

# МАТЕМАТИЧЕСКИЕ МЕТОДЫ И ИНФОРМАЦИОННЫЕ ТЕХНОЛОГИИ В ПСИХОЛОГИИ И МЕДИЦИНЕ

## INFORMATION TECHNOLOGY OF SUPPORT PSYCHOLOGICAL RESEARCH FOR IT-STUDENTS GROUPS OF TOMSK POLYTECHNIC UNIVERSITY\*

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## ИНФОРМАЦИОННАЯ ТЕХНОЛОГИЯ ПОДДЕРЖКИ ПСИХОЛОГИЧЕСКИХ ИССЛЕДОВАНИЙ ГРУПП СТУДЕНТОВ ИНСТИТУТА КИБЕРНЕТИКИ ТОМСКОГО ПОЛИТЕХНИЧЕСКОГО УНИВЕРСИТЕТА\*

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### **Introduction**

Currently, due to the demographic decline, educational institutions are experiencing difficulties with hiring employees corresponding to the world high school standards in the background and a demographic decline.

It's impossible for the senior representatives of the TPU selection committee to examine thoroughly the identity of prospective students. Psychologists of TPU proposed the blitz survey program that allows to study the psychological characteristics of a wide range of both students and first-year students.

For a successful career in the future it is important to determine the level of development of psychological characteristics, cognitive and intellectual capacities of students even during their university studies. In the context of centralized data processing, it is necessary to redistribute psychologist's functions as to provide the opportunity to focus on the analysis of the procedures already automated data. As a result the urgent development of testing and data collection Web-product becomes an issue for a psychologist to process that further.

The advantages of this treatment method may include the unity of processing techniques and its simple and timely improvement, common standards for information, standardization of data and information procedures, the common technical support, that can solve the problem of interface hardware, and the ability for the user to handle large volumes of data.

### **The functionality of the portal MultiTest**

In the Institute of Cybernetics of TPU at the Department of Applied Mathematics, the portal MultiTest was developed – the main advantage of which is free access to testing procedures and results for further processing [1, 2].

The portal is implemented on the basis of WEB-server Apache, which is considered to be the main advantages of reliability and configuration flexibility. It allows you to connect external modules for the provision of the used data, authenticate database users, modify the error messages, and so on. D. The core of Apache includes basic functionality, such as processing of configuration files, the HTTP protocol and the system load modules.

The database MySQL is used for the data storage of the tests and user's information. AJAX technology and data format XML are used for the exchange of data during the test, which, on the one hand, allows using the browser as a client and, on the other hand, creating the customer's portal in the form of a software product.

A standard browser is used to log in the portal and work with it further: Internet Explorer v7 or higher, Mozilla v3 and higher Opera v9 and higher. It can also be used not only a browser, but also as a specialized client, that is just a regular program, that has additional features compared with the system browser – web-site for a particular purpose.

On the basis of the portal MultiTest has developed three applications:

- 1) Estimation of the competence of IT specialists;
- 2) TPU students career counseling;
- 3) Estimation of potential graduates of undergraduate IR TPU.

Данные модули интегрированы в портал Томского политехнического университета.

MultiTest portal with multi-level user access is the core for doing tests and it doesn't allow us to neglect a programmer service and web-designer. The example is the portal <http://gender.am.tpu.ru/>, which contains all the same tests as <http://entrants.am.tpu.ru/>, but has a different appearance .

### **Computerization of the psychologist work: the implementation of blitz survey techniques**

Modern computer systems can be used to unify information [3].

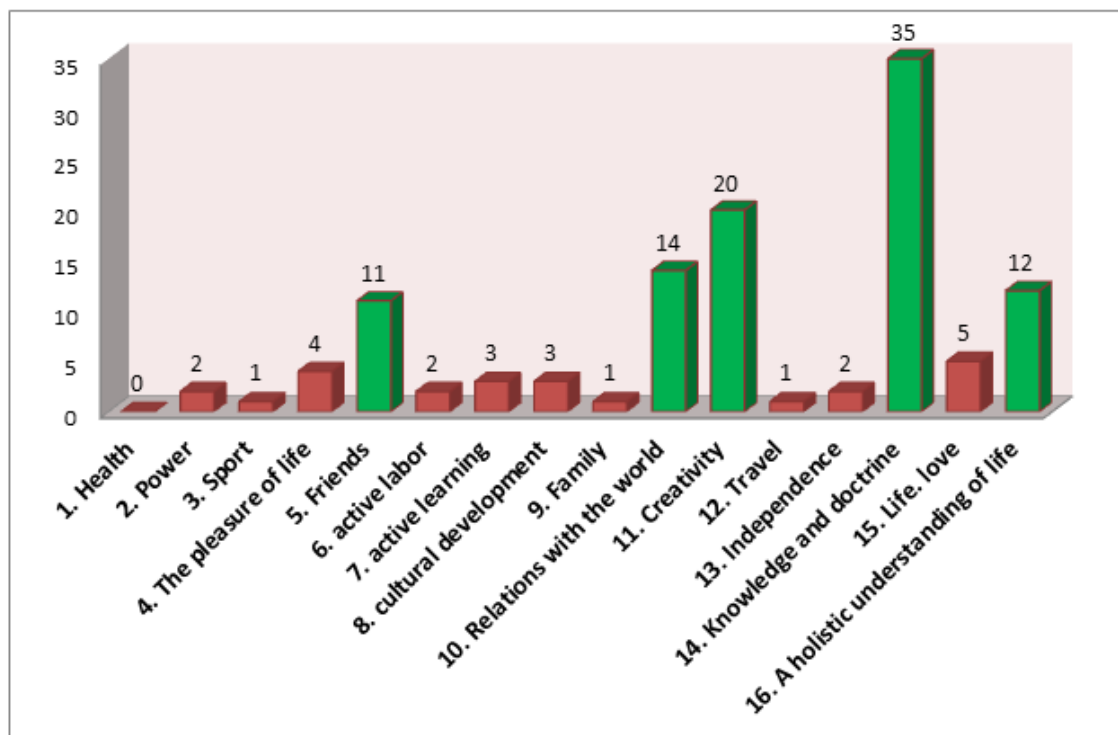
Portal is a dynamic, constantly developing system. Computerization of traditional and new psycho-diagnostic techniques is still an actual process, which is used to automate psychodiagnostic research and significantly reduce the time of testing and results processing. The objectives of our study were:

1. Study of the possibilities of the portal MultiTest.
2. Tools selection for the integration into the portal blitz-survey techniques, as well as for the processing of the results.

Objective: Automation of psychologist with IR blitz survey techniques; introduction blitz survey in massive study of students 'psychological characteristics.

Survey is a method to obtain information through written respondents' responses to the system of standardized questions. According to long term practice, this type of testing always takes a lot of time. Blitz survey methods aim to work with students and first-year students to produce a psychological portrait of the student group. It can also be used to identify individual characteristics of students tested and be the construction of its individual educational trajectory.

We processed the results of the pilot blitz survey made by freshmen IR (Pic. 1). Originally the large amount of data was made up by a psychologist, the processing of which was produced with the help of MS Excel.



Picture 1. Result of blitz survey techniques

The graph shows the answers of first-year students to the blitz survey, which shows the attitude of the participants of the group, his idea of the future, as the realization of their needs. The graph highlighted in green columns is an expectation of the student's future; he wants to get in the learning process at the university. Red bars indicate that the students do not focus on these criteria.

### Closing

Primary blitz survey provides a comprehensive picture of the incoming contingent, which in turn allows the institution to coordinate plans for the educational process before the academic year starts.

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## EXCITATION MODEL OF CARDIAC P CELLS OF THE CARDIAC CONDUCTION SYSTEM

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**Abstract.** The article considers elaboration of the mathematical model of cardiac electrical activity which will allow investigating excitation propagation processes at all sites of the cardiac conduction system. The proposed model is generated on the basis of parametric elements of an electric circuit with distributed parameters and approximation of time dependencies of conduction in ion channels by cubic splines.

**Keywords:** neurons, electrocardiography, cardiology, numerical methods, diagnosis, cardiovascular diseases (CVD), physiology, action potential, membrane potential.

**1. The cardiac conduction system.** There is a specific, anatomically separated master system in a human and animal heart. It comprises the sinoatrial and atrioventricular nodes, internodal atrial filaments, His bundle with left and right bands and Purkinje fibers. This system is formed by specific muscle cells which possess automatism properties and high (compared to non-specific muscle cells of atria and ventricles) excitation speed. A pulse is generated in P cells of the SA node (first-order pacemaker) which naturally sets the heart rhythm.

Then excitation is propagated to atrial surfaces resulting in their depolarization, following which it goes through internodal pathways to the AV node (second-order pacemaker) and excites (depolarizes) it. Afterwards the pulse is transferred along the His bundle and propagated to the right and left while exciting ventricular muscles [1].

Propagation of an electric pulse (action potential) in the conduction system as well as atrial and ventricular muscles is accompanied by depolarization and repolarization of corresponding cardiac cells. These processes are similar to action potential conduction in nerve cell processes [2] and primarily conditioned by conductance change of sodium, calcium and potassium ion channels in cell membranes under action of supraliminal stimulations.

**2. Results of modelling.** The equivalent electric diagram for the unit length of a cell membrane site in the cardiac conduction system can be expressed as five parallel branches. Three branches correspond to sodium, calcium and potassium ion channels. Electromotive forces (EMF)