

Designing a Web-Survey Questionnaire Using Automatic Process and a Script Language

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Abstract - This work describes a solution of gathering questionnaire information by using information technologies. To be precise, it is suggested that distributive information service-the Internet, and possibilities of dynamic hypermedia interface of World Wide Web should be used. The use of those services ensures a number of advantages, although there are some disadvantages. This work describes one system for creating Web-questionnaire by using a script language similar to a common, natural language. The procedure of designing a questionnaire for a Web-survey was clarified by an example that was made. Exploring the possibilities of applying the system like that has a goal to simplify survey interviewing by a questionnaire in determined conditions, and the goal of this work is to clarify possibilities of proposed script language and the way it works.

Key words: the Internet, Web-survey, script language, questionnaire generator

1. INTRODUCTION

When a survey interview is conducted with the help of an interviewer (directly or by a telephone) or without his/her help (e.g. by a group or mail interviewing), when a respondent self-reports data into a questionnaire, the most of the survey work, cost and time refers to the phase of gathering information (contacting the interviewees and filling the questionnaire). In that kind of surveys data gathering is separated from data processing. That is the reason of additional work of converting analogue data from questionnaires to digital form ready to be analysed on a computer. When a big survey is made, it means enormous material, human and financial sources and a lot of time, which can limit the survey.

Automatisation of certain phases in survey research was noted in 1970's. Information technology (IT) is widely applied at planning and making the survey instruments and at analysis of the obtained data. Possibilities for new areas of its use are opening. One of those is the most time-consuming and for the sources the most demanding phase of a questionnaire-gathering of information. Not only that by the use of IT interviewing can be quickened, but it can also be (especially computer technology) used as an interface for direct survey data entry.

The introduction of computers into all the processes of survey research enabled their technological unification. Computer Assisted Data Collection (CADAC) was developed. Computer Assisted Telephone Interviewing (CATI) was used first, and with the development of portable computers Computer Assisted Personal Interviewing (CAPI), as well as computer questionnaires that can be filled by a respondent himself on his personal computer (Computer Self-Administered Interviewing (CSAQ) or Computer Assisted Self-Interviewing (CASI) and a number of other techniques [1,8,19,20,24,30,38]. That kind of support unifies gathering, entering, control, and editing of data, and

that simplifies and rationalises the survey process and increases the quality of results. It should be noted that interviewing such as this has its disadvantages as well, (see table 1). Justification, usability and acceptability of applying IT determine the goal, content and achievement of specific survey.

Interface design	when a computer is used as an interface for data input one should take care that it does not distract attention of the respondent or confuses, so it should be formed in an adequate way [13,42]
response rate	is lower when using computers than when using any other means of data collecting [10,14,22,41]
knowledge	to be able to use IT one needs additional knowledge/skills which are not necessarily present neither with respondent nor with questioner [13]
expenses	the increase of expenses for ensuring information infrastructure [41]
place	one should ensure adequate room where respondents can answer the questions
fear and frustration from IT	the question is what is the way that certain groups of respondents accept technology, are they afraid of it, or if they are frustrated by it [13,22], what can be a reason why the data are incorrect, why the questionnaire is not done, and other negative manifestation.
addressing	the populations coverage problem, problems at contacting the group of respondents, so that it could be a problem of generalizing results
development	it can be applied in developed areas only (considering supply of computers and readiness of respondents to work without fear of technology).
IT diversity	non-coordination of programme and computer support can be a limit in certain cases [13, 17]
Non-transparency of population	inability to reveal characteristics of respondents and ability to influence respondents

Table 1. Troubles at applying IT while conducting a survey

With all the technology described, in the last twenty years, a powerful net infrastructure was developed, which enables distributive exchange of contents and communication among computers and users. A new phenomenon that was being developed in the 1980's in the field of computer communications is the Internet, and in the 1990's World Wide Web (WWW). WWW, with its peculiarities and potential, was the reason for general widespread of Internet surveys [8,9]. Supporting the use of the Internet as the means for data collecting and distribution are the data of the widespread presence and growth of Internet users. Although the data are incomplete, the increase of using the Internet is not in question, especially among certain age groups and educational groups as well as in certain institutions (There were 480,000 users in Croatia in September 2001, what is almost double from previous 2000, when there were 200,000 users.) [31, 33].

2. THE USE OF INTERNET TECHNOLOGIES WHEN CONDUCTING SURVEY RESEARCH

Survey research technology is developing together with quickened development of the Internet. The Internet is used for easier contact and data collecting. As a means for survey research by a questionnaire, the Internet has a role of distributive system of sharing questionnaires, data collecting and interface for interaction with a respondent. When those questionnaires are distributed through the Internet we use 1) e-mail for direct addressing (one should have a respondent database) or 2) WWW for publishing the questionnaire on a fixed address (URL address) in the form of a Web-page. There are some other forms of using the Internet, which are seldom used, as for example is IRC/Chat service [28]. In the first case a questionnaire can be distributed in different formats of writing, (e.g. Word, Excel, or HTML document). In the second case a questionnaire is mostly formed as a hyper textual dynamical document which has the ability to receive the data and to send the received data to the central computer. A Web-page can be formed by using HTML-language or by using some similar Web-technology [27,32,33,39,40]. There is also possibilities of using specialized programming languages for forming Web-questionnaires interface (e.g. QML-Questionnaire Markup Language, QPL-Questionnaire Programming Language), specialized tools for forming dynamical Web-

documents (FrontPage, Dreamweaver), and specialized program solutions for creating Web-survey pages which will be discussed later.

If we apply WWW services when questionnaires are not directly addressed (if respondents are not informed about a questionnaire, they do not know about it), data collecting eases existence of Web sites with specified thematic contents which is directly connected to certain population groups (Web-portals, Web-pages of companies, institutions, schools etc.) which can be used to attract respondents. If the questionnaire has been announced to a certain group of respondents, “unexpected” respondents who found the questionnaire by chance can be a problem. In that case it is better to do an e-mail questionnaire. In any case, it is suggested to study methodical characteristics of applying e-mail/WWW technology [8] and principles and strategies of a “good” interface and questionnaire form [5,13,15,16].

Many people are encouraged by small expenses and the ease of Internet data collecting, especially unprofessional explorers as individuals, and smaller companies [30]. But that is the way which will neglect certain social groups and it should be avoided in certain situations and with certain groups (older people, economically undeveloped areas, non educated people, people with psycho-physiological malfunctions, poor people etc.). Other groups (teenagers, children who attend high school, students, etc.) have a positive attitude about applied technology, which increases their interest for a new technology questionnaire and makes them want to participate in the survey.

With all the advantages of applying the Internet that are mentioned, possibility of using interface which offers visual interaction with a user, appliance of multimedia, and saves respondents’ answers in a digital form. It enables usage of different kinds of survey questions as instruments of measurement, higher quality and better diversity of survey research, better understanding, acceptance from the respondents and many other advantages, see Humphrey T. [25].

The following basic advantages of using Internet-questionnaires are mentioned:

- spatially unlimited area where the questionnaire can be applied
- possibility of collecting an enormous number of data in a short period of time
- financially acceptable form of survey
- data processing in a real time
- control of answers consistency
- possibility of data processing and result display in the same time
- actuality and media attraction
- possibility of multimedia usage

It is certain that with increase of Internet popularity more and more Internet questionnaires appear, on-line or Web-based surveys, especially in marketing oriented surveys [3]. When we say that, we generally mean “computer supported interview based on a HTML-language, presented on a Web-browser and the results of which are transmitted to servers by electronic net” [29].

A great distribution of Internet-surveys is not followed by education of those who use them. That is why Internet-survey is sometimes applied wrongly, so negative characteristics of such a survey could be noticed. It is obvious that Internet usage in survey research has limits that warn us to be careful. There are discussions about topics such as:

- how much can we lower expenses of data collecting by Web-survey
- what level quality can be expected
- how precise the result could be
- can Web-surveys be an alternative for telephone or postal surveys

Recommendations of statistical organizations (ASA, ESOMAR) warn us that there is a possibility of result misuse for Internet-surveys, mostly because of non-representative samples of respondents and warn us that anonymity of the respondents should be protected [22,26]. Connected to the technology of Web-surveys, the human side is considered, psychology and privacy of respondents [12], quality and ethics are compared [6], rate of sampling error and survey expense is investigated [41], the influence of buyers to marketing [37], future of Internet-surveys in public opinion research [11] and especially the problem of non-respondents [4,23]

3. DISCUSSING POSSIBILITIES OF CREATING WEB-SURVEYS USING OTHER WEB TECHNOLOGIES

Useful appliance of the Internet in survey research requests new skills and being familiar with classical methods of forming the survey research instruments. That can be a limit, a burden, or an expense. Various program solution of forming an Internet questionnaire are made to overcome the problem and to get closer to non-professional user. Their task is to simplify form and preparation of a questionnaire for a Web-survey, as well as to automatize it, and to release the respondent from knowing Internet technologies.

There are more program solutions and systems that partially support survey process (iNetSurvey, FormCaster, Eforms, SurveyBilder, Zoomerang, Bitlocker, Ballot-Box, Build-a-Poll, ConFirmat, GlobalPark-OPST, Inquisite, Perseus, Surveyor, WebCATI, WebSurveyor, Sphynx, Artologic and others), a researcher has freedom when forming a questionnaire, he does not have to possess greater informatics knowledge, and they are time-consuming. They contain patterns for e-mail form, Web-questionnaire form, they enable publishing of the questionnaire, automatic data collecting and updating in a database and creation of attractive reports [7,40,43]. While describing and forming a questionnaire those program solutions lean on textual interfaces, these are programming languages or script languages, on visual WYSIWYG interfaces or a combination of the forms mentioned. They can be for general use, or directed to concrete surveys (e.g. market research), and often these are complicated tools, which take time to get used to.

While researching through scientific and professional literature one can notice that there is a great number of published papers which describe the problem of data collecting by the Internet (e-mail, WWW, addressed questionnaires, non-addressed questionnaires, sampling problem, approach to questionnaires, the way users accept it, etc.) or a problem of designing multimedia questionnaires (form and shape of questionnaire, form of interface, ergonomics, interaction with respondents, etc.) On the other hand, there are not many articles that describe or analyse possibilities of forming Web questionnaires or support to make Web-questionnaires. That is why creating of e-mail/Web-questionnaires is often done by programmers, and not by experts for statistical survey research [13].

Some specialized languages for making questionnaires exist today. QML - Query Markup Language [2,34] is derived from the XML - Extended Markup Language. The compatibility to XML could be some advantage but requires a lot of programming experiences. On the other hand, QPL - Questionnaire Programming Language [35] has the syntax typical for scripting languages, which makes creating questionnaires easier.

The mentioned languages work in a generic systems which consist of the questionnaire description and interpreter as a common part of all questionnaires. Each user who want to make Web-questionnaires must install the whole system on his Web server, even if he want to make only one questionnaire.

The language described in this paper works in a different, generative system. Generative systems have the ability to create independent and highly optimised applications [21,3]. This provides possibility of making and installing particular questionnaires for different users with no need of installing the whole generative system. The language syntax is optimised for generating, not for interpreting; instructions are in tight form of parameters and have a hierarchic structure. That reduces the questionnaire descriptions to minimal size, so, a Web-questionnaire could be formed quickly, using a simple textual interface, for the use of which one does not need special knowledge and whose distant administering is supported. The aim of this paper was to offer to a researcher without programming experience tools which he could use to form and publish a questionnaire, as well as check and analyse its results. The result of this research is described in the text below.

4. AUTOMATIC CREATING OF WEB-QUESTIONNAIRE

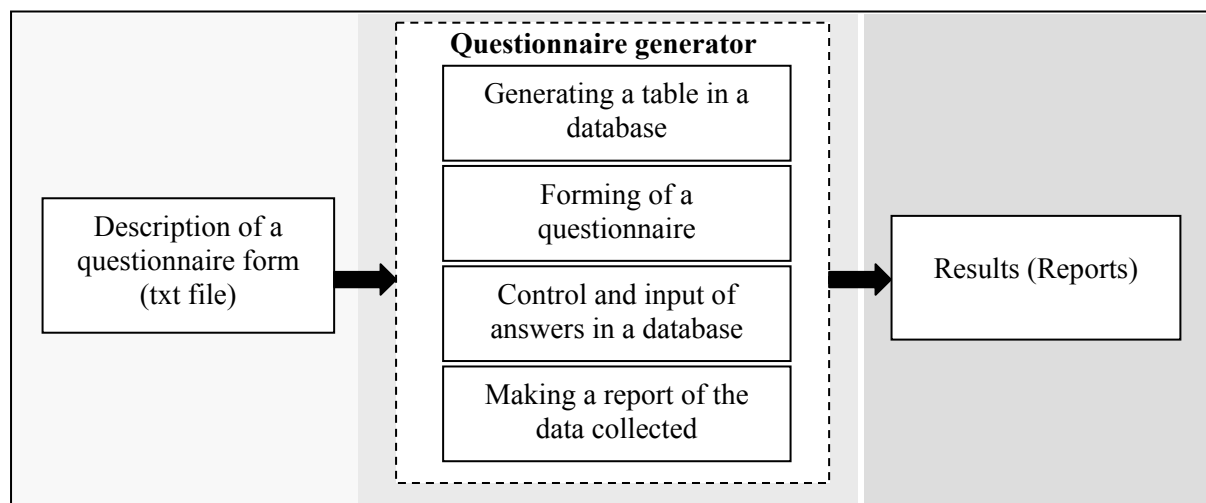
It is about a program system, which simplifies phases of preparing and forming a Web-questionnaire, eases explorer's work, and quickens the whole process. Based on a definition of a questionnaire form with artificial script language based on Croatian natural language, it creates and publishes Web-questionnaire ready to be used by a client's computer on the Internet. Possibilities of automatic creating of a questionnaire include:

- forming a questionnaire for a Web-survey (hyper-textual document)
- publishing a questionnaire on a Web-place
- filling the questionnaire in real time
- storing of data in database
- direct control of form filling
- processing and inspection of data in real time(textually and graphically)
- publishing of analytical survey report to a Web-place
- possibility of doing more complex analysis (correlation) of data
- following the source of questionnaire filling (time related, and partially geographic)

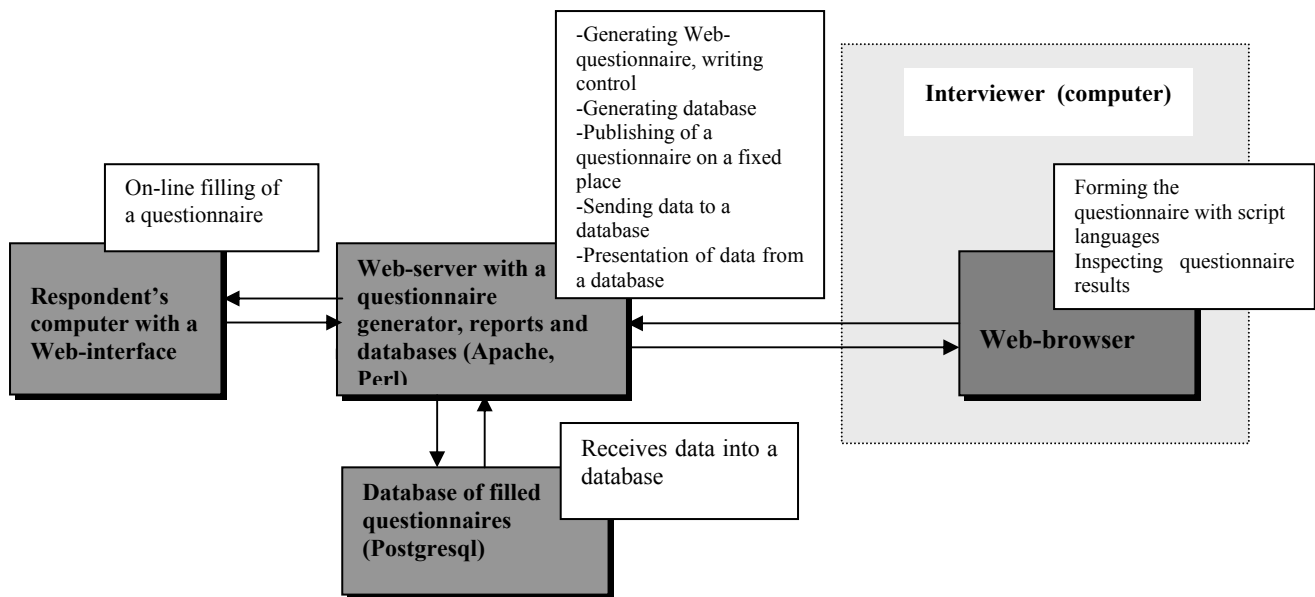
The implementation of that possibilities is provided by using a script language which describe the form and the contents of a questionnaire (instruments of a questionnaire, order of questions, instructions for the respondents, etc.). That part of the system is defined in a Web-interface form, which is accessible from a server computer via Web-browser. Based on the description of a questionnaire, questionnaire generator forms several documents (Picture 1):

- Web-document (questionnaire) for data input by a Web-browser
- Perl script which creates database on a database server (Postgresql at the moment) which is used for data accepting
- Perl script which creates reports of questionnaire results
- Perl script which controls data input into a database

It is needed that questionnaire generator is put on a computer Web-server and by it we can control use of Web-interface (with Web-browser). Questionnaire generator is a programme written in Perl programming language. Perl programming language was chosen because of its transferability to various platforms of a Web-server, its possibility to create dynamical Web-documents and possibility to work with database [18]. The existing version of a generator was set on a Web-server Apache, which has support for Perl programming language. But that whole system can be transferred to a similar platform.



Picture 1. Model of a Web-questionnaire generator



Picture 2. The way a Web-questionnaire generator works

5. SCRIPT LANGUAGE FOR DEFINING CONTENTS AND FORM OF A QUESTIONNAIRE

In order to be able to form a Web-questionnaire quickly and simply, a unique language was devised, which is partially similar to a natural Croatian language. It satisfied all demands and needs to form any questionnaire, and possibilities of Internet technology were used at the same time (creation of multimedia contents and dynamical objects). To be able to use a language one does not need to be experienced programmer, because the language syntax is much easier than those of standard programming languages [36]. Use of Croatian alphabet is supported, as well as all the other signs from ASCII code-table of symbols. Capabilities of proposed script language for defining contents and form of a questionnaire may be summarized as follows:

- possibility to use symbols of Croatian alphabet
- support of forming open and closed questions
- enables forming of closed questions with one or multiple choice questions
- enables creating graphical scales of evaluation
- enables defining of measurement scales
- the number of questions in a questionnaire, as well as the possibility of multiple answers to each of those questions are not limited
- when defining contents and form of a questionnaire textual interface is used

All the capabilities mentioned are defined through a Web-interface in a textual file that is base for creating a Web-questionnaire, with so called questionnaire generator. It usually consists of the following elements:

- title of a questionnaire
- table name in an active database where data of filled questionnaire forms will be processed
- list of questions, and each of the questions has the following specifications:
 - the kind of question (one answer, or multiple choice answers)
 - text of the question
 - possible (given) answers to a question
- titles of parts in a database table where answers to questions will be stored
- conditions to overview partial results (when we want to find out what is the mutual dependence of single answers to questions)

Script language has its limits, which are a result of WWW technology limits. Syntax of the language is simple, so every designer of a Web-questionnaire is enabled to make a form ready to be published on the Web.

Command	Meaning
title: <questionnaire title>	Used to determine the title of a questionnaire, it is written at the beginning of a questionnaire
table: <table name>	Name of the table in database where data of filled forms will be stored and inspected
question_J: <questionnaire question> <answer 1> <answer 2> <answer N>	Determines question with a single answer. All the possible answers in a questionnaire will be chosen by an object like <i>Option -button</i> .
question_C: <questionnaire question> <answer 1> <answer 2> <answer N>	Determines question with a single answer. All the possible answers in a questionnaire will be chosen by an object like <i>Combo-box</i> .
question_T: <questionnaire question>	Determines a question with text answer. Text box.
question_S:	Determines a field for graphic specification of attitude intensity (Scroll bar)
question_V: <questionnaire question> <answer 1> <answer 2> <answer N>	Determines multiple-choice question. Check box.
fields: <field 1> <field 2> <field N>	Determines a place where one can find all fields in a database table, where the answers of questionnaire respondents are. Each field refers to one question, so the order in which they are set must match the order of questions.
partially: <condition 1> <condition 2> <condition N>	Determines a field where conditions for generating of analytical survey results, e.g. if we are interested in mutual dependence of single answers in a questionnaire. Every condition refers to one partial result of a questionnaire. A single condition is created in the following manner: (title of the field from the table)=(value of the field), where the value of the field is formed according to two rules: (1) for fields which refer to questions with one possible answer there is an ordinal number of the answer and (2) for fields with multiple choice questions it is done as sum of values $2^{(\text{cardinal number of answer}-1)}$

Table 2: Script language syntax

To support all the possibilities of survey research mentioned, and because of forming visual interface of a questionnaire form, we use standard graphic program controls such as: Option Button, Combo-box, Scroll Bar, Tex box, or Check box. Their use is supported in all visual Internet browsers. They may be used with a standard keyboard or some other input units such as the mouse, or touch screen. Types and meaning of controls in the language used is described in table 3.


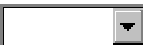


Kind	Type of question	Control name
	Closed questions with one possible answer	Option Button
	Closed question with one possible answer, which is supplied with a falling menu (it is used with a larger number of answer, so it could be overviewed easily)	Combo box
	Graphic evaluation scale	Scroll Bar
	Open question	Text Box
<input type="checkbox"/>	Closed multiple choice question	Check Box

Table 3. Graphic program controls and their meaning as instruments in a Web-questionnaire

6. CASE STUDY

To be able to understand described system and presentation of its results, we will describe the survey made in the form of a Web questionnaire. It was done so that we can test possibilities and the way the system works. The questionnaire titled “How do you like informatics practical lessons?” was formed. The questionnaire was published on a Web-server and it was monitored for five days while the form was being filled. There were five questions in a questionnaire:

- Graphic scale evaluation question:** “Did you get what you expected?”, with a scale offer 1-100
- Closed questions:** “What would you change?”, with answers offered (nothing, technical equipment, program support, curriculum, time of teaching, teaching speed)
- Closed questions:** “There should be...”, with answers offered (less lessons, the same number of lessons, more lessons)
- Closed questions:** “Are you satisfied with the way your knowledge is tested?”, with answers offered (yes, completely; mostly, yes; I am not sure; mostly, no; not at all)
- Open question with a possibility of text input:** -“Write your complaints and suggestions, if you have any.”

Description of a questionnaire in form of proposed script language has a following content:

Table: *questionnaire_practice*

Title: *Informatics practice*

Question_S: Did you get what you expected?
1,100

Question_V: What would you change?

nothing

technical equipment

program support

curriculum

time of teaching

speed of teaching

Question_J: There should be...

less lessons

the same number of lessons

more lessons

Question_J: Are you satisfied with the way your knowledge is tested?

yes, completely

mostly yes

I am not sure

mostly no

not at all

Question_T: Write your complaints and suggestions, if you have any.

Fields:

satisfied1

changes

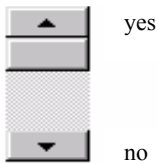
number_of_lessons

satisfied2

note1

Based on a description of a questionnaire, questionnaire generator creates final visual interface in the form of hypertextual dynamic document ready to accept data and suitable to be published on the Internet.

1. Did you get what you expected ?



2. What would you change ?

- nothing
- technical support
- program support
- curriculum
- time of teaching
- speed of teaching

3. There should be ...

- less lessons
- the same number of lessons
- more lessons

4. Are you satisfied with the way your knowledge is tested ?

- yes, completely
- mostly yes
- I am not sure
- mostly no
- not at all

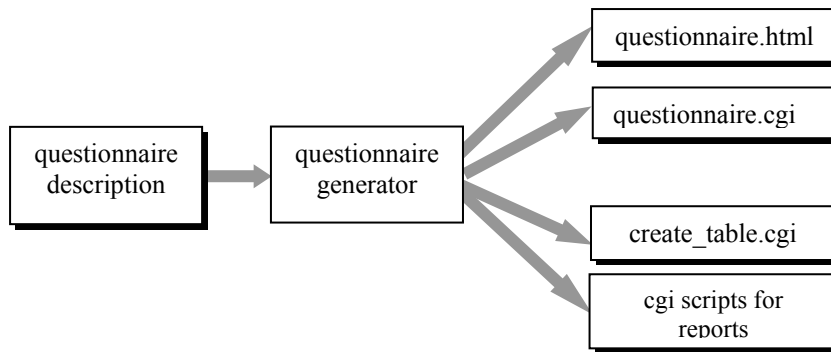
5. Write your complaints and suggestions, if you have any. knowledge is tested ?



Picture 3: A generator-made questionnaire form from description above

There are the following database files in the process of creating a Web-questionnaire :

- **questionnaire.html** - questionnaire form in HTML format, picture 3 (the look of the form may be later edited in one of the programs for HTML-documents editing)
- **create_table.cgi** - cgi-script in Perl programming language for creating tables in file database for storing files about the filled questionnaire forms
- **questionnaire.cgi** - cgi-script in Perl language which does the following actions
 - checks if the questionnaire form is completed properly
 - checks if the questionnaire has already been completed from the respondent's computer in the last 10 minutes
- **writes data** from the questionnaire form in the table of data given
- **cgi script which create survey reports**



Picture 4. Files created while preparing a Web-questionnaire

Besides these files, there are files which do not play a direct role at completing a questionnaire form, but which are a part of an interface that was already made, and they represent graphic program controls. There are also two files that are mentioned separately. These two files are used to create a report (also in a Web-file format) with survey results. The system supports creation of two kinds of reports in real time:

- **standard**, which gives absolute and relative indexes of questionnaire applying results in the Web-file form. Results are given graphically and textually
- **analytical**, which gives correlations between certain groups of questions and displays them numerically (absolutely, relatively) and graphically

For creating a standard report in HTML-format questionnaire generator creates two more cgi-scripts (Perl language):

- **results.cgi** (graphic display of results, including analytical results); answer distribution is shown graphically by lain columns and textually, and percentages
- **rez.cgi** (result display in a table, which is convenient to be processed in a table calculator); results are shown in a table, so that they can be transferred to a table calculator, for further processing

Script for graphic display of results (results.cgi) creates graphical display of respondents' answer distribution. It can give either analytical or graphical display of questionnaire applying results, what is given in a questionnaire description (command "partially"). To create a graphic report and answer distribution display, we use models according to which we create a visual report interface (model of table, model of a single field in a table, model for a graphic display of single answers in a questionnaire). Display of standard report form for all answers and respondents can be seen in picture no. 5.

The report does not contain answers to the fifth question because it cannot be grouped into classes by the nature of the answer. That is why questionnaire generator ignores it. To free, open questions (command: question T) report creating scripts create textual output that is stored in an ASCII format file, together with the answers to other questions. That file is organized into sections, where one section refers to one filled questionnaire. Section structure is as follows:

"12,0,3,0,3,1, In my opinion, there should be more lessons in a week, and practice should be in the morning or in the afternoon, 161,53,120,103-1012237"

The first part of a section contains data for answers to the first four questions, then there is the answer to the fifth question, and, in the end, there is an IP address of a computer, where questionnaire has been completed.

When an analytical report is to be made, the way the results are displayed is identical to the standard situation, but, then, only those results that meet the conditions are shown. For example, if there is condition like this one: question=3, answer=2, then only those data are shown where answer two is given for the third question.

Result of the interview (results are fiction)

1. Did you get what you expected ?



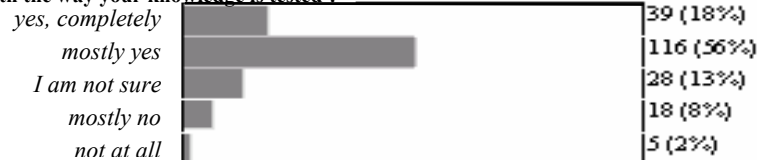
2. What would you change ?



3. There should be ...



4. Are you satisfied with the way your knowledge is tested ?



Picture 5: What does a standard report look like

7. SUMMARY

When we apply a Web-questionnaire, we ease a great deal of questionnaire data collecting. Based on an empirical survey, to program a standard questionnaire for a Web-questionnaire consisting of five questions without using the described system, together with data file editing, data processing and result display, a single programmer needs five working days. If he needs to make some changes in the questionnaire or display some extra results, the time is longer. The described system of automatic creating a Web-questionnaire form enables us to automatically adjust the questionnaire. It is based on a description by script language similar to Croatian natural language. For that kind of describing a questionnaire form one does not need knowledge of a programmer, and if you want to describe a questionnaire consisting of five questions, you need a couple of minutes (if the contents of a questionnaire form is already prepared). The result is a Web-questionnaire application which is fully independent from the system used to generate it.

By using this system one can save time and financial means. Except that, an explorer is not bothered by unnecessary work of creating a Web-form, database collecting and publishing the questionnaire on the Internet. Data processing is done in real time and it is partially automatized.

If the appliance of Web-questionnaire looks like a convenient method of data collecting, the use of automatized system for its forming and creating is a reliable, simple, and quick way by which all the imagined activities are realized.

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