

Flexible and Extended IWS (Item Writing System) as a Part of INT-Test Design Software

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Abstract—The purpose of this paper is to describe INT-Test Design Software that helps psychologists and educators in developing innovative diagnostic tools and e-cognitive learning technologies. The main feature of the system is that any psychological test, created on its basis, is not a monolithic formation, but is gathered from relatively independent fragments, like a mosaic, according to a Scenario. Such an organization enables psychologists to create a test battery, in which conditional transitions among subtests, adaptive testing, flexible processing of test data and consistent interpretation of the results are possible. The task of increasing the presentation capabilities of non-standard tests is solved through creating new Controls, integrated into an existing system of Frame Design.

Keywords—e-learning tools; psychodiagnostic testing; Item Writing System; Controls; INT-Test Design Software

I. INTRODUCTION

How to help psychologists and teachers, developing innovative diagnostic tools and cognitive learning technologies, become independent of programmers? To understand the problem, let us consider a brief historical overview of computerization of psychodiagnostic tests.

At the dawn of the computerization, the main-frame computers were mostly used in the field of psychodiagnostic for reports generation, as well as for scoring and interpretation of time-consuming tests such as the MMPI [1]. With the advent of microcomputers and personal computers, computer-based testing in psychology received an additional impetus for rapid development [2], which allowed us to create of a variety of computer programs implementing psychological tests like “paper – pencil” tests. Broadly speaking, we can distinguish several types of computer programs according to the criteria of the number of tests and the involvement of a programmer in the process of their computer implementation.

Firstly, these were the programs for the processing a single test [3]. Some of them provide only input test data from the forms filled in the “paper and pencil” test, but the whole process of scoring is automatic. Others implement a full range of opportunities provided by a computer: from testing to interpreting the results.

Secondly, these were the programs which contained the

sets of tests or test batteries. The implementation of each of the tests might have its advantages or disadvantages which were typical for the first group. Some programs of this group are just a computer shell that allows us to perform and process individual tests not linked among themselves [4]. The other part of the programs contains the set of tests that are combined at the level of processing of test results for obtaining consistent interpretation [5, 6]. Hardware and software systems, equipped with specialized devices, connected to a PC, can probably be complemented to this group. A test taker can sit in front of the monitor with a light pen on which typical test tasks are presented. In this case, the monitor is usually connected to a special keyboard, optionally equipped with a variety of joysticks, levers, pedals and rudders, etc. Separate devices are also used for assessing motor and tactile features without connection with the monitor. For example, panels with a lot of large buttons and devices for measuring tremor, and others are used (for instance, the Vienna Test System, www.Schuhfried.com).

The both groups of programs share the same idea, on which a psychologist depends entirely on the programmer. Moreover, an addition of a new test to the battery or the modification of an existing test is impossible without the participation of the programmer.

The third group of programs might include individual programs or software packages. These software systems include such a mandatory part as Item Writing System (IWS) or even Test Design Software and Test Player. Test Player must provide all that is put to the test at the design stage (collecting of personal information, testing, input forms, processing and interpreting of the results, accumulating and saving of test data, etc.). All parts of the complex may be realized not only for Windows Forms, but also for WEB applications.

It is well known, the first of Item Writing System and Test Design Software for the PC have started to develop in the eightieth of XX century [7, 8, 9, 10, 11]. Early versions of these programs for the presentation of the stimuli were based on text files, created for generic text editors. Accumulated database files with questions and answers tests, conducted by the “paper-pencil” method, were used there, too. Often, in these files, text mark-ups were made with special icons (for example, mark #1 indicates that there is a text following the first question, and mark [1] that is a text of the first answer).

The study was supported by RSF grant (project №14-28-00087), Institute of Psychology RAS.

Test keys, conversion rules into standard scores, the output conditions and interpretations of texts are placed in the same separate text files on certain positions or after appropriate labels. In other words, the design consists in elaboration of the desired format of text files, which sometimes is very uncomfortable and requires increased attention and accuracy.

Modern Test Design Software has special Windows interfaces for editing the mark-up texts, which are then loaded into a different database (MySQL, MS SQL Server etc.). The whole range of multimedia (images, video, 3-D stimulus, sounds, music and their combinations) encourages psychologists to use them as stimulus material [12, 13, 14, 15]. Various options for specific programming languages began to be used instead of the marked-up text [16]. User-friendly interface is also provided for creation of scales, keys, interpretation, visualization, and other components, without which psychodiagnostic programs are suitable only for research. An increase in the complexity of program structures, including the placement of components on different servers has led to the need for administration, distribution rights of participants in the overall process.

Giants of psychodiagnostic industry emerged, offering solutions for almost all situations, including WEB-testing (www.questionmark.com, www.ht.ru, etc.). However, the dreams of programmers to create a generic Designer (a Universal Constructor Tests) are not embodied. Psychologists and educators complain that while using programs they cannot realize a certain test or the other one is uncomfortable.

At the same time it seems that most of the existing Test Design Softwares in its IWS part are still turned to the absorption of solutions developed for the “paper – pencil” method. A psychologist writes test questions and answers in a file, and the program places them on the screen in a convenient format.

What shall psychologists do if they need to interfere with the testing process (for instance, to hinder the participants focus on choosing a correct answer)? What shall psychologists do if they need elements which are not provided by application developers? What shall psychologists do if the procedure or process of innovative test does not fit into the standard frame? Will they have to ask programmers to create a new program from the beginning?

II. FEATURES OF INT-TEST DESIGN SOFTWARE

The purpose of this paper is to describe software system to address the above mentioned issues. Our software “INT – Ideographic and Nomothetic Testing” consists of two traditional parts: Test Design Software and Test Player Software (Fig. 1).

Design Software is presented in this paper. The software works on IBM-compatible computers running operating systems Windows XP, 7, 8. The program code was made in a MS Visual Studio 2010 using VB.NET and C# programming languages, drawing on the Net Framework 3.5.

Three types of databases are used for saving designed test programs. First, Database “User Instance RANU” is a separate file of SQL Express, which is not attached to the server

database (User Instance RANU). Second, SQL Server database is the same database as “User Instance RANU”, but attached to the server. The third database is a separate protected MDB-file that can be transferred to another computer by simply copying as in case of database RANU.

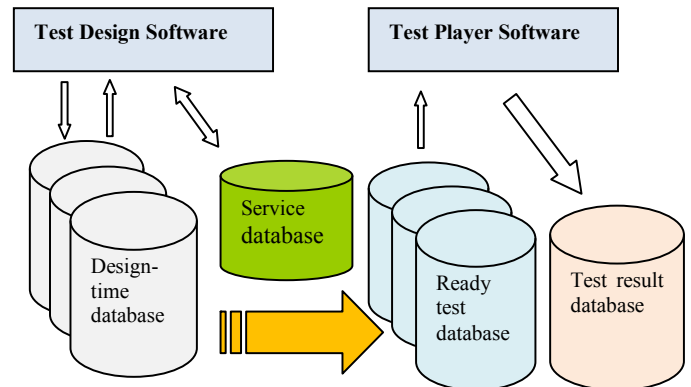


Fig. 1. Structure of INT Software

Service database is used for storing information about program users, logging their actions, and other auxiliary computer operations. The program administrator maintains a list of users and, if necessary, restricts their rights (for example, doesn't allow them to create a new database tests). The program creates a Design-time database and tables when new developments are initiated. Each database can store one or many tests. The person, who develops a Database, is its owner. He/she defines a program users list and their authorities.

Each of the tests, generated by the program design, is not a monolithic formation, but is gathered from relatively independent fragments, as a mosaic. Connection among the fragments is maintained at the level of names and comments. Frames (a visible part of the test), scale (keys, standardization), visualization of results and conditions for outputting of various fragments of text interpretation are created separately. Disembodied fragments are collected in the holistic test, based on the Scenario.

Such an organization enables us to create a test battery, in which conditional transitions among subtests, adaptive testing, flexible processing of the test data and consistent interpretation of the results are possible.

III. CREATING A PSYCHODIAGNOSTIC TEST

Work on a new test, as a rule, begins with the creation of a stimulus fragment, which is called, in our terminology, “Frame”. Frame Designer, taken from the main Window constructor tests, is used for this purpose. Standard mechanisms .NET as a class DesignSurface and DesignSurfaceManager, as well as other classes and programming interfaces of namespace System.ComponentModel.Design were used for creating of a Frame Designer (DesignerOptionService, ComponentSerializationService, UndoEngine, IDesignerHost, ISelectionService, IDesignerSerializationService, IMenuCommantService and others). User interface of the Frame Designer is based on a system of Dock Windows, widely used in modern programming environments (Visual

Studio, SharpDeveloper, and so on). The basic Windows are those that display the constructed frames, Property Grid and Toolbox with a list, of what can be placed in the frame (Fig.2).

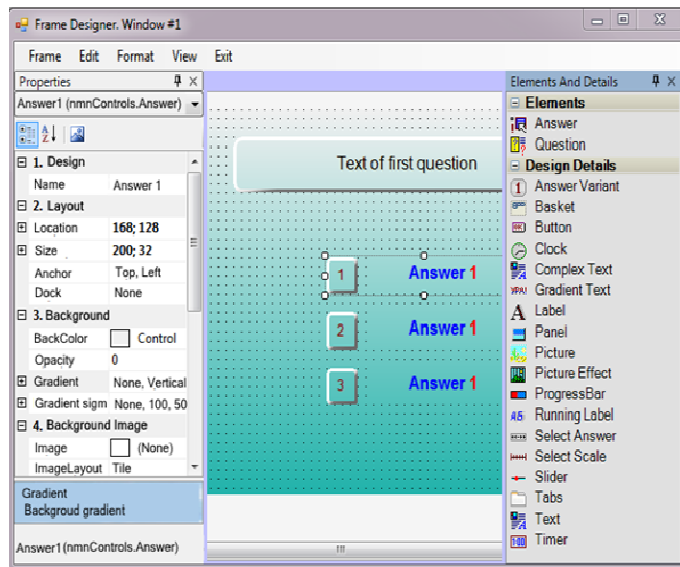


Fig. 2. Snapshot of Frame Designer with Property Grid and Toolbox

It is possible to edit multiple frames in a single window constructor as well as to open multiple windows of Frame Designer in each window and to edit one or more frames (Fig. 3).

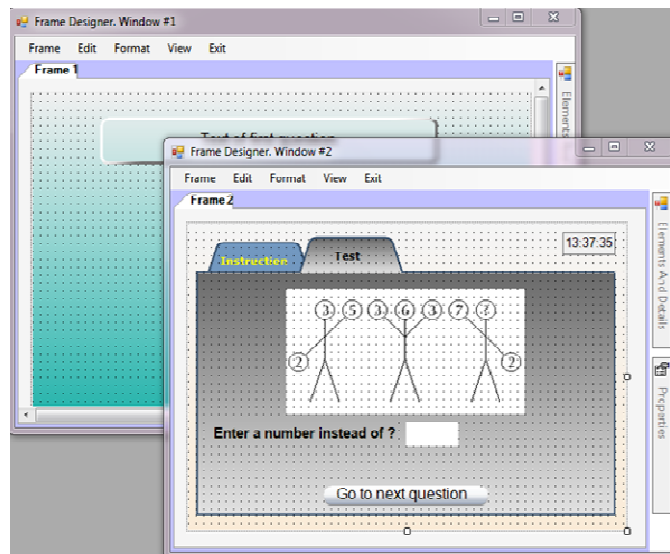


Fig. 3. Creating of the Frames in two Design Windows

Construction of the visible part of the test (frame) starts with determining how and where to submit the content, and whether the details that are not directly related to the display of content (Screen) are needed.

Controls for placement in the frame are moved with the mouse from the Toolbox. At any moment the location and the size of a Control can be changed with the mouse. It is also possible to address to the Property Grid for adjusting its internal or external features. Frame Designer may hold

standard operations formatting group of selected Controls (trimming, equalization, distribution, alignment).

Controls in the program are divided into two groups 1) Elements and 2) Design Details. Elements are oriented towards presentation of questions and answers of the test. They differ in that they can present the content of various modalities (first, a text, then a picture, a video, then again a text, music, and etc.). Design Details cannot change the type of the display content, for instance, Label cannot produce nothing but the text.

Elements implement the concept of the steps content. Window for adding steps appear after selecting the context menu Elements. For example, Elements Question is chosen for designing of a simple text of the questionnaire which is composed of 50 items and three-choice answers. So, the first step is to display the text of the first item under number 1, the second step is to display the text of the second item under number 2, and so on. These Elements should have 50 steps content in total.

The Elements Answer differs in that it is adapted to interact with the test taker, it can respond to a mouse click or keystroke. The content of the Elements Answer is performed through an additional Window. If the answers to each question vary, then each of the three “answers” should have also 50 steps. As the content of the Elements Answer does not vary from item to item (for example, an alternative choice of three options “Yes”, “Not Sure”, “No”), each of the responses is provided with only one step of content or the text answer is entered directly into the frame, without invoking an additional Window. Type of the Elements Answer content (text, input field, image, video, or sound) and its source (such as a database or external file) should be indicated for every step. Optionally, the visibility and accessibility of Elements can be specified at this stage (for example, the current step offers a choice of two but not three responses) as well as latency time of inaccessibility and visibility, since the transition to this step. It is possible to enter the list of access keys, specify how many points are attributed to each response, and whether or not the points for each answer in the database should be saved. To facilitate routine operations, import of Items from a text or RTF files is available. In the import Window the content of the file is displayed line-by-line in the table provided with the selectivity label of the rows. To import image files, it is necessary to select the folder and mark files for recording in the import table. Depending on the source of the database content, either file itself or its path is stored in the database.

Users, who are accustomed to the traditional way of filling in the questionnaires, can use an automatic generation of a standard frame based on the markup text file with the questions and answers, and then, if necessary, modify the Elements.

It should be noted that the step number serves only for its identification. The procedure for the presentation (direct, inverse, or random), the initial and final steps, as well as the choice of the steps out of the database is set at the level of Properties of Frame.

In order that Controls appeared in Toolbox, it must implement the programming interface ITestINTControl, and its .dll-file should be located in the Applications folder. The

specificity of Controls can be set by means of other software interfaces and integrated into the existing system Frame Design. Thus, the task of increasing the capabilities of non-standard test presentation is solved through creating new Controls. A similar approach to an increase in a variety of Tools is used in Experiment Builder “OpenSesam” [17], where the capacity boosting is brought about by creating a new Plug-Ins.

Some of Design Details are capable of producing texts. A text can be used as a guideline or a label which clarify, motivate and divert individual's attention (Fig. 4).

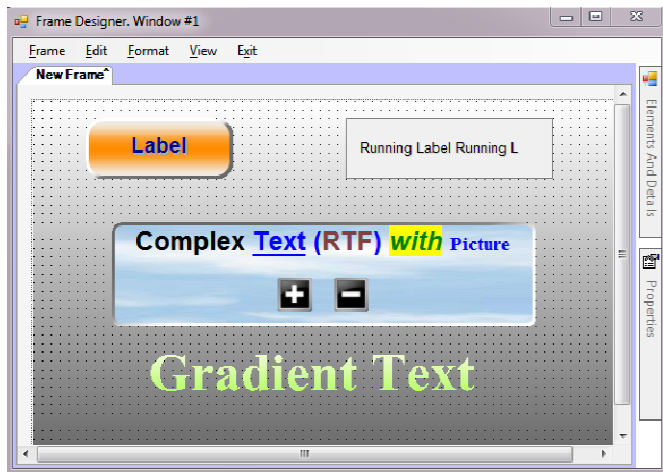


Fig. 4. Design Details: Label, Running Label, Complex Text, Gradient Text

Design Details Picture and Picture Effect are used for the demonstration of a variety of images, originally downloaded from graphic files. Picture can produce a static image. If adjusting an image property is not set, ScrollBars appear and continue to work even during the test construction. The other interesting feature is its ability to set a zoom ratio image (Zoom).

Picture Effect has properties that specify an appearance and a change of the image. For example, a crowding-out effect of one image by the other is presented in Figure 5.

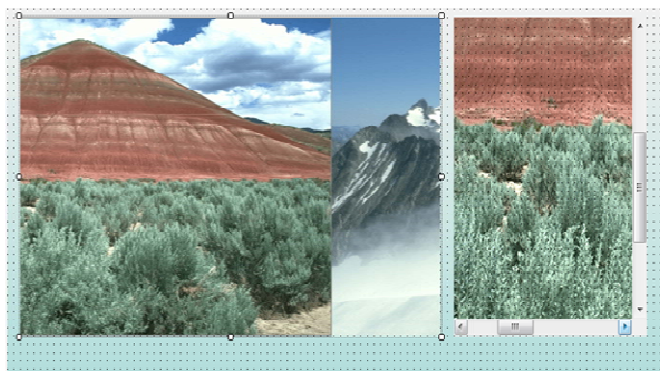


Fig. 5. Design Details: Picture and Picture Effect

Furthermore, twenty-two basic image transition effects and their variations are implemented (Rotation, Extrusion, Stripes, Diagonal, Blinds, Filling, Squares, Turn, Wheeling, Manifestation, AlphaBlend, Radius, RadiusDouble, Stretching,

Rhombus, Shift, Slide, Spiral, Knitting, Contraction, Shuffle, Ellipse).

It should be mentioned that Picture Effect contains a set of sensitive Polygons or Hot Spots which are loaded from a file. Hot Spots are created by using a special editor, incorporated into the INT-Software. Polygons, uploaded to Design Details, can remain invisible and respond by displaying its contours or filling, when the cursor passes or somebody clicks the mouse on Hot Spot. Hot Spots Properties are created and saved in a special file. Hot Polygons can be used both for testing and training purposes, showing the names of polygons or comments (Fig. 6).

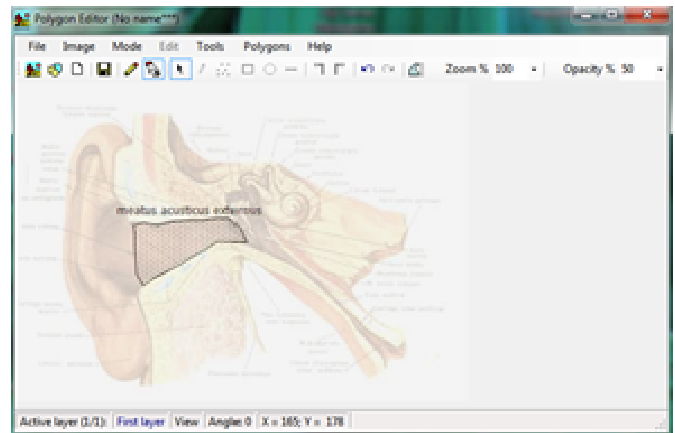


Fig. 6. Hot Spots Editor in view mode

Some Design Details are intended to display the current time, as well as the warnings about the end of test period (Fig. 7). So, it is possible to set a time interval at which a visual or sound alarm will be served.

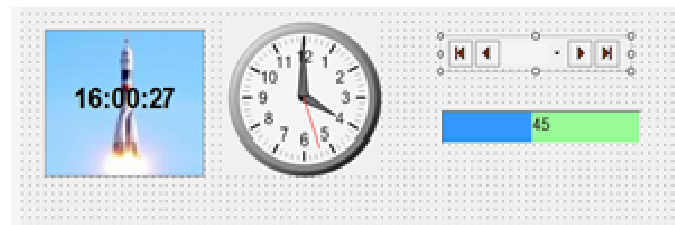


Fig. 7. Design Details Timer, Clock, Progress Bar

Design Detail Select Question is placed in the frame when it is necessary to provide an opportunity to return to the previous questions, which is a commonplace during testing by the “paper-pencil” method.

Design Detail can also be used for obtaining a response by replacing the Elements Answer. For instance, Design Details Select Scale and Slider (Fig. 8.), accompanied by two Elements Question for describing the individuals’ polar features, can be used for subjective scaling [18].

Design Detail Basket can be used for developing those tests where classification or grouping is required. Basket cooperates with the Elements Answer for which the property “Move during display” is set. The responses are moved to the Basket with the mouse. The order and entering time of each item to Basket are stored.

Such Design Detail as Tabs and Panel can be used as the basis for placing other items and elements. It facilitates the grouping of items, both when designing Frame and semantic connectivity of Details during the testing.

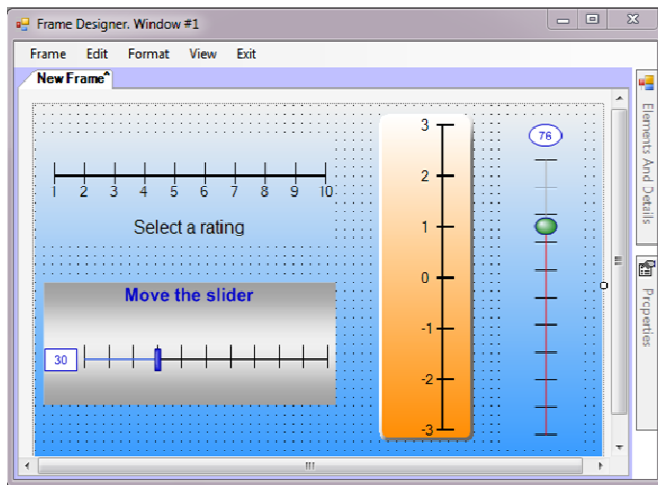


Fig. 8. Design Details Select Scale and Slider

Tabs with two pages allow a test participant to turn to the instructions any time. Instructions can be placed on the first page and the items and details for the presentation of the test can be placed on the second page. Then, the test taker can click on Tabs Pages to the test and back during the testing process. At any stage of the screen designing, it is possible to view how the screen will look while testing and how the elements will respond to their choice. To do this, it is necessary to right-click on the screen outside Elements and Design Details and select menu Element Show Frame.

IV. CONCLUSIONS

The results of verification of INT-Test Design Software (INT - Ideographic and Nomothetic Testing) convincingly demonstrate their great possibilities for psychologists and educators in developing innovative diagnostic tools and e-cognitive learning technologies. The above mentioned Item Writing System (IWS) allows us to computerize most of the known psychological tests and questionnaires used in other fields of science and practice (for example, tests for checking-up knowledge, sociological surveys and etc.). With the help of the IWS one is able to create multimedia interactive presentations and teaching courses. Although a number of tests (for instance, labor-intensive methods of assessing creativity (Torrance Test of Creative Thinking), intelligence (WAIS, WISC), cognitive styles (Embedded Figure Test), cannot be computerized with the help of the IWS so far, the system can be expended in the near future by developing new Controls.

The major advantage of the IWS, in our opinion, is that it provides great freedom when developing new non-standard tests directly on the computer. The developer of a test him/herself determines not only what will be presented but also

where this or that content will be presented. The developer decides without programmers' help whether the test must look as an academic test (nothing extra) or the test will contain a lot of distracting details or non-standard array of questions and answers, ways and means of their presentation and data treatment.

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