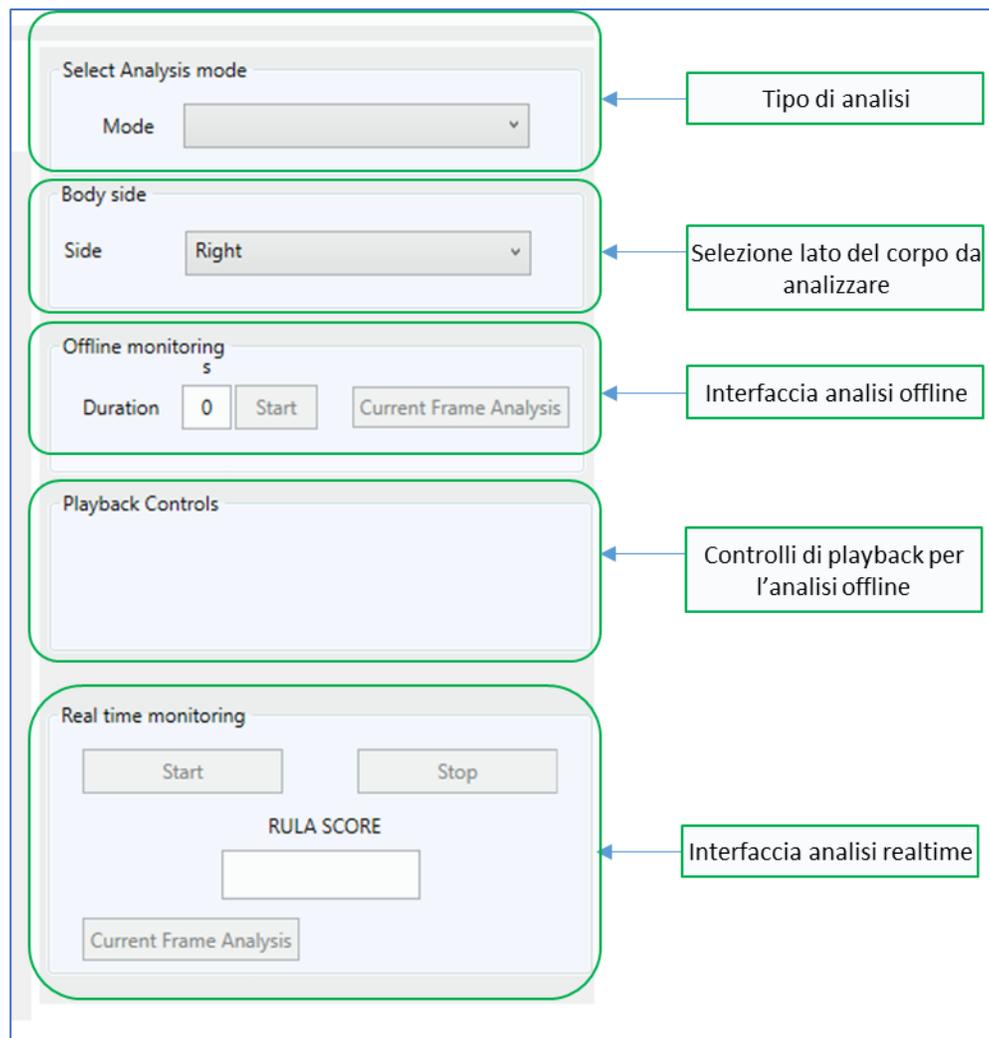
2) User interface for analysis management

Figure 6: Analysis management User Interface

This area hosts the controls of the ergonomic analysis, consists of five panels:

1. Type of analysis
2. Selection of the body side to be analyzed
3. Offline Analysis Interface
4. Playback Controls for offline analysis
5. Realtime Analysis Interface
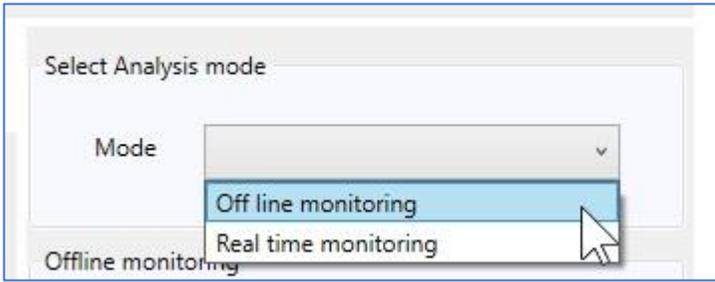
Analysis mode (Mode)

Figure 7: Mode of analysis selection

This panel allows you to select one of the two available analysis modes:

1. Off line monitoring: Allows you to analyze files previously acquired with the Kinect Studio utility
    Once you have selected the option you enable the corresponding panel along with the playback control Panel
2. Real time monitoring: Allows to analyze the real time the postures acquired through the sensor connected to the PC
    When you have selected this option you enable the relevant panel

Selection of the body side to be analyzed

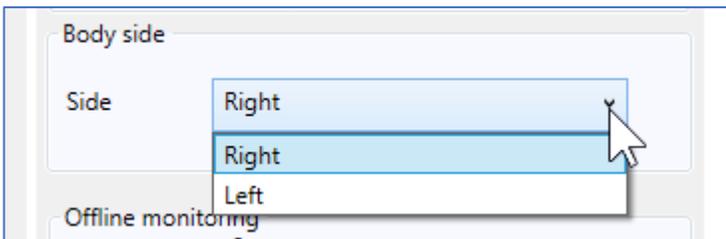This panel allows you to select the side of the body to analyze:

*   Right;

*   Left.

Figure 8: Selection of the body side
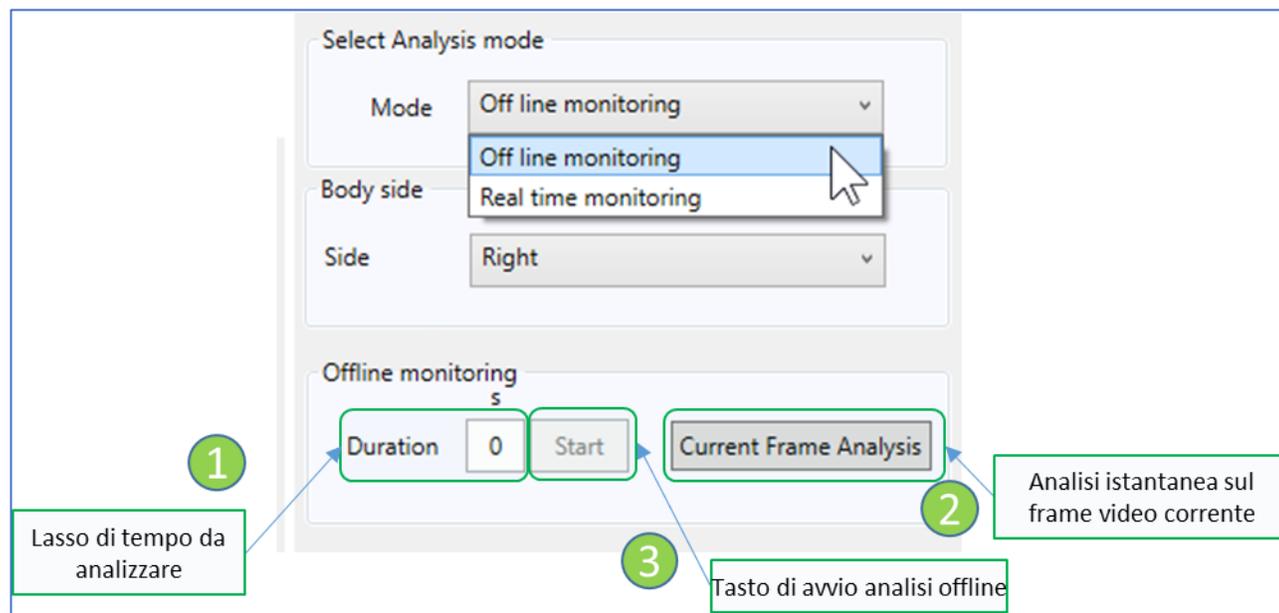
Offline analysis interface

Figure 9: Offline analysis interface

This panel handles offline analysis and has the following components:

1.   The sub-panel (1) it is used to set the length of time to be analyzed in seconds (a maximum of 5 seconds is allowed in the Lite version)
2.   The button (2) It is used to analyze the current video frame and its activation opens a window with the report of the Rula scores for the posture taken in the analyzed frame
3.   The button (3) It is used to initiate the offline analysis

For detailed instructions on how to perform the analysis go to Offline Analysis.
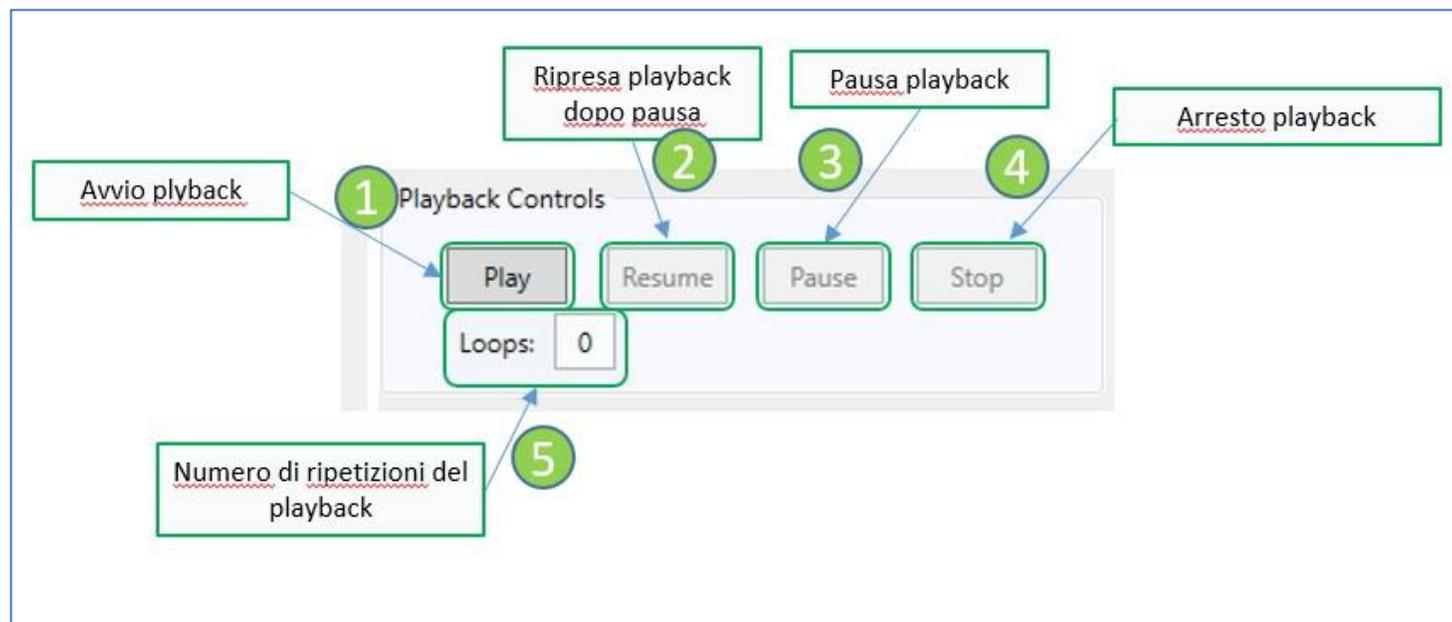
Playback controls for offline analysis

Figure 10: Playback Controls for offline analysis

This panel manages the playback of a previously opened file menu, it has the following functions:

1.   The button Play (1) starts the playback;
2.   The button Resume (2) restarts the playback after a pause;
3.   The button Pause (3) pauses the playback;
4.   The button Stop (4) stops the playback;
5.   The field Loop (5) allows you to define how many repetitions of the playback to perform, if you do not want repetitions leave its value set to 0.

When browsing the file, the playback progress is displayed (area (3) Figure 12). Using the navigation controls you can take a precise moment of recording and make a Detailed postural analysis of the current frame.
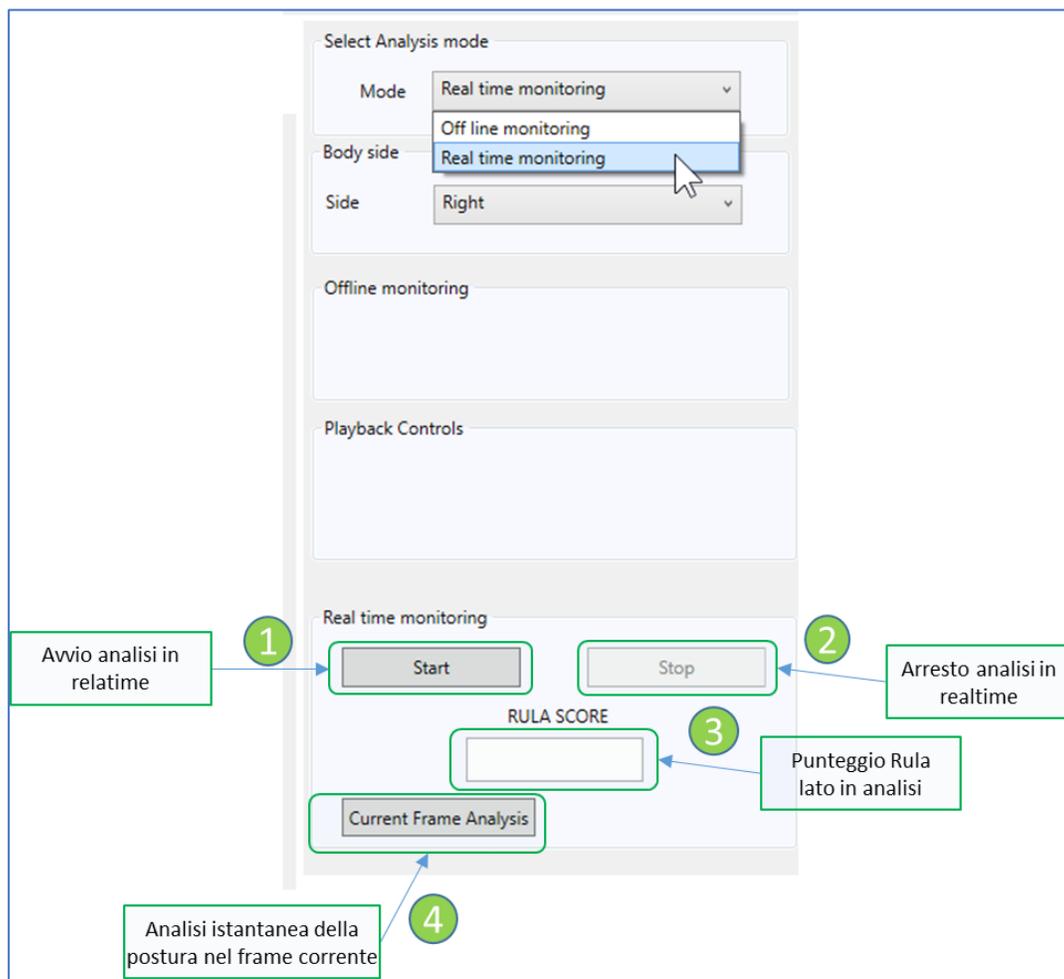
Real-time analysis interface

Figure 11: real time analysis interface

This panel manages the real-time analysis and displays the scores.

The panel consists of the following elements:

1. The button Start (1), starts the analysis in real time whose results are plotted in the real-time analysis view area
2. The button Stop (2) stops the analysis
3. The box RULA SCORE (3) visualizes the score for the body side under analysis
4. The box Current Frame Analysis (4) it is used to analyze the current video frame and its activation opens an instant analysis window with the report of the Rula scores for the posture taken in the analyzed frame
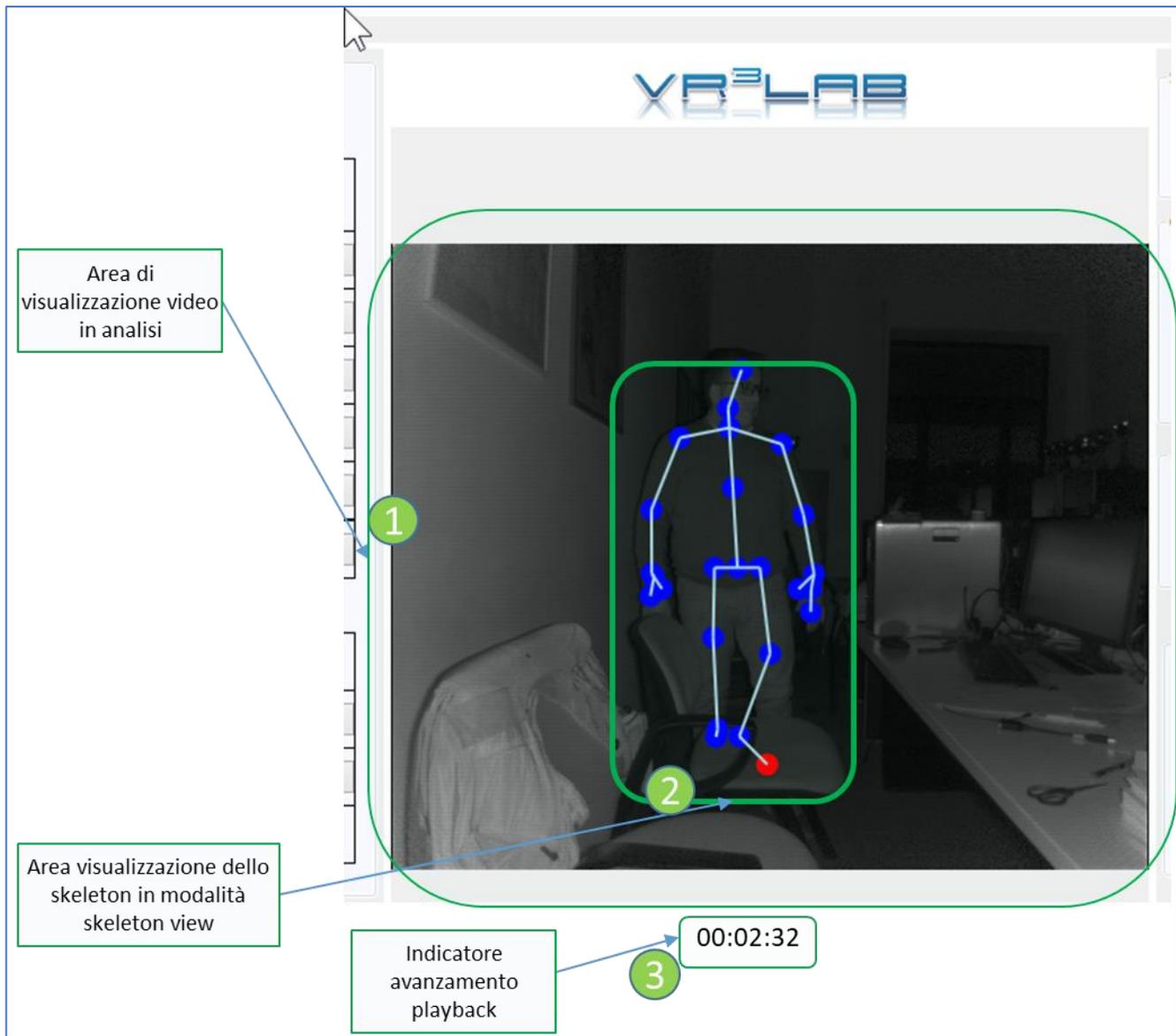
3) Video stream display area

Figure 12: Video stream display area

In area (1) the video stream is shown, if the Skeleton view option is activated from the menu visualization, the skeleton is displayed area (2).

If you are doing the offline analysis, the time progress of the playback is highlighted at the bottom area (3).

4) Real-time analysis display area (scores display)

Figure 13: Real time Analysis scores view-area

The real-time analysis allows monitoring through a visual feedback.

There are two visual feedbacks:

1. In the box (1) the is reported Rula Grand Score related to the body-side under analysis. The background of the display window is color-coded to highlight the degree of risk associated with the posture.
2. In the bottom panel (2) it is plotted the temporal evolution of the Rula Grand Score.

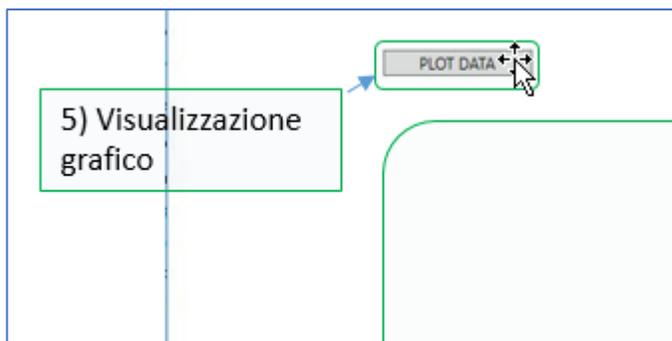## 5) Graphic score-trend display area: button plot data

Figure 14: Score trend visualization, button plot data

The PLOT DATA button gives you access to the standard file-menu of the operating system (Figure 15) to open a file (in "CSV" format) containing the results of a previously conducted off-line analysis. Once the file has been selected and opened, the results are displayed in an interactive plot of the time trend (Figure 16).
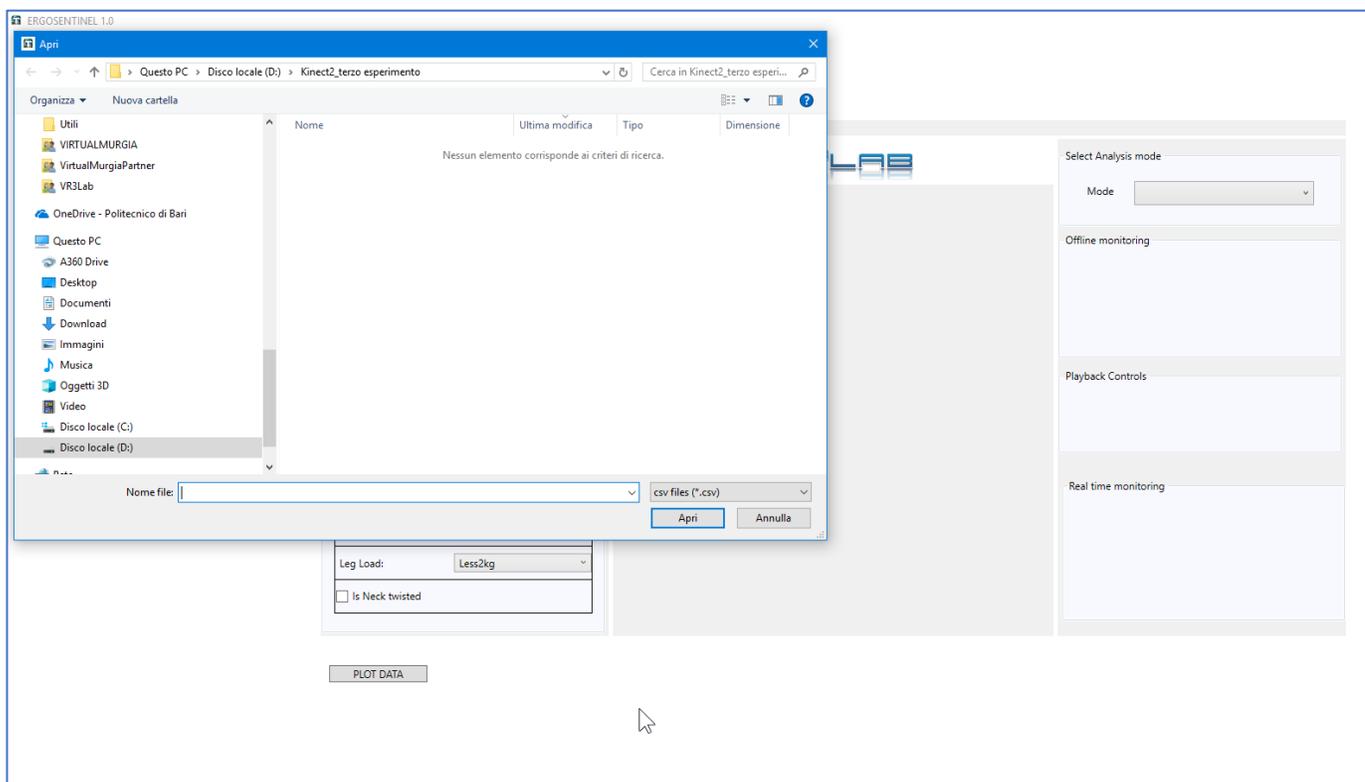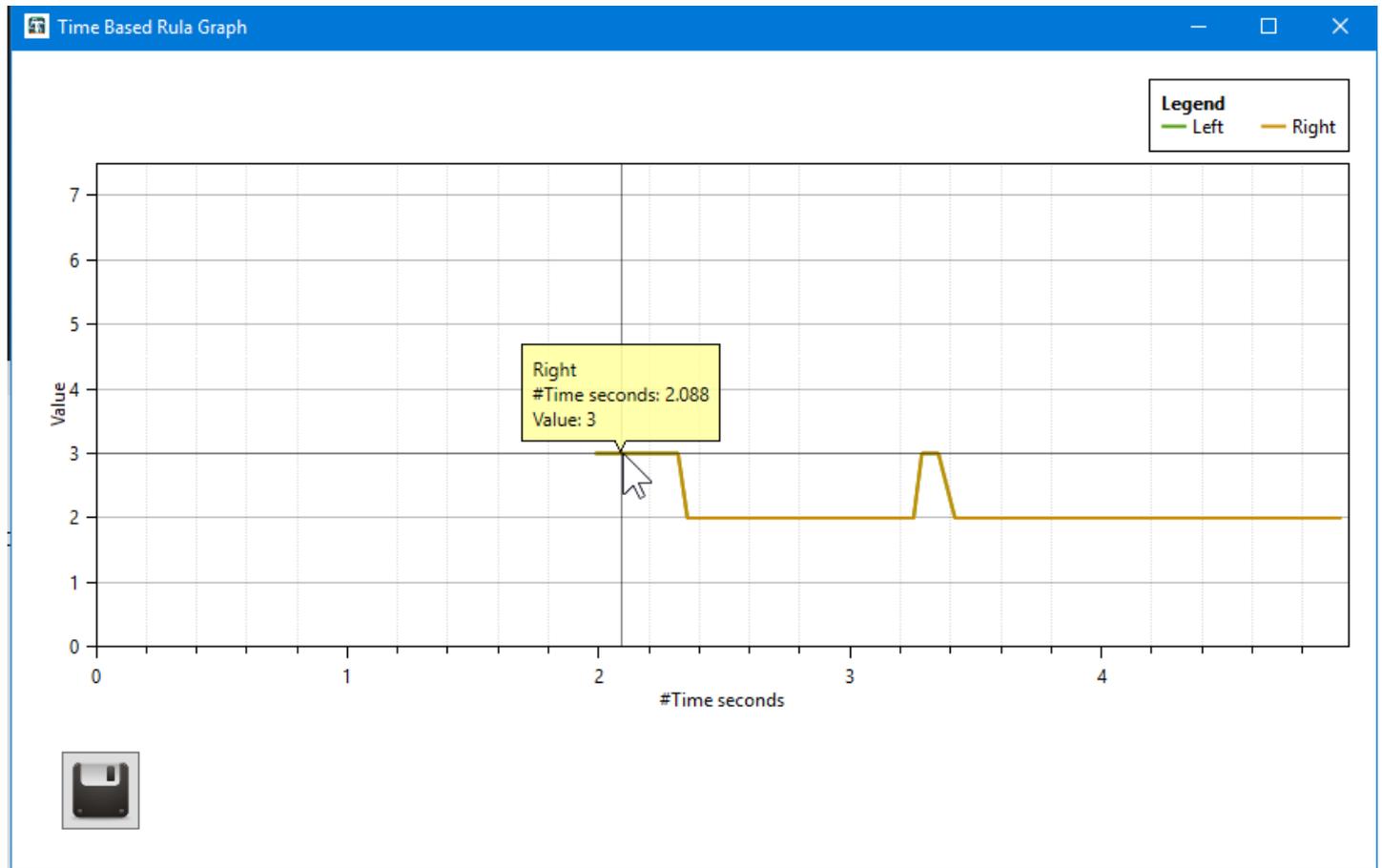

Figure 15: Standard OS file-menu

Figure 16: Plot display window with the time trend of the Rula Grand Score calculated in the off-line analysis

6) Activate Premium release

A Premium release of this tool is available. It has extended functionalities such as no time restrictions, setup customization. This button provides contacts to request the activation of the Premium Release.

Quick start guide (How to)

1) Real-time continuos-monitoring

To carry out real-time continuous-monitoring, follow the steps below:

1.   Make sure the sensor is plugged and powered;
2.   In the right panel (Select Analysis Mode) click on the drop-down menu (Mode) and select *Real time monitoring* (Figure 17). If the sensor is connected and active the display area of the video stream will visualize the images acquired by the sensor;
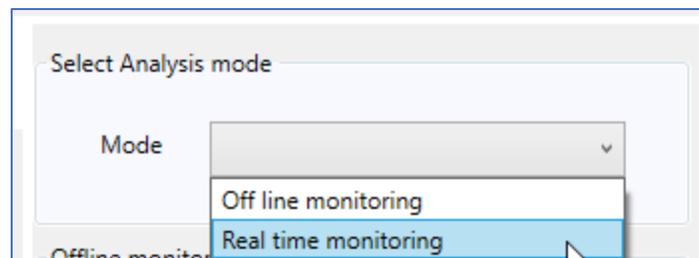

Figure 17: Analysis mode selection

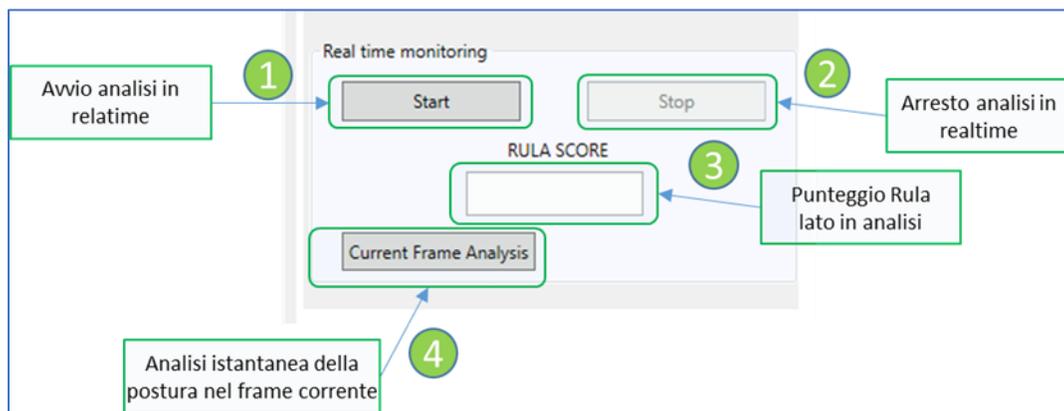1.   To start monitoring click on the button start (1) (Figure 18);

Figure 18: Real Time Analysis Control interface

        Scores are reported in the Display area that is triggered;
2.   To stop the analysis, click on the button stop (2).
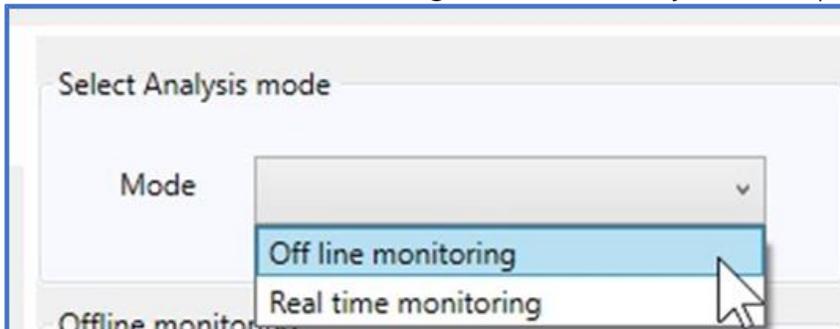
2) Offline-analysis of a previously recorded file

To perform the off-line analysis on a prerecorded file, proceed as follows:

1.   Open the file to scan through the menu-file;
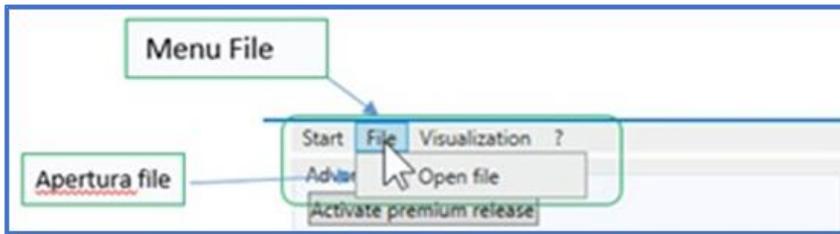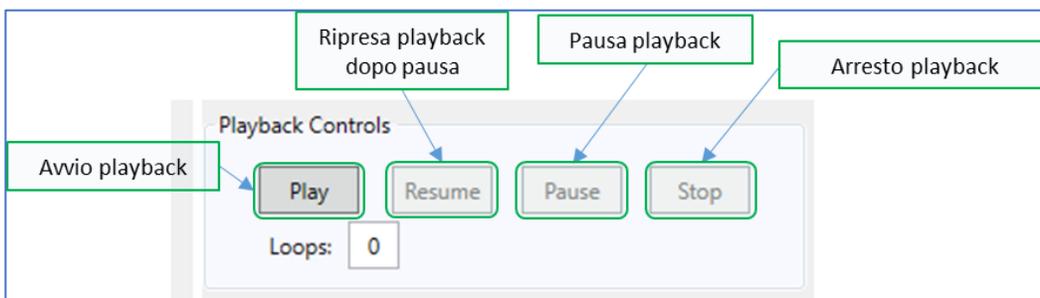

2.   Select the offline mode through the Select analysis mode panel;

3.   Set the duration of the scan period (1) In the Offline monitoring panel;
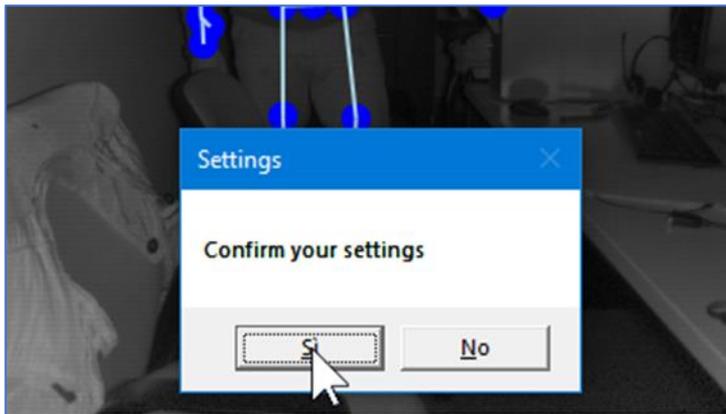

4.   Click the Play button on the playback control Panel;
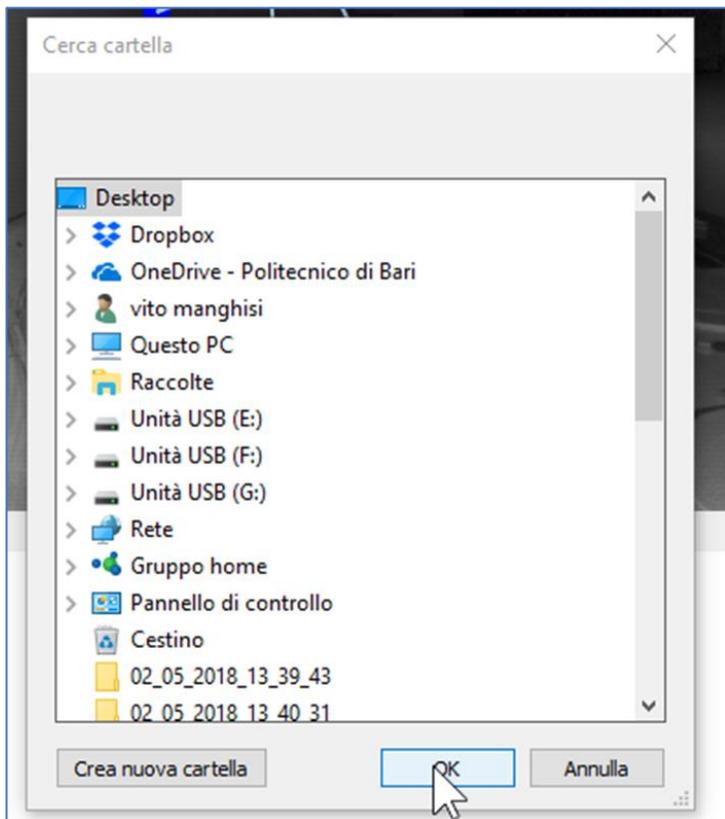

5.   Click on the Start button (3) In the Offline monitoring panel;
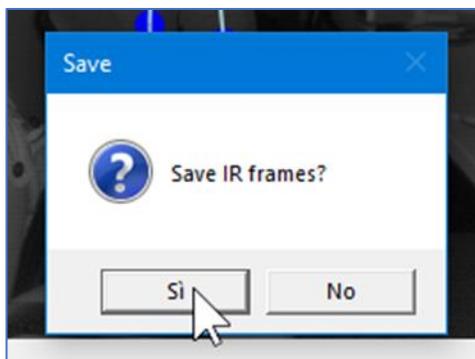
6.   Confirm the default settings and wait for the analysis to finish;

7.   Confirm or not if you want to save the analysis results;

8.   Confirm whether to save frames related to each calculated score;

If you confirm saving the individual frames are saved in a folder and you can then check the score calculated on each of the saved frames or check which posture was taken at a high score.

9. Analyze the graph with the time trend of the risk scores. The graph is interactive and allows you to click at a point to see the score measured in that time instant;
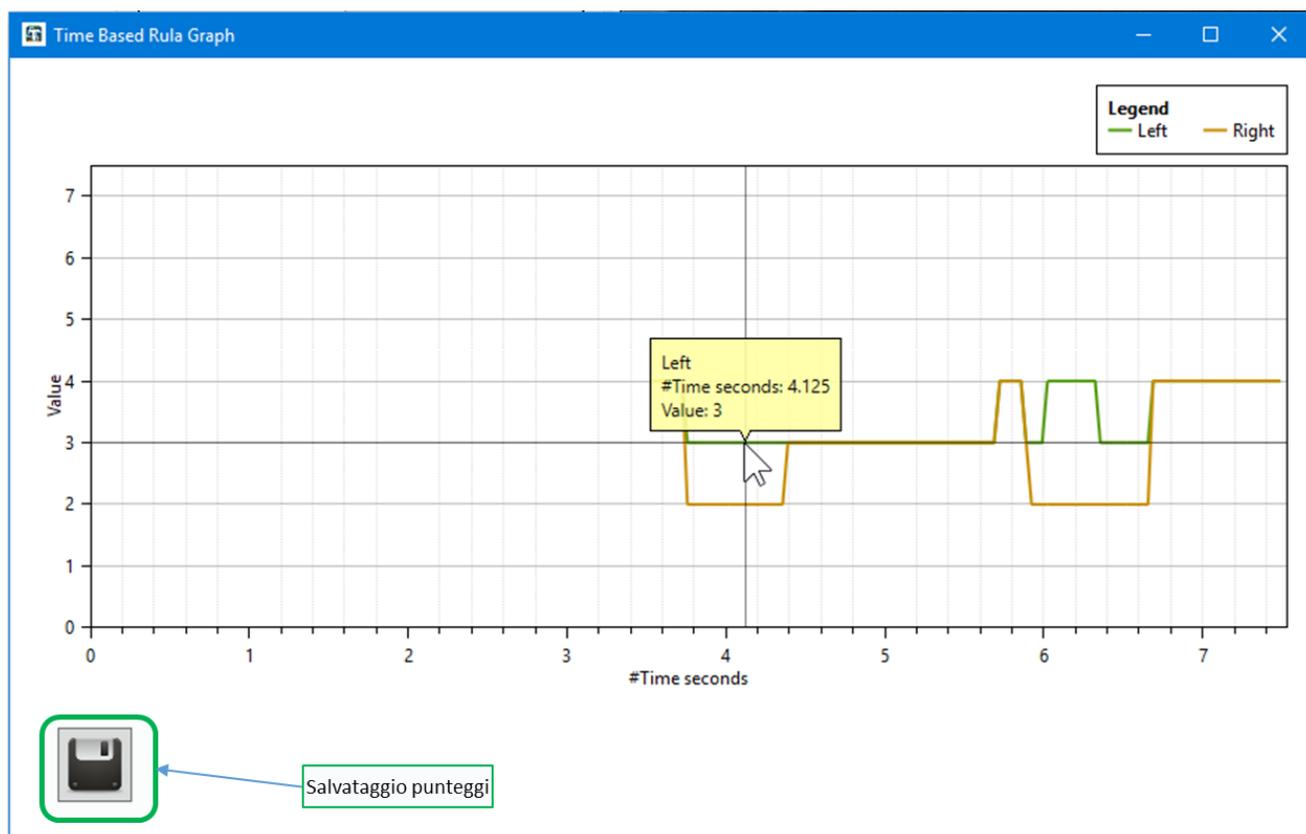
10. You can save the file with the scores calculated by clicking on the icon of the disk drive. This way you can analyze them later by pressing the button plotdata.

3) Current Posture Analysis

It is possible to conduct a thorough analysis on a single frame to evaluate in detail the postural risk with respect to all body parts. This type of analysis can be carried out during both the real-time analysis and the off-line analysis.

Real Time Analysis:

1. Follow steps 1 and 2 of the previous paragraph (Real-Time continuous monitoring);
2. By clicking on the button Current frame analysis (4) (Figure 18) Displays the screen with the detailed report of the postural analysis on the current frame (Figure 19);
3. By clicking on the disk drive icon (Figure 19Element 17) Saves the report screen.

Offline Analysis:

1. Follow steps 1, 2 and 4 of the procedure to Offline Analysis;
2. By clicking on the button Current frame analysis (4) (Figure 18) the software displays the detailed report of the postural analysis on the current frame (Figure 19);
3. By clicking on the disk drive icon (Figure 19, element 17) it saves a screenshot of the report.
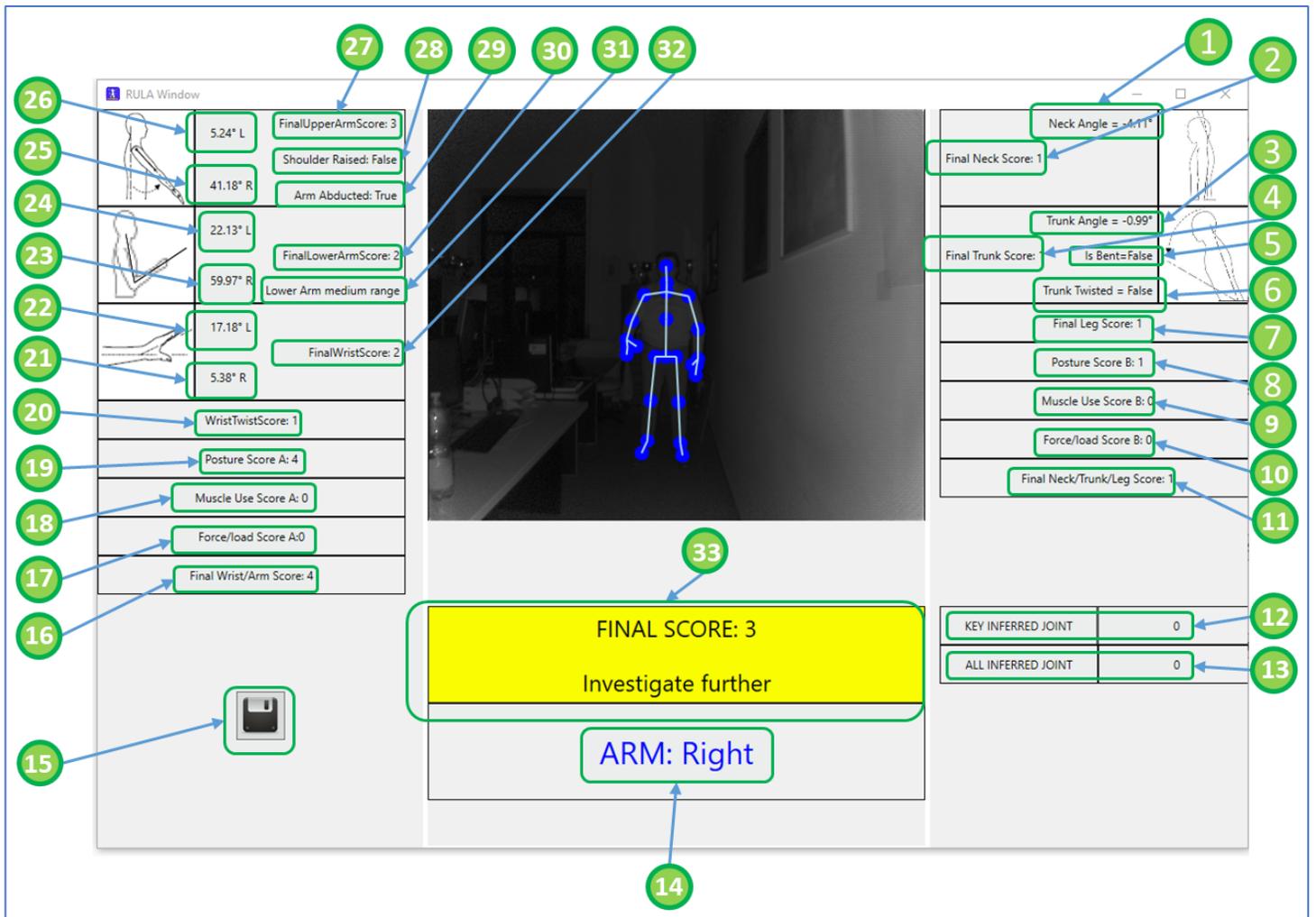
Figure 19: Detailed Report of the postural analysis for a single frame

Fields in the score report and their meaning:

(1)   Bending angle of the neck in the sagittal plane with respect to the frontal plane;
(2)   Score Rula for the Neck;
(3)   Bending angle of the trunk in the sagittal plane with respect to the frontal plane;
(4)   Score Rula for the Trunk;
(5)   Lateral bending condition of the trunk with respect to the sagittal plane;
(6)   Torsion condition of the Trunk;
(7)   Score Rula for lower limbs;
(8)   Global Rula Score Section B (please refer to the RULA metric for further details);
(9)   Rula Score Muscle Engagement section B;
(10)   Rula Score Weight weights/forces section B;
(11)   Final Rula score Section neck/trunk/legs;
(12)   Number of basic joint joints obtained by interpolation;

(13)   Total number of joint obtained by interpolation;
(14)   Indication of the analyzed side;
(15)   Button to save the screen shoot of the scores;
(16)   Final score arm/wrist;
(17)   Rula Score Weight weights/forces section A;
(18)   Rula Rating muscular engagement section A;
(19)   Rula Score Global Section A;
(20)   Rula Score wrist torsion;
(21)   Right wrist bending angle;
(22)   Left wrist bending angle;
(23)   Angle between arm and right forearm;
(24)   Angle between arm and left forearm;
(25)   Angle between trunk and right arm;
(26)   Angle between trunk and left arm;
(27)   Rula Score arm;
(28)   Condition of lifting of the glomerular articulation;
(29)   Abduction status of the arm;
(30)   Rula Score forearm;
(31)   Condition of translation of the forearm with respect to the sagittal plane;
(32)   Final wrist score;
(33)   RULA Grand Score.