Telediagnosis and Monitoring of Student Psychophysical Condition

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For citation:
Bakutkin V.V., Bakutkin I.V., Zelenov V.A. Telediagnosis and Monitoring of Student Psychophysical Condition. *Scientific Research and Innovation. 2021;1(2):57–62*
DOI:10.34986/MAKAO.2021.21.43.001

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Conflict of interest:
The authors declare that they have no conflicts of interest.

Acknowledgements:
The project was performed in accordance with the Russian Foundation for Basic Research agreement No. 17-29-03219ofi_m *Methods of Developing High-Speed Algorithms for Diagnosing the Anterior Chamber of the Eye and Human Pupillary Responses for Autonomous Use on Mobile Devices*.

Received: 13 April 2021
Revised: 16 May 2021
Published: 20 May 2021

Abstract: Telediagnosis and monitoring of psychophysical condition in students via digital technologies is based on using hardware and specialized software. There is a remote questionnaire, the results of which are analyzed. A reporting form is generated in both text format and in the form of a graph. Objective examination is carried out *via* digital biomicroscopy of the eye, which allows to analyze the parameters of pupillary reactions, size of the palpebral fissure, range of eye movement, blinking frequency, the degree of eyeball redness, presence of nystagmus, and the state of the tissues surrounding the eye. In the hardware part of the computer appliance, there are sensors for detecting and measuring the concentration of ethyl alcohol vapors. Digital measurement of body temperature is performed with a sensor in direct contact with the forehead area during the examination. There is an additional program for iris-based identity authentication of the examined person. The use of digital methods in the system of medical checkups increases their efficiency through the use of objective examination methods.

Keywords: medical examinations, digital technology, health status, students.

Introduction

Much attention is paid to training the specialists in the system of secondary and higher specialized education. This is due to the high requirements for the personal and professional qualities of future specialists. Organization of medical examinations by educational institutions is regulated by articles of the Russian Federation Labor Code. It is possible to identify health disorders in students only if they regularly undergo medical examinations [1]. Medical checkups are carried out in order to identify signs of exposure to harmful or hazardous factors, conditions and diseases, including alcohol, drug or other intoxication and residual phenomena of such intoxication [2]. The student's health status is influenced by many factors, in particular, by various diseases, psychophysical fatigue, or intake of psychotropic drugs [3]. The equipment of examination rooms does not always provide an adequate quality of diagnostics [4].

Materials and Methods

Telediagnosis and monitoring of the psychophysical condition in students should provide the comprehensive assessment of their health status. The initial stage includes interviewing students to reveal their

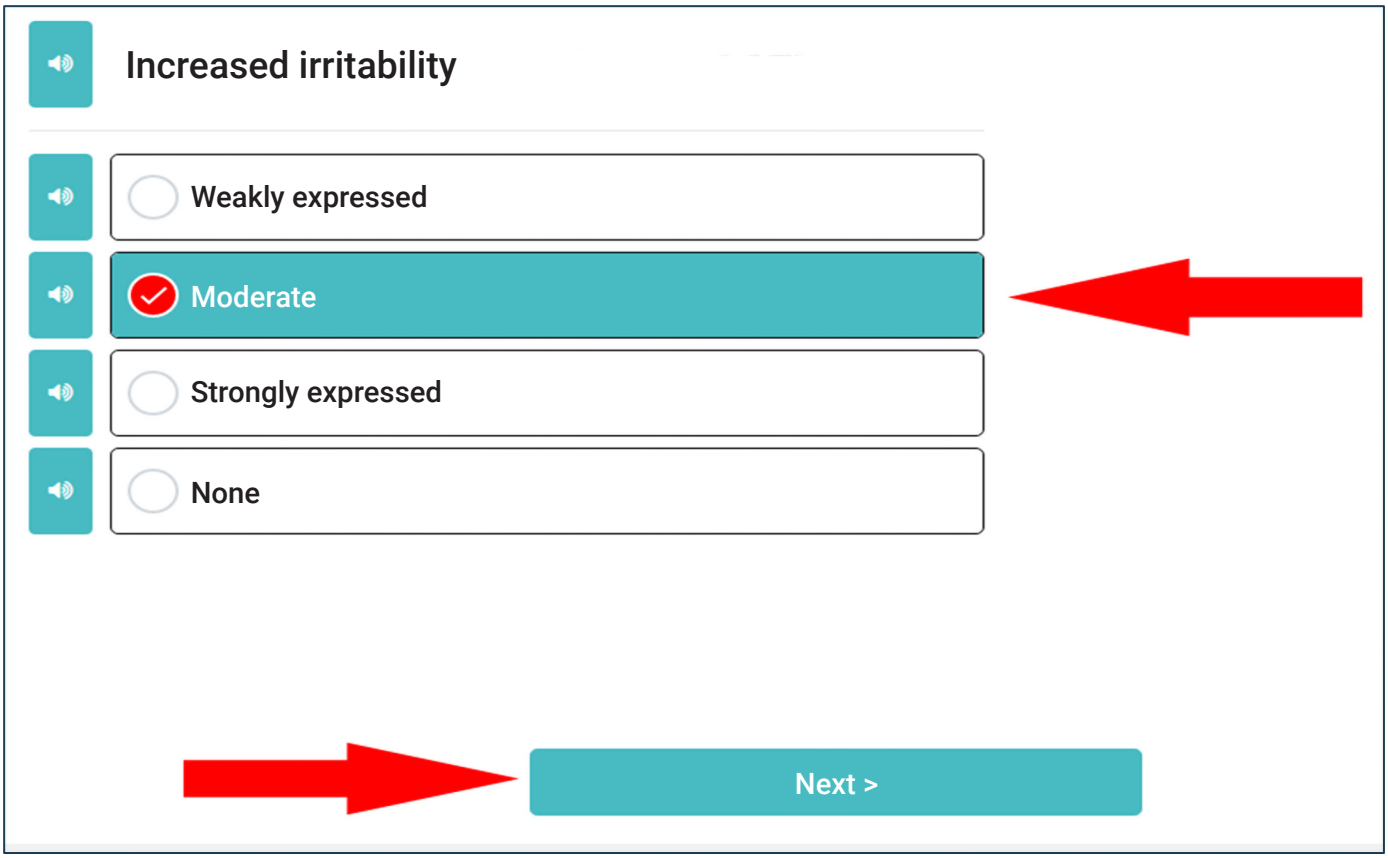

Figure 1. Analysis of answers in the patient's medical record

psychophysical condition. We have developed an Internet questionnaire that is available at the link www.intemsys.ru. The list of questions is conventional, and is compiled on the basis of existing standards. Answers are given consecutively, with the possibility of quantitative assessment.

Choose the answer options:

1. Do you have any health complaints?
- None.
- Some.
  - Ache
  - Dizziness
  - Weakness
  - Impaired vision
  - Other (specify!).

2. How long did you sleep last night?
- Over 8 hours
- 6–8 hours
- Less than 6 hours.

3. How do you rate your sleep?
- Adequate, continuous sleep; no difficulty falling asleep
- Disturbed sleep: I do not fall asleep well
- I wake up at night.

4. Did you consume alcoholic beverages within last 24 hours?
- Yes
- No.

5. Did you take any stimulants or highly potent pharmaceutical drugs in the past 24 hours?
- Yes
- No.

6. Do you have increased irritability?
- Weakly expressed
- Moderate
- Strongly expressed
- None.

Answers to test questions are given directly by students. They are responsible for honest responses. Based on the results, an analysis is carried out, and

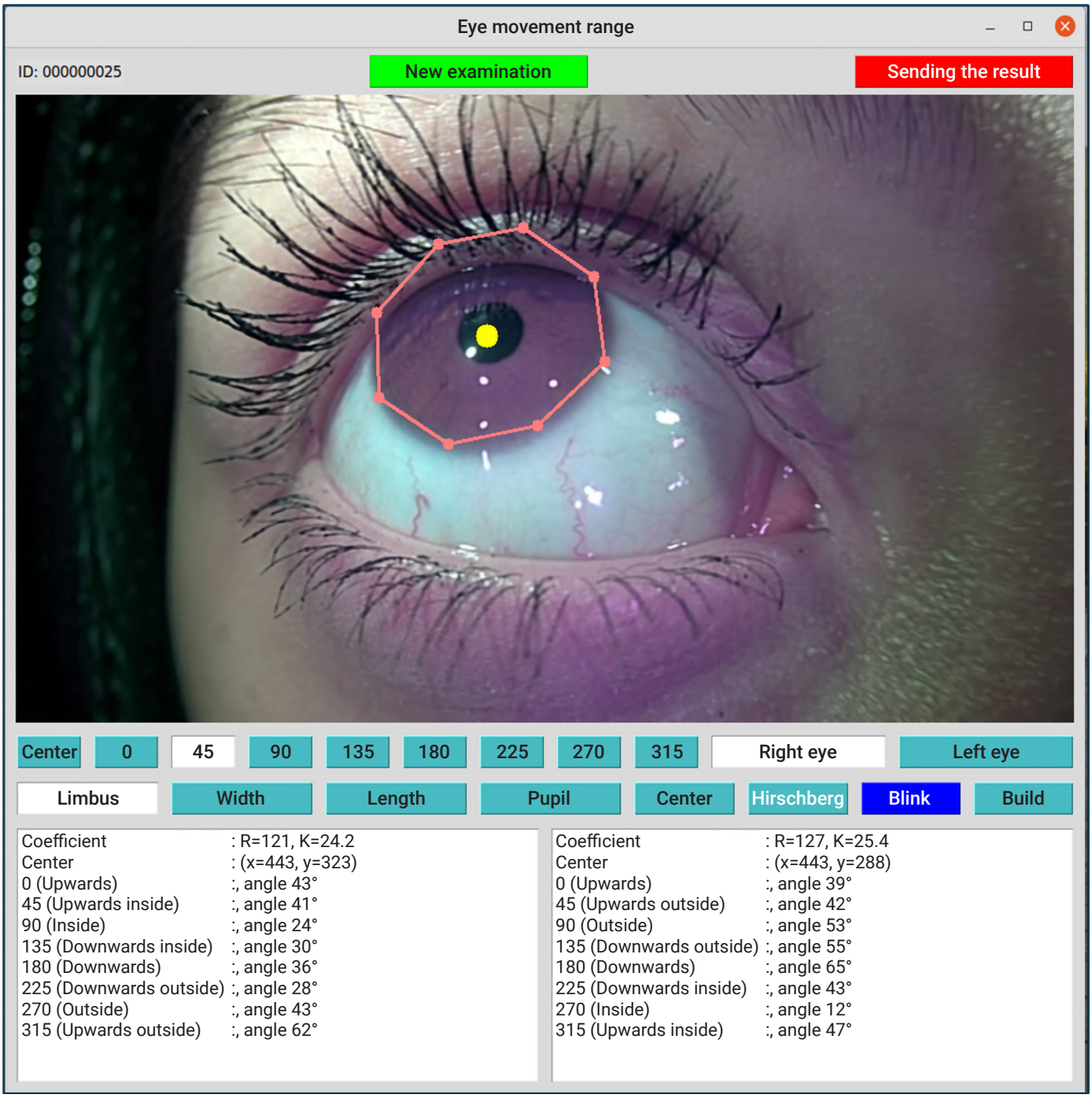

Figure 2. **Telemedicine examination process**

a reporting form is generated in text format and in the form of a graph. In case of positive answers to consumption of alcohol and highly potent pharmaceutical drugs, a student is sent to medical examination. If there are discrepancies between student's responses and an objective picture, the indications for additional medical checkup are substantiated. The hardware part of the developed computer appliance is a compact self-contained device for digital biomicroscopy of the anterior chamber of an eye, and a specialized software.

The computer appliance for telemedicine examinations is autonomous, using autonomous power sources and the ability to connect to the Internet *via* mobile router. Also, in the hardware part of the

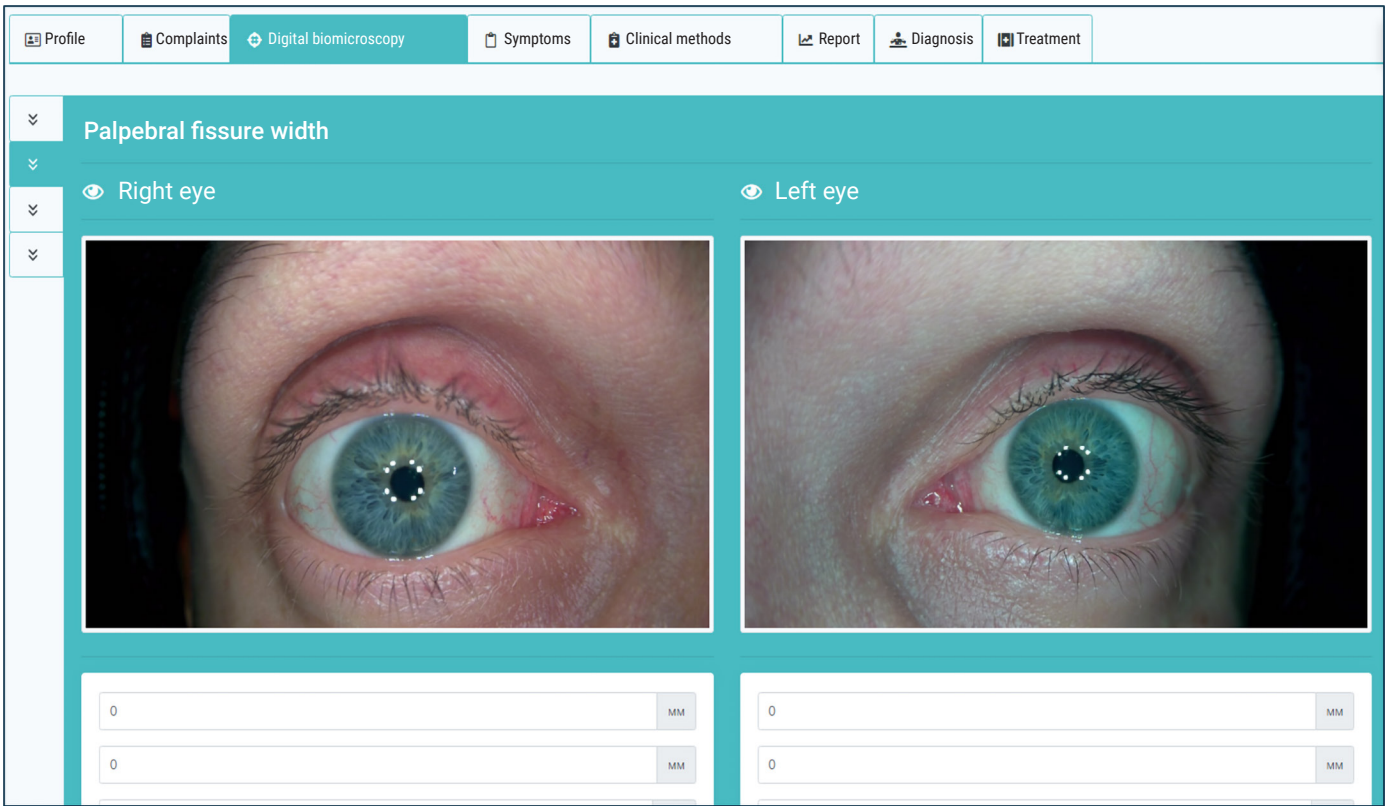

Figure 3. Remote examination

complex, there are sensors for detecting and measuring the level of concentration of ethyl alcohol vapors. In accordance with existing requirements, a digital measurement of body temperature is performed with a sensor in contact with the forehead area during the examination. Additionally, there is audio communication via the zoom communication channel on the tablet computer. An objective examination is carried out using the method of biomicroscopy by means of digital methods, which allows obtaining primary data for the analysis of pupillary reactions, palpebral fissure size, eye movement range, blinking movement frequency, eyeball redness degree, nystagmus presence, and the condition of the tissues surrounding an eye. There is an additional program for the iris-based identity authentication of the examined person.

Results

Telediagnosis and monitoring of the psychophysical conditions in students using digital technology was used at a higher education institution of a technical profile on 122 students. The use of questionnaires has significantly reduced the checkup duration. The responses reflect the condition of the subject and allow to identify existing complaints. Examination on the hardware part is possible in the remote version of medical checkups. Digital biomicroscopy is an objective examination method, providing an analysis of the parameters of pupillary reactions, size of palpebral fissure, range of eye movement, blinking frequency, the degree of eyeball redness, presence of nystagmus, and the condition of the tissues surrounding an eye. The range of eye movements and pupillary reactions permit to comprehensively assess the neuropsychic state of a student. Eye redness is classified as a red eye syndrome, indicating an inflammatory process in the mucous membranes, or an increase in blood pressure or intraocular pressure. In the presence of such symptoms, the student is offered to undergo an additional medical examination. Sensors for detecting and measuring the level of ethanol vapors concentration are located in the nasal part of the subject's face; they record the exhaled air for 30 seconds. A digital measurement of body temperature is performed with a sensor in direct contact with the forehead area during the examination.

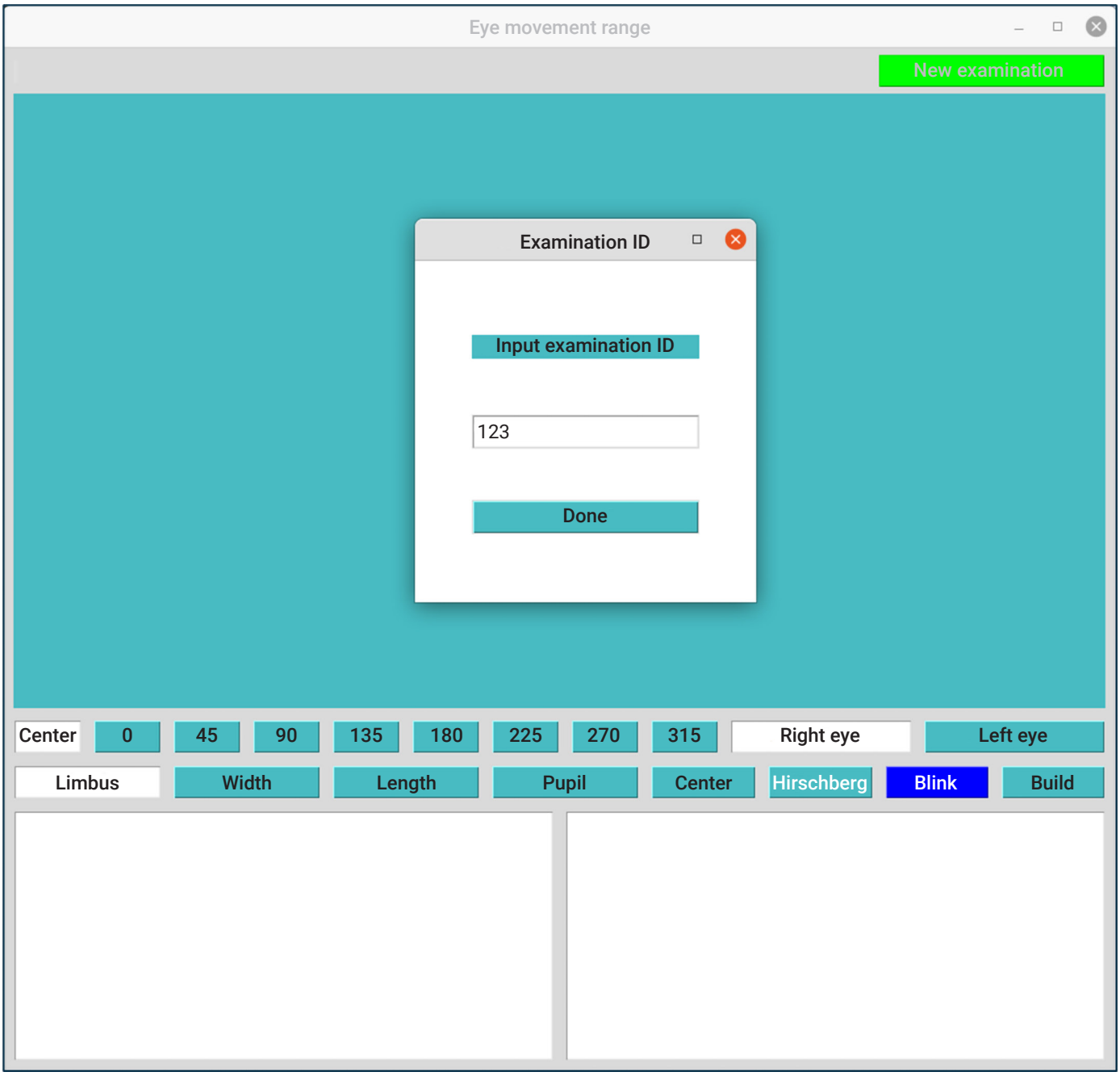

Figure 4. Medical report on the patient's condition and readiness for work

Discussion

Remote diagnostic methods, including medical examinations, are increasingly used in practice. This is due to the general trends in the development of digital technology, as well as to economic factors. The possibility of transmitting data *via* Internet channels opened new opportunities for processing the information obtained for analysis and medical decision-making. Currently, there are studies that are devoted to computer appliances used in remote sensing [5, 6, 7]. The main advantage of using digital methods in pre-travel medical examinations is to obtain objective information about the patient's condition. The data collected as a result of biomicroscopy of the eye allows assessing general medical condition of the subject [8]. The biomicroscopic picture of the condition of the eye mucous membrane indicates the state of blood circulation, as well as reveals early signs of microcirculation disorders, inflammatory diseases and various intoxications [9].

Identification of the eye movement range and pupillary reactions ensures the multifunctionality of employed methods, their significance and clinical effectiveness. Objective assessment methods allow tracking the dynamics of the subject's condition and save these data for further comparative analysis.

Conclusion

Telediagnosis and monitoring of the student psychophysical condition presumes the development of the service using the methodology and hardware of digital biomicroscopy of an eye. The examination technique is non-invasive, safe, and based on digital methods of investigating multiple indicators of the psychophysical condition in students. The service includes questionnaires and objective examination methods for indicators of fatigue presence, inflammatory diseases, and identification of signs of drug and alcohol intoxication. To fulfill this task, high-precision sensors and diagnostic algorithms are used. The data on medical checkup results are archived, and it is possible to conduct their comparative analysis. The hardware and software were developed by domestic scientists, they are protected from falsification and unauthorized information copying. To achieve this, the iris-based methods of user identification are used.

The main objective for creating this service was to provide motivation in students for a healthy lifestyle, professional advancement, and control over their health status.

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