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Development of the Expert System for Sport Talents Detection

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Abstract: - This paper presents an expert system for the evaluation of young sport talents. Based on the knowledge of ten human sport experts, various tests of motoric abilities are quantized according to their importance for chosen set of sports. Obtained values are entered into the knowledge database along with the grades of the measured results for each test. Stand alone and web version of a computer program supporting this knowledge base and the decision process was developed. Finally, output results of the system are giving acceptability prediction and proposal of the most suitable sports for the person being tested.

Key-Words: - Expert system, Sport talents, Web application, Measurement database

1 Introduction

Numerous sport clubs, parents and sportsmen are permanently seeking the answer to the question: How to recognize talented child and what sport is the most appropriate for him or her? Problem solution should be based on expert and scientific knowledge of relevant motoric skills tests, morphologic characteristics measurements and functional tests. Although extensive research has been done in this field and results are presented in various books [1][2], there is no definite and complete answer to this question.

To obtain the right or satisfying answer, we have to overcome two main problems. First one is a very difficult task of finding an expert in this field since domain specific knowledge is separated into various sports and, generally, experts have in-depth knowledge of the relevant factors for specific sport and more superficial for the other sports. Second problem is that this knowledge has to be widely available, almost 24 hours per day and in various conditions and places. All this facts leads to the decision of developing a computer based expert system [3][4]. Knowledge acquisition from the experts can be done using several approaches with different levels of automatization [5] and determination procedures of the factors weights [6]. Development of such system should include accessibility through Internet. Internet based expert systems can have different architectures such as centralized, replicated or distributed. This categorization is done according to the place where the code is executed [7][8].

Our software based solution will have following characteristics: ability of forming a referent measurement database with records of all potential and active sportsmen, diagnostics of their anthropological characteristics, sports talent recognition, advising and guiding amateurs into the sport activity appropriate to their potentials.

This approach gives us the possibility of optimal sport choice for the children and, as the consequence, the possibility of wrong selection and losing several years in training of "wrong" sport is significantly reduced. Other benefits are: proper use of the anthropometric potential of a sportsman, fewer frustrations due to poor performance, achievement of the top results in sport and improved efficiency of spending financial funds.

2 Expert System Elements

Basic concept of our expert system and its main elements is presented in figure 1.

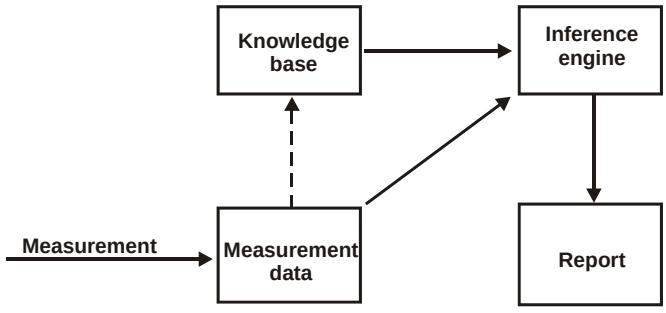

Fig.1 Basic elements of the expert system

Possible corrections of the knowledge base by the measurement data should be outlined. There are three kinds of KB corrections that can be made: grading rules, test weights and measurements database. This issue will be discussed later, in the concluding part of this article

because at this stage of system development, only measurements database can be appended with new data.

2.1 Knowledge base

The most important part of this system is the knowledge base so we will describe it in more details. Main challenge of the knowledge acquisition is to define set of relevant tests, their influence (weight factors) to specific sport and test grading rules regarding the measured data. Research of the normative values for the school children in Croatia, age 6-18, was done by V. Findak et al [9]. Interactions between basic knowledge base elements are presented in figure 2.

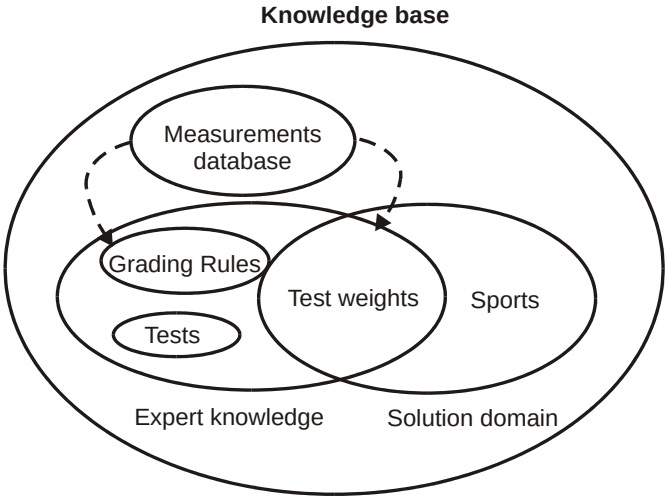

Fig.2 Knowledge base

As it can be noted, list of chosen sports is also a part of the knowledge base. At this moment, there are fourteen sports that are part of this KB:
- Athletics (sprint, jump)
- Athletics (throws)
- Athletics (long distances)
- Gymnastics
- Swimming
- Handball
- Football (soccer)
- Basketball
- Volleyball
- Water polo
- Tennis
- Rowing
- Fighting (kicking)
- Fighting (pulling)

Broken arrows connecting measurement database with grading rules and test weights shows potential of self-adjusting KB that will be one of the future research directions.

Eleven tests were determined as the minimal set providing reliable evaluation. These tests can be divided into three groups: locomotion skills tests, morphologic characteristics measurements and functional tests.

Grading of the measured result ranged from 1 (poor) to 5 (excellent). It should be noted that grading classes were done according to the gender and age of the tested subject. Rules have the following form:

$$\text{if } C_M\text{Min}(G,A) <= \text{Msr}(N).\text{value} < C_M\text{Max}(G,A) \quad \text{then grade} = M \tag{1}$$

where Msr(N).value is measured value for the n-th test, C_MMin(G,A) is minimal value of the M-th grading class and C_MMax(G,A) is maximal value of the M-th grading class. Both, C_MMin and C_MMax are depending on G (gender) and A (age) of the tested person.

Although, the initial grading rules were taken from the literature, another important part of the knowledge base-test weights were determined by acquiring knowledge out of ten experts in the field. Each expert is specialist and university lecturer for one or two of chosen sports. A questionnaire in which each expert had to write, in his opinion, importance of each test for the sport he is specialized in. Test weight factors ranged from 0 to 999.

2.2 System output

After each test has been graded, complete evaluation of the measured potential for the available sports should be given. Cumulative sum of all the grades multiplied with the weight factors for the particular sport is divided with maximal possible result gives the quality factor of the person and sport. Quality factor may vary from 0 to 1. The higher is the quality factor, the better results could be expected in that particular sport for the observed person.

Typical report that can be obtained consists of complete list of sports and quality factors expressed in percentages for subject being tested. Also, this report should allow the additional information on the main reasons (tests) that proved to be decisive in the overall evaluation for each sport.

3 Computer-Based Solution

As it has already been written, at this moment our system is based on data available for 11 tests and 14 sports. This data has been entered in two databases. First one is in DBF format and is used for the stand-alone version of the application software. Second one is the Microsoft SQL and this database is used for the Internet version of the application software.

Application versions have different graphical user interfaces because of different application tools being used for the development (Borland Delphi 2 and Borland Delphi 2005). Interfaces could be made visually the same, but at this point, visual unification is not important issue. Recommended operating system is Microsoft XP.

Both versions are highly modular and adaptable, which means that additional corrections, expansions of all the main system elements can be made with no code interventions. Only the implementation of additional self correction functions would require very simple changes in code. Main features of each version will be described in the following sections.

3.1 Stand-alone version

This version of Sport Talent application is based on rather outdated DBF tables where all the knowledge base data is stored. Tests and test weight factors are stored in separate tables. Sports, grading rules and measurements are stored in separate tables as well. In addition to these five main tables, some other supporting tables exist such as test groups and configuration table.

Depending on the entered password, different menus are available to the person being logged. Common users may enter only measurement data and obtain required evaluation. They don't have access to other parts of the knowledge base and can not change or even view data in other tables. Power users may see all the tables but they can't change grading rules and test weight factors. Only users with administrative rights can edit all the tables and even add new tests and sports.

Basic disadvantage of database placement on local user computer could even be the advantage in the case of unavailable connection to the Internet due to technical or some other problems.

Šifra osobe	Šifra testa	Opis testa	Rezultat	Ocjena	Datum testa
99999	005	Taping rukom	33	2	20.1.2006
99999	006	Skok u dalj s mjesta	190	2	20.1.2006
99999	007	Pretklon raskoračno	32	1	20.1.2006
99999	008	Poligon	44	1	20.1.2006
99999	009	Zgibovi	40	2	20.1.2006
99999	010	Pretklon trupa	30	1	20.1.2006
99999	011	Tričanje 3-6 minuta	1400	4	20.1.2006
99999	003	Opseg podlaktice	23	3	21.1.2006
99999	004	Kožni nabor nadlakt	5	5	21.1.2006
99999	005	Taping rukom	33	2	21.1.2006
99999	006	Skok u dalj s mjesta	225	4	21.1.2006
99999	007	Pretklon raskoračno	66	5	21.1.2006
99999	008	Poligon	14	2	21.1.2006
99999	009	Zgibovi	39	2	21.1.2006
99999	010	Pretklon trupa	30	1	21.1.2006

Fig.3 Accessing the recorded measurements in stand-alone version. Search by key or date. (GUI in Croatian)

Already recorded measurements of particular person can be obtained any time (Figure 3). This feature allows the user to observe, compare and analyze results of one person during larger period of time (if more than one measurement was made).

3.2 Web version

Stand-alone version has serious disadvantage, or we can rather say that it is unable to use maybe the biggest benefit of the computer-based approach for the evaluation and discovering of sport talents. This benefit is the measurement database that grows with each new measurement and, as outcome, bringing new data and knowledge of various anthropometric, locomotion and functional capabilities of new generations. This approach can bring us complete, up to date database that is ready for further analysis.

Due to expected maximum number of simultaneous logins, a centralized approach was implemented in design of the application. Web version of Sport Talent is built on a Microsoft asp.net platform with Borland Delphi 2005 as asp.net application. Application database is Microsoft SQL server 2000 which is connected with Sport Talent application using SQLConnection component.

An application consists of files with aspx extension made available via http using the Internet Information Service as web server. These files are containing a mix of HTML and server-side code which is written in object pascal. This HTML and server-side code combine to create the final output of the page consisting of HTML markup that is sent to the client browser.

Client is user with unique user name and password defined in database. After user is authenticated, he is able to input, read or configure data on his authentication level. User rights are limited so he can only read mutual data but not configure it. User is only able to input data regarding his measurement.

One user is superuser and he is administrator. He can see all other users, read all data and he is able to change mutual data.

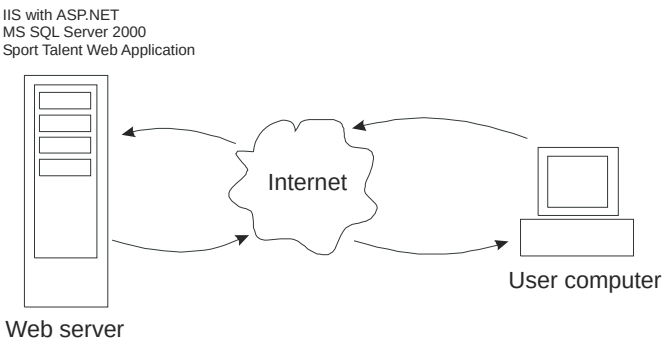

Fig.4 Web server with application and user connection

Figure 4. shows connection between web server with application and user. Connection can be divided into seven steps:

Step 1: User is sending request for Sport Talent Web Application over Internet

Step 2: Web server receive request from user

Step 3: Web server request user name and password

Step 4: User receive inquiry

Step 5: User is sending user name and password

Step 6: Web server receive user name and password and compare it with data in the database

Step 7: If user name and password exist in database, user is authenticated and he is connected with Sport Talent Web Application, otherwise user receive error message and he can not enter application.

4 Conclusion and future work

In this work, we have shown our approach to sport talents selection. An expert system was developed with potential of working as a stand-alone and web-based application. Out of two computer-based solutions, web based one is the approach with higher potential in using new technologies for improvement in diagnostics and analysis. Although Internet version has obvious advantages, stand-alone version gives even the users that don't have connection to the Internet a tool for evaluation of young sport talents. Knowledge base was described along with interactions between various knowledge base elements. Applied methodology of knowledge acquisition and use of that knowledge in final evaluation of tested person has shown good results so far. Output results of the test measurements were compared to the expert evaluations and correlation coefficient is high.

Proposed approach is expected to significantly improve selection of school population into various sports. It makes expert knowledge permanently available to the teachers of physical education and trainers. Team work of all the participants will eventually form a referent database of all the children in Croatia.

More results will be available after large amount of measurements on the school population that are planned throughout Croatia. With increasing number of measurements, we expect the system to present itself in full strength. Further improvements and work is planned in the following directions:

- introducing additional sports
- improvements of grading rules
- corrections of test weights

Introduction of new sports into knowledge is short-term priority and will be conducted after new group of experts are contacted.

Changes in grading rules can be made in two ways: by manual intervention or by allowing the system to automatically modify rules and the classes according to newly available statistically processed measurement data.

Corrections of the test weights can also be made in two ways: according to refreshed weights obtained by the experts and by automatic adjustment. For this kind of automatic adjustment, solution is not as simple as for the previous one. Authors are planning possible introduction of neural network that could be used for this purpose. Supervised learning network that will be monitored by the experts is the most likely approach.

Finally, we shall say that implementation of fuzzy reasoning is underway and we expect further improvement in system performance.

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