Psychophysiological Contactless Detection System

VibraLie10

MANUAL

Version VibraLie10

ELSYS Corp.

CONTENT

1 Introduction

Welcome to the VibraImage World! Thank you for your purchase of VibraLie10 system. This Manual is written to help you enjoy vibraimaging and open new features in well-known objects!

VibraImage technology measures micromovement (micro motion, vibration) of person by standard digital, web or television cameras and image processing. Human head microvibration is linked with the vestibular-emotional reflex (VER) of a person and reflects emotion status and personality traits. VibraLie system detects human emotions by the control of three dimensional (3D) head-neck movements and fluctuations, accumulated as frame difference in several video frames.

1.1 Basic applications

VibraLie software solves the following targets:

- emotion recognition;
- psychophysiological detection of deception;
- lie detection with fixed actual and individual questionnaires;
- research and ranking of psychophysiological responses to presented stimuli.
- monitoring of person physiological parameters;
- video surveillance in real time by vibraimage and suspicious person detection;
- psychological testing.

1.2 System specifications

1.2.1 VibraImage system parameters

- Resolution, TVL, not less   400
- Noise level of VibraImage, bit, less than   0.1
- Frame rate, frame/sec, not less   25
- Frequency range, Hz, more than $0.1 \div 10$

1.2.2 Digital (web) camera requirements

- Sensor   CCD or CMOS
- Resolution, pixel., not less   640 x 480
- USB compatible   USB 3.0, USB 2.0, IP
- Frame rate, f/s, not less   25
- Microphone   external
- Exposition control   auto and manual

- Color mode   color and B/W switch
- Flicker mode   Flicker 50 Hz and 60 Hz

1.2.3 System requirements for local module computer

- Operation System   Windows 7/8/10 or later **64 bit only**
- Processor   Intel I3 2400 MHz or later
- RAM   more than 4 Gb
- HDD   more than 10 Gb free space
- USB port   1free USB ports version USB 2.0
- Video capture   WDM-compatible video device

1.3 Package contents

1. VibraLie software   -   1

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4. Digital USB camera (option)   -   1

5. Microphone (option)   -   1

6. Personal computer (option)   -   1

2 VibraLie software installation

To install VibraLie please follow steps below:

1. Go to Web page www.psymaker.com/support/downloads/
2. Load file setupVibraLie10.exe www.psymaker.com/downloads/setupVibraLie10.exe
3. Run file setupVibraLie10.exe from archive file

Attention!

Please, be careful and paste code without additional gaps!

4. Select language for installation procedure (fig. 2.1).
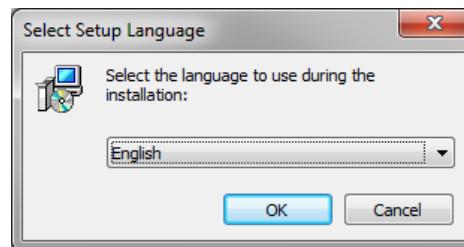
Fig. 2.1. Choice of language installation

1. Press button «Next» in the appeared window of the beginning installation.
2. Accept the license agreement and to press button «Next» in the appeared window.
3. In the appeared window specify a way to the catalogue where files of the program will be written down, then to press button «Next».
4. Press button «Next» in the appeared window, allows installation of software files on your computer.
5. In the appeared window select versions of the program which you want to install on the computer (fig. 2.2).

Fig. 2.2. Choice of additional tasks during installation

6. Press button «Install» at the start of installation.

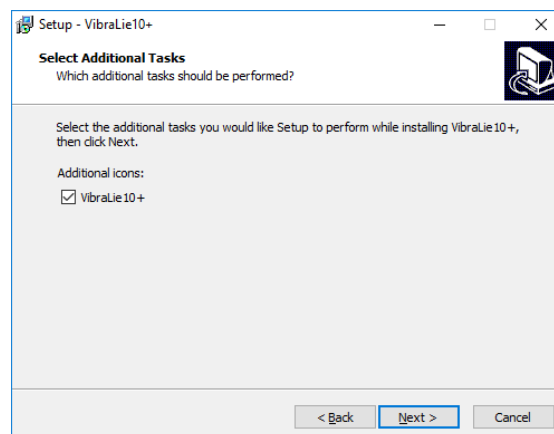7. If you want to have the VibraLie program with other programs, in the appeared window it is necessary to choose item of installation of virtual camera drivers, and press «Next».

8. Press button «Finish» at the end of installation.

9. VibraLie program pictogram appears after the end of installation in system menu and on desktop of your computer.

10. To reboot a computer.

2.1 VibraLie software activation

Attention:

1. Procedure of activation is necessary only at the first start of the program.

2. Before the program activation it is necessary to buy this modification of the program in the online shop Psymaker http://www.psymaker.com/ru/shop/

3. Activation procedure requests access to the Internet for receiving answer code from server.

4. Activation code has the structure given in the table.

Key type	Software modification
VIXX_xxxx_LD	VibraLie software is intended for:
	- psychophysiological lie detection;
	- fix and compare psycho physiological parameters of the person during the various moments of time;
	- vibra-aura (external vibraimage) real time surveillance, research, analysis and interpretation

2.1.1 Standard activation

1. To start activation it is necessary to get starts the program VibraLie.

2. At the first start of the program the activation window will be displayed (fig. 2.3).

Fig. 2.3. Activation window

3. In the field «**Request**» it is necessary to enter the activation code received by e-mail or specified by the seller. After input of activation code to press the button «**Get Answer code using HTTP**».

4. The activation code will be checked up through the Internet and, in case of successful end of activation procedure, the answer code will be sent (fig. 2.4).

Fig. 2.4. Successful activation

5. Press button «**OK**». VibraLie will be automatically started.

   Attention!

   The first launch must be carried out with administrator rights!

2.1.2 DEMO activation

   Note, for each modification you have a possibility of the program start in the DEMO mode only 5 times. Then the Internet code is required to be bought.

1. To start activation it is necessary to get starts the program VibraLie.
2. At the first start of the program the activation window will be displayed (fig. 2.5).

Fig. 2.5. DEMO activation window

3. In the field «**Request**» it is necessary to enter uppercase letters of «**DEMO_LIE**» (fig. 2.5). After input of an demo activation code to press the button «**Get Answer code using HTTP**».

4. The activation code will be checked up through the Internet and, in case of successful end of activation procedure, the answer code will be sent and will be appeared in the field «**Answer**» (fig. 2.6).
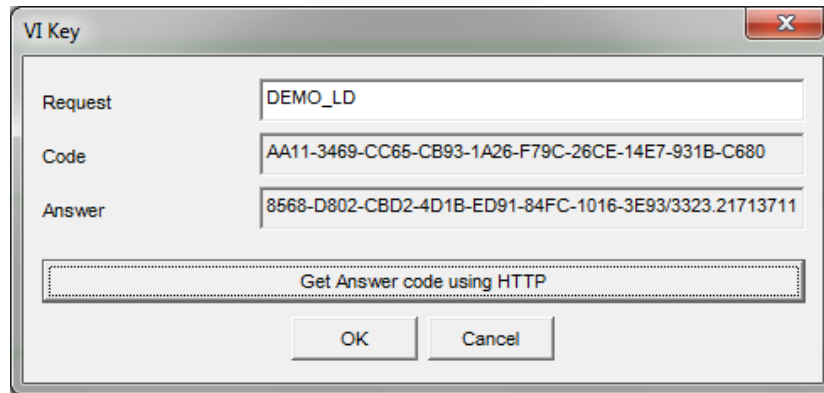
Fig. 2.6. Successful DEMO activation

5. Further items 5-8 as in case «**Standard activation**».

2.2 Reinstallation of VibraLie

Note, the ability to reinstall VibraLie software on a new computer is given to user. For this purpose, it is necessary to execute the following actions:
1. Connect computer to the Internet.
2. Start VibraLie program for reinstallation on a new computer.
3. In the menu «Help» choose item «**About VibraLie…**» (fig. 2.7).

Fig. 2.7. Menu «Help»

4. In the opened window press the button «**Unregister key**» (fig. 2.8).
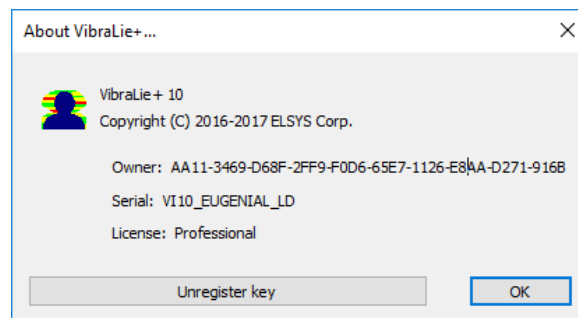
Fig. 2.8. Information about the program

5. Close the program.

6. Connect a new computer to Internet.

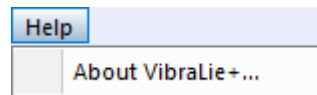7. On the new computer install the program and make registration of an «old» modification activation code through the Internet, according to recommendations of section 2.1.

8. After successful program registration the given activation code will be fixed to the given computer.

2.3 First start of VibraImage system

1. After the first start of system, you will see the program window shown in fig. 2.9.

Fig. 2.9. First program start

2. In menu «**Settings**» => «**Language**» select interface language (fig. 2.10).

Fig. 2.10. Select language

3. Once connected to the computer camera in the menu **"Settings" => "Video »** (fig 2.11) you need to select the camera to work (in fig 2.11 -. Microsoft Lifecam Cinema camera).

Fig. 2.11. Video camera connecting

4. After correct connecting the camera the image appears on the screen.
5. Perform video camera settings (see. ch. 2.4).
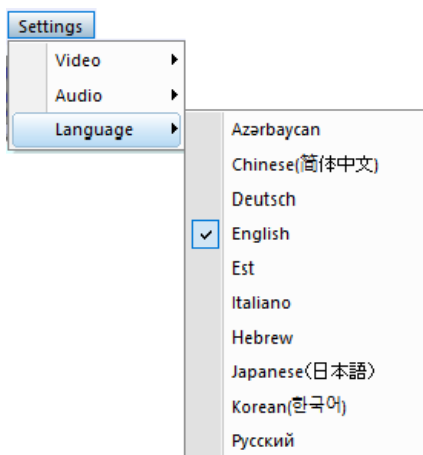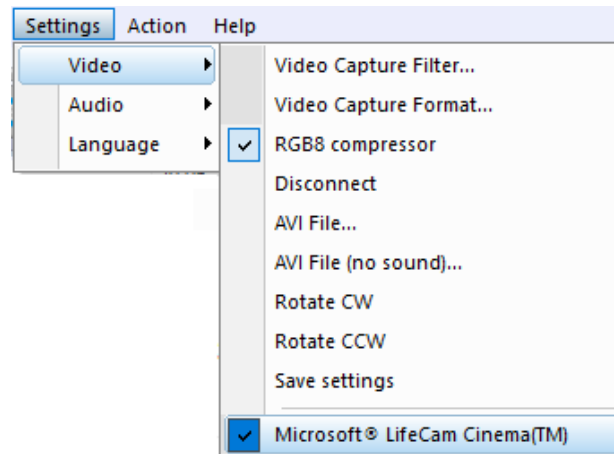6. Perform quality control of videoimage (see. ch. 2.5) and, if it is necessary, eliminate the causes of low-quality video.
7. Get started in accordance with the program description (ch.4).

2.4 Camera settings

2.4.1 Video camera choice

It is necessary to select in the main menu **«Settings»** => «**Video**» => «.../**name used camera**/...». In figure 2.11 the process of selecting the camera «Microsoft LifeCam Cinema» is shown. If the camera is connected, selected and works, then the left of the name there will be an icon «✔», and the menu will be extended with the **«Video capture filter...»** and **«Video capture format...»**.

Note, use free program CamIP for the IP network camera connection (http://www.psymaker.com/downloads/CamIP_installer.msi). Parameter setting procedure is described in the CamIp manual http://www.psymaker.com/downloads/CamIP_eng.pdf

2.4.2 Video capture filter

To open the menu of the camera settings you must be select «**Video capture filter...**» in the submenu «**Video**» (fig. 2.12). Item «**Video capture filter...**» appears in the menu only in case of the correct installation of drivers of the camera and a choice of the working camera.
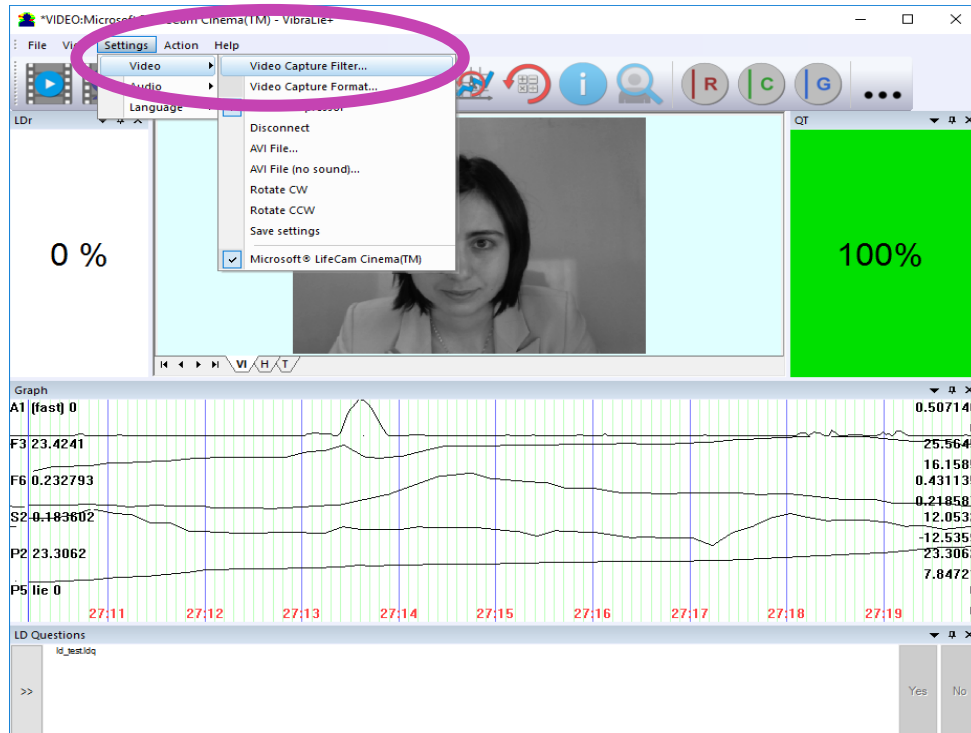
Fig. 2.12. Opening of the camera's settings menu («Video capture filter...»)

After a choice of the «**Video capture filter...**» the window «**Settings**» will open. Settings window differs depends on camera type. The first tab of this window is usually devoted to the image setup (Brightness, Contrast, etc.). In a figure 2.13 the window «**Settings**» for the camera «**Microsoft LifeCam Cinema**» is shown. Camera Microsoft LifeCam Cinema has low noise level and is preferable for vibraimage applications among webcams.

«Brightness», «Contrast» and other parameters should be set up so that image of object has more contrast. Switching on/off flicker-effect from artificial lighting could be necessary for some illumination types.
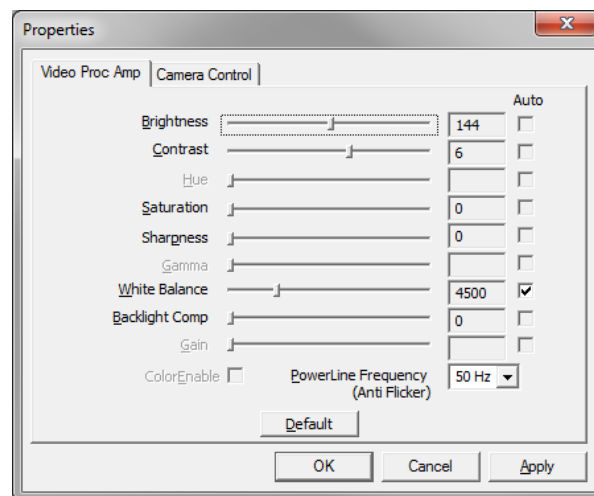
Fig. 2.13. Video setting, camera « Microsoft LifeCam Cinema»

After a choice of the «**Video capture filter...**» the window «**Settings**» will open. Settings window differs depends on camera type. When adjusting the camera settings, you must fulfill the following general requirements:

- The **«Brightness», « Contrast »** and others parameters should be configured so that the image of the object was the maximum contrast

- Switch on **«Flicker»** mode for setting lighting power line frequency (repayment flicker); in most countries it is 50 Hz.

- If your camera supports, then switch on the black-and- white image **«B/W mode».** If the camera works only in color mode, it is recommended to set **«Saturation»** parameter to minimum value.

- Depending on the experimental conditions and light to use automatic or manual setting **«Exposure»** parameter. If constant lighting, it is recommended to use the manual adjustment. If changes (for example, an object depends on the lighting street lighting), it is better to use the automatic adjustment mode setting.

- Parameters «Zoom» and «Focus » is recommended to use in the manual mode and change their values not due to electronic image processing, but by approaching / removing the camera from the object. The «**Scale**» (Zoom) is recommended to select based on two factors. Firstly you need to have maximum image size of control object and it is preferably to stand maximum zoom level. From the other side high level of electronic zoom in some cameras could go down the frame rate and it is necessary to control this parameter and fixed frame rate more than 25 f/s (error 3). Therefore, for webcam Microsoft LifeCam Cinema the optimal meaning of zoom for personal control is 4. For other cameras is possible to adjust other optimal zoom settings.

2.4.3 Video capture format

To open the menu of the camera settings you must be select «**Video capture filter...**» in the submenu «**Video**» (fig. 2.14). Item «**Video capture format...**» appears in the menu only in case of the correct installation of drivers of the camera and a choice of the working camera. Frame rate is necessary to set 30 and the frame size to set («Output Size») 640 x 480 elements (fig. 2.15).
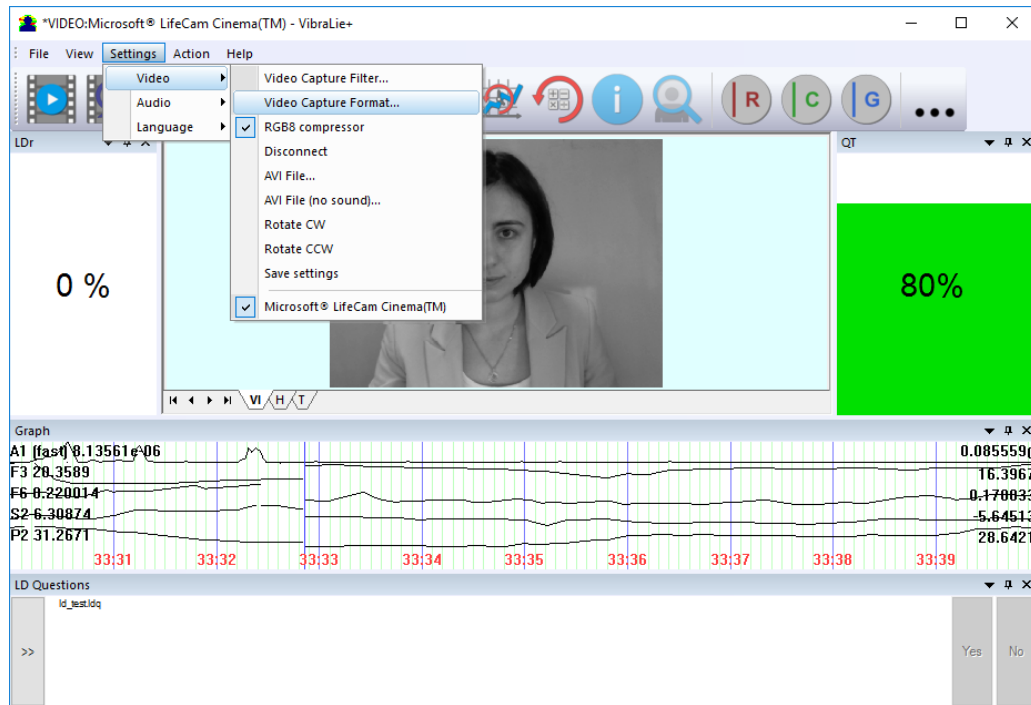
Fig. 2.14. Opening the settings window «Video capture format»
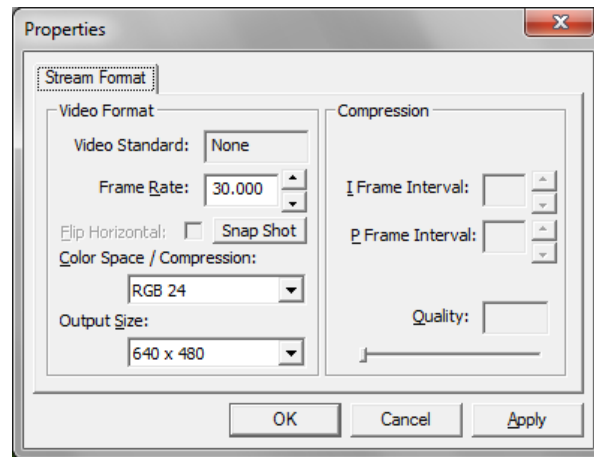
Fig. 2.15. Window «Video capture format»

Note, when changing camera settings in the program VibraLie frame rate «In» should be in the range of 25 - 30 frames/s. The parameter IntegratedN (Am) must be minimum, but not exceeding 0.1.

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2.4.4 Checking the settings on the test table

During the first start of Vibraimage system and periodically it is recommended to test image quality by the test table. It is required to place a test pattern opposite to the camera so that the image of the table occupies the entire space of the frame. To achieve the optimal contrast range of object is need to stand in camera settings auto regulation of illumination in case of unstable illumination (fig. 2.16) and manual regulation of illumination in case of a constant illumination (fig. 2.17).
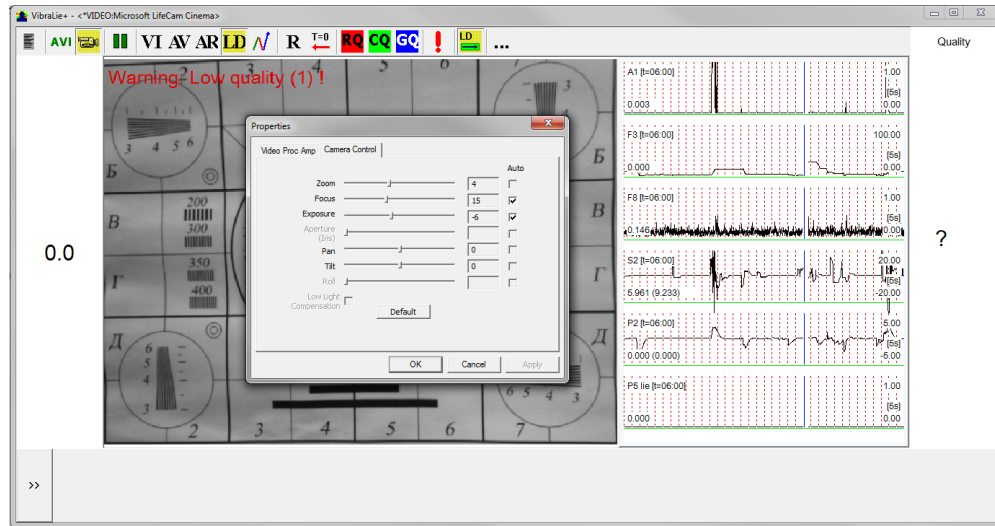
Fig. 2.16. Checking the camera settings on the test table, automatic regulation of the exposure (mode is recommended for unstable object illumination).
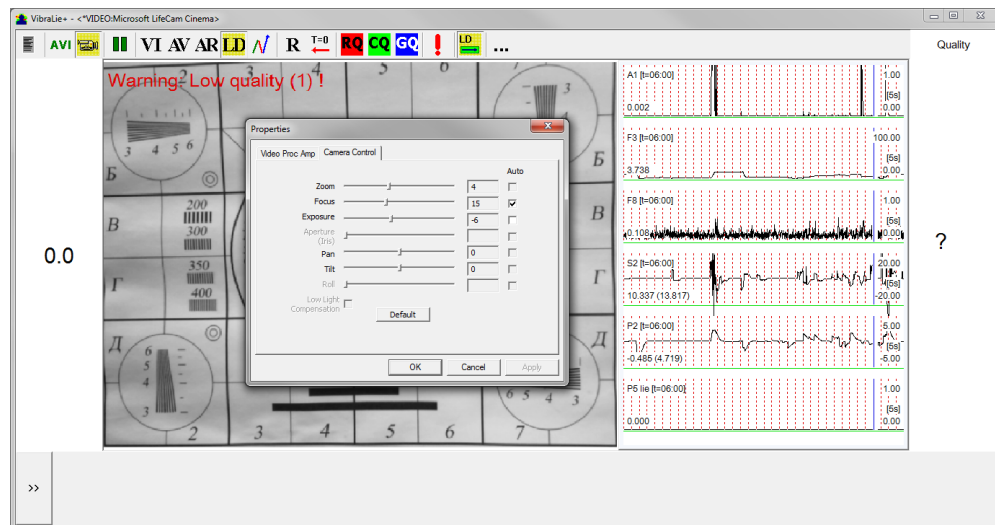
Fig. 2.17. Checking the camera settings on the test table, manual regulation of the exposure (mode is recommended for stable object illumination).

2.4.5 Video quality auto checking function (QT)

The VibraLie program has quality control function image quality control during the test. Since the calculation of human reaction using the video image, the quality control for the processed video is necessary to obtain a correct test result. Error message and the low quality of video will appear on top of the **QT** windows (fig. 2.4), but only if the **"Quality test"** mode in "S" information panel is switch on.

Program gives error indication if the image quality is lower than standard vibraimage requests:

Error 1 – indicates when facial image is lower than necessary. For cancel this error is need to move checked person near to camera or start zoom function on camera.

Error 2 – indicates when camera noise level is higher than necessary. The reason of this error could be low illumination, incorrect camera settings or camera vibration.

Error 3 – indicates when computer input frame rate is lower than necessary. Requested norm for processed frame rate is more than 24 f/s. This errors indication was done for deleting unqualified Lie influence during results control.
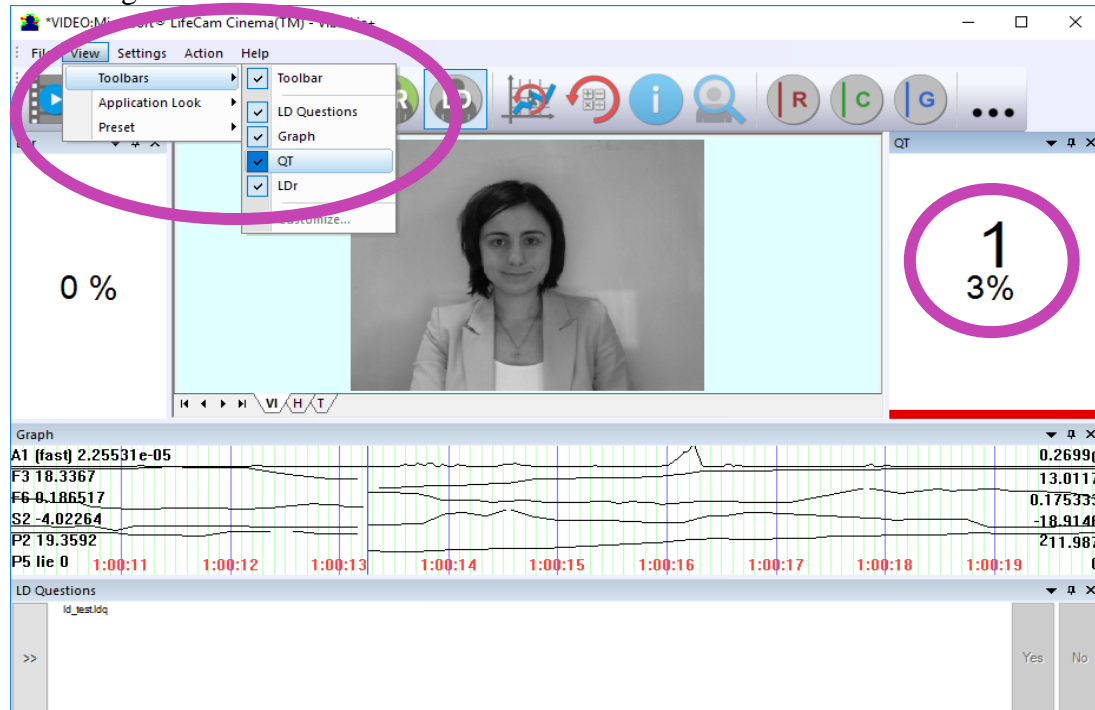
Fig. 2.21. Quality test indication stands Yes in settings and Error 1 shows in the image window. Head image size is lower than requested.

Program gives error indication if the image quality is lower than standard vibraimage requests:

Error 1 – indicates when facial image is lower than necessary or when system cannot detect user's face. For camera with horizontal resolution across 640 pixels the person's face should be not less than 200 pixels. For cancel this error is need to move checked person near to camera or start zoom function on camera.

Error 2 – indicates when camera noise level is higher than necessary. The reason of this error could be low illumination, incorrect camera settings or camera vibration.

Error 3 – indicates when computer input frequency rate is lower than necessary. Requested norm for processed frame frequency is more than 24 f/s. This errors indication was done for deleting unqualified Lie influence during results control.

The size of the person's head image in the picture elements (pixels), which determines the accuracy of recorded vibrations, requires constant monitoring during testing. When tested with a video image analysis there are no severe restrictions on the movement of the test person, as required by the contact method. This person feels natural, which increases the accuracy of test results.

However, the natural behavior can lead to the fact that during the test response deviates from the camera and the size of the human head image becomes less than required. To resolve this issue vibraimage system constantly monitors a person's head size of the image and displays an error message (1) in the window «**QT**» in the case of reducing the size below the limit. In addition, vibraimage program includes a permanent face detection algorithm, which ensures elimination of errors from a lack of a real image of the person in the frame during testing.

Temporary noise signal from the video camera includes a video camera noise and illumination instability and can significantly affect the test results. In this case, at the slightest noise's level exceeds the specified threshold, the system automatically displays an error message (2) in «**QT**» window (see. fig. 2.5).

Despite the fact that the television camera may transmit to 30 f/s with the set resolution, it does not guarantee that the computer receives and processes the incoming video data in real time. And any deviation from the information processing in real time resulting in a loss of information and hence reduce the reliability of the test. By reducing the actual input frames frequencies and processing frequencies below the set limit, the system automatically displays a warning error (3).

Window «**Quality Test**» (**QT**) indicates the time in %, for which the image quality of 100 %. When the quality test indicates 43 % means that only 43 % of the testing time have no errors, and the 57 % of test time the image quality contained 1, 2 or 3 errors.

Note, before the start of the test should ensure that the program processed the image of a human without errors.

3 VibraLie. User's manual

After start of VibraLie in the main window there is an image from connected video device.

3.1 Main window

In heading of the basic window the following information is indicated (see fig. 3.1):

- type of video source: Video camera or AVI file;

- model of video source: Video camera model or AVI file name;

- name of running VibraLie module;

- name of the current database record to which there is an operation.
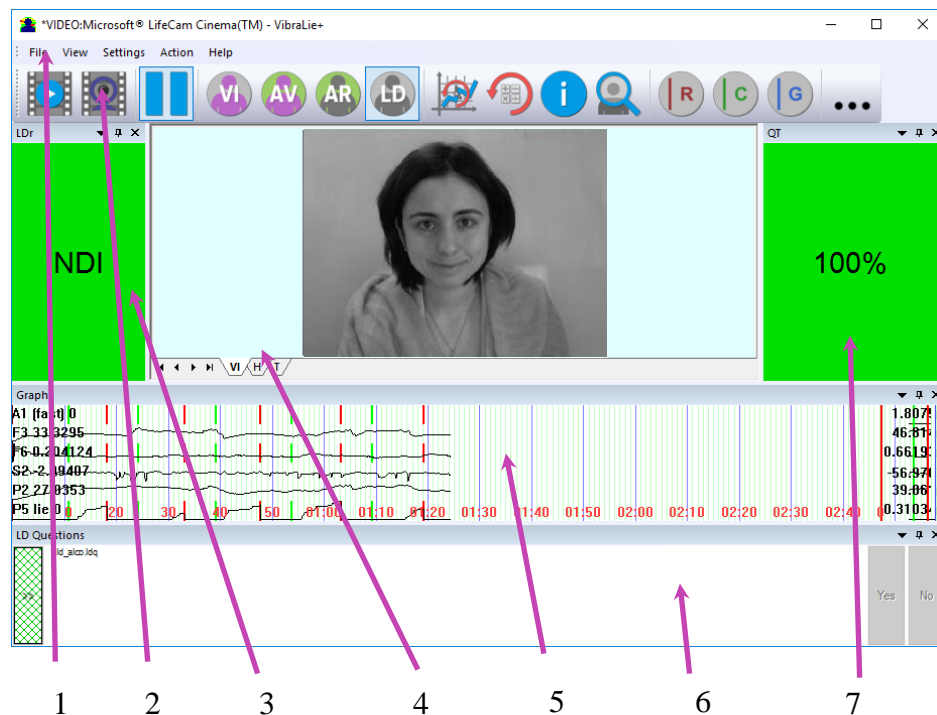
Fig. 3.1. Main window VibraLie

The program for the user's convenience have the ability to change the style of the main elements of the working window. To change the style, use the submenu «**View**» - «**Application Look**» (fig. 3.2.).
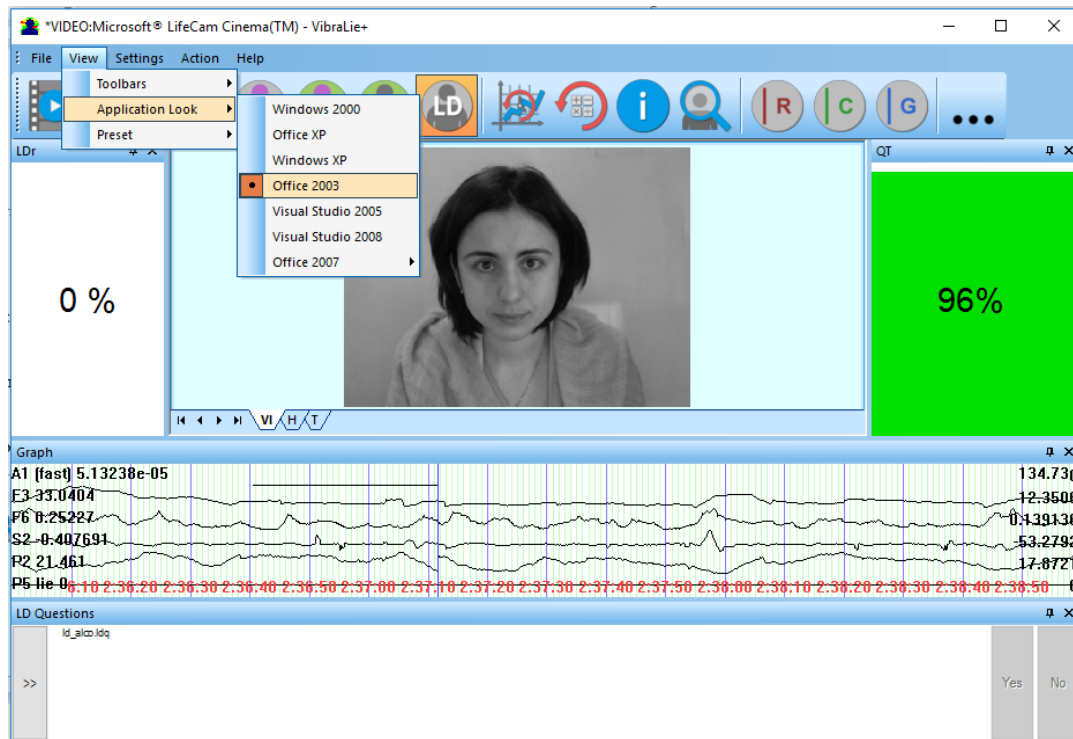
Fig. 3.2. Style «Office 2003»

3.1.1 Basic window design

In total in the main window of the program in addition to the video area, you can see an additional 7 windows that display information about the parameters of mental and emotional state of a person, and program settings (on fig 3.1 the windows labeled corresponding numbers):

1. File, View, Settings, Action, Help – main menu;
2. Toolbar – main toolbar;
3. LDr – lie level window (parameter P20);
4. Images window for displaying vibraimages (VI), result's histograms (H), information-energy graph (T);
5. Graph – window with changing main parameter (by default A1 (fast), F3, F6, S2, P2, P5 lie);
6. LD question – window for show questionnaires question
7. QT – image quality window.

User can add or delete windows by submenu «**View**» - «**Toolbar**» (fig. 3.3).

Note, double click by the left button of a mouse in the image field of makes **RESET** of all saved up information and statistics about frames and start new cycle collection of information.
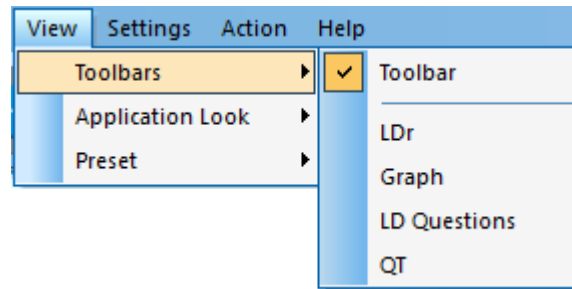
Fig. 3.3. Submenu «Toolbars»

3.1.2 Program windows position control

The user can control the placement of additional windows on the screen and the size using the controls elements on the left side of each window title. For each window it is available control menu (fig. 3.4). This menu also appears when you click the left mouse button in finding the mouse pointer in the desired window. In «Docking» mode, window position and size are fixed, and when opening/closing the window will open in a given position. The mode «Floating» window position and size can be changed by the user.

If the window is in a random location on the screen, then double-click the left mouse button on the window, the window will move on the screen in the «default» position.
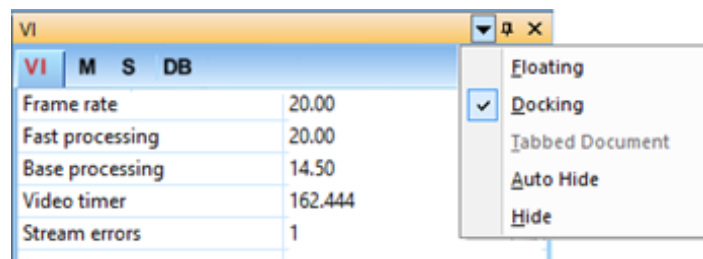
Fig. 3.4. Window control element

Each window can be closed, or by using the window menu or by using a separate control element (fig. 3.5).

Fig. 3.5. Control element «close window»

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Each window can be temporarily minimized and moved to the border of the main program window (fig. 3.6). Figure 3.11 additional windows hided and moved to the border of the main window and they icons are highlighted in orange color.
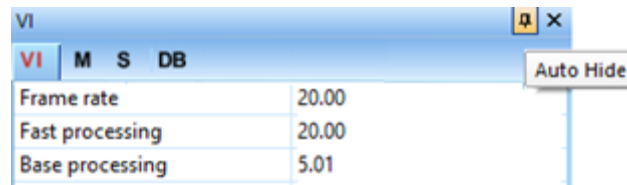
Fig. 3.6. Control element «hide window»
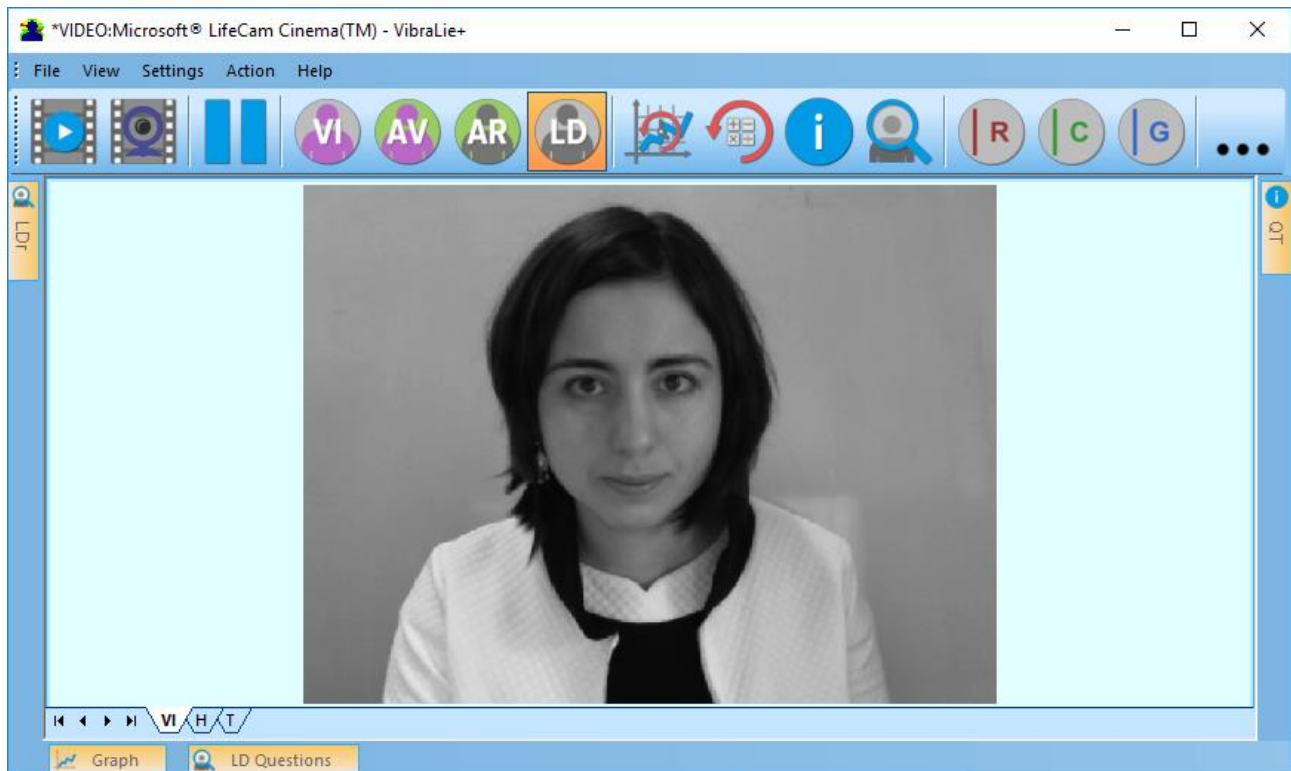
Fig. 3.7. All additional windows are hide.

3.2 Main menu

The main menu contains the following items:

- «**File**»
- «**View**»
- «**Settings**»
- «**Action**»
- «**Help**»

3.2.1 Menu «File»

Menu «**File**» (fig. 3.8) contains following items:
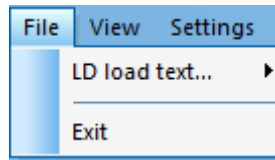
Fig. 3.8. Menu «File»

Item «**LD load text…**» – load questionnaire file with format «*. ldq»

Item **«Exit»** - exit from program.

3.2.2 Menu «View»

Menu **«View»** (fig. 3.9) defines visible in the basic window information and contains the following items:
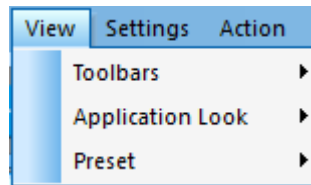
Fig. 3.9. Menu «View»

Item **«Toolbars»** - switch on/off the toolbar (fig 3.3).

Item **«Application Look»** - choose style of program (fig 3.2).

Submenu **«Presets»** menu «**View**» (fig. 3.10) intended to choice one basic mode in image area.

- In **«VI»** mode [«VibraImage mode»] displays vibraimage of person. Color for every image pixel depends on its amplitude or frequency of vibrations (fig. 3.11a).

- In **«AV»** mode [«Aura - Vibraimage mode»] the contour of the object allocated around the vibraimage. Vibra-aura line size depends on Lieium line vibration amplitude. Vibra-aura line color depends on maximum line vibration frequency inside vibraimage contour (fig. 3.11b).

- In **«AR»** mode [«Aura on the Real image»] the vibra-aura of the person is shown around his real image (fig. 3.11c).

- In **«LD»** mode [«Lie Detector mode»] image area shows real object image(fig. 3.11d).
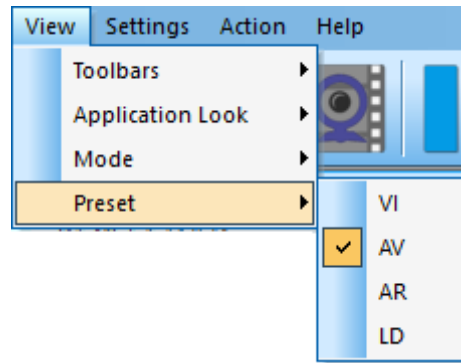
Fig. 3.10. Submenu «Preset»
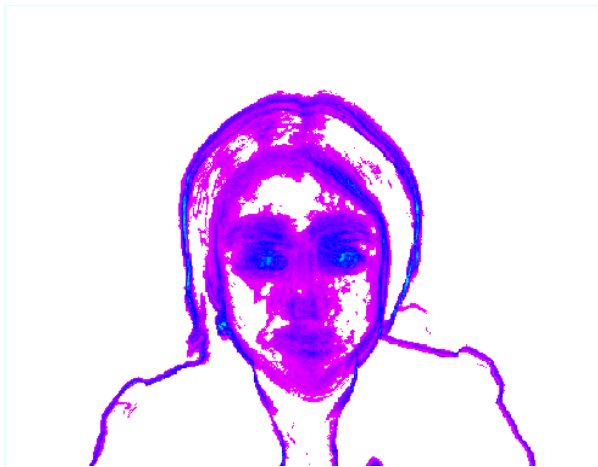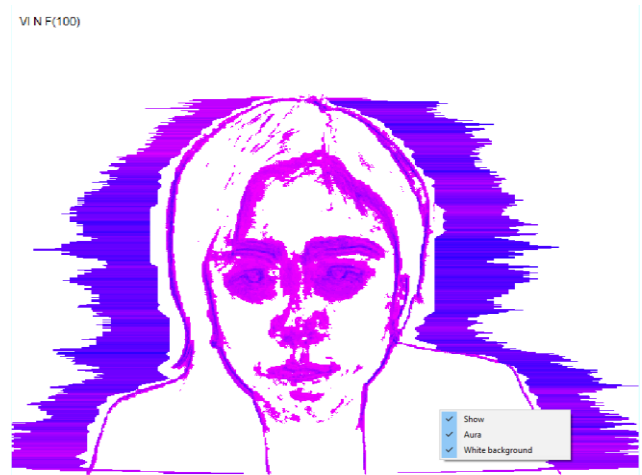
3.11a Режим VI	*3.11b Режим AV*
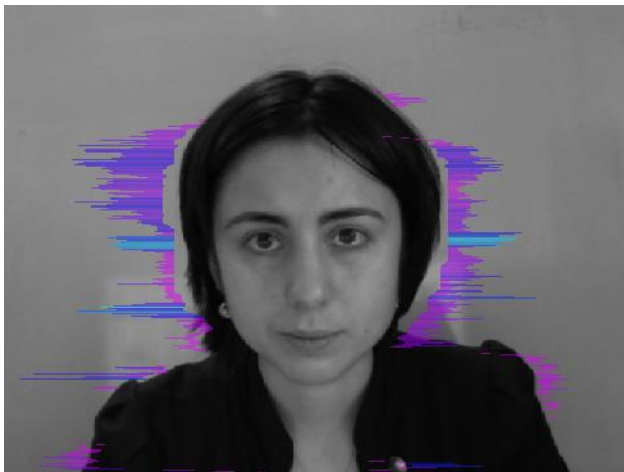
3.11c Режим AR	*3.11d Режим LD*

3.11 Image area in different modes

3.2.3 Menu «Settings»

Menu «**Settings**» (fig. 3.12) allows choosing video or audio source, language, settings by default and auto start program:
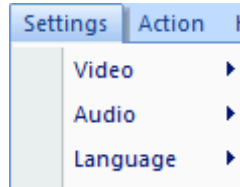
Fig. 3.12. Menu «Settings»

VibraLie allows to process «live» video signal coming from a video camera and video data recorded before and saved as AVI-file. The system works with a signal from a video camera by default.

Submenu «**Language**» allows to select interface language (See par. 2.3).

3.2.3.1 Video source choice

Submenu **«Video»** contains settings of video modes. It can differ depend on connected devices. For example, this menu contains the following items (fig. 3.13). You can choose as video source one from many installing in PC video-devices or load external video file.
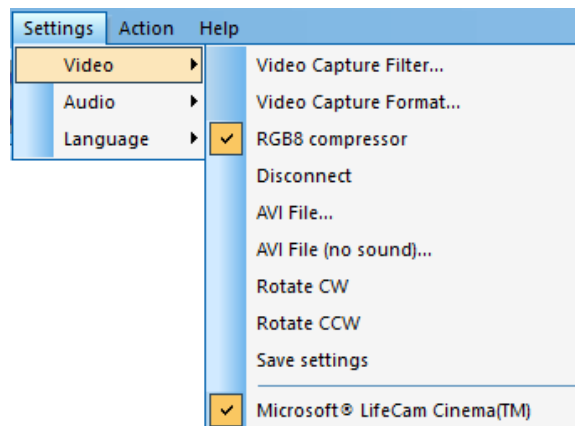
Fig. 3.13. Submenu «Video»

Subitem **«Video Capture Filter…» -** by pressing the window of video device setting (contrast, exposition, brightness) opens. Each device has the especial window of settings.

Subitem **«Video Capture Format…» -** change video capture format.

Subitem **« RGB8 compressor »** are intended for management of a videofile record format. If this item is chosen, that, for economy of a space on a hard disk, the videofile saved in a black-and-white format.

Subitem **«Disconnect»** allows to disconnect all videocamera or videofile

Subitems «**AVI File…**» and «**AVI File (no sound)…**» [AVI File (no sound)…] are intended for selecting for the analysis of an external video file

Subitems **«Rotate CW»** and **«Rotate CCW»** allow allow to make turn of an input video image on 90 and 270 degrees before its processing in the VibraLie.

Subitem **«Save settings»** allows to save current camera settings in the Windows registry in order to load them at next startup programs with this camera

The bottom menu allows you to choose a used device video capture from multiple installed on this computer.

3.2.3.2 Audio source choice

Submenu **«Audio»** contains settings of audio modes. It can differ depend on connected devices. For example, this menu contains the following items (fig. 3.14). You can choose as video source one from many installing in PC video-devices or load external video file.
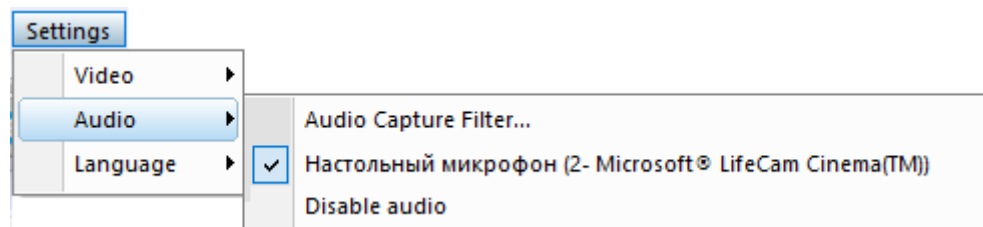
Fig. 3.14. Submenu «Audio»

Subitem **«Audio Capture Filter…»** - the window of audio device setting. This subitem exist only when you choose videosource. Each device has the especial window of settings.

Subitem **«Disable audio»** allows disconnecting all audiosource.

Menu between these subitems allows choosing used audio device capture from multiple installed on this computer.

3.2.4 Menu «Action»

Menu «**Action**» (fig. 3.15) contains the following items:
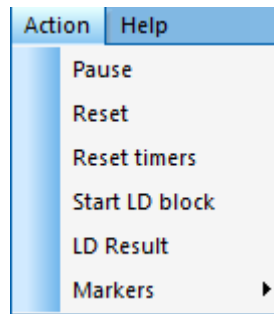
Fig. 3.15. Menu «Action»

Item **«Pause»** - stop last accepted frame of data in image area of windows.

Item **«Reset»** - reset all saved up information and statistics about frames and start new cycle collection of information.

Item **«Reset timers»** - reset to «0» all timers: video file timer, graph timer. The conclusion video and construction of graph begins all over again.

Item **«Start LD block»** (or corresponding toolbar button) begin calculation of parameters of a lie level in a «manual mode». It is necessary to press this button again to stop calculation in a manual mode. The moment of start calculation in a manual mode noted on graphs by a vertical green line, the moment of stop calculation - by red line).

Item **«LD Result»** – indication of PDD results as DI, NDI, INC.

The item «**Markers»** used at work with graphs and intended for draw on graphs the markers (0-9) and markers of questions (RQ, CQ, GQ).

3.3 Toolbar

VibraLie toolbar (fig. 3.16) contains following buttons:

Fig. 3.16. VibraLie toolbar.

All toolbar buttons (fig. 3.16) duplicated the corresponding items in the menu system. When the tool tip determines the assignment of toolbar buttons. **Note**, the selected toolbar button is highlighted in color or volume, depending on the main window style.

 –AVI files download for PDD analysis;

– live video camera connection;

– pause on image and program operations;

– choice of internal vibraimage mode (VI);

– choice of external vibraimage (vibra-aura) around internal video image mode (AV);

– choice of external vibraimage (vibra-aura) around real video image mode (AR);

– choice real video image mode (LD);

– reset timer of video files to «0» (Menu «Action»);

– reset all accumulated information about frame difference. Start accumulation again after reset (Menu «Action»);

– indication of PDD results as DI, NDI, INC (LD Result);

– «Start LD mode» to begin/stop data processing for a «Lie detector» mode;

– «Markers RQ, CQ, GQ» serve for installation markers on graphs at the time of «certain» type questions;

– open the folder where you saved the images and measurement's data.

3.4 Graphs

There are the following graphs (fig. 3.17) in VibraLie10:
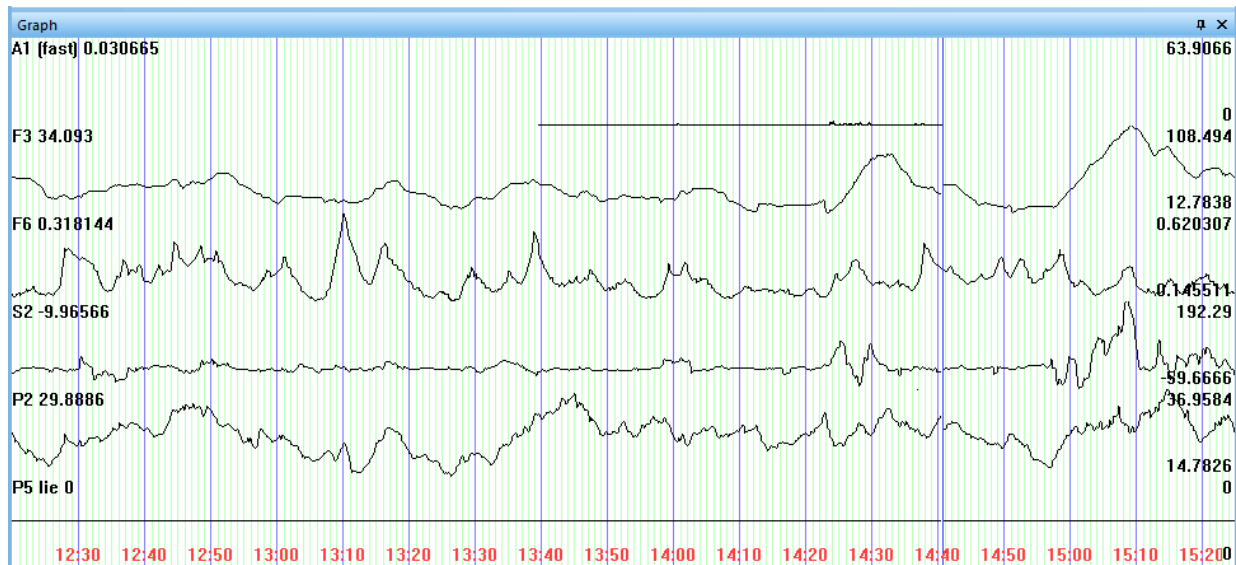
Fig. 3.17. VibraLie graphs.

Attention, at work in a LD mode it is recommended to supervise under graphs of change in time following psycho physiological parameters describing all types of impellent activity: A1 fast, F3, F6, S2, P2, P5 lie.

A1 (fast) – shows maximum fast reaction of person for question or situation, so it changes before any other VI parameters, but goes down also immediately as it changed. This parameters shows macro movement and sometimes used for deleting artifacts from the lie detection process.

F3 – shows general mental energy level of examinee, in default settings this parameter calculates for time period of 20 seconds, so it is slowly changing parameter reflects psycho physiological state. High level of this parameter indicates high level of exciting, aggression or activity so it could be correlated with lie.

F6 – shows inhibition of person and also correlated with respiratory tracing or breathing activity, because it is physiology linked with inhibition process.

S2 – shows asymmetrical of movements in middle time (2 sec) period, so it includes left/right hemisphere activity components and it high changes usually indicates lie.

P2 – shows Mean-Square-Deviation (MSD) of frequency histogram and low meaning of this parameter usually indicates normal state, so high meaning of this parameter could be correlated with lie.

P5 lie – indicates Lie level auto calculated for selected parameters, in Default settings for Lie indication need to have significant changes at least in 8 vibraimage parameters, typically in Lie detection system registers significant changes in 12 or more parameters, given in Lie Report.

When working with graphics, special attention should be paid to signal changes in the graph of parameter P5 (lie), which define the most «suspicious» moments in human behavior. Each

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question and answer (preferably separated by a time interval of not less than 10 seconds) is characterized by a level change psychophysiological parameters tested person. This level is characterized by two integral indicators - the level P5 and parameter P20 in the window «LDr» (see p. 3.5), which provides a quantitative assessment of human responses to the question. The higher this parameter, the more likely lies in the response.

For each parameters set following numerical values, which using in Lie detector calculation:

Calculate   Yes - this parameter using in LD level calculation, No - not using.

R1V   «Weight» of parameter (Rate1) if its current value became more than the set base maximum bMax **OR** became less than the set base minimum bMin. Use in P5 parameter calculation.

R2V   «Weight» of parameter (Rate2) if its current value became more than the set base maximum bMax **AND** became less than the set base minimum bMin. Use in P5 parameter calculation.

R1C   «Weight» of parameter (Rate1) if its current value became more than the set base maximum bMax **OR** became less than the set base minimum bMin. Use in P20 parameter calculation.

R2C   «Weight» of parameter (Rate2) if its current value became more than the set base maximum bMax **AND** became less than the set base minimum bMin. Use in P20 parameter calculation.

Level   In % determines on how many value of parameter should exceed the set limits that the system «considered» this change.

The following are examples which illustrate the principle of collecting information. Fig 3.18 has no difference in the «threshold» values of S2 in intervals «Stat period» and «Base period. Fig 3.19 during the interval of definition lies (Stat period) value S2 has exceeded the maximum threshold.
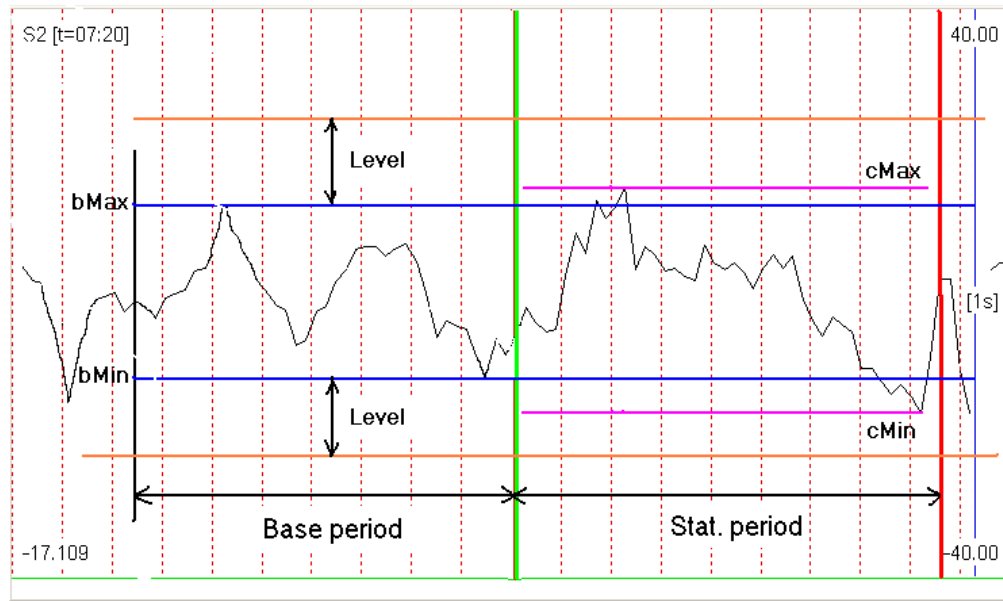
for parameter S2 Rate=0

Fig. 3.18. S2 parameter value is within the limit.
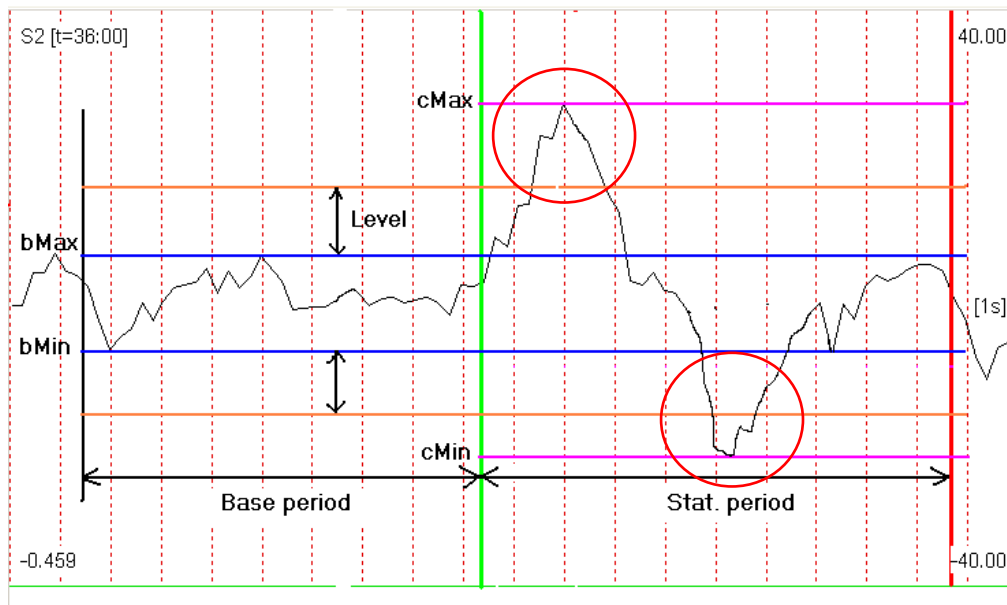
for parameter S2 Rate2=2

Fig. 3.19. One of the parameters was significantly higher than both the established limit.

3.5 LDr and LD questions windows

Parameter **P20** in VibraLie10 – quantity indicator of a degree of change psychophysiological parameters in view of various factors of the importance of measured parameters since the part of

parameters is accelerated, and others are slowed down during one reaction. Parameter P20 is defined at the moment of P5 maximum and display in **«LDr»** window (fig. 3.20).

<table>
<tr><td align="center">*a)*</td><td align="center">*b)*</td></tr>
</table>
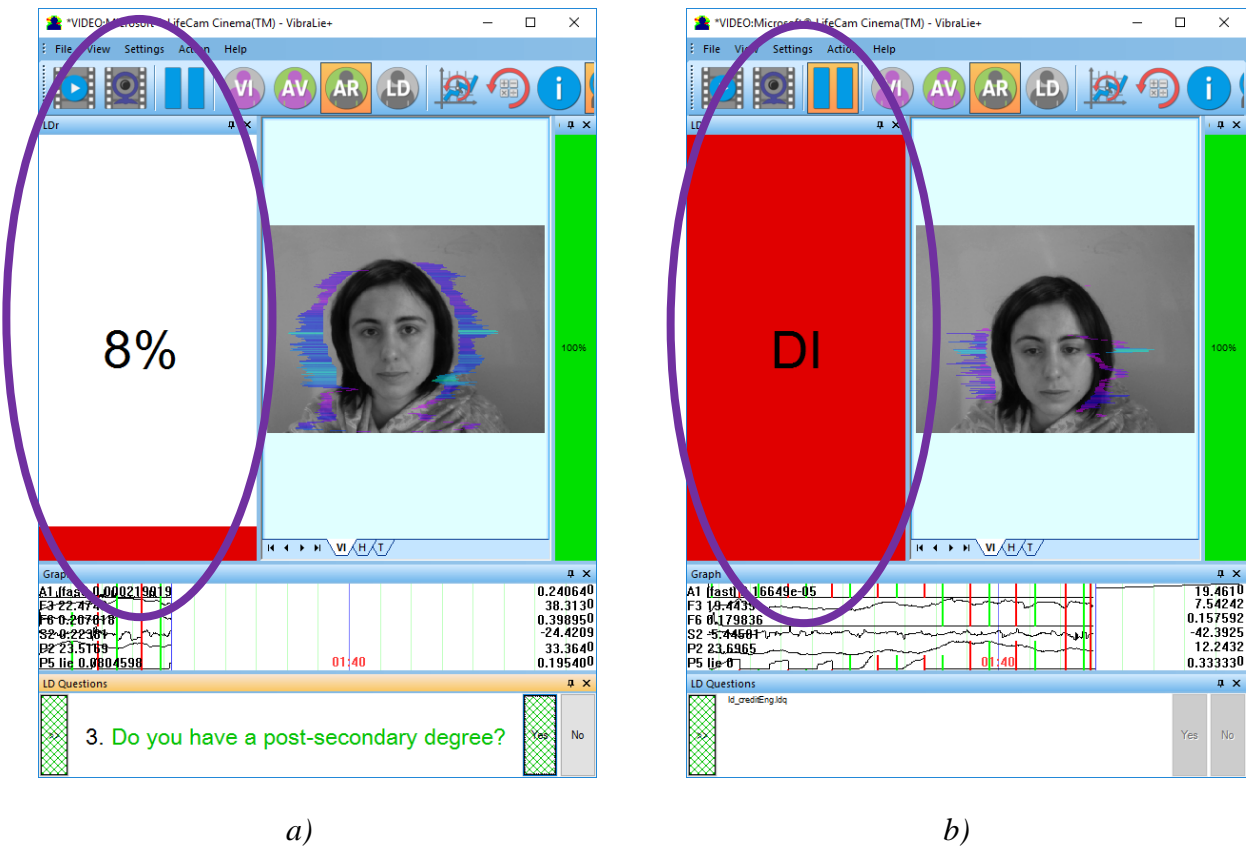
Fig. 3.20. «LDr» window. a) during the test b) after the test.

LD questions window is intended for operating with questionnaire in VibraLie10. Pressing the [>>] button in the window allows you to start working with the questionnaire. Double-click returns to the beginning of the work as a questionnaire and video. Buttons [Yes] and [No] allows answering on questions without voice, for example, during the self-test. On fig. 3.21 questionnaires process in LD mode is displayed.
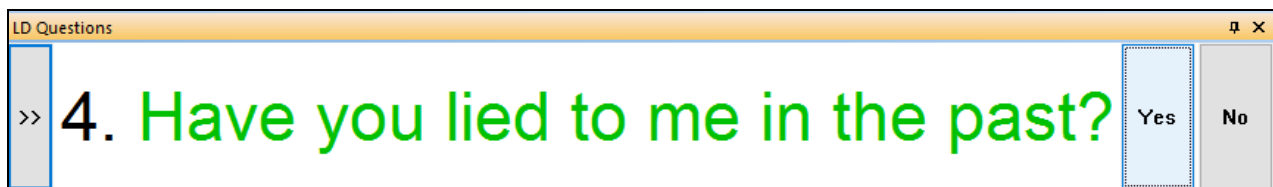
Fig. 3.21. Questionnaires process

4 VibraLie. Lie detection

4.1 Basis of psychophysiological testing by vibraimage technology

VibraLie program of psychophysiological person testing (PPT) on the vibraimage technology based on conversion in real time standard video of the object to the video formed by the accumulated frame difference. This approach gives information only about moving objects and it allows amplifying the signals of objects performing vibration. If a person is in quasi-stationary state his head continuously makes micromovements (vibration) so parameters of these micromovements depend on a psycho-emotional and psychophysiological status (PPS) of the person. This phenomenon has been called vestibular-emotional reflex as physiological mechanisms of the human head micromovements are regulated by the vestibular system and depends on an emotional state of a person.

Practical testing vibraimage system showed that real time control of three main errors 1, 2, 3 (item 2.4.5) is necessary and sufficient to ensure the required reliability of the PPT results.

The main advantage of vibraimage technology is possibility to receive multi-dimensional physiological dependences in addition to the temporal dependences of physiological parameters. Analysis of temporal and spatial micromovement's parameters of the head has its own templates for any modifications of emotions and psycho-physiological state. The physical approach to the person as a complex cybernetic system can be shown by displaying any change of the human PPS in the simplest Cartesian or rectangular system of coordinates. The horizontal axis shows the value of the energy consumption of a person during testing time, and it is usually measured in kcal / min. The vertical axis is the level of psychological comfort or mood, which can be reflected as a component of the information perfection of an investigated person. Understanding of information in Cybernetics, introduced in the works of Norbert Wiener, Claude Shannon and Nikolai Bernstein, bases on the General regularities of management processes and information transmission in machines, live organisms and society, and is used very little at the PPS estimation. While the energy and information are the basic and defining concepts of modern science, therefore, it is necessary to characterize PPS of the person as a complex cybernetic system exactly by these quantities. From the viewpoint of a person consumption energy measuring everything is quite simple and clear, as there are many other methods for measuring energy consumption for checking vibraimage technology. But the problem of determination of person information comfort isn't simple at all. At the same time each adult, at the level of a self-esteem, can easy say, how good he feels at the moment and how happy at present he is. It is the simplest to show a self- esteem of comfort of the PPS (or information perfection) as a percentage therefore we will choose percent or relative units for measurement of information comfort of a person's state. Level 100 % or 1 indicates a state of happiness or Nirvana, and level 0 will correspond to the death of a person (i.e. stop the exchange of information between person's physiological systems).

4.2 Psychophysiological (subconscious) response

Actual PPS is displayed in the form of a point and change of person's PPS in time is displayed in the form of a straight line or a curve between two points. The example of PPS change from a state 0 to the various states 1, 2, 3, 4, 5 is given in figure 4.1.
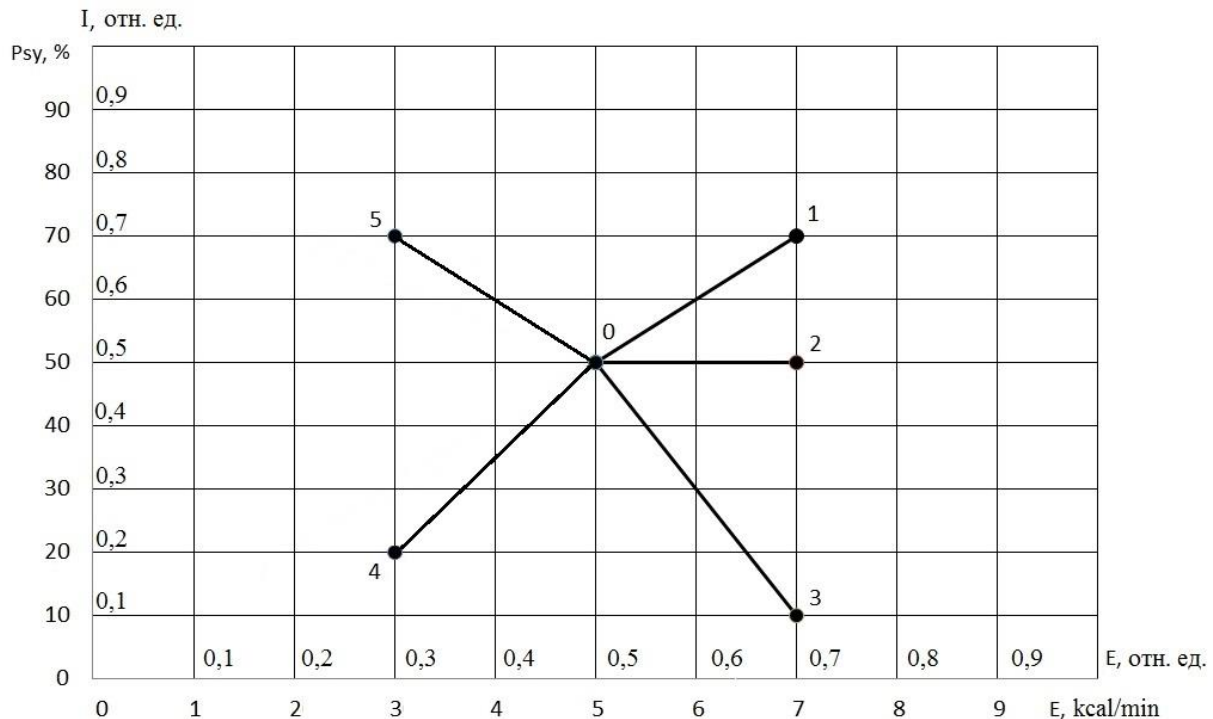
Fig. 4.1. Information-energy diagram of the PPS.

As shown in fig. 4.1 on the information-energy diagram changing from initial PPS (point 0) to the other states are characterizing by the equal changes of consumed energy and different states of psychological comfort.

Transition 0-1 characterized by an increase in energy consumption and improvement of psychological state. The reason of this PPS change can be a good or pleasant news (the stimulus), it leads to a more intensive exchange processes (increase in energy consumption), and the psychological condition and mood notably improved (entropy of metabolic processes decreased, and the information content of the exchange increased).

Transition 0-2 characterized by an increase in energy consumption and an even level of psychological state. The reason can be, for example, an increase in mental and physical activity, which lead to more intensive exchange processes (increase in energy consumption), at the same time, the psychological state and mood are unchanged, as conducted by the impact did not cause emotional changes.

Transition 0-3 characterized by an increase in energy consumption and impairment of psychological state. The reason can be unpleasant information that leads to a more intensive exchange processes (increase in energy consumption), and the psychological condition and mood

became notably worse (entropy of metabolic processes became worse, and the information content of the exchange decreased).

Transition 0-4 characterized by a decrease in energy consumption and impairment of psychological state. The reason can be unpleasant information that leads to a slowing of metabolic processes (reducing energy consumption), and the psychological condition and mood became notably worse (entropy of metabolic processes became worse, and the information content of the exchange decreased).

Transition 0-5 characterized by a decrease in energy consumption and improvement of psychological state. The reason can be pleasant news, which soothes and slows down the metabolic processes (reducing energy consumption), and the psychological condition and mood are notably improved (entropy of metabolic processes decreased, and the information content of the exchange increased).

In all these examples, the change of energy consumed by a person from the state 0 to the other PPS was 2 kcal/min, at the same time each transition has its emotional and psycho-physiological sense, however, to determine the meaning of the time dependence of the physiological parameters (EDR, heart rate, EEG, etc.) is physically impossible. It does a classic polygraph by the art depending on the operator conducting research, but not reproducing by the scientific researches.

Vibraimage technology allows to obtain multi-dimensional relationship of PPS characteristics and to measure not only the energy change but also the direction of this change. Of course, real change of the consumed energy on presentation of stimuli far always straightforward, as energy consumption and psycho-emotional comfort are features on many factors. However, result of the PPS shift after stimulus presentation on psycho-energetic diagram is easy to calculate, for example, by using the proposed algorithm program VibraLie.

The psychophysiological reactions of a person answering to the control and relevant questions are comparing. During question answering, a person PPS, displayed on the diagram changes from the point with coordinates (E1, I1) to a point with coordinates (E2, I2).

ER = E1 – E2

IR = I2 – I1

Below we consider the situation where the respondent did not like a question, he's going to say a lie on it.

Energy state in such case increases, i.e. $ER < 0$, the psychological comfort is reduced, and $IR > 0$.

Comparison of the sum of these indicators for answers to relevant and control questions allows defining truthfulness of the answer or information-energy expenses of a response to the shown answers or stimulus.

R = IR + ER

If a difference $Rr – Rc = dR < 0$, that means a person has told a lie (DI) or reacted negatively to the shown stimulus.

Hereinafter the lower indexes «r» designate value of measurement for relevant questions, and «c» – for control questions.

The example of this calculation for comparison of 3 groups of control and relevant questions is given in the table 4.1:

Table 4.1

				IE result
Qc1:	E1 = 0.465	E2 = 0.449	ERc = 0.016	
	I1 = 0.603	I2 = 0.583	IRc = -0.020	
Qr1:	E1 = 0.447	E2 = 0.337	ERr = 0.110	
	I1 = 0.578	I2 = 0.638	IRr = 0.061	
	Rc = -0.003	Rr = 0.171	dR = 0.174	NDI
Qc2:	E1 = 0.360	E2 = 0.389	ERc = -0.029	
	I1 = 0.565	I2 = 0.545	IRc = -0.020	
Qr2:	E1 = 0.389	E2 = 0.377	ERr = 0.012	
	I1 = 0.543	I2 = 0.549	IRr = 0.006	
	Rc = -0.049	Rr = 0.017	dR = 0.066	NDI
Qc3:	E1 = 0.422	E2 = 0.422	ERc = -0.001	
	I1 = 0.623	I2 = 0.594	IRc = -0.029	
Qr3:	E1 = 0.419	E2 = 0.386	ERr = 0.033	
	I1 = 0.595	I2 = 0.620	IRr = 0.025	
	Rc = -0.030	Rr = 0.059	dR = 0.088	NDI
IE result:	sRc = -0.082	sRr = 0.247		NDI

An example of information-energy state changing diagram for the data in Table 4.1 is shown in figure 4.2.
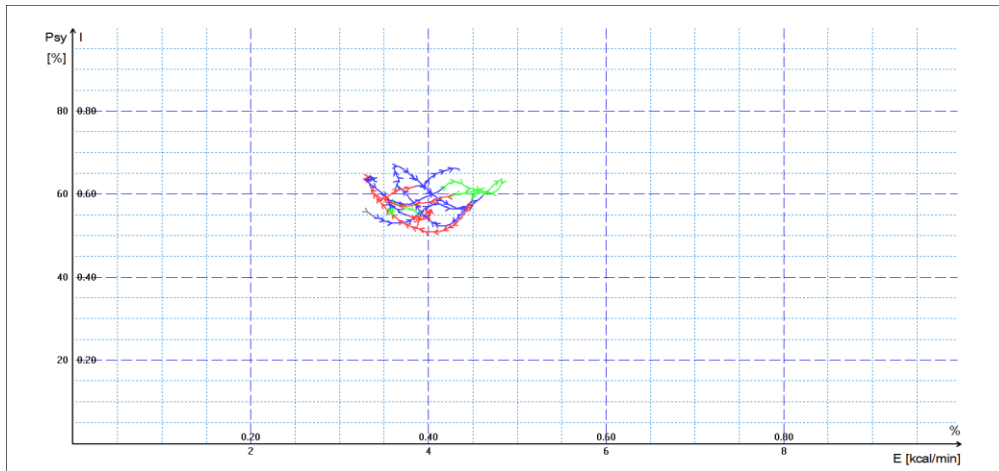
Fig. 4.2. Information-energy diagram of the PPS changing during the test of the loyalty to terrorism.

Changing of PPS at the answer to general questions (GQ) is shown by blue color, reaction at the answer to control questions (CQ) is shown by green color, and change of PPS at the answer to relevant questions (RQ) is shown by red color.

VibraLie program intents for psychophysiological detection of deception of verbal and non-verbal lie in auto, auto-manual and manual modes. Program fixes and compares psychophysiological characteristics of person captured in different period for standard examination methods. Nowadays existing technical means of lie detection registers changes in different psychophysiological parameters of humans. Current opinion that significant changes in psychophysiological parameters happens when person is nervous, worry and lie. When person is

still and calm his psychophysiological parameters are more stable in time, so if we compare known still time period with examinees question period, we determine is it lie or true. Different examination methods (Comparative Questions test (CQT), Guilty Knowledge Test (GKT), Concealed Information Test (CIT)) are constantly developed and improved, it is possible to read a lot of literature about it, for example (http://en.wikipedia.org/wiki/Polygraph). The modern technical lie detection is mostly based on Integrated Zone Comparison Technique (IZCT) was firstly suggested by Cleve Backster (http://en.wikipedia.org/wiki/Cleve_Backster). The comparison test principals are easy for everybody understanding and requests only comparing of responses to control and relevant questions, controlled by psychophysiological detector like VibraLie system.

PPT with VibraLie is possible not only in the classic version, similar to the standard contact polygraph, when an expert is testing on the computer and the subject is under the control of the television camera and he is located near or in front of an expert (interview, lie detection). In the program is realized the possibility of self-testing when the user is in front of the computer with the started vibraimage program, and the TV camera is located opposite to the user and controls his actions for work with the program (passing of psychological tests, interview online, control of PPS before a shift).

4.3 Backster's test

The basis of lie detection is a technical comparison of the principle of psychophysiological reactions responses zones (introduced Cleve Backster), it is quite easy to understand and allows each person to accurately determine the truth and lie even with minimal experience in working with VibraImage system.

Principals of comparative testing and averaging for responses of question-answer zones, coined in the 60th years of XX century by Cleve Backster (http://www.backster.net/images/accuracy.pdf), gave requested high accuracy for psychophysiological detection of deception and have done lie detector the reliable instrument in expert hands. The comparative zones are based on the fixed structure of question-answer testing, including general, comparative and relevant questions in one test. So fixed test structure allows combine analyzing of response to several similar questions, so it is possible to calculate average response to several control questions and separately calculates average response to several relevant questions. This testing structure gives more accuracy for any measurement, so it is acceptable also for lie detection, too. Standard lie detection test structure includes 9-14 questions, one of these questions relevant (most important) is presented by several times (during one test), because was proved that during one test is correct to present the only one relevant question. Several relevant questions in one test give more errors, because examinee could concentrate only on one question during the test.

Let's consider the test structure on the simple actual test sample: You are interesting where your partner was at night, when he tells that was working in office. In this case the question «Really, were you in the office last night?» is relevant question and the main important question of this test. All test must include several questions for replying one meaning answers as Yes or No, like the suggested sample:

1. Did you have breakfast yesterday, as usual?
2. Was the cold weather on the morning street?
3. Did you tell lie to your friends?
4. Did you work in office this night?
5. Let's go to cinema this weekend?
6. Did you ever tell lie to me or my family?
7. Really you were in office this night?
8. Did you take your purse from home at this morning?
9. Did you steal something before?
10. Is it true, that you were working this night?

General (blue) questions (GQ) have diverted meaning and have not influence to calculation result, but they are necessary for reducing concentration attention of examinee on the relevant questions. Response to the control (green) question (CQ) is very important to the test calculation, control question usually asked about past criminals, which are happened in everybody life. The verbal answer on control question is not so important (Yes or No), more important is psychophysiological response corresponding to this reply. If quantitative average response to control questions is more than analogical quantitative average response to the relevant (red) questions (RQ) that means person tells true. If quantitative average response to relevant questions (RQ) is more than analogical quantitative average response to the control questions (CQ), that means person tells lie.

Others principals of psychophysiological detection of deception are described in FEDERAL PSYCHOPHYSIOLOGICAL DETECTION OF DECEPTION EXAMINER HANDBOOK

4.4 Existing questionnaire

Program VibraLie has a special type series of thematic questionnaires intended for human PPT, such as passing an interview before obtaining a credit.

You can select an existing questionnaire suitable for you ("Loyalty", "Alcohol", "Credit", "Bribe", "Family" and others.) or create your own (file with the extension <ldq>).

The aim of the survey **«Loyalty»** is the definition of human loyalty basic principles of security of modern society, and combating terrorism. The questionnaire includes graphics (incentives) that increase psychophysiological effect on the test.

The aim of the survey **«Credit»** when issuing a credit is the lack of definition lies in the intention of the applicant for the loan and detection of fraud in obtaining credit.

The aim of the survey **«Bribe»** is to determine the reliability of the test person answers that he did not take bribes at the current position.

The survey **«Family»** is to detect lies with whether or not he had the answer to the question of the subject the previous evening, at work, or located elsewhere.

Questionnaire **«Insider»** is intended to test, to hire personnel, the possibility of selling company secrets to competitors.

The questionnaire **R_Test** allows rank (to determine the significance of) the test psychophysiological response to questions.

Questionnaire **«Alco»** is intended to identify those who are likely to use alcohol.

The questionnaire **«Computer»** is designed to identify individuals who are prone to compulsive gambling.

Questionnaire **«Violences»** is intended to identify individuals who are prone to violence in the family.

4.5 Questionnaires structure

According to the upgraded Bakster's test of control questions questionnaire including three blocks of control and relevant (test) questions (impact on the person can be strengthened by the graphic information shown on the screen, the image of the pictures corresponding to a question) is shown to the examinee person, general questions at the beginning and in intervals between which are located. An example of such questionnaire indicating the time delay between the questions and the type of questions used program is given below:

1. <GQ delay="10" length="7" text_delay="2" text_length="0" img="images/1.JPG"> Is your age over 20 years old?</GQ>
2. <GQ delay="5" length="7" text_delay="2" text_length="0" img="images/2.JPG"> Are you married or single?</GQ>
3. <GQ delay="5" length="7" text_delay="2" text_length="0" img="images/3.JPG"> Are you ready to answer truly the questions?</GQ>
4. <CQ delay="5" length="7" text_delay="2" text_length="0" img="images/4.JPG"> Earlier have you been condemned for violations of the law?</CQ>
5. <RQ delay="5" length="7" text_delay="2" text_length="0" img="images/alco/5.JPG"> Do you justify terrorist acts?</RQ>
6. <GQ delay="5" length="7" text_delay="2" text_length="0" img="images/6.JPG">Have you a hobby?</GQ>
7. <CQ delay="5" length="7" text_delay="2" text_length="0" img="images/7.JPG"> Do you consider yourself an honest and calm person?</CQ>
8. <RQ delay="5" length="7" text_delay="2" text_length="0" img="images/8.JPG"> Are you ready to commit a terrorist act?</RQ>
9. <GQ delay="5" length="7" text_delay="2" text_length="0" img="images/9.JPG"> Are you a believer?</GQ>
10. <CQ delay="5" length="7" text_delay="2" text_length="0" img="images/alco/10.JPG"> Are you ready to do anything for money or people close to you?</CQ>
11. <RQ delay="5" length="7" text_delay="2" text_length="0" img="images/alco/11.JPG"> Are you ready to support a terrorist, if he is your friend?</RQ>
12. <GQ delay="5" length="1" text_delay="2" text_length="0" img="images/alco/12.JPG"> Thank you for your cooperation</GQ>

To reduce the uncertainty of comparative testing must have approximately the same time interval upon presentation of the control and relevant questions, so the length of questions and pauses when the synchronous presentation of a variety information needs to be given increased attention. Tag **«delay»** sets the interval in seconds between questions. Tag **«lenght»** - the time interval of the show text of the question. Tag **«text_delay»** delay before the question text painted. Tag **«text_lenght»** determines the speed of text painting green, if value «0» the text is painted with

a constant speed depending on the number of letters in question, at other text is painted for a specified time.

Note the **«Img»** tag in the structure of the questionnaire is optional. But properly selected image (incentives) that the respondent sees on the screen increase its psycho-emotional response to this question (fig. 4.3).
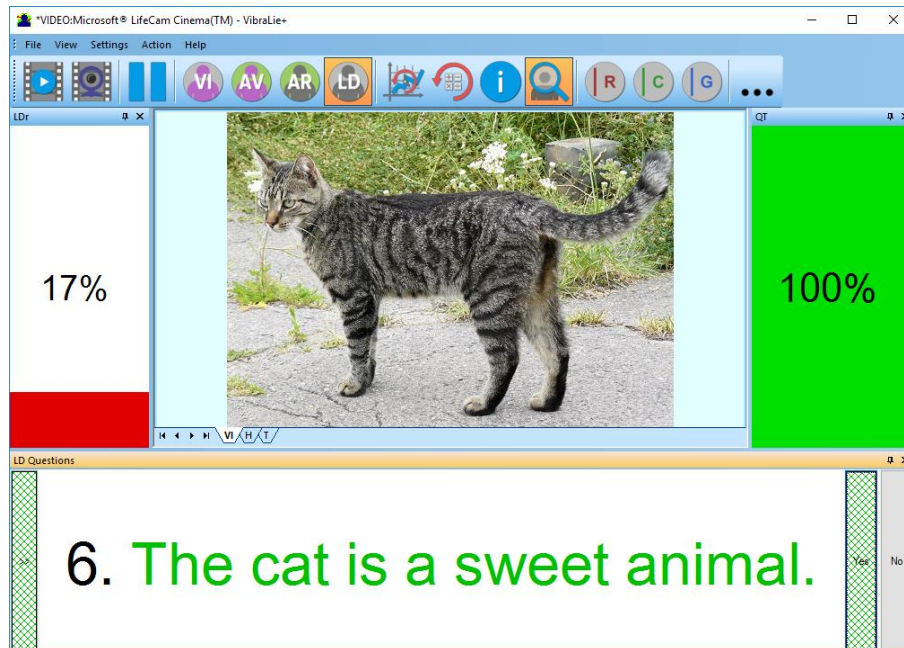
Fig. 4.3. Display questions in karaoke mode.

4.6 Creating new questionnaires

Change the text of the questionnaire

User can be similar questionnaires on topics of interest to him and put them into the program's installation folder in the same file format ld_xxxxxx.ldq by selecting «**LD edit text...** » in the main menu.

Adding images

To improve the efficiency of the questionnaire and increase the reaction of the test, you can add an image corresponding to the question subject by adding images from your computer to a folder /ELSYS/VibraLie10/images/«name of questionnaire» (image name – number of question, for example, for first question name of image – 01).

4.7 Operating with questionnaires

For start a questionnaire test you need;

1 Choose a questionnaire file by selecting «**LD load text…**» (fig. 4.4).
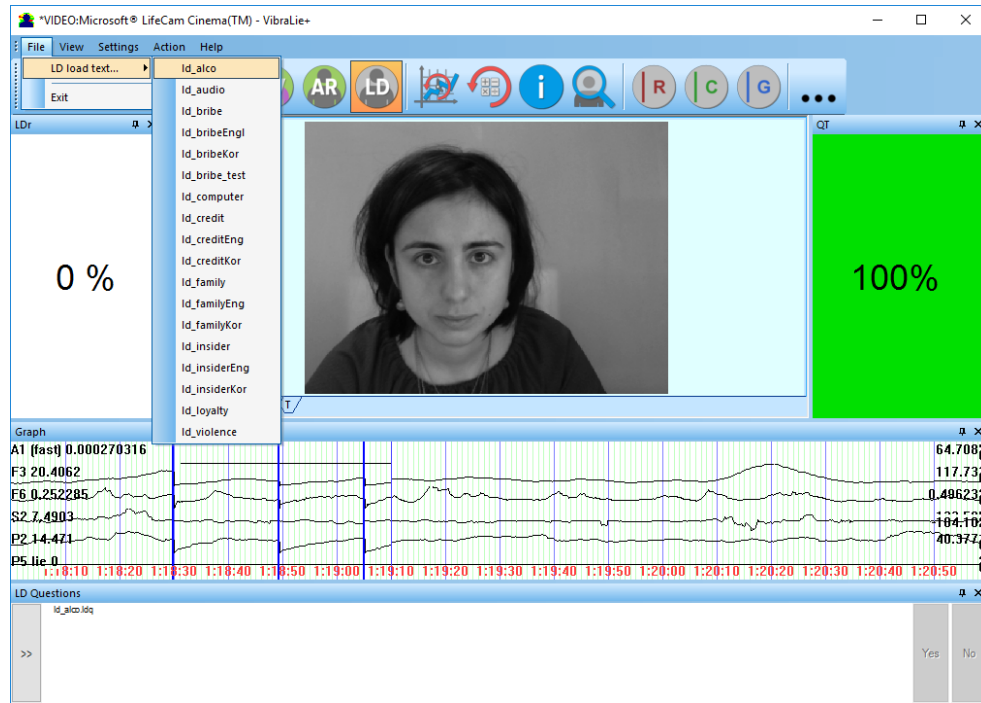
Fig. 4.4. Selecting the questionnaire

2 Wait the program run the questionnaire after choice it in the main menu.

3 Read and ask questions to interviewing person

After the choice of the file, for example, **«Credit»,** the program passes into the mode of reading and visualization of a questionnaire. The person conducting survey reads the questions displayed in the karaoke mode (fig. 4.4). Interviewed person responds to questions clearly, only «**Yes**» or «**No**».

Note This brief vibraimage parameters interpretation correspond default vibraimage system settings and based on main rules for right vibraimage scanning:

- uniform and stable object illumination;
- high quality and low nose camera application;
- frontal plane object before camera;
- maximum facial image size on monitor;
- mechanical stabilization of camera.

4 Analyse results according section 5.

5 Saving and analyzing results

5.1 LD results on the screen

Upon completion of the survey, the system will automatically go into «Pause» mode to enable the user to analyze the results on the screen (see fig. 5.1). In the lies level window «LDr» will display the final test result. For example, DI- the final test result is found «Lie» and the graphs at the answer to questions 9 and 10 recorded high value P5 parameter (lie).

In «Lie level» window (LDr) on test results may be display 3 variants:

- True (green column - NDI), then the test person has successfully passed the test.
- False (red column - DI), it means that the test person has not passed the test.
- Uncertainty (yellow column - INC), the test result is not clear; the test should be repeated or modified.
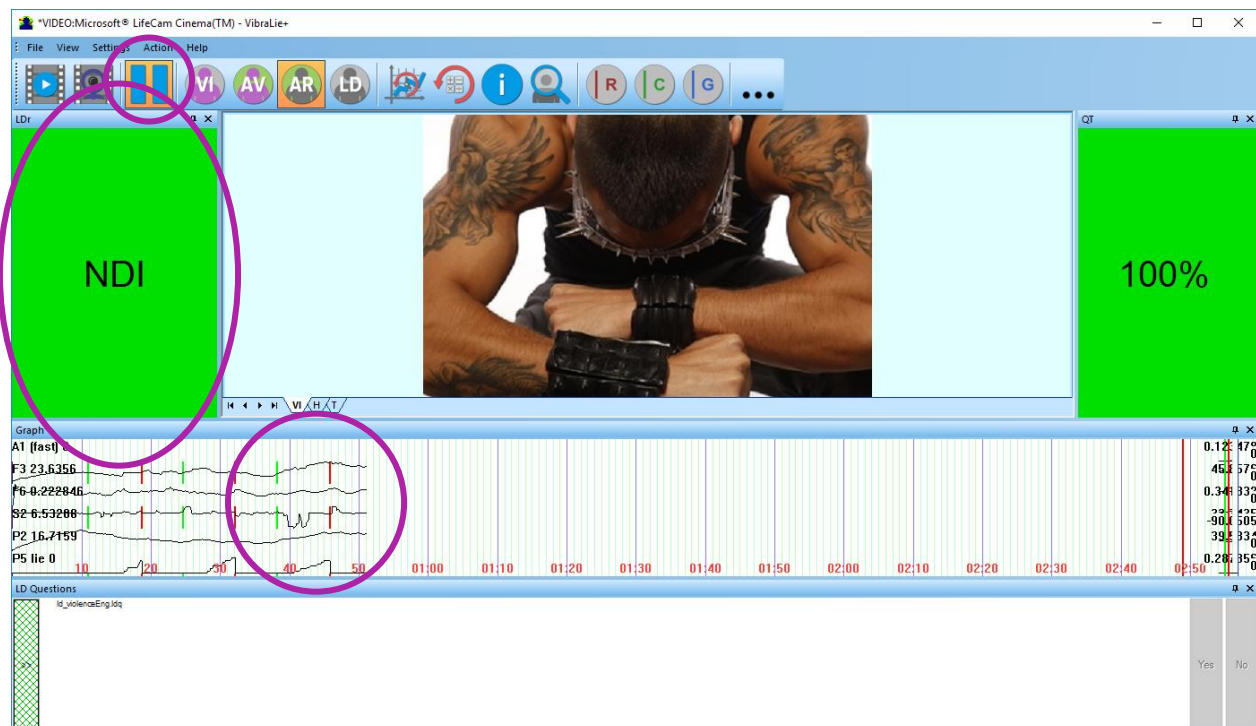
Fig. 5.1. LD test results

User can see histograms on tab VI H T on the main window.

Each histogram is characterized by the following parameters:

- M – the center of weights of frequency distribution (average value of microvibrations frequency);
- S – root-mean-square deviation of frequency distribution;
- D – a dispersion of frequency distribution.

User can see I-E state graph on tabs VI H T on the main window.
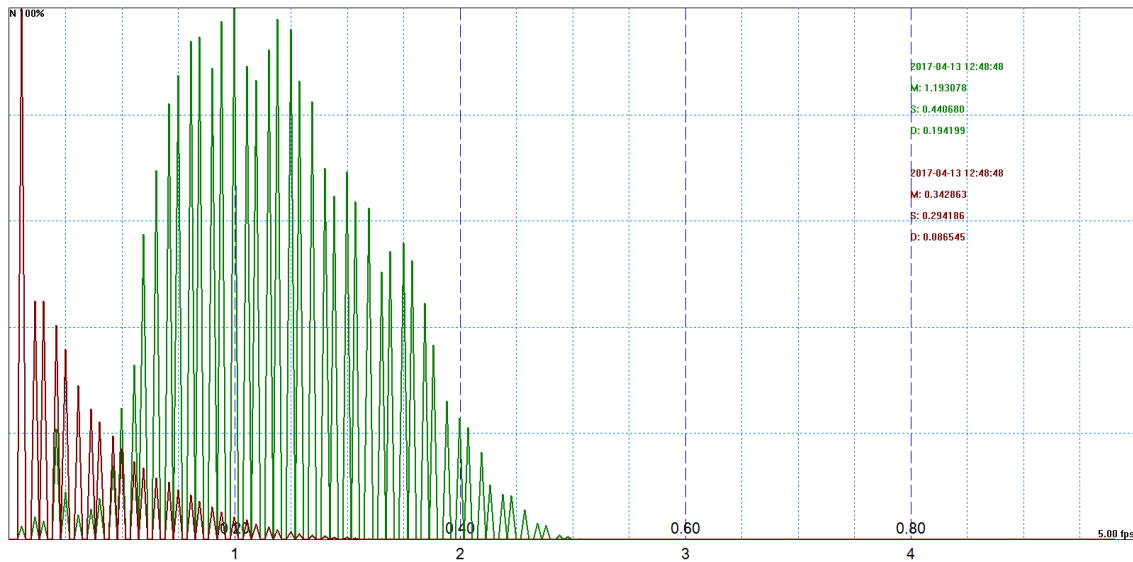
Fig. 5.2. The histogram of vibraimage frequency distribution

5.2 Files with LD results

After end of the test program VibraLie automatically also creates files with the test results in the directory «C:\Users\user\Documents\LD Result» (**ONLY WHEN OPERATING IN «QUESTIONNAIRE» MODE**).

The result of testing recorded in the form of files of the following types:

YYY-MM-DD hh_mm_ss_LD.txt	lie detector report and result file
YYY-MM-DD hh_mm_ss_row.txt	full record values recorded vibraimage system parameters. This file can be used for statistical research and testing of algorithms for determining the psychophysical and psychoemotional human condition.
YYY-MM-DD hh_mm_ss_LD_e.txt	an additional file with the results of ranking the importance of questions for the test.
YYY-MM-DD hh_mm_ss_histH.png	graphic file with the histogram of frequency distribution (fig. 5.2)
YYY-MM-DD hh_mm_ss_histT.png	graphic file with graphs of I-E state of a person changes over the period (p. 4.2)
YYY-MM-DD hh_mm_ss_histH.xml	data file with the histogram of frequency distribution. XML format

In all files in names **YYYY-MM-DD** and **hh_mm_ss** date and time of measurement.

5.3 Main test results

The main results of change of psychophysiological state when carrying out psychophysiological testing saved in the text file which structure is given on figures 5.3, 5.4 (structure of file **YYY-MM-DD hh_mm_ss_LD.txt**).

```
######    1        RQ        02.02.2016 10:48:53  video: 91.7935
Have you been delayed at work today?
##########################################################
Start time            02.02.2016 10:48:53
Video timer (start)   01:32
Stop time             02.02.2016 10:49:03
Video timer (stop)    01:42
LD time               02.02.2016 10:49:00
LD video timer        01:38
##########################################################
```

Name	cMin	bMin	cMax	bMax	vRates	cRates
A1X	0,000150238	7,55247e-005	0,0771637	0,0282315	**1**	**-2**
A1	0,00409047	0,000426037	0,549241	0,066692	**1**	**-1**
A2	20,1334	10,0224	86,2681	19,5487	1	-1
A3						
A4X	0,000251693	0,000198452	0,0242119	0,00419498	**1**	**-1**
A4	0,0278119	0,00656809	0,253695	0,0292217	**1**	**1**
F1X	3,61082e-005	1,96954e-005	0,00541951	0,00272781	**1**	**1**
F1D	-0,00291492	-0,00152639	0,00382747	0,0026162	**2**	**2**
F1	0,00142904	0,000123698	0,048903	0,0132878	**1**	**-1**
F2	54,607	40,606	78,4315	55,9861	**1**	**1**
F3						
F4	102,544	94,83	151,742	124,894	**1**	**-1**
F5X	0,16845	0,321748	0,399377	0,484708	**1**	**1**
F5						
F6	0,150574	0,124949	0,199305	0,152812	**1**	**-1**
F7	0,0596623	0,031001	0,114005	0,0664505	**1**	**1**
F8	0,0384835	0,0491532	0,386444	0,268609	**2**	**2**
F9						
S1	-131,267	-83,3541	139,172	86,3353	**2**	**1**
S2	-18,3586	-9,66255	1,47161	7,26032	**1**	**-1**
S3	-0,916659	-0,710579	0,775945	-0,212643	**2**	**2**
S4						
S5						
S6	-0,131085	-0,119924	0,0736296	-0,0764681	**1**	**1**
S7	-25,2939	-26,4201	-10,6387	-14,2742	**1**	**0**
P1						
P2	23,6709	25,6102	26,8731	26,7899	2	-1
P3	0,266011	0,207058	1,40152	0,509807	**1**	**1**
P4						

```
LD       4
##########################################################
Audio
 Level     31,1
 Threshold 5,0
 Delay (s) 0,00
##########################################################
R(m)    4
R(a)    46.4286
tR(i)   357.615
######    1        RQ        02.02.2016 10:49:03  END
```

Fig. 5.3. Example of the beginning of the text file with the first relevant question (RQ).

Information about the test questions at the start of the common text file is shown. The text of the question, its serial number, the type of the question (GQ general, CQ control, RQ relevant), and the time when, during the question was the maximum value of the parameter P5 (**LD Time**).

Also for each question are given values of the parameters that have exceeded the established bMin and bMax limits, and the «weight parameters» in the calculation of the lie level - vRates (for P5 calculation) and cRates (for P20 calculation).

Than shows the sym **ΣcRates** for all parameters, which values are deviated from norm, for example, LD = -2 – 1 – 1 – 1 + 1 + 1 + 2 – 1 + 1 – 1 + 1 – 1 + 1 + 2 + 1 – 1 + 2 + 1 + 0 – 1 + 1 = 4

At the end of the field shows the resulting measurement valuesfor each answer, calculated in three ways :

- **R(m) 4**   (max result) – results from the analysis of the parameter P20;
- **R(a) 46.4286**   (average result) – results from the analysis of the parameter P5;
- **tR(i) 357.615**   (integrated result) – results based on the analysis of the area under the graph of the parameter P5.

At the end of the common text file shows the results of all measurements (fig. 5.4).

The decision is considered the sum of «weights» on relevant RQ question and CQ control question. If **Σ (RQ) > Σ (CQ),** a person tells a lie (DI).

Max result – assessment of psycho-physiological reactions to stimuli is carried out taking into account the various factors of vibraimage parameters significance (RateC).

Comparative information on psychophysiological reaction of the test (similar to the classical polygraph) in answering the relevant (Rr) and control (Rc) questions, that includes an evaluation of the reaction of the test at the maximum level (max result) of vibraimage parameters:

- Rc > Rr; NDI (test is passed positively if total psychophysiological reaction at the answer to control questions is higher, than at the answer to relevant questions);
- Rc = Rr; INC (the test result isn't defined if total psychophysiological reaction at the answer to control questions is approximately equal to reaction at the answer to relevant questions);
- Rc < Rr; DI (test is passed negatively if total psychophysiological reaction at the answer to control questions is lower, than at the answer to relevant questions).

Average result – average assessment of psycho-physiological reactions to stimuli is carried out taking into account the equal factors of vibraimage parameters significance (RateV).

Comparative information on psycho-physiological reaction of the test (similar to the classical polygraph) in answering the relevant (Rc) and control (Rr) questions, that includes an evaluation of the reaction of the test at the average level (average result) of vibraimage parameters (calculation is similar to a method 1).

###################### **max result**
RQ(m)   7,00   3
RQ(m) stat: 4,00   0,00   3,00

CQ(m)   7,00   3
CQ(m) stat: 5,00   1,00   1,00

LD(M)   INC

###################### **average result**
RQ(a)   39,29   3
RQ(a) stat: 46,43   28,57   42,86

CQ(a)   34,52   3
CQ(a) stat: 33,93   32,14   37,50

LD(a)   DI

###################### **integrated result**
RQ(i)   275,93   3
RQ(i) stat: 357,62   190,76   279,41

CQ(i)   211,47   3
CQ(i) stat: 214,99   189,43   229,97

LD(i)   DI

###################### **dT result**
Q1:   Tc=3.967 Tr=5.666 DI
Q2:   Tc=6.067 Tr=5.233 NDI
Q3:   Tc=1.534 Tr=1.900 DI

dT result: sTc=11.568   sTr=12.799   INC

###################### **IE result**

Qc1:   E1=0.298   E2=0.263   ERc=0.035
           I1=0.527   I2=0.553   IRc=0.026
Qr1:   E1=0.262   E2=0.278   ERr=-0.016
           I1=0.554   I2=0.615   IRr=0.061

           Rc=0.062   Rr=0.045   dR=-0.017   DI

Qc2:   E1=0.300   E2=0.260   ERc=0.040
           I1=0.557   I2=0.586   IRc=0.028
Qr2:   E1=0.260   E2=0.256   ERr=0.003
           I1=0.589   I2=0.587   IRr=-0.001

           Rc=0.068   Rr=0.002   dR=-0.066   DI

Qc3:   E1=0.217   E2=0.234   ERc=-0.017
           I1=0.530   I2=0.522   IRc=-0.007
Qr3:   E1=0.236   E2=0.292   ERr=-0.056
           I1=0.527   I2=0.636   IRr=0.109

           Rc=-0.024   Rr=0.053   dR=0.076   NDI

IE result: sRc=-0.063   sRr=-0.181   DI

IE final: sRc'=-0.063   sRr'=-0.181   DI=0   NDI=0

###################### **global result**
LD result INC

Fig. 5.4. Example of LD results file.

Integrated result – integral assessment of psycho-physiological reactions to stimuli is carried out taking into account the equal factors of vibraimage parameters significance (RateV).

Comparative information on psycho-physiological reaction of the test (similar to the classical polygraph) in answering the relevant (Rc) and control (Rr) questions, that includes an evaluation of the reaction of the test at the integrated level (integrated result) of vibraimage parameters (calculation is similar to a method 1).

IE result – analysis of changes in psycho-energetic state of a person in the process of response (fig. 4.39). We compare the physiological response to the control and relevant questions.

Information about changes in the dynamics of psycho-energetic (information-energy) diagram of the test person at the answer to control and relevant questions. In more detail the algorithm of calculation of this parameter is stated in the following section 4.1 of this description.

dT result – at the end of the file is an analysis of the time delay (in seconds) in answering to the control (Tc) and the relevant (Tr) questions. Then longer a person is thinking about the answer, than more likely a lie.

Information on the time delay in answering the questions. If the subject does not press any of the buttons during the time set on this question, the system transitions to the next question. According to the set algorithm absence of any response to the relevant questions leads to a negative test result (calculation is similar to a method 1).

According to set algorithm, the answer is YES to any of the relevant questions leads to a negative test result.

The calculation of the final result of the test is carried out automatically with all the data. The data calculation method 5 are used as the basic information. Results of the first four estimates change the numerical value of reaction to relevant questions received by a method 5 according to the following formula:

$$sRr = sR^{(5)}r + 0,1*sR^{(5)}r*(\sum NDI - \sum DI)$$

The final result of psychophysiological testing is defined according to the following conditions:

NDI: sRr – sRc>0 or
NDI: sRr>0
DI: sRr– sRc<0
INC: 0,01<sRr – sRc < 0,01

Note, if the camera settings and shooting conditions are wrong, then at the end of the question, and at the end of the file appears message on the specific reasons for the error with the quantitative contribution to the overall quality.

Warning: Low quality (1) !   [0.35%]
Warning: Low quality (2) !   [13.66%]
Warning: Low quality (3) !   [18.06%]

5.4 Ranking mode of reactions to questions

In contrast to the mode of comparative testing (comparison test zones proposed by Clive Bakster) for many variants of psychological and psychophysiological testing necessary to obtain information about the degree of importance of the various questions for the test person. In this case, using a questionnaire R_Test program shows the absolute (not relative) the test reactions to questions. In the text of the questionnaire all the questions marked with the tag <EQ>, for example:

<**EQ** delay=«5» length=«7» text_delay=«1» text_length=«0»> Are you often change the decision ?</**EQ**>

After completing the questionnaire in lie detection mode automatically in the selected database directory \ VibraImage10 \ Database \ *** creates files with the test results :

- Data_time_histH.png – frequency histogram.

- Data_time_histT.png – an analysis of changes in the human psychoemotional state at the time of testing.

- Data_time_histH.xml – system settings and change the basic parameters of the psychoemotional state of a person.

- Data_time_LD.txt – lie detector report and result files.

- Data_time_row.txt – full record values recorded vibraimage system parameters. This file can be used for statistical research and testing of algorithms for determining the psychophysical and psychoemotional human condition.

- **Data_time_LD_e.txt** – an additional file with the results of ranking the importance of questions for the test.

An example of the calculation results of the file with the ranking table is shown in figure 5.5.

The number of rows in a matrix table is the number of questions in the questionnaire. The top line in the table shows the number of questions that caused the maximal response of the subject.

The number of columns equal to 7 - for the number of used calculating algorithms (A, I, S, S1, At, It, M). Formula each algorithm are shown in the lower part of the log file. In each column the number of questions in order of their importance (human response). The higher the number of the question in the column cells, the more psycho-physiological reaction to it showed during the test.

In the «results of ranking» section shows the importance of the overall performance of each of the questions asked. For example, the question №4 is rated the lowest from all the remaining question and equal to 24, i.e. in answering this question the testing human showed the biggest reaction.

4(24) – question №4 (its reaction = 1 (string number) *1 (the number of repetitions of the question number in the string)+ 2*3 + 4*2+ 9*1 = 1+6+8+9 = 24).

----------------matrix table--

R	A	I	S	S1	At	It	M
1	9	2	12	12	12	4	7
2	6	4	4	4	5	2	6
3	5	9	1	5	6	5	9
4	4	1	5	10	4	10	3
5	2	5	10	6	9	9	12
6	1	8	6	9	10	6	10
7	10	6	9	2	2	8	8
8	12	10	2	3	3	3	11
9	8	7	3	8	7	12	4
10	7	11	8	7	1	1	2
11	11	3	7	1	11	7	1
12	3	12	11	11	8	11	5

----------------results of ranking----------------------------------

R: 4 (24), 9 (30), 6 (31), 5 (32), 12 (37), 2 (40), 10 (40), 1 (55), 3 (60), 8 (60), 7 (61), 11 (76)

---------------- formula calculation for 7 algorithms------------------------------------

A: P5 [t' = t(max(P5))]

M: P20 [t' = t(max(P5))]

I: Σ P5

S: A/(t(max(P5))-t(P5>0))

S1: A/t(max(P5))

At: A/dt

It: I/dt

Fig. 5.5. The results of the ranking of psychophysiological reactions in answering to questions

6 Warranty

Maintenance service and service regulations of VibraLie system is carried out according to this Manual and instructions of used hardware maintenance (a computer, the camera, etc.).

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Version VibraLie10

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