

Psychophysiological Contactless Detection System

VibraLie+

Manual

Version VibraLie+

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1. Introduction

Welcome to the **VibraImage** World! Thank you for your purchase of **VibraLie+** 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, IP or television cameras and image processing. Human head microvibration is linked with the vestibular-emotional reflex (VER) of a person and indicates 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

Psychophysiological Contactless Detection System **VibraLie+** software solves the following aims:

- psychophysiological testing;
- research and measurement of psychophysiological and emotional states of a person;
- psychophysiological detection of deception;
- lie detection with fixed actual and individual questionnaires;
- research and ranking of psychophysiological responses to presented stimuli.

The software and the hardware form a **VibraLie+** system.

VibraLie+ – program of psychophysiological testing (PPT) allows analyzing changes in psychophysiological state (PPS) of a person, detecting verbal and nonverbal lie in automatic, semi-automatic and manual modes.

VibraLie+ program has special questionnaire for lie detection of the person, for example, in situation before the credit obtaining.

The purpose of the «Credit» questionnaire is the definition of a lack of lies in the intents of the candidate for the credit obtaining and the detection of the cheating.

The purpose of the «Bribe» questionnaire is the definition the reliability of the tested person response that he (she) didn't take a bribe at the current post.

The purpose of the «Family» questionnaire is the definition of lies when the examinee response to the question, did he (she) last night at work, or different place.

The «Insider» questionnaire is for testing to recruit staff on the possibility of the selling of company secrets to competitors.

The «R_Test» questionnaire allows rank (to determine the significance) the psychophysiological response to the test's questions.

Current **VibraLie+** version includes also additional questionnaires for the other different tests.

You can compose similar questionnaires on topics of interest to you and put them into installation directory of the program in the same format ld_XXXXXX.ldg. Choose it in the main menu of **VibraLie+**.

1.2. Specifications

To correct work of the program, the user must have the hardware with the following parameters:

1.2.1. Basic parameters

- Resolution, TVL, more than 400
- Noise level of vibraimage, bit, less than 0.1
- Frame speed, frame/sec, more than 30

1.2.2. Digital (web) camera requirements

- Resolution, pixel., more than 640 x 480
- USB compatible USB 3.0, USB 2.0.
- Frame speed, f/s, more than 30
- Microphone external
- Exposition control automatic 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 XP Prof/Vista/7/8 with DirectX 9.0 or later
- Processor Intel I3 or later
- RAM more than 1024 Mb
- HDD more than 10 Gb
- USB port 1 free USB ports version USB 2.0
- DVD-ROM DVDRW
- Installed software 1 DirectX 9.0 or later
- Installed software 2 Windows Microsoft.NET Framework 1.1 or later
- Video capture WDM-compatible video device

1.3. Package contents

- | | | | |
|----|-------------------------------|---|---|
| 1. | VibraLie+ software | - | 1 |
| 2. | Activation code | - | 1 |
| 3. | User's manual | - | 1 |
| 4. | Digital USB camera (hardware) | - | 1 |
| 5. | Microphone (hardware) | - | 1 |
| 6. | Personal computer (hardware) | - | 1 |

Attention!

Hardware with the specified parameters isn't included in the delivery. User gets the hardware for the VibraLie+ system themselves.

It is recommended to use Microsoft LifeCam Cinema webcam or similar with parameters not worse than this webcam.

2. VibraLie+ software installation

It is necessary to execute the following actions for installation of VibraLie+ program on your computer:

1. Go to Web page <http://www.psymaker.com/ru/support/downloads/>
2. Load file www.psymaker.com/downloads/VibraLieC.exe
3. Run file VibraimageLieC.exe from archive file.
4. Select language for installation procedure.
5. Press button «Next» in the appeared window of the beginning installation.
6. Accept the license agreement and to press button «Next» in the appeared window.
7. In the appeared window, specify a way to the catalogue where files of the program will be written down, then to press button «Next».
8. Press button «Next» in the appeared window, allows installation of software files on your computer.
9. Press button «Install» at the start of installation.
10. Press button «Finish» at the end of installation.
11. VibraLie+ program icon appears after the end of installation in system menu on desktop of your computer.
12. To reboot a computer.

2.1. VibraLie+ software activation

Attention!

1. Procedure of activation is made once at the first start of the program.
2. Before the program activation it is need to buy this version of the program in the online store Psymaker
<http://www.psymaker.com/store/>
3. Activation procedure requests access to the Internet for receiving answer code from server.
4. Activation code has the structure shown in the table.

Key type	Software modification
VI7_XXXXXXXX_LD	VibraLie+ program for contactless psychophysiological detection of deception in automatic, audio and manual modes. The program is intended for the different psychophysiological testing, for example, to detect cheating at the credit obtaining from a bank or other organization.

2.1.1. Standard activation

1. For the activation beginning it is necessary to run the **VibraLie+** program.
2. At the first start of the program the activation window will be displayed (fig. 2.1).

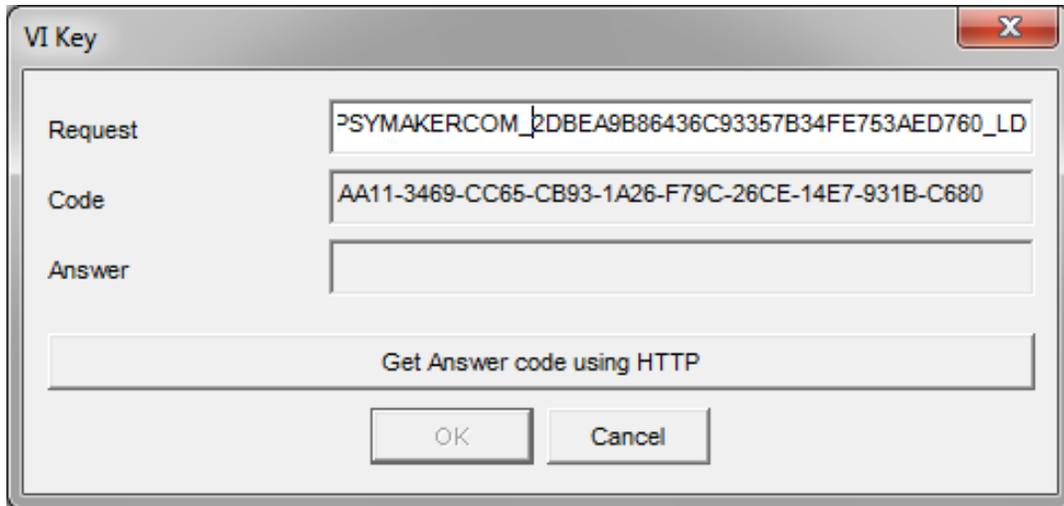


Fig. 2.1. Activation window.

3. In the field «Request» it is necessary to enter the activation code received by e-mail or specified by the seller (fig.2.2).

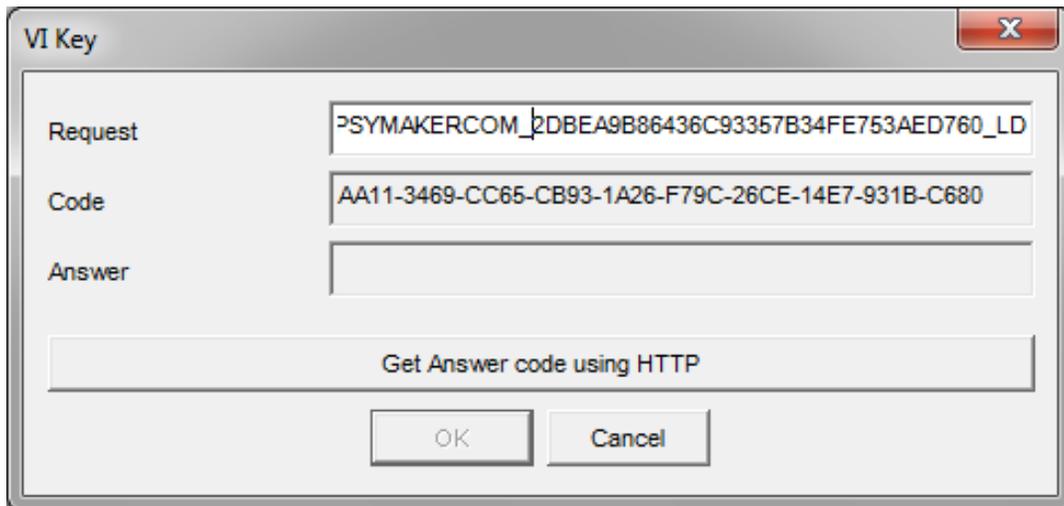


Fig. 2.2. Putting activation code.

4. After input of activation code to press the button «Get Answer code using HTTP».

Attention!

Please, be careful and paste code without additional gaps!

- 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. 2.2).

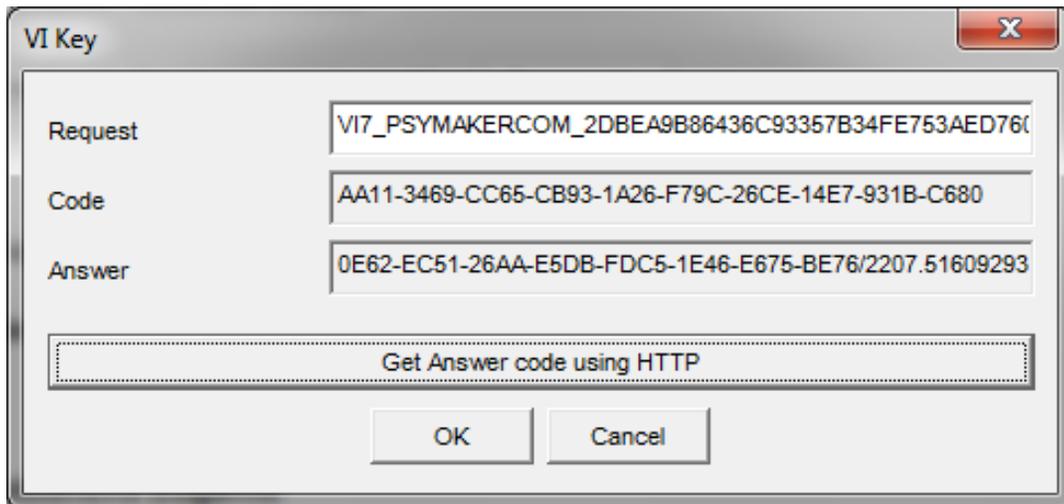


Fig. 2.3. Successful activation.

- Press button «OK». **VibraLie+** will be automatically started in selected version.

2.1.1. DEMO activation

- For the activation beginning it is necessary to run the **VibraLie+** program.
- At the first start of the program the activation window will be displayed (fig. 2.1).
- In the field «Request» it is necessary to enter the activation code received by e-mail or specified by the seller (fig.2.4). After input of activation code to press the button «Get Answer code using HTTP».

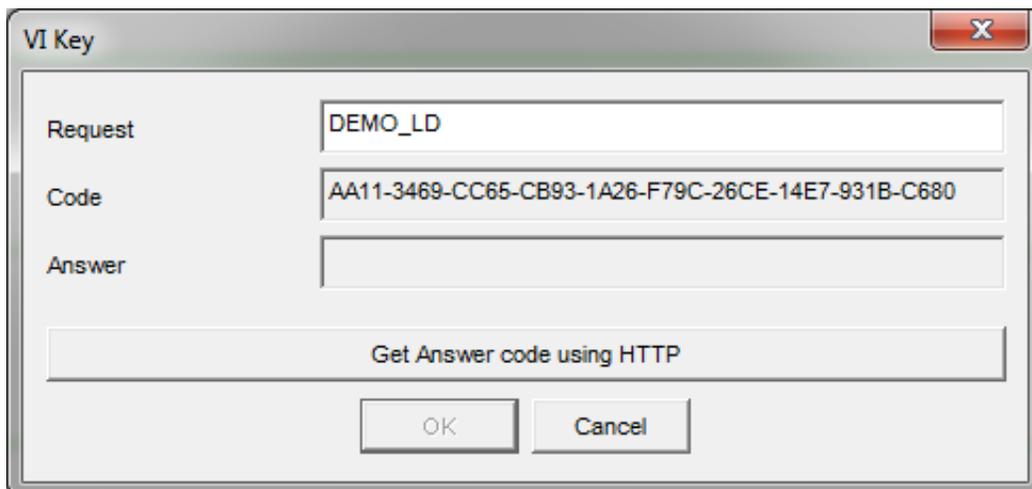


Fig. 2.4. Putting activation code.

Attention!

Please, be careful and paste code without additional gaps!

- 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. 2.5).

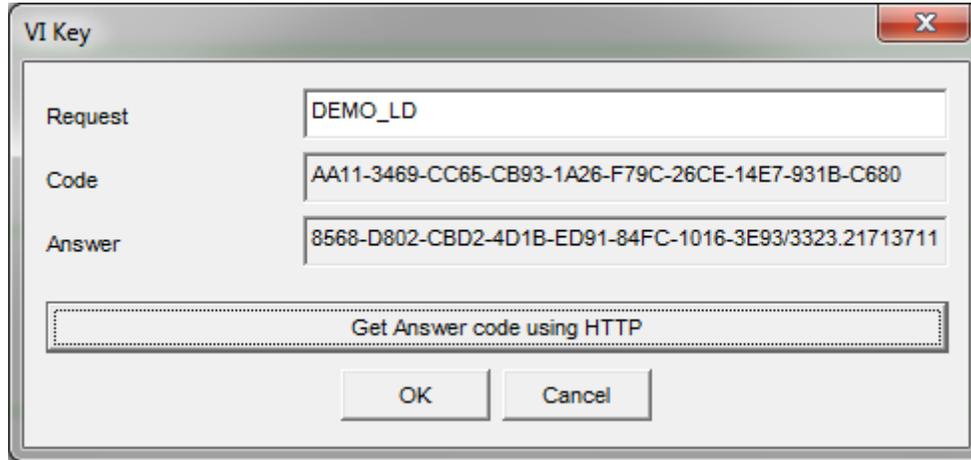


Fig. 2.5. Successful activation.

- Press button «OK». **VibraLie+** will be automatically started in selected version.

After starting program you will see white screen (fig. 2.6). For camera selection in program it is necessary to click the right mouse button and to select the camera from the appeared submenu «Video» for operation (fig. 2.7).

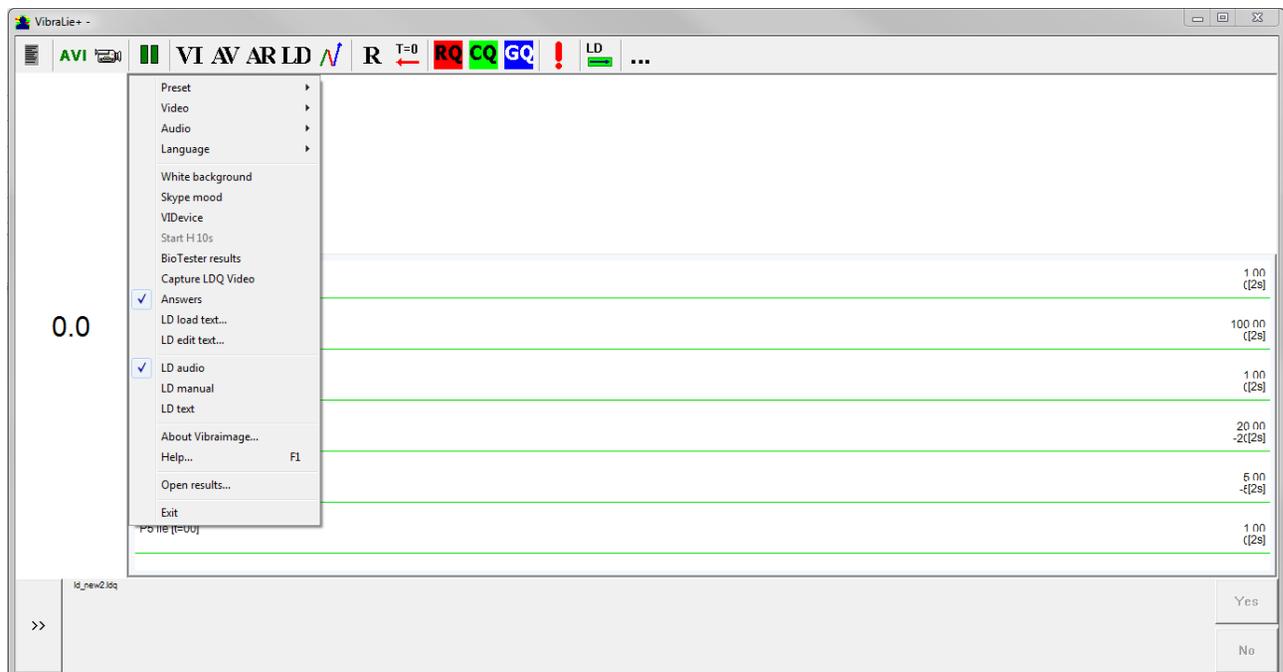


Fig. 2.6. The first start of the program. The camera isn't connected.

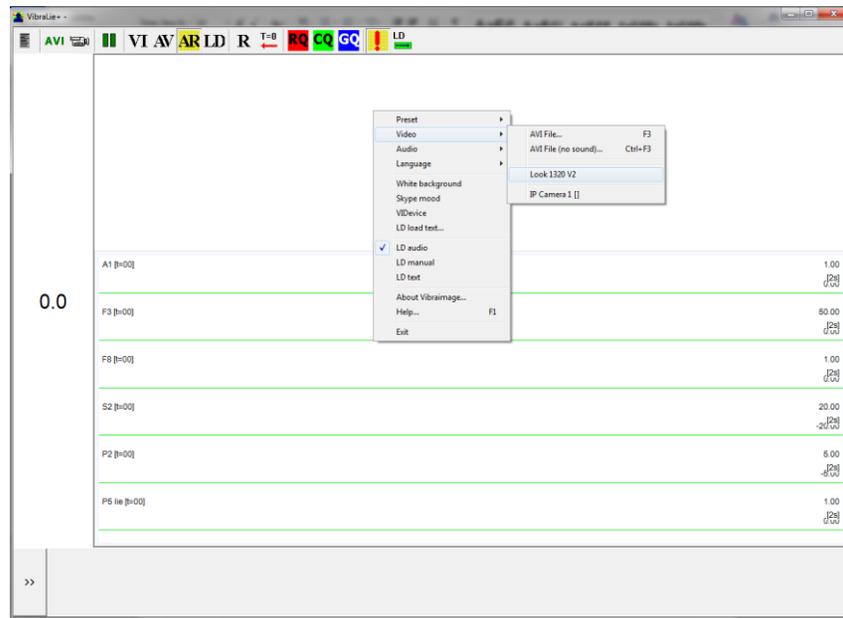


Fig. 2.7. Connection of the camera.

6. Start operation with system.

2.2. Reinstallation of VibraLie+

Note, it is recommended to uninstall the VibraLie+ program before any upgrade software or hardware on PC and to reinstall after this upgrade.

For this purpose it is necessary to execute the following actions:

1. To connect to the Internet a computer on which one of VibraLie+ has been installed.
2. To start VibraLie+ program for reinstallation on a new computer.
3. In a program window, having pressed the mouse right button, to cause the menu and to choose item «**About Vibraimage...**» (fig. 2.8).

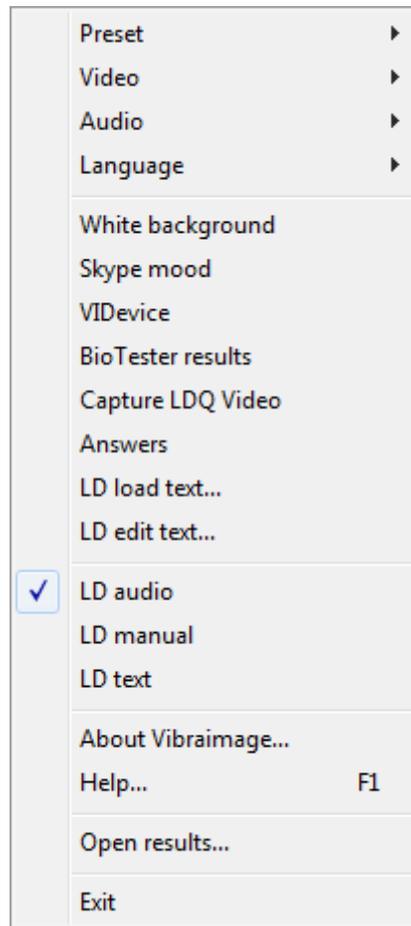


Fig. 2.8. Program menu.

4. In the opened window to press the button «**Unregister key**» (fig. 2.9).

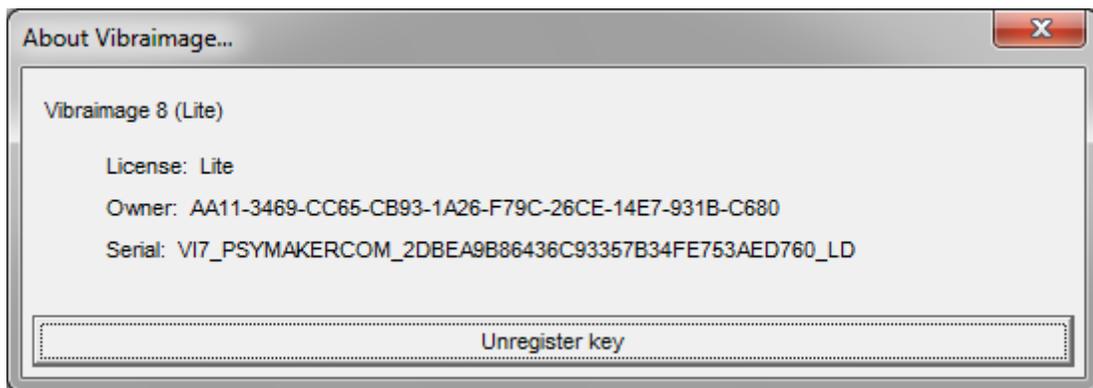


Fig. 2.9. Information about the program.

5. Close the program.
6. Connect a new computer to Internet.

7. On the new computer to install the chosen program modification and to make registration of an "old" modification activation key 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 Camera's setting

Standing correct camera settings is very important operation for the next vibraimage processing, because mistakes in image quality have great influence to the vibraimage processing results.

2.3.1 Video camera choice

It is necessary to select in the main menu «Settings» => «Video» => «.../name used camera/...". In figure 2.10 the process of selecting camera «Microsoft LifeCam Cinema» is shown. If the camera is connected, selected and works, then on the left of the name there will be an icon «✓» (fig. 2.11), and the menu will be extended with the «Video capture filter...» and «Video capture format...».

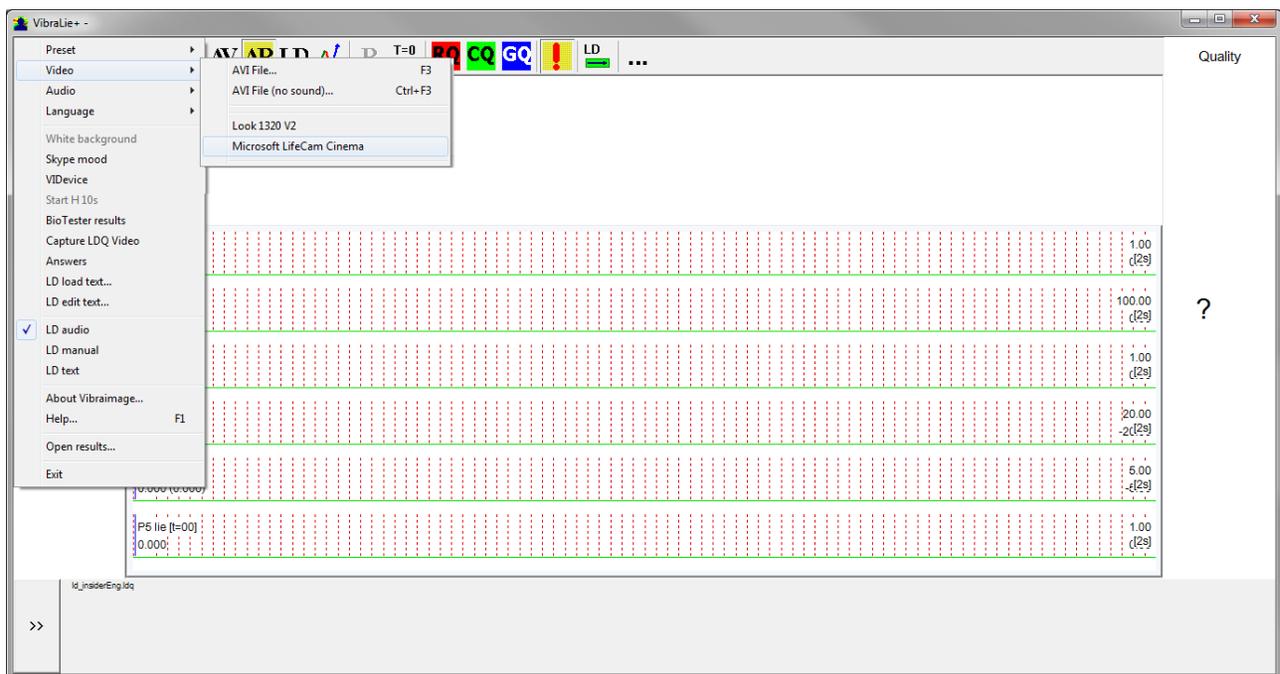


Fig. 2.10. Example of camera choice.

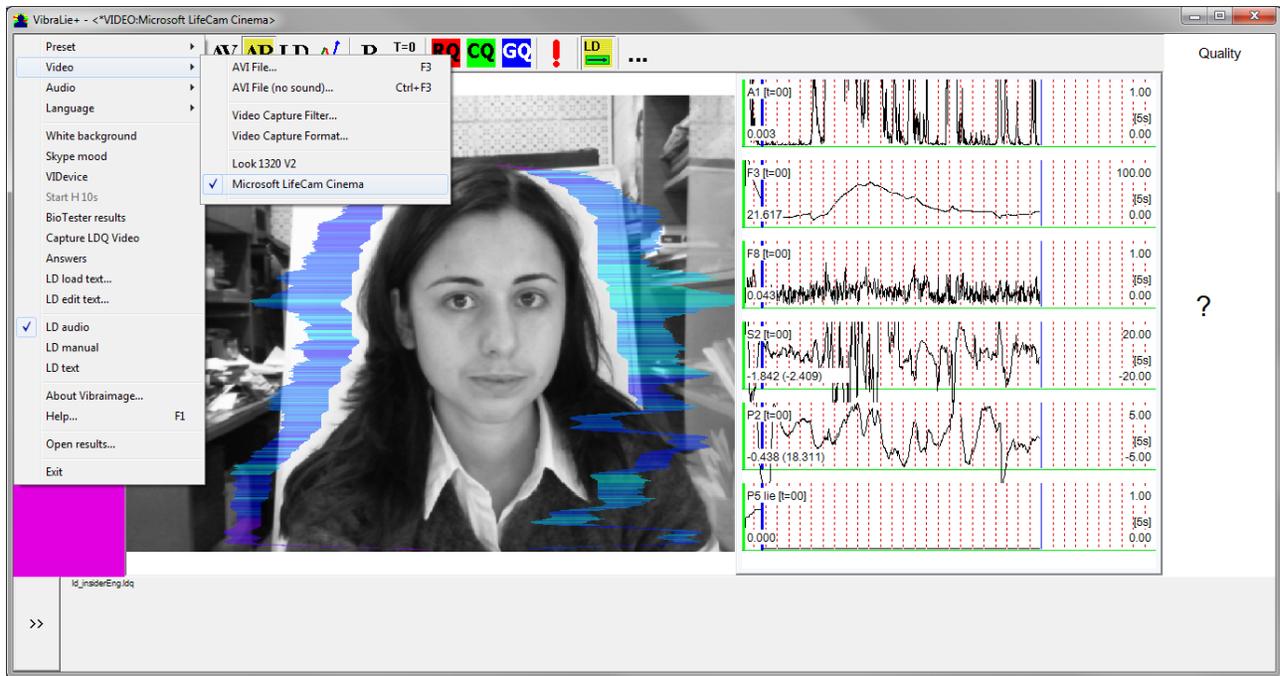


Fig. 2.11. The camera «Microsoft LifeCam Cinema» is selected.

2.3.2 Video capture filter

Select «**Video capture filter.....**» in the submenu «**Video**» (fig. 2.12) for open menu of the camera settings. Item «**Video capture filter....**» appears in the menu only in case of the correct installation of camera drivers and correct choice of operating camera.

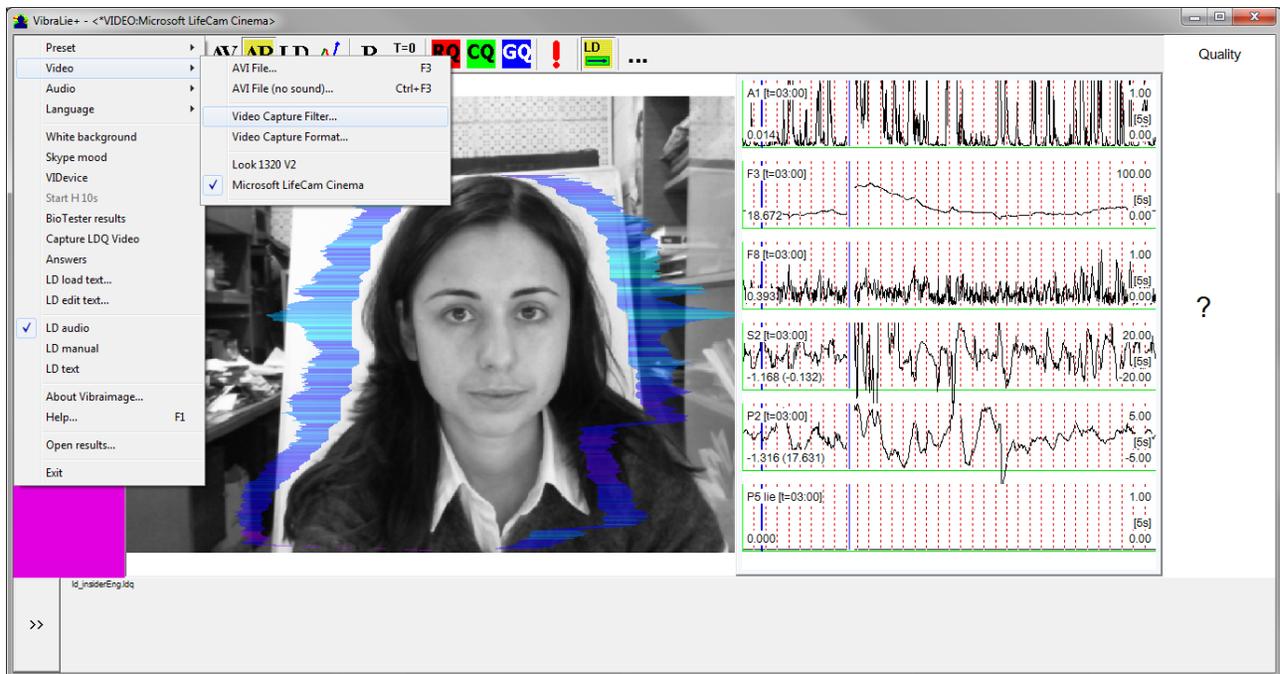


Fig. 2.12. Opening of the camera's settings menu («Video capture filter...»).

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**», and in a figure 2.14 for the camera «**Look 1320 V2**» 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.

Depending on the experimental conditions and light is necessary to select auto or manual settings «**Focus**», «**Exposure**». If the illumination is constant, then it is recommended to use manual configuration, if you change (for example, the illumination of an object depends on street lighting), it is better to use automatic configuration. 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. So for webcam Microsoft LifeCam Cinema the optimal meaning of zoom for personal control is 4, see Fig. 2,15. For other cameras is possible to adjust other optimal zoom settings.

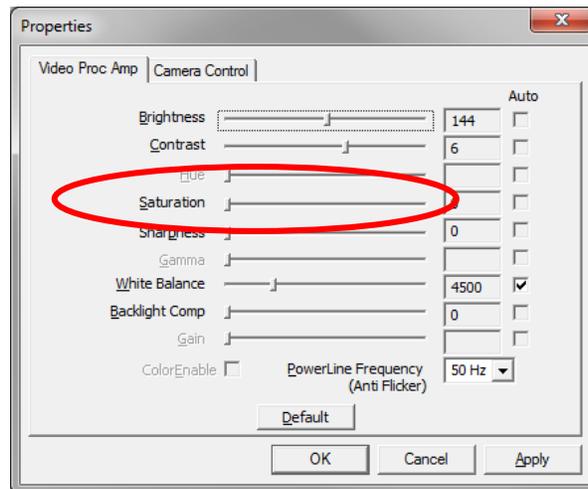


Fig. 2.13. Video setting, camera «*Microsoft LifeCam Cinema*»

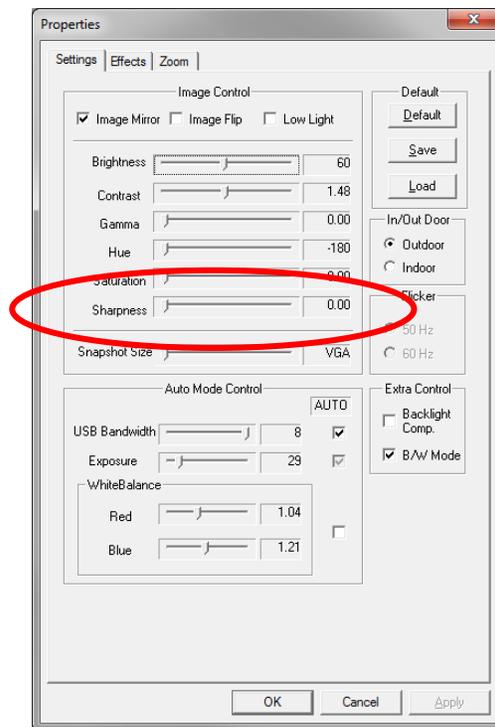


Fig. 2.14 Window «Settings», video setting, camera «Look 1320 V2»

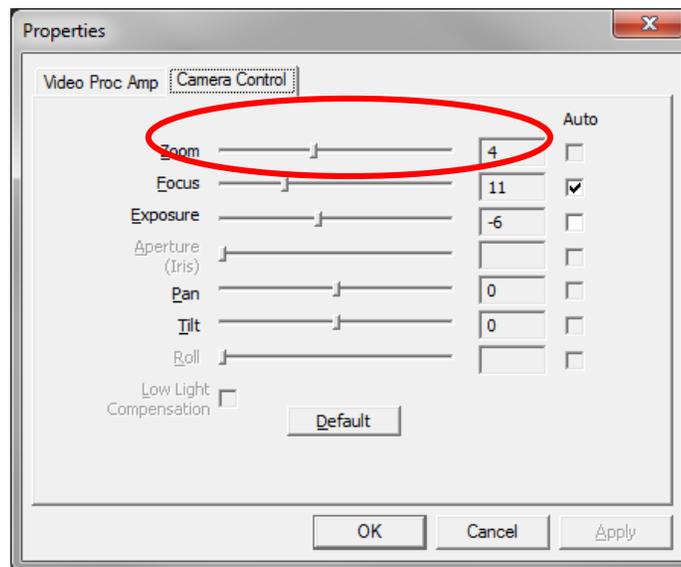


Fig. 2.15. Zoom setting, camera « Microsoft LifeCam Cinema»

2.3.3 Video capture format

Select «**Video capture filter...**» in the submenu «**Video**» (fig. 2.15) for open menu of the camera settings. 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") not less than 640 x 480 elements (fig. 2.16).

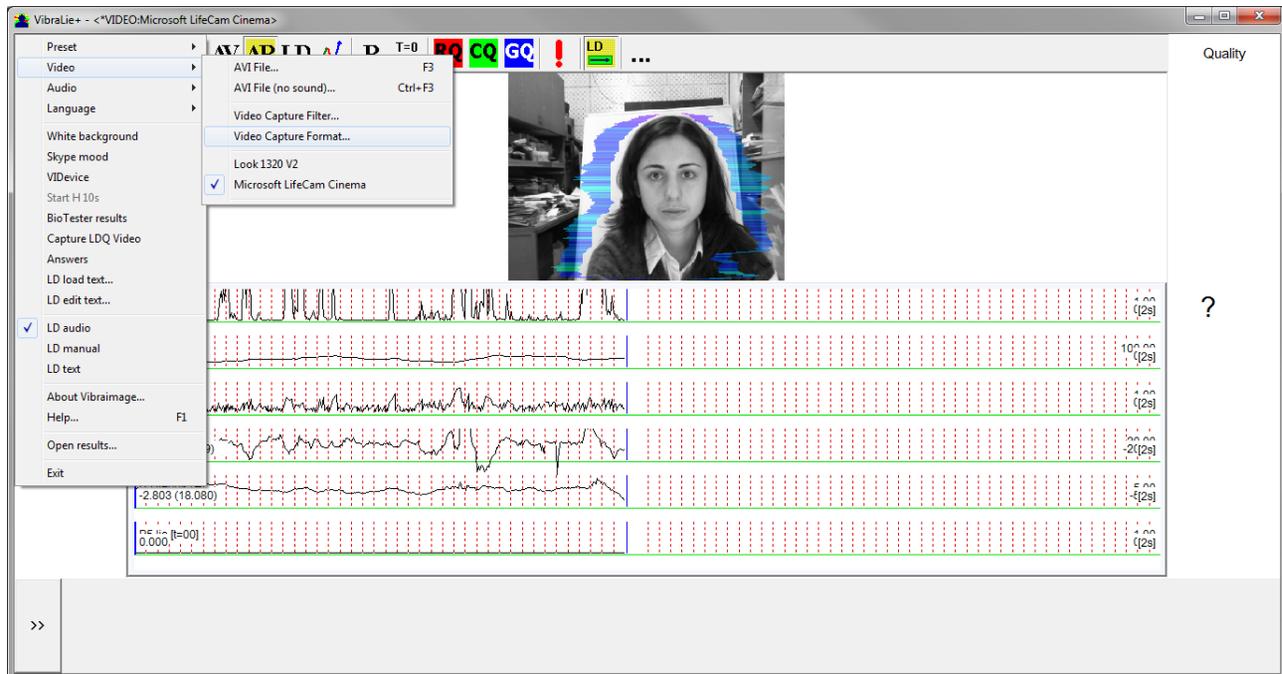


Fig. 2.15. Opening the settings window «Video capture format»

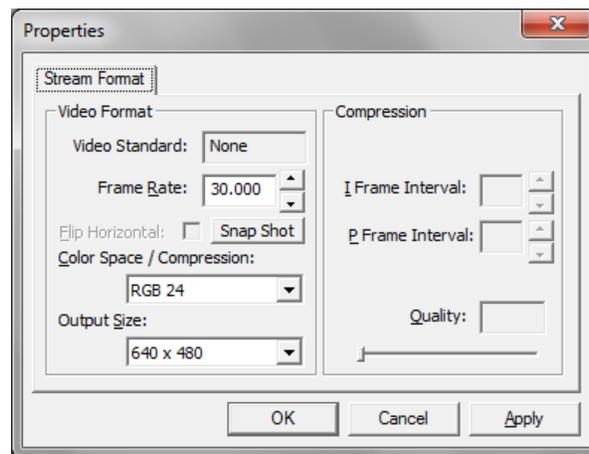


Fig. 2.16. Window «Video capture format»

Note, after changing camera settings in the program VibraLie+ frame rate «In» must be in the range of 25 – 30 frames/s.

2.3.4 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. 2.17) and manual regulation of illumination in case of a constant illumination (fig. 2.18).

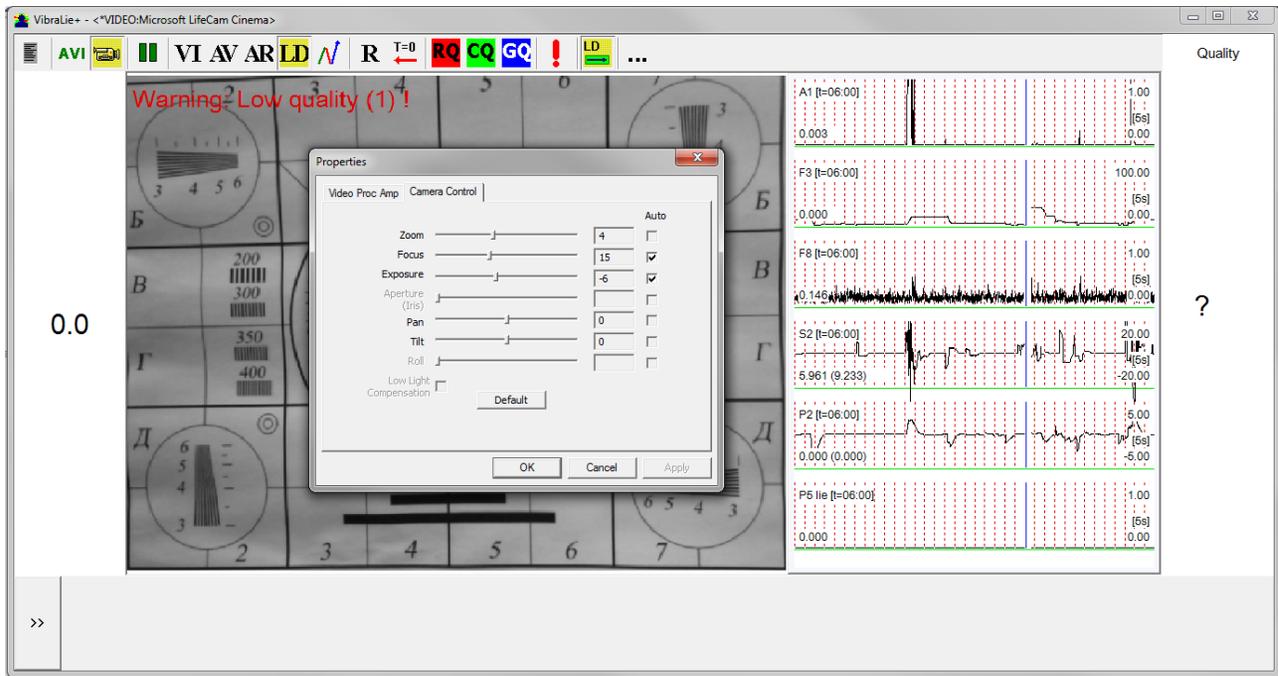


Fig. 2.17. Checking the camera settings on the test table, automatic regulation of the exposure (mode is recommended for unstable object illumination).

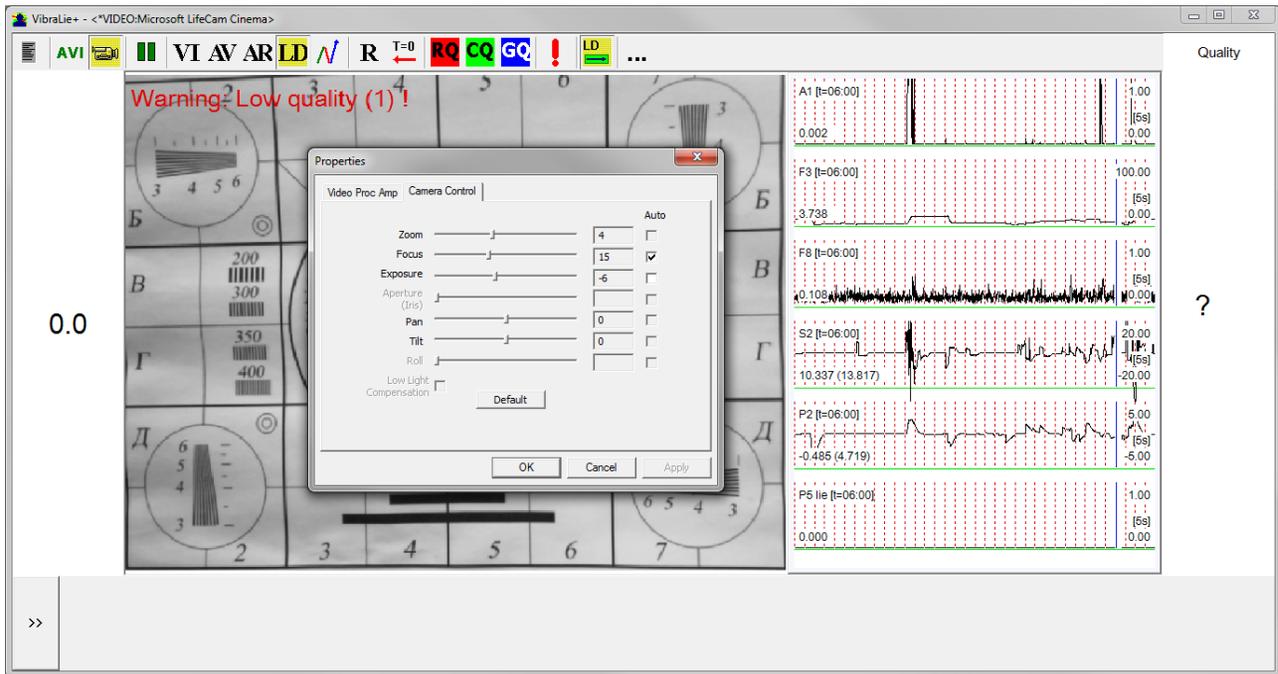


Fig. 2.18. Checking the camera settings on the test table, manual regulation of the exposure (mode is recommended for stable object illumination).

2.3.5 Video quality auto checking function

The program **VibraLie+** has auto checking function and image quality control during the test. Because the definition of human reaction occurs on the video, the quality control of the processed video is necessary to get the right test result.

Program gives error indication in left upper corner of image area 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 (fig. 2.19).

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 (fig. 2.20).

Error 3 – indicates when computer input frequency rate is lower than necessary. Requested norm for processed frame frequency is more than 25 f/s. This errors indication was done for deleting unqualified staff influence during results control (fig. 2.21).

Note, before the start of the test should ensure that the program processes image of a person without any errors.

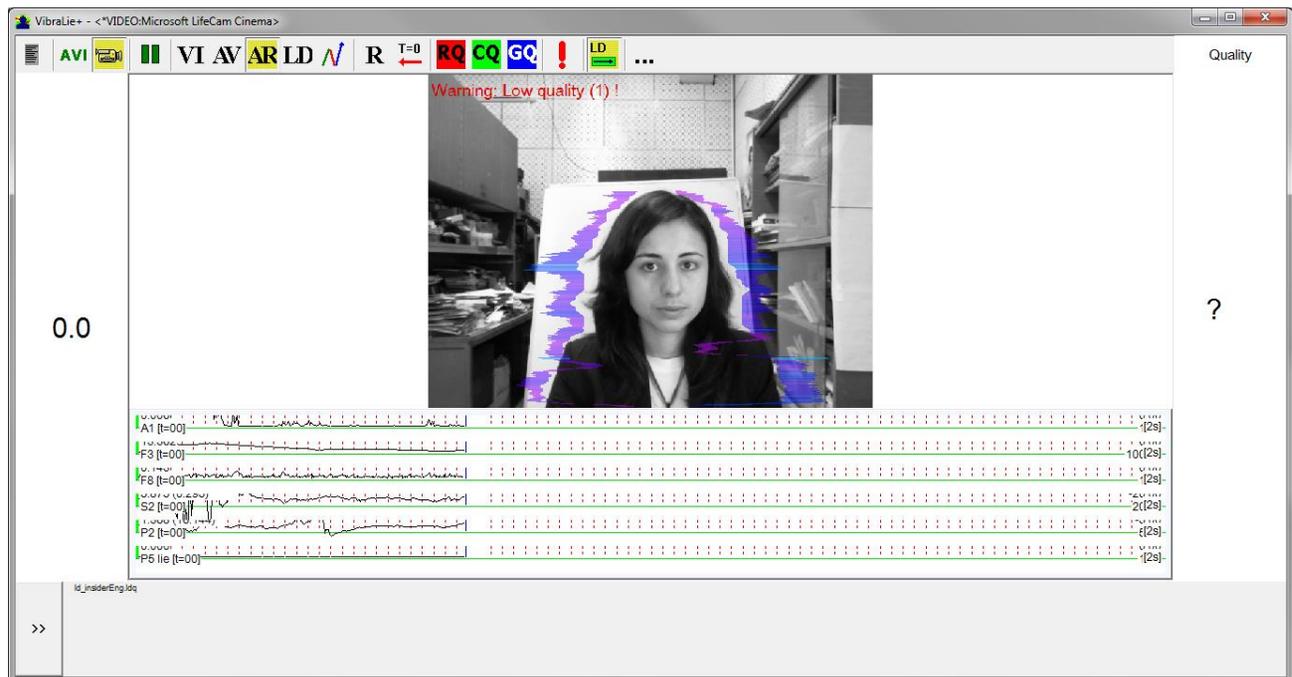


Fig. 2.19. Quality test indication stands Yes in settings and Error 1 shows in the image window. Head image size is lower than requested.

Head image size in the elements (pixels) determines the accuracy of recorded vibration and requires permanent control during the test. When tested with a video image analysis there are no strong restrictions on the movement of the test person, as required the contact polygraph. Thus, the person feels natural, which increases the accuracy of test results. However, the natural behavior can lead to the fact that the person during the response will deviate from the camera and the head image

size becomes less than required. To resolve this problem vibraimage system continuously monitors a person's head size of the image and displays an error message (1) 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.

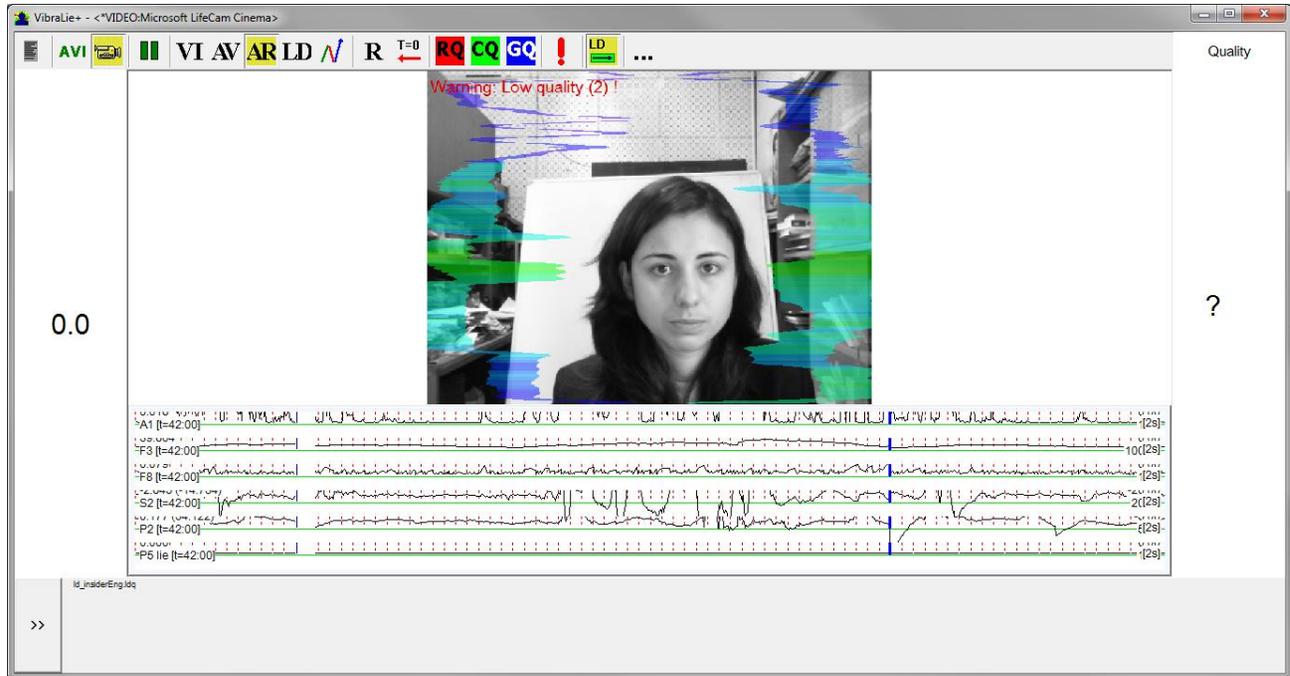


Fig. 2.20 Quality test indication stands Yes in settings and Error 2 shows in the image window. Camera vibrations is strong and on the image there is a noise.

The figure 2.20 shows an example of strong camera vibrations. For good vibraimage you should mount the camera on a fixed support so that the vibration of the support was minimal. If the camera is mounted on a table, while working with the program you should not lean on the table.

The noise of the signal from the web-camera includes a video camera noise and illumination instability and it can significantly affect the test results.

Continuous calculation of the noise level should be carried out by methods similar to the measurement of the noise from the photodetector of the television camera. In this case, when you exceed the noise threshold, the system automatically displays an error message (2) (fig. 2.20).

Despite the fact that the television camera may transmit 30 frame/sec with the given resolution, it does not guarantee that the computer receives and processes the incoming video data in real time. However, any deviation from the information processing in real time results to loss of information and to reducing the reliability of the test. By reducing the input and processing actual frequencies frames below the set limit, the system automatically displays an error message (3) (fig. 2.21).

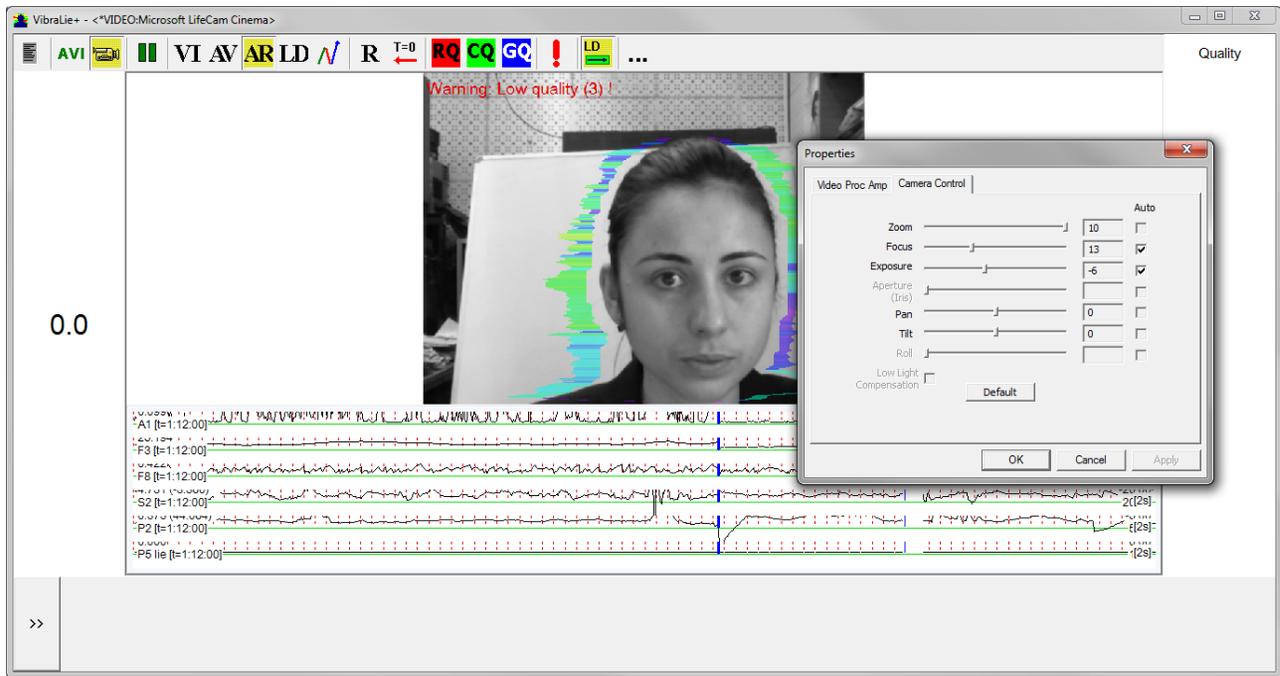


Fig. 2.21 Example of error 3. Frame rate «In» less than 25 f/s. You should set the "Brightness," "Contrast" and others in submenu "Video Capture Filter" to increase this value.

In this situation, it is necessary to reconfigure parameters of the camera ("Brightness," "Contrast," et al.) to increase the frame rate. For web-camera Microsoft LifeCam Cinema that happens in the case of zoom in the maximum, as shown in Figure 2.21. In the case of reducing zoom should control the frame rate in the menu "Video Capture Format ..."

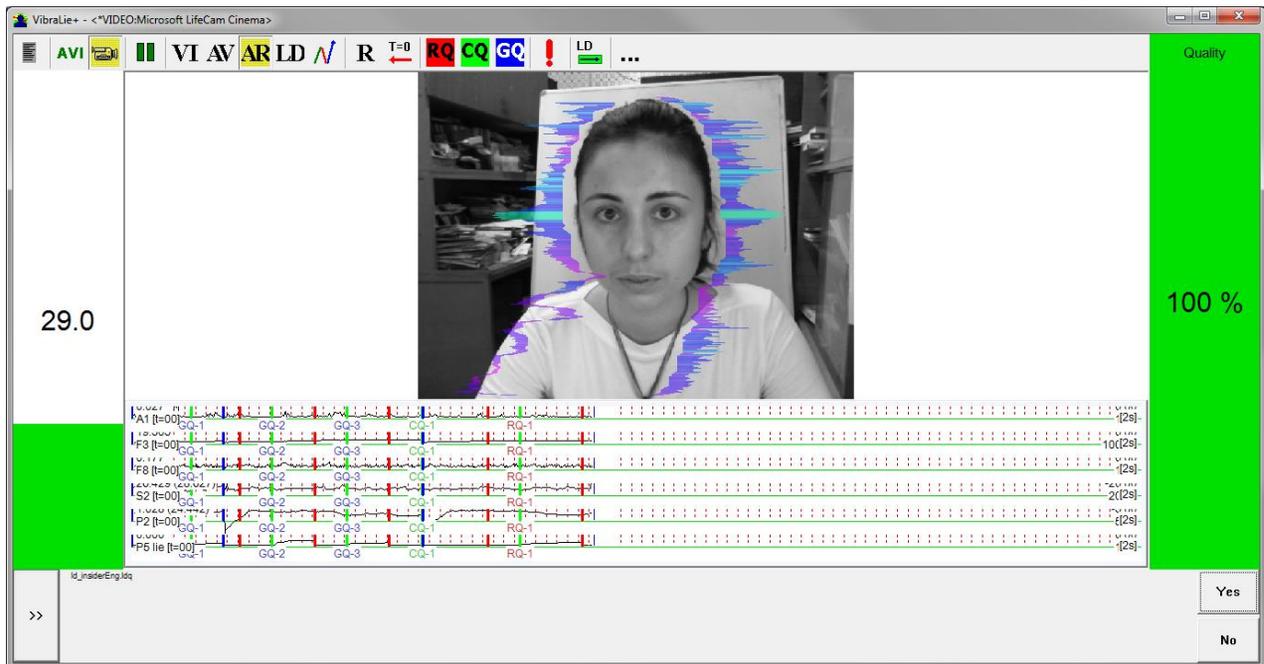


Fig. 2.22. Quality test indication stands Yes in settings and Quality 100% shows in the image window. Head image size and other parameters are correct.

Quality column shows time % during the testing when image quality is equal 100%. When we have quality indication 91 % (Fig 2.23), that means 91% of testing time image quality hasn't errors and 9% of testing time image quality includes errors with the number 1 or 2 or 3.

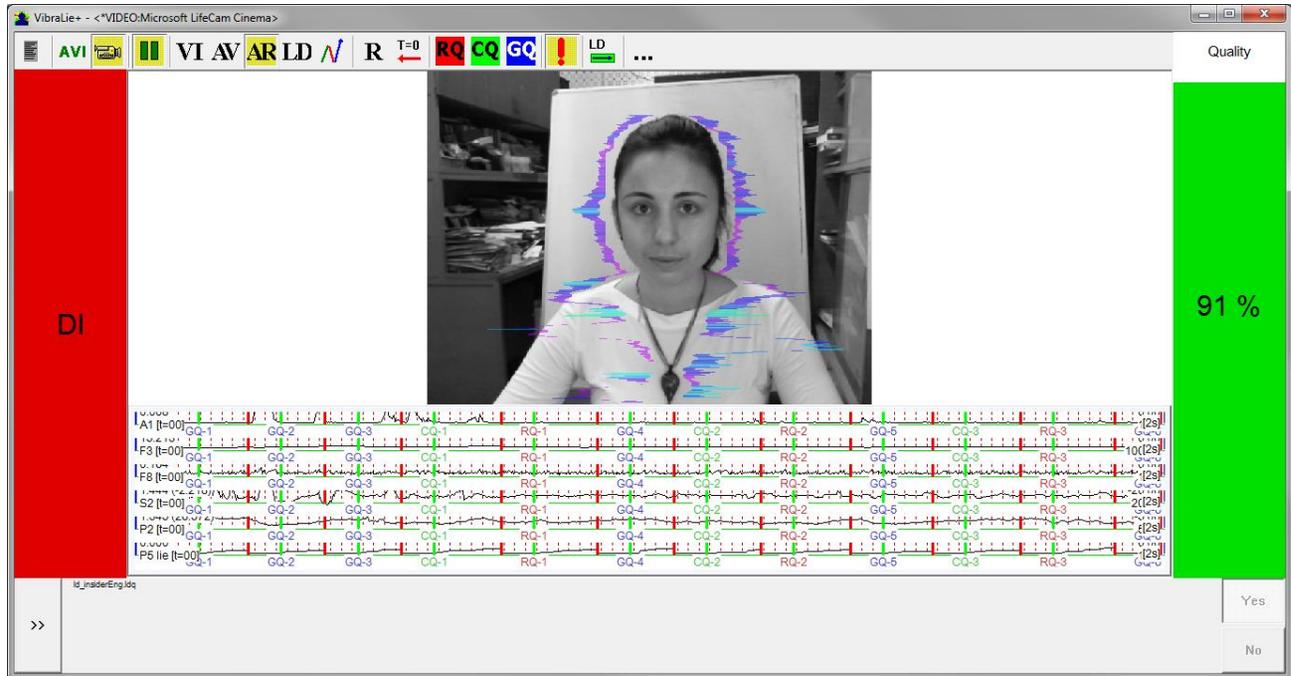


Fig. 2.23. Quality test indication 91 %

Pressing button R reset image quality to the beginning 100 %. In lie detection mode and M mode image quality is very important and testing with image quality lower 80 % could not be acceptable for processing.

3. VibraLie+. User's manual

Psychophysiological Contactless Lie Detection System **VibraLie+** software solves the following aims:

- psychophysiological testing;
- research and quantitative measurement of psychophysiological and emotional state of a person;
- psychophysiological detection of deception;
- lie detection with fixed actual and individual questionnaires;
- research and ranking of psychophysiological reactions to presented stimuli.

Lie detection with fixed actual questionnaires like Credit, Family, Bribe, etc. 3 minutes test and about 100% sure in result. [VibraLie+](#) gives confidence in any relations!

After start of **VibraLie+** and connection of the video device (fig. 2.10) in the main window there is an image from connected video device.

3.1. Main window

Main window (fig. 3.1) consists of the following parts:

- image area;
- information column;
In an information column (at the left side on the screen) it is displayed, calculated by the program, values of person level of psychophysiological response and lie detection result (DI, NDI, INC).
- tools panel;
- subtitles panel;
- quality test column.

In heading of the basic window the following information is indicated (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 VibraImage module.

Image area for additional modes differs from the main mode, see fig.3.2.

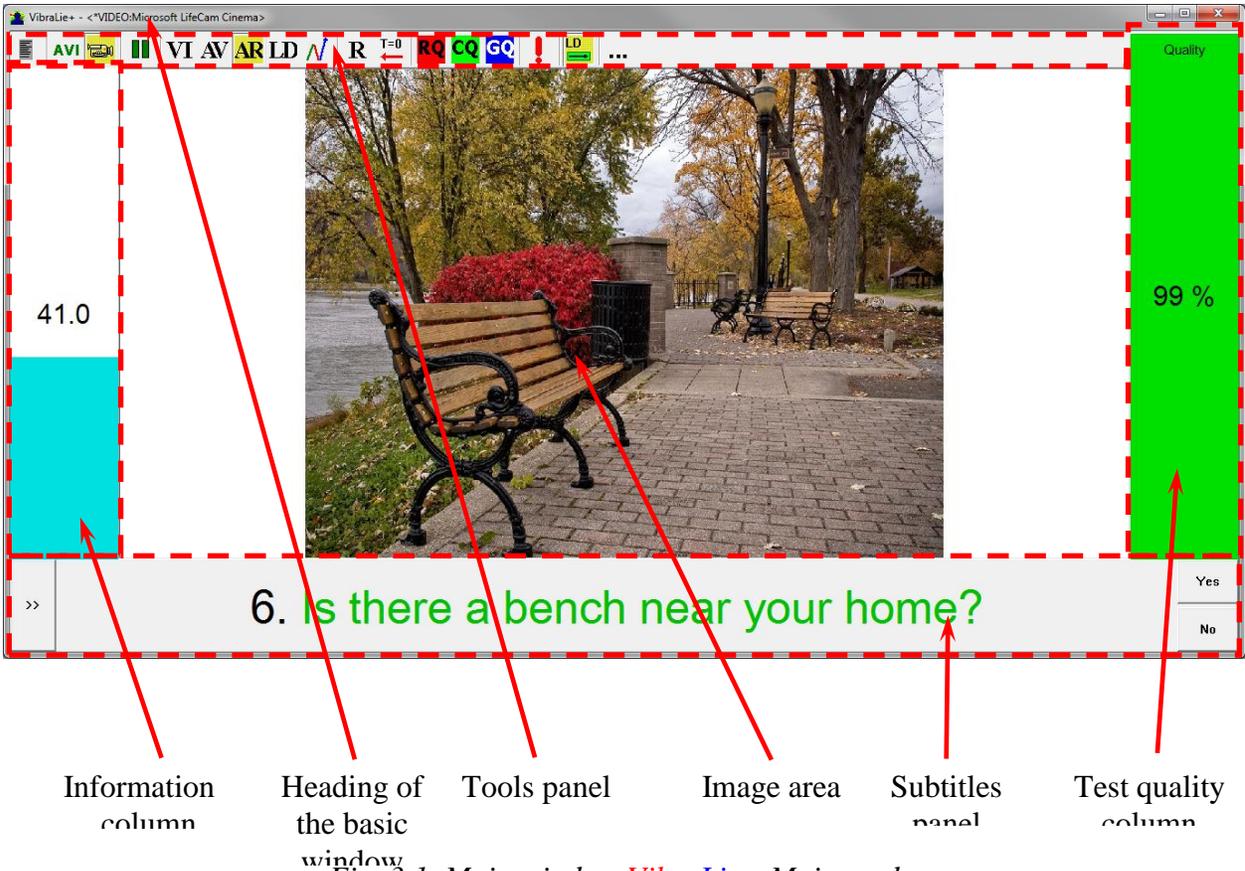


Fig. 3.1. Main window *VibraLie+* Main mode.



Fig. 3.2. Main window *VibraLie+* Additional mode.

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.

Attention!

Vibra-aura should be placed directly around the head of the test person for correct hardware (camera and computer) operation.

3.2. Main menu

For a call of the program menu it is necessary to click in the main window the mouse right button. The appeared main menu will consist of the following items (fig. 2.6):

- «**Preset**» – choice of visualization mode from.
 - LD** - real video image,
 - AR** - external vibraimage (vibra-aura) around real video image,
 - AV** - vibra-aura around internal vibraimage,
 - VI** - internal vibraimage.
- «**Video**»– choice of video source, as recorded video files (AVI), or live camera video.
- «**Audio**»– choice of audio threshold of the start LD detection and finish LD detection in LD audio mode.
- «**Language**»– choice of the interface and help system language (fig. 3.4).

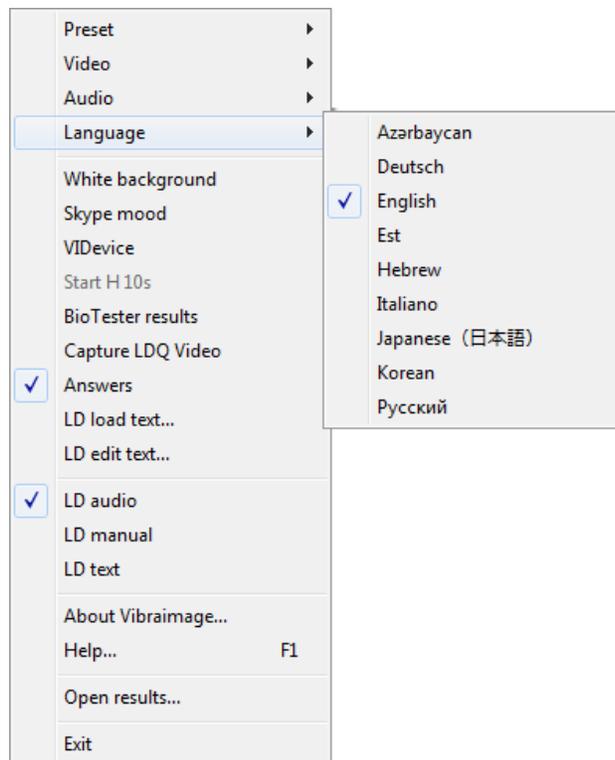


Fig. 3.3. Submenu «Language».

- «**White background**» – white background using.

- «**Skype mood**» – at teamwork of Skype and Vibraimage programs you can observe current psycho-emotion parameters of the interlocutor in Skype program window.
- «**VIDevice**» – support virtual camera drivers.
- «**Bio Tester results**» – view psychoenergetic diagram of the last test person.
- «**Capture LDQ video**» – video recording synchronized with the questionnaire.
- «**Answers**» – answer is given by pressing buttons Yes/No.
- «**LD load text...**» – load questionnaire file with format «*.ldq» for mode «LD text».
- «**LD edit text...**» – change question in actual questionnaire, add images to questions, create files with format «*.ldq».
- «**LD audio**» – choice of audio mode for lie detection, where audio signal more than stand threshold used for start lie detection analyzing time period.
- «**LD manual**» – choice of manual mode for lie detection, where time period for lie detection selected by pressing LD button on the Tools panel.
- «**LD text**» – choice of mode for lie detection with subtitles (questionnaire).
- «**About Vibraimage...**» - view the information about software version, license type and registered user name.
- «**Help...**» – call the help system about full version VibraImage software.
- «**Open results...**» – open the file «LD result», where your results are saved.
- «**Exit**» – allows quitting the program.

3.2.1. Image area control

Vibraimages, images and external vibraimages (vibra-auras) are displayed in the image area.

The main window of the basic **VibraLie+C.exe** module can be configured for observations in several operation modes.

Item «**Presets**» menu (fig. 3.4) designed 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. 3.6). In VibraLie+C version color for every image pixel depends on its vibrations frequency.
- In «**AV**» mode [«Aura Vibraimage mode»] external vibraimage (aura) allocated around the internal vibraimage or simple vibraimage. Aura line size depends on medium line vibration amplitude. Aura line color depends on maximum line vibration frequency inside vibraimage contour (fig. 3.7).

- In «AR» mode [«Aura on the Real image»] the aura of the person is shown around his real image (fig. 3.8).
- In «LD» mode [«Lie Detector mode»] image area shows real object image.

Note, at a displayed of the image in VI and AV modes it is possible to change color of a background of the image, having chosen main menu item «**White background**».

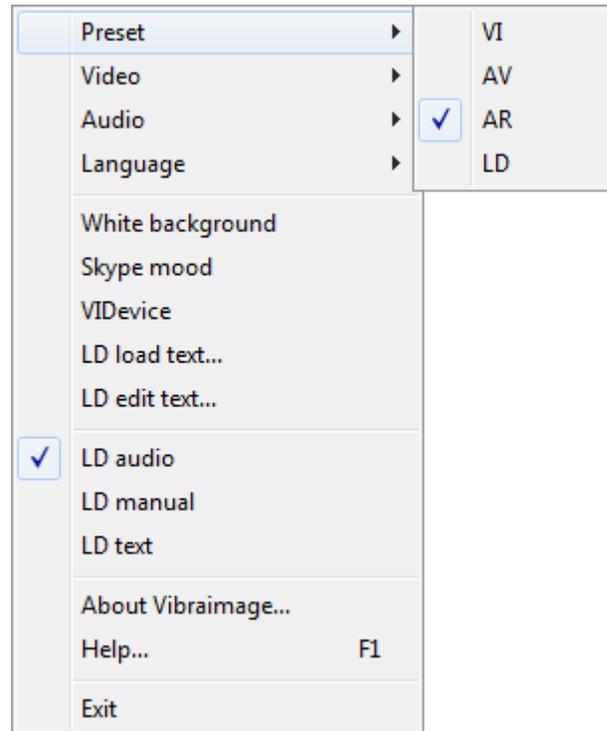


Fig. 3.4. Operation mode select.

3.2.2. Video source choice

Video source choice is carried out through the settings window, caused by the submenu «**Video**» (fig. 3.5). Submenu «**Video**» contains options of video modes. It's can differ depending on connected devices. For example this menu contains the following items. You can choose as video source one from many installing in PC video-devices or load external video file.

Subitem «**Video Capture Filter...**» allows to set up parameters of video input signal such as: brightness, contrast range, shade, exposure and others. With its help windows with the settings which look differs for different devices of video capture are caused. It is recommended to include a mode of the black-and-white image for cameras, to turn on the filter from flicker of fluorescent lamps (flicker), the parameter of sharpness (sharpness) to set no more than 1.

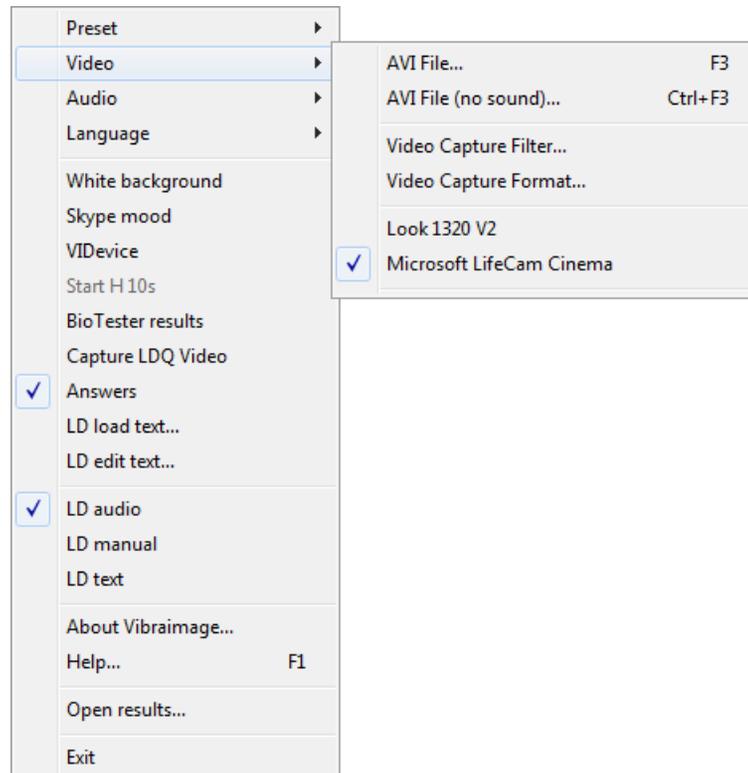


Fig. 3.5. Submenu «Video».

Subitem «**Video Capture Format...**» is intended for change video capture format.

VibraLie+C system allows to processing as the «alive» video signal acting from a video camera, and the video data, before written down and saved as an AVI-file. On default the system works with a signal from a video camera. Subitems «**AVI File ... F3**» and «**AVI File (no sound)... Ctrl+F3**» are intended for a choice for the analysis of an external videofile.

Mode «**File (no sound)...**» - use for load AVI files without audio support. This mode designed for work with **VibraSound** mode.

3.2.3. Audio source choice

Audio source choice is carried out through the settings window, caused by the submenu «Audio» (fig. 3.6). Submenu «Audio» contains settings of audio modes. It is can differ depending on connected devices.

Subitem «**Threshold**» allows setting the value of the sound threshold for correctly **VibraLie+C** operation.

Subitem «**Settings...**» allows adjusting settings.

Subitem «**Audio Capture Filter...**» allows adjusting the microphone selected for operation (see items below).

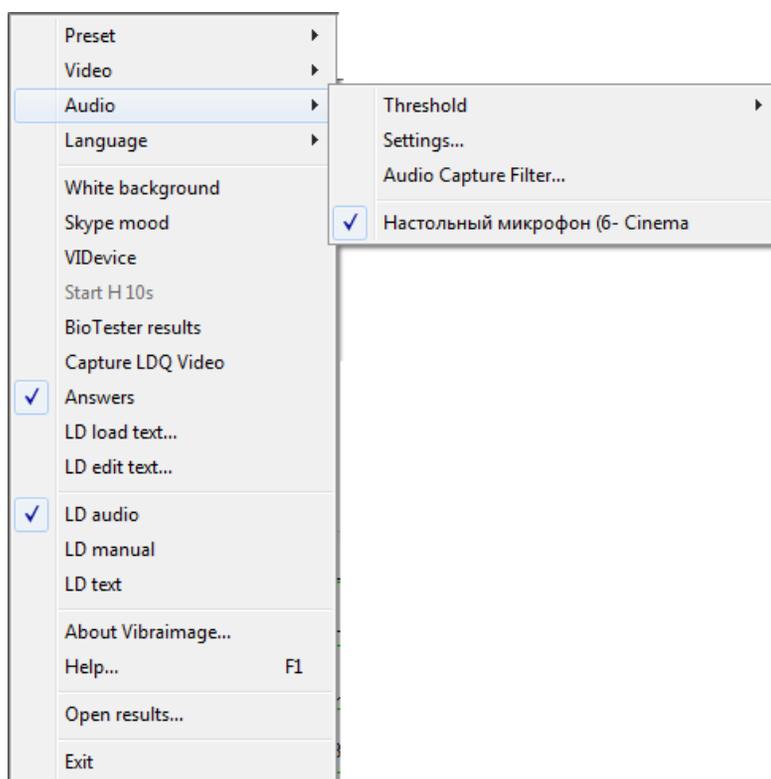


Fig. 3.6. Submenu «Audio».

3.2.4. Tools and LD panels of VibraLie+ program

Tools panel of VibraLie program shown on fig. 3.7.



Fig. 3.7. Tools panel of VibraLie program.

Tools panel of VibraLie program includes functions corresponding to buttons on the Tools panel from left to right:

-  – main menu;
-  – 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);
-  – R – reset parameters and graphs to 0;
-  – T= 0. setting to zero graphs on the timeline and installation of video being played in the beginning of the file;
-  – RQ – mark of relevant questions on graphs and LD calculation results;
-  – CQ – mark of control questions on graphs and LD calculation results;
-  – GQ – mark of general questions on graphs;
-  – indication of PDD results as DI, NDI, INC;
-  – LD – start/stop of psychophysiological response analyzing time period in manual mode.
-  – open the file «LD result», where your results are saved.

LD panel of VibraLie program shown on fig. 3.8.



Fig. 3.8. LD bar. Starting of a questionnaire.

One-clicking on the button  on the LD bar let start a questionnaire at that moment. Double-clicking returns to the beginning of the questionnaire and the video file. The questionnaire can be selected by putting on the item «LD load text...» in the main menu. The questionnaire can be edited by selecting the item «LD edit text...» in the main menu, also you can select and add images to questions.

If you work in mode «Answers» buttons Yes/No will appear on the right side of LD bar (Fig. 3.9).



Fig. 3.9. LD bar. Mode «Answers»

4 Main mode of VibraLie+ program

4.1 Basis of psychophysiological testing by vibraimage technology

VibraLie+ program of psychophysiological person testing (PPPT) 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 to amplify 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 2.3.5) 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 micro movements 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 very little used 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).

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 in various states 1, 2, 3, 4, 5 is given in figure 4.1.

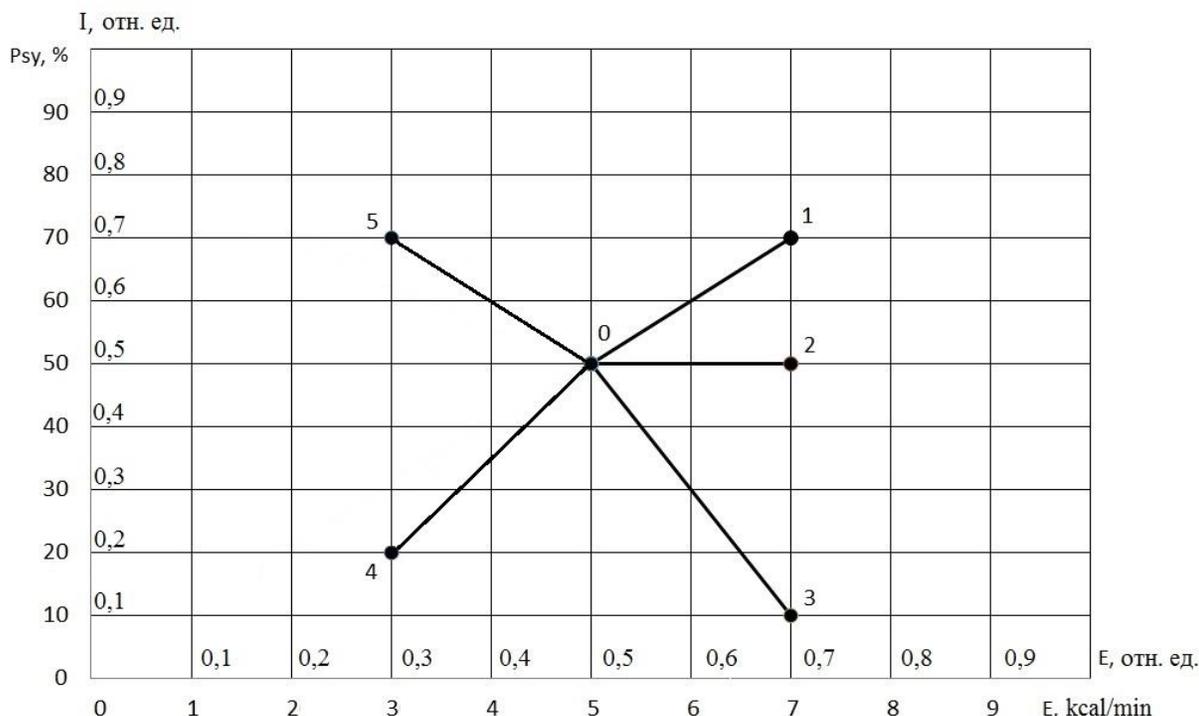


Fig. 4.1. Psychoenergetic (information-energy) diagram of the PPS.

As shown in fig. 4.1 on the information-energy diagram changing from initial PPS (point 0) to other states is characterized by one change of consumed energy and different states of psychological comfort.

Transition 0-1 is 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 is 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 is 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 is 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 is 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 psychophysiological 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.

Vibrainage technology allows to obtain multi-dimensional relationship of a 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+C**.

The psychophysiological reactions of the person at the answer to the control and relative questions are compared. In answering the question 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 the question, he's going to say a lie on it.

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

Comparison of the sum of these indicators for answers to relevant and control questions allows to define truthfulness of the answer or psycho-energetic expenses at reaction to the shown answers or incentives.

$$R = IR + ER$$

If a difference $R_r - R_c = dR < 0$, then the person has told a lie (DI) or reacted negatively to the shown incentive.

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 psycho-energy state change diagram for the data in Table 4.1 is shown in Figure 4.2.

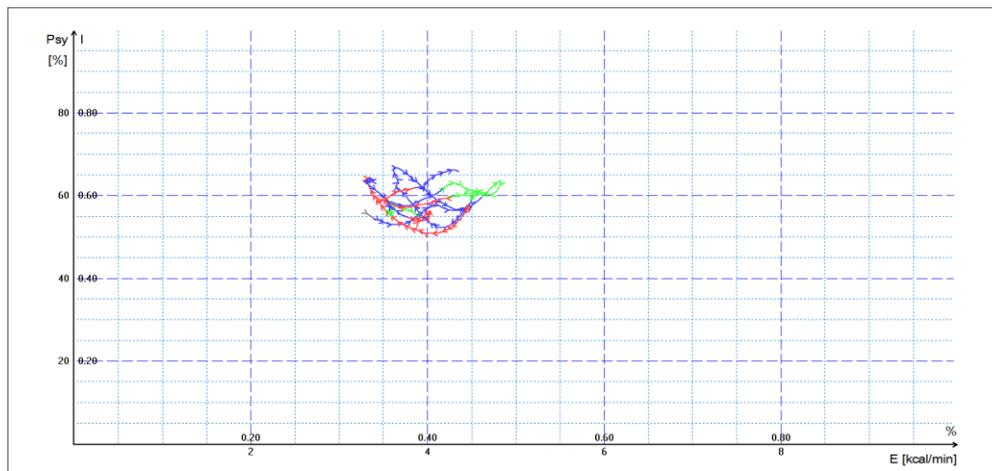


Fig. 4.2. Psycho-energetic (information-energy) diagram of the PPS change. during the test for the loyalty to terrorism.

Change 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 time period for standard examination methods. Every 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 improving, 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).

4.2 Questionnaires settings

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.

4.2.1 Selecting an existing questionnaire

Selecting the questionnaire performed by the operator in the main menu by selecting «LD load text...» (fig. 4.3).

The user chooses a questionnaire file with the extension <ldq> from a number of family, Bribe, Credit, Insider, Family or other file with the same extension (fig. 4.4). The program run it after choice in the main menu.

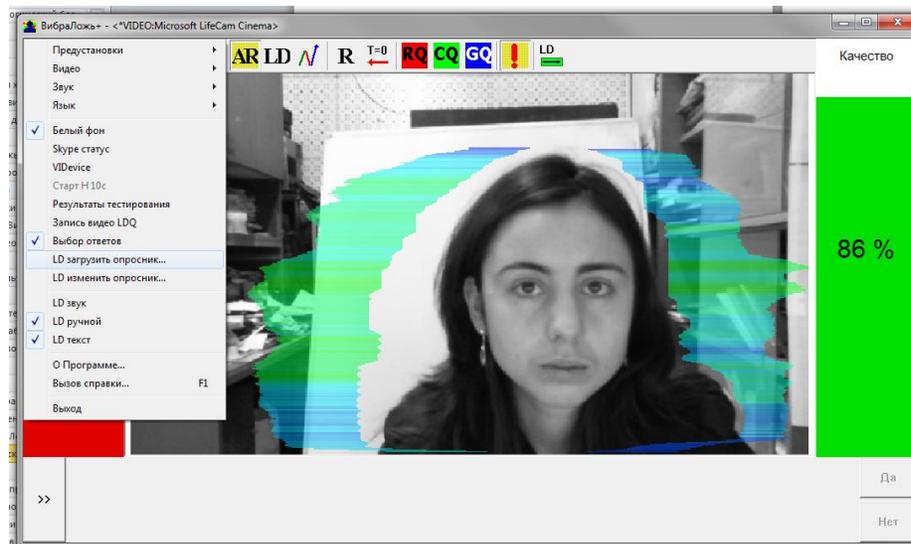


Fig. 4.3. Selecting the questionnaire

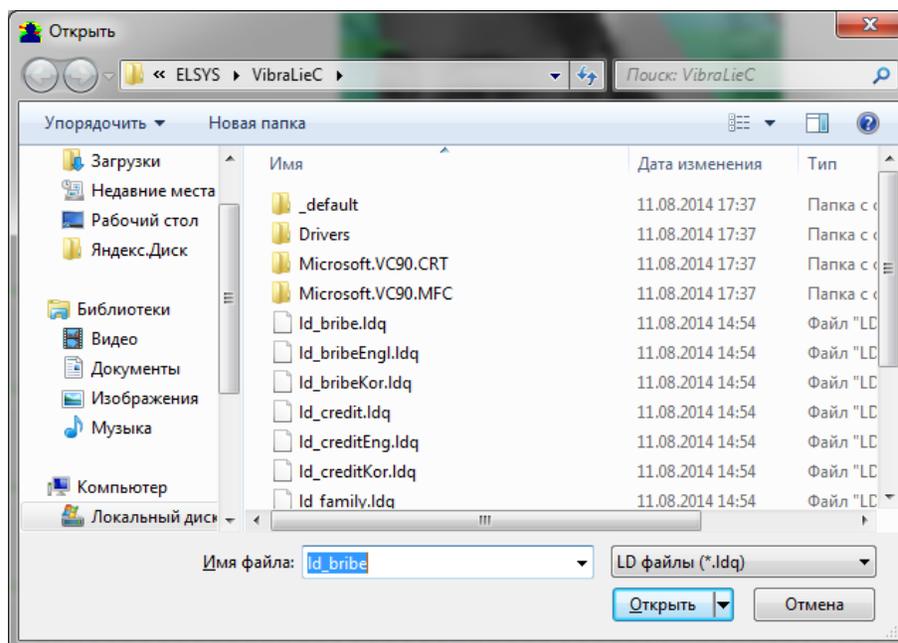


Fig. 4.4. Selecting the questionnaire

After the choice of the file, for example, Alcoholism, the program passes into the mode of reading and visualization of a questionnaire. The person conducting survey reads the questions which are displayed in the karaoke mode (fig. 4.5).

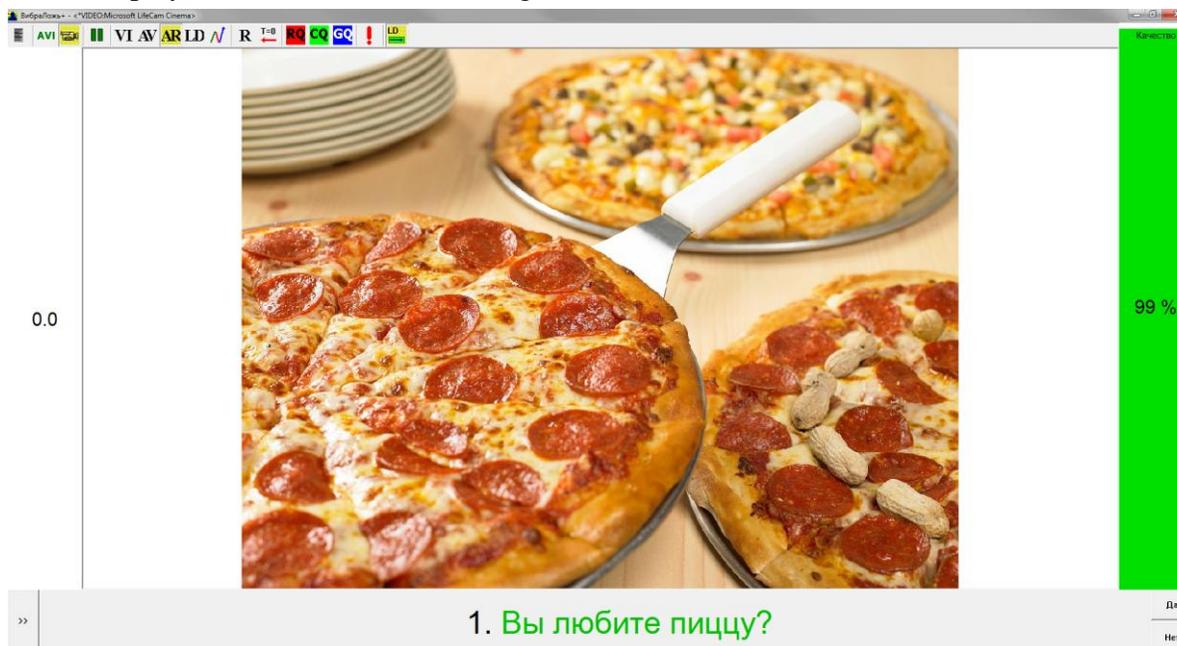


Fig. 4.5. Display questions in karaoke mode.

Interviewed person responds to questions clearly, only «Yes» or «No».

The result of the survey, showing the possibility of cheat in obtaining credit, is displayed directly on the screen after the end of the test in the form of the left column:

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.

Example of survey results is shown in figure 4.6.

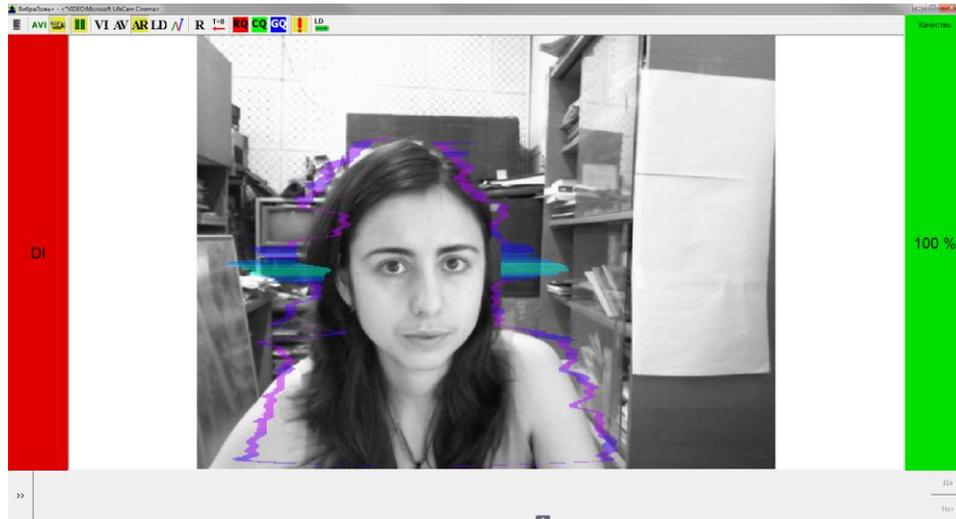


Fig. 4.6. Example of testing results.

4.2.2 Create 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. Then the window «**LDQ**» of creation of a new questionnaire will appear (fig. 4.7), where you can enter questions and save profile by clicking «**Save As**».

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 clicking «**img ...**» to the right of the question in the window «**LDQ**» (fig. 4.7) and selecting them from the pictures stored on your computer (fig. 4.8).

Self-testing

In self-test mode, it is recommended to enable selection of answers in the main menu, then appear on "Yes" / "No" button on LD bar (fig. 3.6). When tested with a selection of answers by pressing the "Yes" / "No" as a result of the test the times delay between a stimulus (question asked, the image) and the response (answer) will also be analyzed.

LDQ

GQ: Do you have a higher education degree? img...

GQ: Is your last name (Smith)? img...

GQ: Do you live in (Ottawa)? img...

CQ: Prior to joining our company, did you break any laws or disrupt public order? img...

RQ: Are you prepared to sell company's know how or intellectual property? img...

GQ: Do you have any free time? img...

CQ: Do you consider yourself an honest (man/woman)? img...

RQ: Will you safeguard our company's sensitive information? img...

GQ: Did you arrive by car to this meeting? img...

CQ: Is money the most important thing for you in life? img...

RQ: Are you capable of selling our company's information to anyone? img...

GQ: Thank you for your cooperation img...

Save as...

Fig. 4.7 Creation of a new questionnaire

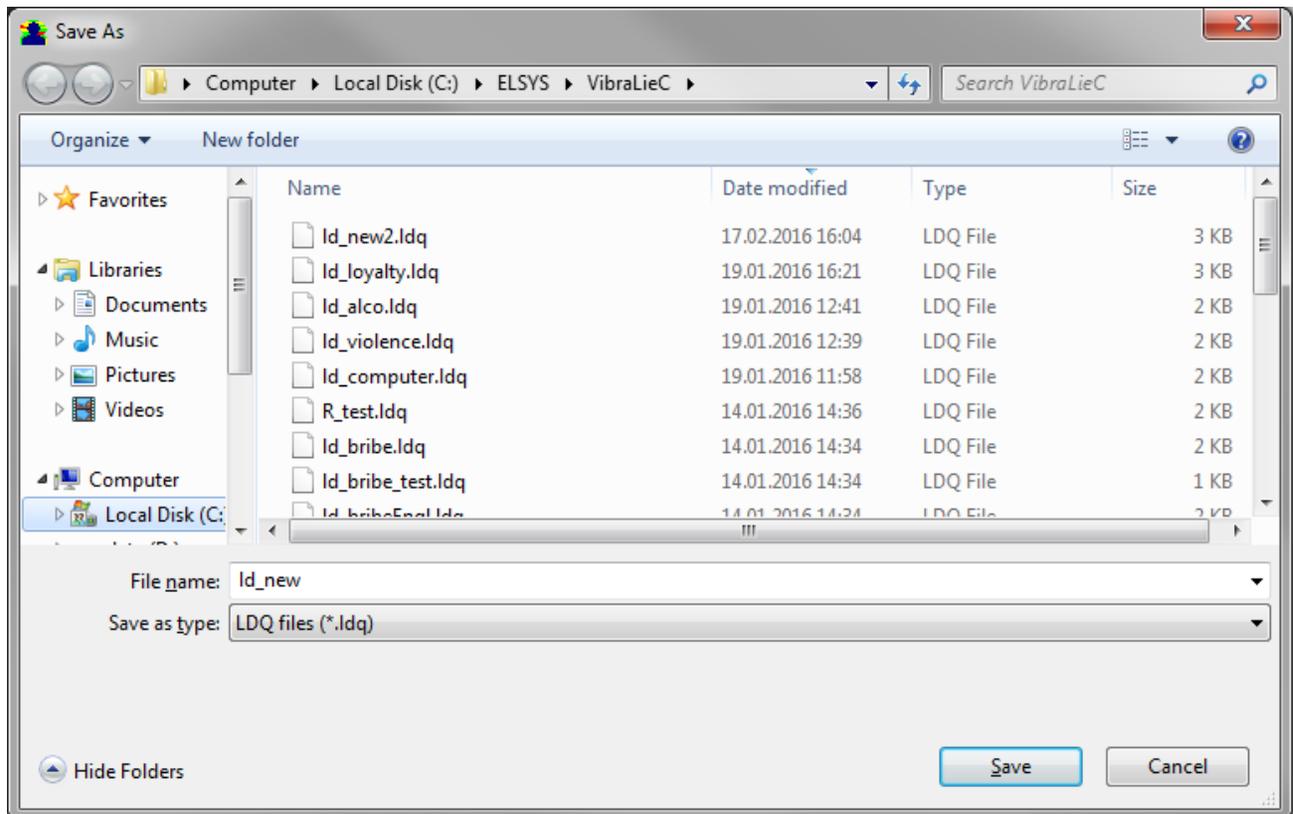


Fig. 4.8. Saving of a new questionnaire

4.3 Auto PPT

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 **VibraLie+** program is given below:

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

To reduce the uncertainty of comparative testing should 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 of information need to pay special attention. Examinee is located in front of the monitor, on which he sees shown images and questions. By selecting the button "**Yes**" or "**No**" on the screen (fig. 4.9), the subject answers the presented questions in real time.



Рис.4.9. The image and question on the monitor in front of the examinee.

The proposed method allows to receive and to use for the automatic conclusion of psychophysiological information obtained 5 different independent methods during the three minute test:

1. 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 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).

2. 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).
3. 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).

4. 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).
5. 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 5.1 of this description.

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: $sRr - sRc > 0$ или

NDI: $sRr > 0$

DI: $sRr - sRc < 0$

INC: $0,01 < sRr - sRc < 0,01$

As additional the following information obtained by results of testing is used:

- Information on the quality of the image. When the quality indicator is below 80% test result is considered invalid.

- The standard information as a YES or NO in answering the questionnaire. According to set algorithm, the answer is YES to any of the relevant questions leads to a negative test result.

The most important information in the processing of test results is comparative information in answering the relevant and control questions obtained vibraimage technology. The information flow analyzed of vibraimage technology is more than 10 MB / c, which greatly exceeds the amount of information analyzed by the contact polygraph technology. Incentives and questions for the test operator can choose himself.

All testing information is saved in files recorded on the test results.

5 Saving and analyzing results

Test results can be viewed using standard Windows functions, such as pressing the PrintScreen and download images from the screen to any standard program such as Paint to view graphics.

Automatic saving of the results to a file is available only when operating in the main mode.

After completing of the questionnaire program **VibraLie+** automatically creates files with the test results in the directory «C: \ Users \ user \ Documents \ LD Result».

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

- **vi YYYY-MM-DD HH_MM_SS.txtT.png** – graphic file with graphs of psychoenergetic state of a person changes over the period (fig. 5.1). A circle on the graph shows the point of collecting information for building a histogram of the frequency distribution.
- **vi YYYY-MM-DD HH_MM_SS.txtH.png** – a graphic file with the histogram of frequency distribution (fig. 5.2);
- **vi YYYY-MM-DD HH_MM_SS _1.png** и **vi YYYY-MM-DD HH_MM_SS _3.png** – image files with an vibraimage of test person before and after the test to assess the accuracy of the measurements in terms of the recording conditions (fig. 4.6, 5.3, 5.4);
- **vi YYYY-MM-DD HH_MM_SS _row** – the text file with results of measurements of parameters on questions for statistical processing (п. 5.5)
- **vi YYYY-MM-DD HH_MM_SS.txt** – the total text file with the results of measurements of parameters (fig. 5.5, 5.6).

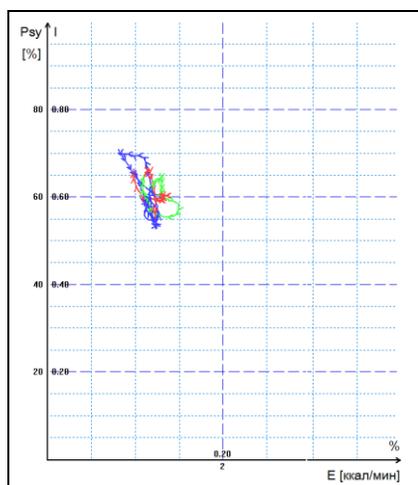
In all files in names **YYYY-MM-DD** and **HH_MM_SS** date and time of measurement.

5.1 Graphics of PPS changes

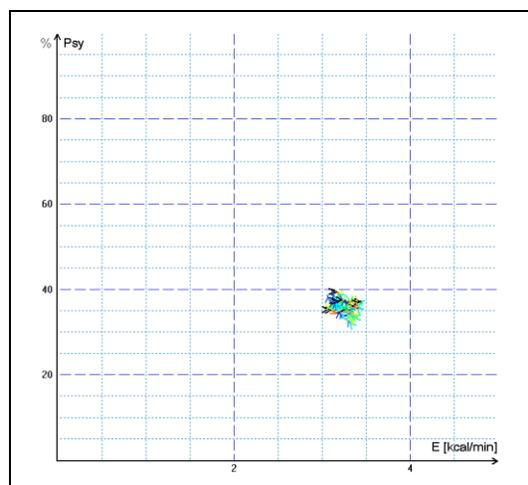
Changing of psychoenergetic state of a person to a controlled period of time clearly displayed on the graph (see. fig. 5.1). Only a person who is in a relaxed or in a state of high concentration (see. Fig. 5.1b) may be in a fixed psychoenergetic state during such insignificant time as 1 minute. Most of the people make a noticeable fluctuations of psychoenergetic state, even for short periods of time, depending on their thoughts (see. Fig. 5.1a) and under the influence of the environment (see. fig. 5.1c).

Color line of psychoenergetic state changes corresponds to the "color" of the test question:

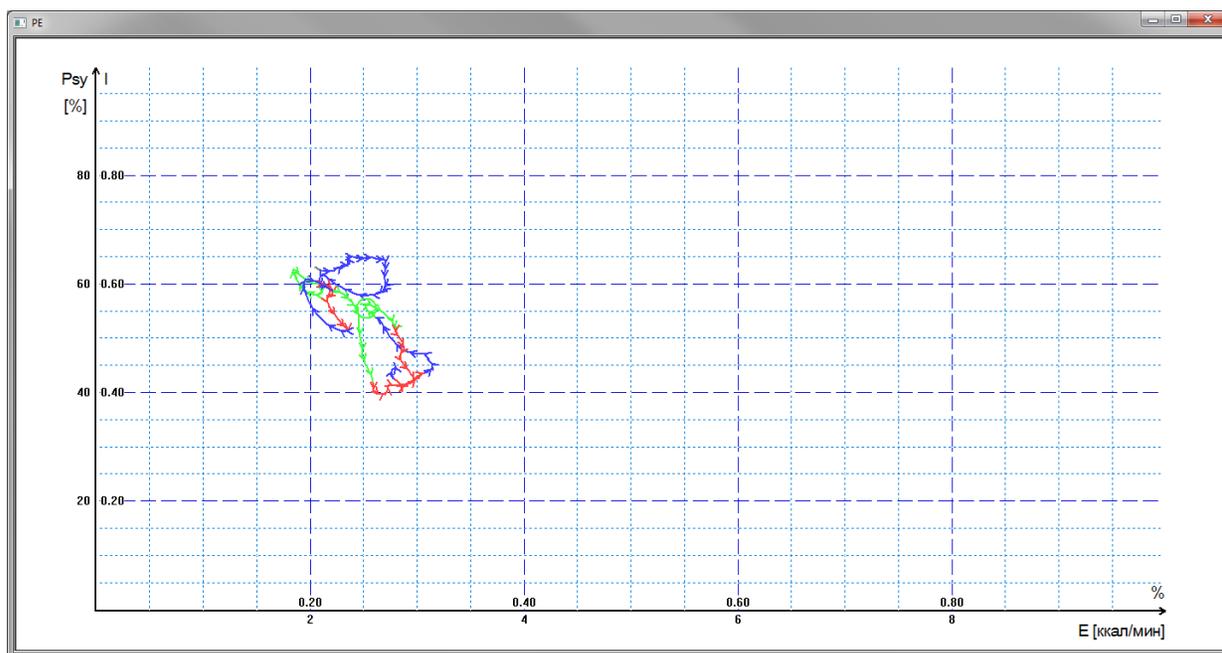
- general questions – blue;
- control questions – green;
- relevant questions – red.



a) Changing around the average value



b) Stable condition, indicating a high degree of self-control person..



c) Periodic change psychoenergetic state along a certain trajectory, usually characteristic for an interview, type a question-answer

Fig. 5.1 (a, b, c). Change person psycho-energy conditions for the chosen period.

5.2 Frequency histogram of PPS

The frequency histogram of PPS shows the total distribution of the tested person vibrations for all the test time. The similarity of the received histogram to the normal law of distribution means a normal state of the tested person during the test. Asymmetry or multimodality of the received histogram argue of certain deviations from the norm during the test.

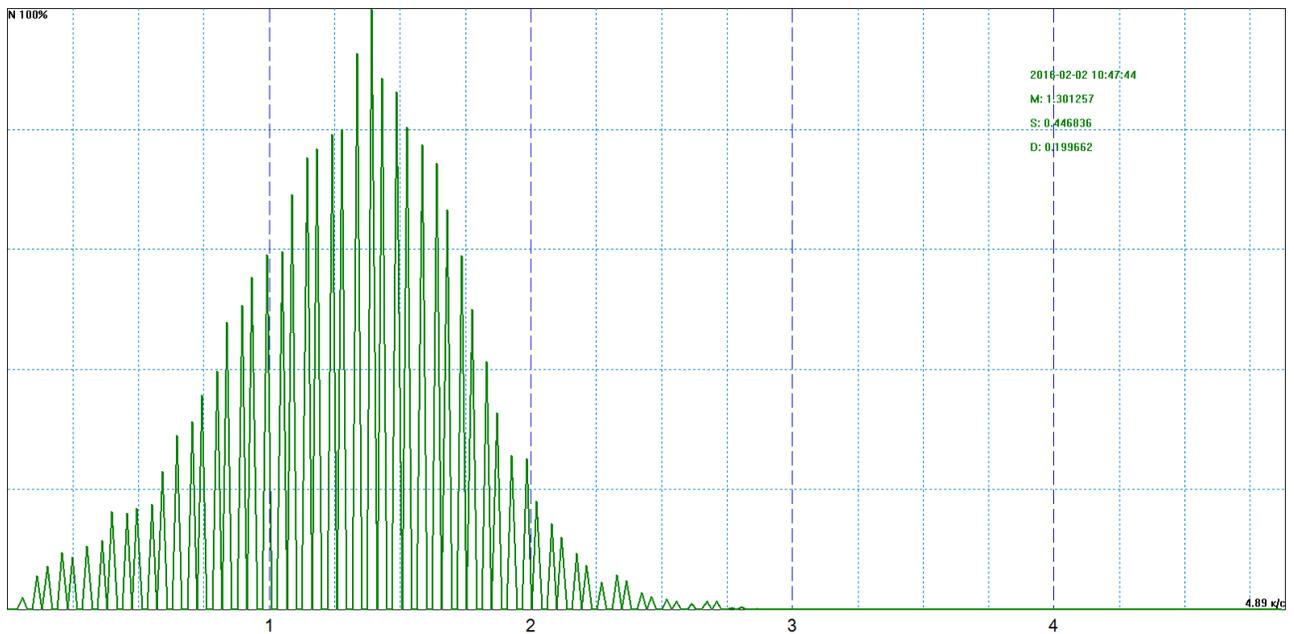


Fig. 5.2 Example of frequency distribution histograms.

5.3 Image files of start and end of test

During the tests two interviewee person images are recorded at the beginning of the start and the second image at the end of test. Data recording of files has information and test character, for example, excludes replacement of the examinee in the course of testing, duplicates quality control of the image and allows to control temporary changes of vibraimage parameters during PPT.

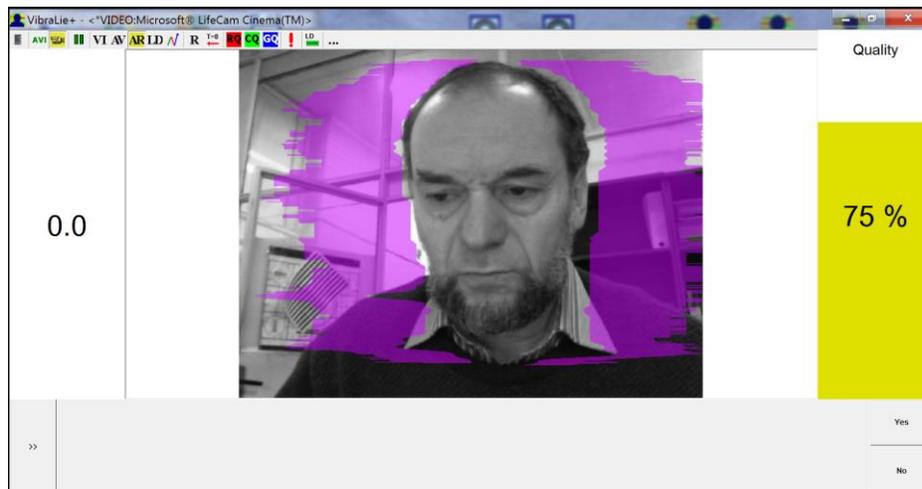


Fig. 5.3 Image of start of the test.



Fig. 5.4 Image of end of the test.

5.4 Recording the main test results

The main results of change of PPS when carrying out PPT synchronously with the shown graphic and text information remain in the text file which structure is given in figure 5.5.

```
#####
Area 1
02.02.2016 10:47:44
*VIDEO:Microsoft LifeCam Cinema
video timer:      23.3975
LDQ:      C:\ELSYS\VibraLieC\ld_credit.ldq
#####
### Main config
#####
#####
Area 2
##### 1      RQ      02.02.2016 10:48:53 video: 91.7935
Are you prepared to sell company's know how or intellectual property?
Area 3
#####
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
#####
#####
Area 4
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
#####
Area 5
R(m)      4
R(a)      46.4286
tR(i)      357.615
[Yes 5.67] { Are you prepared to sell company's know how or intellectual property?}
##### 1      RQ      02.02.2016 10:49:03 END
```

Fig. 5.5. Example of the beginning of the text file with the first relevant question (RQ).

In the text file *area 1* (fig. 5.5) relates to general information about the test:

02.02.2016 10:47:44 – date and time of the beginning of measurement in a format YYYY-MM-DD HH_MM_SS;

*VIDEO:Microsoft LifeCam Cinema – information on a video signal source in case the source is a video file, then the way to the file and its duration (U:\Eugenia\2016_01_27\LD\05.KJKa.avi 05:04);

video timer: 23.3975 – current time of receiving video signal;

LDQ: C:\ELSYS\VibraLieC\ld_credit.ldq – a file where the current questionnaire are stored.

Area 2 contains information about the test questions:

1 RQ 02.02.2016 10:48:53 video: 91.7935 – order number of question of this type, type of question (**general GQ**, **control CQ**, **relevant RQ**), date and time of question in the format YYYY-MM-DD HH_MM_SS, total time of the video;

Are you prepared to sell company's know how or intellectual property? – test question.

Area 3 includes information about the start and end of the question, as well as the lie level maximum time (the maximum value of the parameter P5) for the answer (LD Time) absolute in format DD.MM.YYYY HH: MM: SS, and from the beginning video recording in format MM:SS.

In the *area 4* displays only those values of parameters (Name column header), which exceeded set limits, at that:

cMin – current minimum value of parameter;

cMax – current maximum value of parameter;

bMin – set basic minimum value of the parameter;

bMax – set basic maximum value of the parameter.

vRates – "Rate" of the parameter, with which parameter will be taken into account in the calculations, if its current value is out of limits AND/OR of set the basic maximum bMax AND/OR of set the basic minimum bMin

v - visualization – used in the calculation of the parameter lie (P5)

cRates – "Rate" of the parameter, with which parameter will be taken into account in the calculations, if its current value is out of limits AND/OR of set the basic maximum bMax AND/OR of set the basic minimum bMin

c - calculation – used in the calculation of the parameter P20

At the end of this area the sum of all the parameters $\Sigma cRates$ with a norm deviation is given:

LD = -2 - 1 - 1 - 1 + 1 + 1 + 2 - 1 + 1 - 1 + 1 - 1 + 1 + 2 + 1 - 1 + 2 + 1 + 0 - 1 + 1 = 4

The P5 parameter (Lie, L) is shown on the lower graph appearing at the end of testing (fig. 5.4) and is calculated by the following formula:

$$L = \frac{\sum_{i=1}^m P_i * K}{\sum_{c=1}^n P_c * K}$$

where P_i – parameter with change the value between the periods of collecting Base period and analyzing Stat period;

P_c – parameters, measured at the lie detection;

K – rate of this parameter P_i in the calculation of lies;

n – quantity of parameters, measured at the lie detection;

m – quantity of parameters, which changes have exceeded the set limits.

On completion of each response when tested in main mode (p. 4) in the information column displayed a parameter value P5 (on the left of the image area) (fig. 3.1).

In the *area 5* the resulting measurement values for each response, calculated in three different ways, are given:

- (m) (max result) – results based on the analysis of the parameter P20;
- (a) (average result) – results based on the analysis of the parameter P5;
- (i) (integrated result) – results based on the analysis of changes in the area under the parameter's P5 graph.

R(m) 4

R(a) 46.4286

tR(i) 357.615

[Yes 5.67] { Are you prepared to sell company's know how or intellectual property? } – answer to a question, value of the P5 parameter, a question text;

1 RQ 02.02.2016 10:49:03 END – order number of question, type of question, end time.

At the end of the total text file the results of all measurements are given (fig. 5.6).

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

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=0.106 sRr=0.099 INC

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

global result

LD result INC

Fig. 5.6. Example of a text file of the test results.

At decision-making the sum of "scales" on relevant RQ questions and control CQ questions is considered. If $\Sigma(RQ) > \Sigma(CQ)$, a person lies (DI).

Max result – estimation of psychophysiological reactions to stimuli is carried out taking into account the different factors of significance vibraimage parameters (Rc).

Average result – average estimation of psychophysiological reactions to stimuli is carried out taking into account the equal factors of significance vibraimage parameters (Rv).

Integrated result – integral estimation of psychophysiological reactions to stimuli is carried out taking into account the equal factors of significance vibraimage parameters (Rv).

IE result

Analysis of changes in psycho-energetic state of a person during the response (fig. 5.1). The psychophysiological reactions of the person at the answer to the control and relative questions are compared. In answering the question the 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 the question, he's going to say a lie on it.

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

Comparison of the sum of these indicators for answers to relevant and control questions allows to define truthfulness of the answer or psycho-energetic expenses at reaction to the shown answers or incentives.

$$R = IR + ER$$

If a difference $Rr - Rc = dR < 0$, then the person has told a lie (DI) or reacted negatively to the shown incentive.

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

dT result

At the end of the file the analysis on a time delay in seconds in the answer to control and relevant questions is given.

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

The longer a person is thinking about the answer the higher the probability of lies. However, for a correct evaluation it is necessary to compare the response time on the relevant Tr and control Tc questions. If $Tr > Tc$ a person lies (DI).

Global result

It is calculated on the basis of the overall results of all sections. so for example shown in figure 5.6 answer INC, because the results of three of the five calculation result can not be determined.

Test results: False (DI), True (NDI), Uncertainty (INC) are displayed in the information column (fig. 3.1) on the left of the image area.

Note, if the camera settings and video shooting conditions were incorrect, at the end of the question, and at the end of the file error message about the specific reasons for the error with the quantitative contribution to the overall quality are appeared.

Warning! Low quality (1) [41.39%]

Warning! Low quality (2) [55.59%]

Warning! Low quality (3) [3.02%].

5.5 Recording of technical test results

Полная запись значений регистрируемых параметров системы виброизображения фиксируется в текстовом файле с окончанием .gow. Данный файл может использоваться для проведения статистических исследований и отработки алгоритмов определения ПФС и ПФТ.

Указанный файл может быть скопирован и перенесен в Excel для проведения самостоятельной обработки.

6 Additional VibraLie+ program features

Despite the complexity of the internal processing algorithms **VibraLie+** system is quite simple for the user and can make a detection of lies generally applicable, as the use of personal computers. Although psychophysiological detection of deception appeared before the computer, it still has not received wide distribution, especially due to the complexity and disadvantages of working with contact sensors. The first computers were massive boxes that are available only to big corporations, and the term personal computer as folly was considered. Also, do not hold up statement of some traditional polygraph, that the only reliable method of psychophysiological detection of deception is the use of traditional (for this moment) methods to obtain the contact information of the person psychophysiological, electrodermal response (EDR), heart rate (HR), respiratory rate (BH) and blood pressure (BP). Indeed, it is necessary to receive independent data (psychophysiological characteristics with minimal correlation) to obtain the most complete information about the object, however the modern digital television allows to receive much more than not correlated psychophysiological characteristics of the person, than traditional contact polygraphs.

Note, the use of additional modes of program **VibraLie+** is recommended for advanced users.

6.1 Capture LDQ video mode for testing

To activate the Video capturing mode must be set in the main menu a mark on the row «Capture LDQ video», in accordance with fig. 6.1.

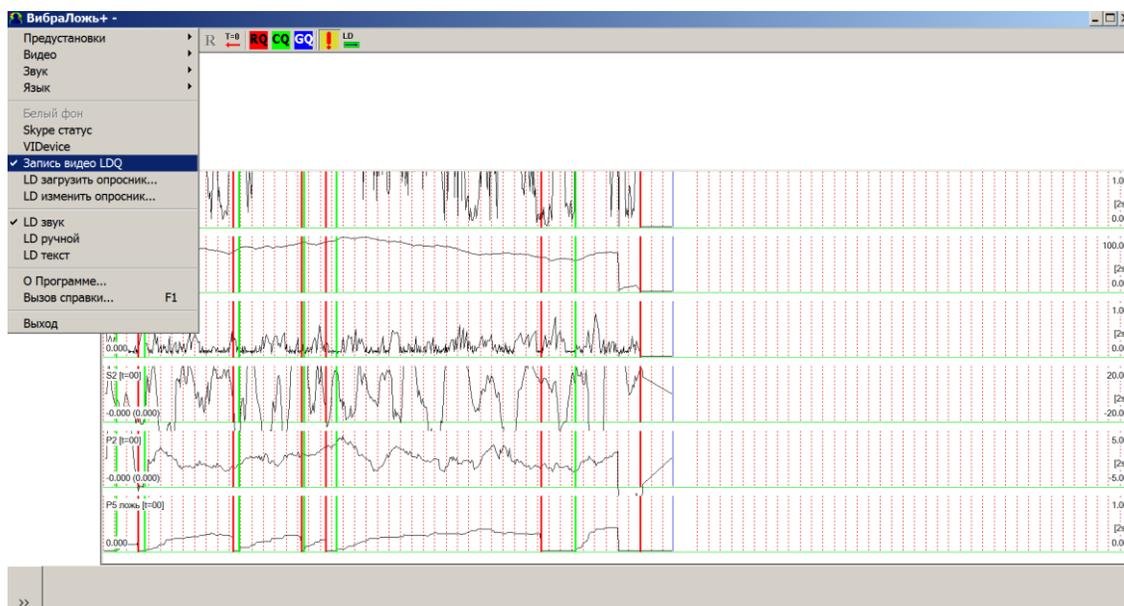


Fig. 6.1. Mark of the Video capturing mode

Results after setting of the mark in the subsequent pressing “test” on the left side panel of the questionnaire during the test are stored in the “LD Result” folder along with the recorded video file.

Attention!

Video recording is done without compression, so the hard drive must have enough space to record video. The standard size of 3 minutes of recorded video is about 2 Gb.

6.2 Psychophysiological detection of deception in semi-automatic mode, random questions

In LD audio mode user needs firstly to adjust Audio Threshold so that background audio level must be lower than Audio Threshold and audio level of questions and answers must be higher than Audio Threshold. In this case every question-answer response divided by time period not less than 10 seconds from the next question-answer response is characterized by level of changes for every measured psychophysiological parameter. The total changes in psychophysiological parameters are characterized by two general indicators – P5 integral parameter indicated on the down graph, and P20 differential parameter indicated on the vertical column. More quantity of P20 parameter after response indicates more high level of psychophysiological response and gives more lie probability for two response comparison.

Sample of program window for PDD is shown on fig. 6.2.



Fig. 6.2. Program *VibraLie+* window of PDD sample in Audio mode.

It is necessary to note, that calculations of integral response P5 and differential response P20 are doing based on the more quantity of psychophysiological parameters than is indicated on the fig. 3.19. In the base of LD calculation algorithm are using the same equations as in **VibraImage** PRO version including calculation of time dependence changes about 30 psychophysiological vibraimage parameters. The results of comparative testing between traditional contact polygraph and vibraimage PDD shows 95% matching.

For psychophysiological changes visualization in VibraLie are using the indication of the following vibraimage parameters:

- A1 – value of base processing frame difference amplitude, indicated fast head movement of person,
- F3 – average value of pixel quantity, change for time period of 100 frames processing, shows general level of head movements and emotional energy for current 20 seconds period,
- F8 – peak value of F6 parameter (in seconds) shows current period of F1 parameter changes, indicated minimal time of person response,
- S2 – average difference between left and right accumulated movement response of object for 2 second, show movement and minds asymmetry,
- P2 – dispersion of vibraimage frequency distribution for 100 processing frames, indicated dispersion of head movement in time and space,
- P5 – – integral indicator of psychophysiological response, calculated with equal rates for every fixed vibraimage parameters,
- P20 – quantitative indicator of psychophysiological response, calculated with different rates for the fixed vibraimage parameters, because for vibration process some part of psychophysiological parameters are accelerated and other part are inhibited during the one psychophysiological response.

In auto mode examiner need to control left vertical column, because maximal level in this column (P20), shows maximum psychophysiological response and could be interpretive as lie.

6.3 Psychophysiological detection of deception in semi-automatic mode, Backster's test

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. These results are based on experience of several dozen years of psychophysiological detection of deception.

Sample of psychophysiological responses for comparative zones test to control and relevant questions captured by VibraLie system is shown on fig. 6.3.



Fig. 6.3. *VibraLie+* window for comparative zones test of PDD.

Examiner or operator marks control questions (CQ) and relevant questions (RQ) pressing on corresponding buttons on the Tools panel of VibraLie window. After test finishing operator or examiner (person asking questions) press button  on the same Tools panel. *VibraLie+* program immediately shows test result on the vertical column. The true test shows green column with NDI (Non Deception Indication), the lie test shows red column with DI (Deception Indication), if it is impossible to do precise calculation of lie detection, program shows yellow column with INC (INConclusive result).

6.4 Psychophysiological detection of deception in manual mode

Lie detection in manual mode used when question-answer audio quality (live or recorded) is poor for correct mark of questions start and it is impossible to divide questions-answers from background audio. In this case is necessary to switch program into LD manual mode as it is shown on the fig. 6.4.

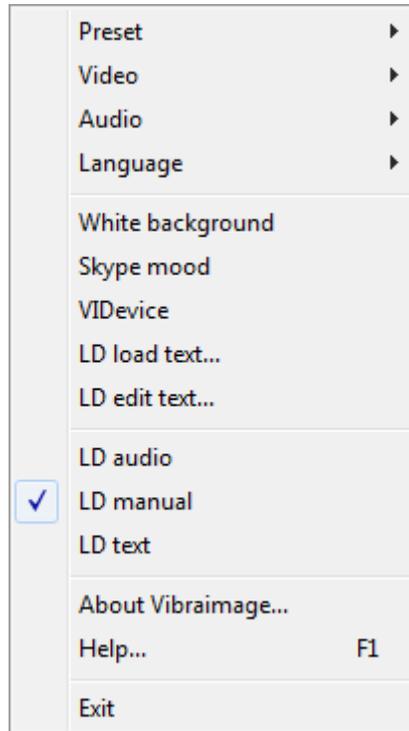


Fig. 6.4. Choice of LD manual mode.

In LD manual mode also is possible lie detection based on comparison test zone, and in this case operator or examiner mark the start of control question zone and finish of control question zone, so as for relevant question zones pressing button LD on the Tools panel of VibraLie+ window.

6.5 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 VibraLie+ program shows the absolute (not relative) the test reactions to questions. An example of the calculation results of the file with the ranking table is shown in figure 6.5.

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

R: 11 (25), 6 (27), 3 (29), 4 (36), 7 (38), 12 (40), 5 (47), 2 (49), 8 (53), 1 (64), 9 (67), 10 (71)

Fig. 6.5. The results of the ranking of psycho-physiological reactions in answering to questions

Top rows in the matrix show numbers of questions that caused the maximal response of the test person. The highlighted ranking row R results final rating reactions to questions on certain 7-algorithms (A, I, S, S1, At, It, M).

7 Definition of emotions

Head movements in space classically associated with vestibular system are studied and discussed in relation to the status of vestibular reflexes (i.e., the vestibulo-ocular, vestibulo-collic, and cervico-ocular reflexes). But it is possible to look on head movements according to the vibraimage system and technology. We supposed that head balance for person without consciously movements could be considered as isolated thermodynamic system and any emission of internal energy would change the balance of this isolated system and realized by movements or vibrations.

Every emotional state characterized by specific energy conversation and work done by the system transfers to micro vibrations, if the person forced to stand or set still. The head vibration parameters (frequency in range 0.1-10 Hz and amplitude) are stable in time for stable emotional state of person. Parameters of vibrations changed only after emotional state alteration. **VibraImage** technology allows to contactless register of person vibration parameters and calculates emotions according to accumulated statistics of comparative testing with EEG, skin galvanic reaction and psychological testing. **VibraImage** technics, parameters and research results are below.

7.1 VibraImage parameters

Values of amplitude and frequency of vibrations of a person head differ in each point of space and are displayed as pseudo color image. Integrated processing of parameters values of vibration in each point can give the general information on parameters of the person movement. Vibraimage the person heads displaying amplitude (fig. 7.1) and frequency (fig. 7.2) the distributions of vibrations modulated by a color scale (fig. 7.3), are showed below:



Fig. 7.1. Amplitude vibraimage Fig. 7.2. Frequency vibraimage Fig. 7.3. Pseudo color scale of frequency distributions

Each point (pixel) amplitude vibraimage (fig. 7.1) reflects the relative moving of an element of the image saved up for determined time as it is known, that at insignificant moving the frames difference is proportional to the movement of object. For transformation of this relative moving in absolute, it is necessary to have the exact information on distance up to object and a working corner of an objective of the chamber, and then a color scale (fig. 7.3) can be scaled in millimeters or microns. However, at about the same location of faces on the screen, automatically the condition the single relative amplitude vibraimage scale satisfies. This allows to compare the obtained information about moving images to different people.

As against amplitude analyses, each point frequency vibraimage has physical dimension frequencies (Hz) as really displays frequency of signal change in each element of the image. Therefore the resulted color scale (fig. 4.3) scaling in Hz, i.e. violet color frequency vibraimage displays a range of vibrations (0-1) Hz, dark blue displays a range of vibrations (1-4) Hz, green the range of vibrations displays (4-8) Hz, red displays a range of vibrations (8-10) Hz.

On the basis of the given two primary images the technique assumes definition more than 40 integrated vibraimage parameters, reflecting various types of movement and vibration, and the parameters divided into 4 basic groups:

- A – amplitude parameters;
- F – frequency parameters;
- S – symmetry parameters;
- P – spatial and timing parameters of mathematic calculation.

7.2 Aura-VibraImage

External (around of a head) interline display of the maximal frequency and average amplitude vibraimage looks as aura and more informatively displays a condition of the person, than internal vibraimage. Color of vibra-aura is coded by the same color scale, as vibraimage (fig. 7.4), and displays the maximal frequency in each line. The size of aura is defined by average amplitude for the given line. Any non-uniformity in color and the size of aura characterizes movements of object and its emotion condition. The normal condition of the person is characterized more uniform external vibraimage (vibra-aura), and for an intense condition of the person are characteristic the big space and color non-uniformity of vibra-aura.

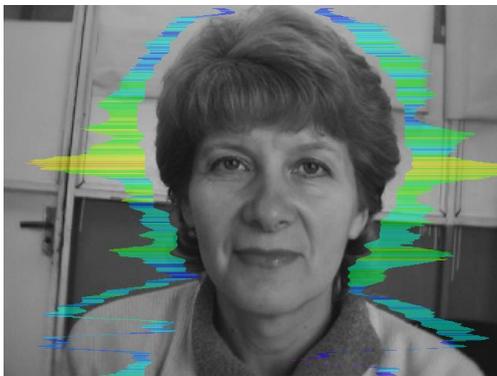


Fig. 7.4. External vibraimage (vibra-aura) of person in normal condition

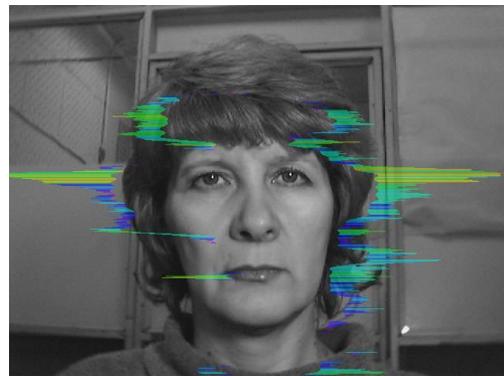


Fig. 7.5. External vibraimage (vibra-aura) of person in tension condition

Obvious distinctions between images on fig. 7.4 and fig. 7.5 illustrate advantages of the visual analysis of the person condition on external aura in comparison with the visual analysis initial vibraimage. The vibraimage method gives significant freedom of a choice of registration of a condition, and visual supervision of aura allows to estimate quickly and evidently practically all emotion parameters of the person. Brief interpretation of the form and color of aura is resulted on the fig 7.6. This brief information does not limit, and sets to the user of system the basic directions of the analysis of person condition. Getting experience and taking into account the specificity of application, each user of system can diversify and deepen essentially results of the analysis of vibra-aura, open secret secrets of soul and a body of the person.

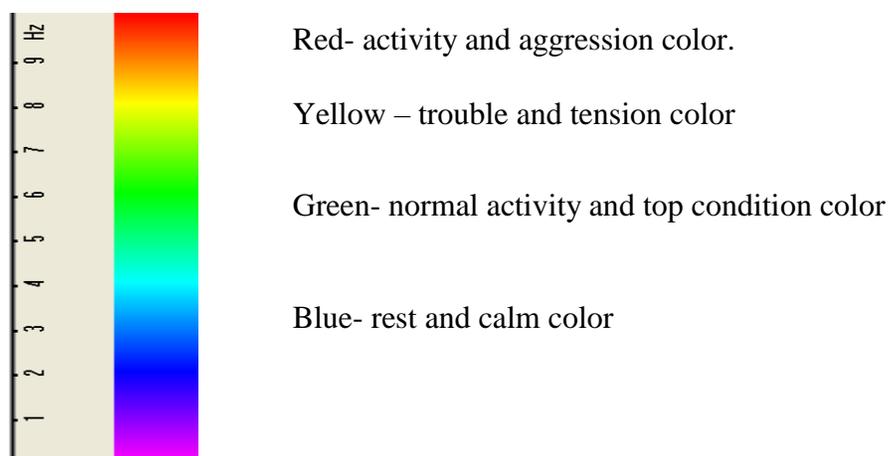


Fig. 7.6. Brief vibra-aura color interpretation.

Brief aura form analysis

1. Any aura asymmetry (form, color) characterized deviation from mental or physiological norms.
2. Color irregularity of vibra-aura characterizes psycho-physiological imbalance of a person status.
3. Any breaks in aura uniformity characterized deviation from mental or physiological norms.
4. Ideal aura has mono color, symmetrical and uniform. Any real aura differs from ideal and the question of interpretation is to characterized real aura deviations.

Note!

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

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

7.3 Vibraimage emotion samples

Normal and top emotional state

Normal condition characterized by aura color and form uniformity around the head, relevant monochrome color in the middle of suggested color scale (fig. 7.7). Activity level is about 0.3– 0.6. Stress level is about 0.2– 0.5.

Tension level is not more than 0.4.

Every emotion level measured in the range from 0 till 1,0 and minimal value coordinates with minimal emotion intensity.

Frequency distribution histogram is near normal (Gauss) distribution and spectrum of high speed vibraimage signals is near exponential distribution.

Vibra-aura photos samples for normal condition of person are on fig. 7.7 below:



Fig. 7.7. Vibra-aura photos samples for normal condition of persons.

Stress state

Stress state characterized by amount gaps in aura form and greatly aura colors non uniformity. Vibra-aura includes every scale colors and sharp color transfer, like red color could transfer to blue (fig. 7.8). Stress level more than 0.7.

Aggression or activity level is low, not more than 0.5 and tension level is high and usually more than 0.4.

Frequency distribution histogram has several modes and high speed vibraimage signals spectrum presents superposition of exponential and uniform distributions.

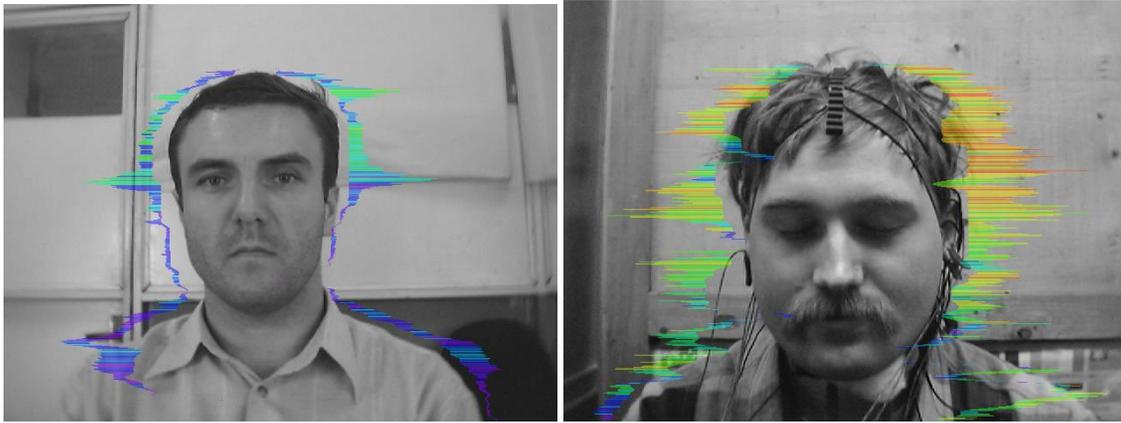


Fig. 7.8. Vibra-aura photos samples for stress condition of person.

Aggressive and/or tension state

Aggressive state is not every time coordinates with tension, and tension state is not always coordinates with aggression. But often these two emotions accompany each other. Aggressive state obligatory characterized by high frequency vibrations and red colors in vibra-aura (fig. 7.9). Vibra-aura size is more than normal and gaps could absent, but color and form non uniformity must present. Stress level could be low, less than 0.3.

Anger level is more than 0.7 and tension level is more than 0.4.

Frequency histogram distribution has maximum in right part of the range and distribution has amount dispersion. High speed signals spectrum envelope looks like uniform distribution.

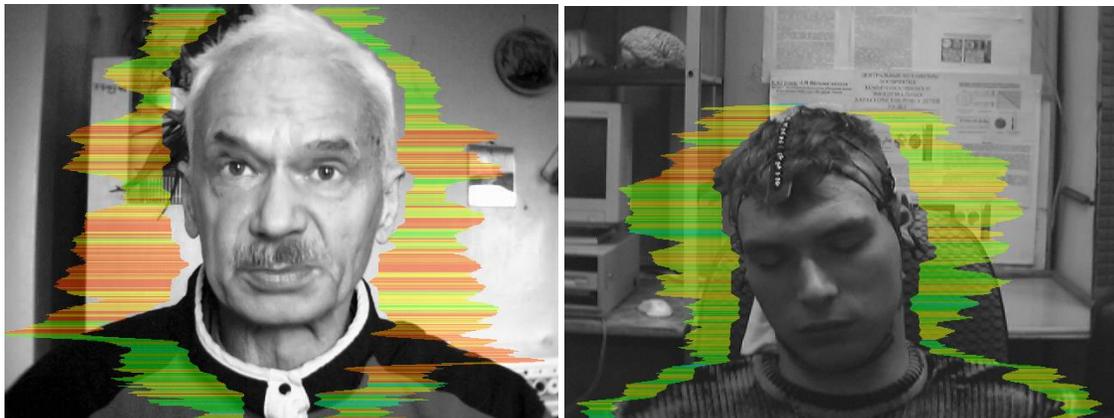


Fig. 7.9. Vibra-aura photos samples for aggression condition of persons.

Meditation

VibraImage system application allows to register distinction not only between the aggressive (abnormally excited) and normal condition of the client, but also and to register a degree of condition change of the person when the person calms down (fig. 7.10) or meditates.

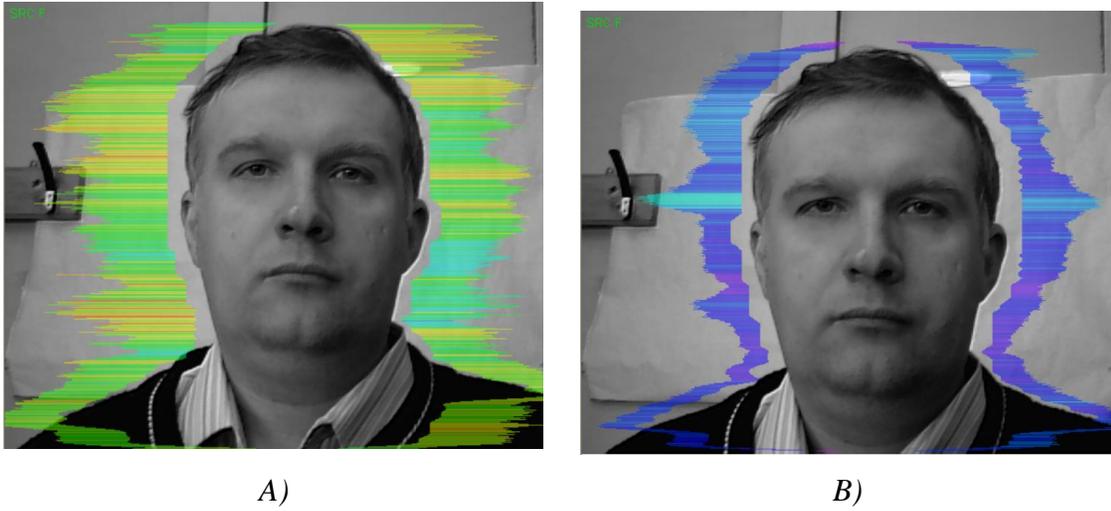


Fig. 7.10. Samples of self-correction person emotional states. A - 10 seconds after the beginning of supervision. B - 100 seconds after (the person have asked to calm down and count up to 100).

8 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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