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Expert System for Identification of Sport Talents: Idea, Implementation and Results

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1. Introduction

Selecting children for appropriate sport is the most demanding and the most responsible task for sport experts and kinesiology in general. Sport activities have significant differences regarding structural and substance features. Different sports are determined by authentic kinesiological structures and specific anthropological characteristics of an individual (Chapman, 2008; Abernethy, 2005). Success of an individual in particular sport activity is predominantly determined by the compatibility of his/her anthropological characteristics with the anthropologic model of top athletes in that sport (Morrow & James, 2005). Extensive research that has been done in order to test, analyze and compare athletes of various sports (MacDougall et al, 1991; Stergiou, 2004) brings precious information and knowledge that can be used for the sport talents identification, also.

Unfortunately, there is usually no systematic selection in sport. The selection is based on a subjective and non-scientific judgment with a low technological and methodological support. However, fast development of new information technologies as well as the introduction of new methods and knowledge provide a novel, systematic and scientifically based approach in selecting the appropriate sport for an individual.

In sports talent recognition process, two main problems were detected. First, task of finding an expert in this field is quite difficult due to the fact that domain of specific knowledge is separated into various sports. Also, usually experts have in-depth knowledge of the relevant factors for a specific sport and more superficial for other sports. The second problem is in fact similar with the first one and it relates to the availability of the knowledge (expert) even if we have the right person. In order to avoid this problems, the decision of developing a computer based expert system was brought (Rogulj et al., 2006).

Generally, knowledge acquisition techniques that are most frequently used today, require an enormous amount of time and effort on the part of both the knowledge engineer and the domain expert. They also require the knowledge engineer to have an unusually wide variety of interviewing and knowledge representation skills in order to be successful (Wagner et al., 2003). As a result, inclusion of the experts with the knowledge from both worlds, in the development of the expert system is a pre-request that should be satisfied if possible. Due to previously mentioned problem with availability of the knowledge, expert system accessibility through Internet was also required. Also, in the second version of the expert system, fuzzy logic was introduced because of detected specific issues in the evaluation process of a children or student (Papić et al., 2009). This approach is even intuitive because

of the vagueness of expert knowledge, grades and some other data. Our approach can, in some aspects of fuzzy logic implementation, be compared to the solution proposed by Weon and Kim (2001) or the system developed for the evaluation of students' learning achievement (Bai & Chen, 2008).

The World Wide Web is reducing technological barriers and make it easier for users in different geographical locations to access the decision support models and tools (Shim et al., 2002; Bhargava et al., 2007). 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 (Šimić & Devedžić, 2003). Another, similar categorization (Kim, et al., 2005) of the existing methodologies is into two categories, the server-side and the client-side, depending on the location of the inference engine of a Web-enabled, rule-based system. Less burden to Web servers is present when the ASP as the server-side script approach (Wang, 2005) is used.

Review of the uses of artificial intelligence in the area of sport science and applications with focusing on introduction of expert systems as diagnostic tools for evaluating faults in sports movements has been presented in (Bartlett, 2006). The use of the expert systems for the assessment of sports talent in children have been reported in the past (Rajković et al., 1991; Leskošek et al., 1992). Some results obtained by this research were used for the development of a more specific expert system for the basketball performance prediction and assessment (Dežman et al, 2001a, 2001b). Neither of these systems have used web technologies nor implementation of fuzzy logic.

An expert system should be adaptive to constant changes of new standard values and measures as well as open to insertion of new knowledge. As already stated, first version of the expert system developed by the authors was presented in (Rogulj et al., 2006) but further development and evaluation of the system showed that there are many questions left unanswered. Improvements regarding methodology, technology and a scope of the application were done and preliminary results were presented by Papić et al. (2009). Current version of developed software based solution has the following characteristics: ability of forming a referent measurement database with the records of all potential and active sportsmen, diagnostics of their anthropological characteristics, sports talent recognition, advising and guiding amateurs into the sports activities suitable for their potential. Also, a comparison of the test results for the same person and for overall achievement monitoring through a longer time period is possible. Evaluation and tests of the presented fuzzy-based approach with some other approaches used for the evaluation of the morphology models suggest that it is capable of successful recognition of the sport compatible for the tested individual based on his/her morphological characteristics (Rogulj et al., 2009). In this chapter, detailed description of the complete system will be given along with some new results and discoveries obtained during passed time.

2. Idea and knowledge acquisition

Basic idea and development steps of the expert system are presented in figure 1. It should be noted that thorough testing has to be done after each development phase. In the case of detected bugs and deficiency, previous steps should be repeated. As it can be seen from the figure 1, first four steps are relating to knowledge base forming and knowledge engineering. Basic assumptions used for this stage will be explained in the following text.

In Croatia, there is already defined set of functional, motorical and morphological tests that are mandatory for all children age 6-18 during every school year. These tests are used for the

evaluation of each children/student capabilities. Thus, in order to make proposed system widely applied without any additional demands on new tests and equipment, these tests were chosen as the measurement instrument for input data to our expert system.

Also, normative values for chosen tests are available from the literature (Findak et al., 1996) and updated according to Norton and Olds (2001).
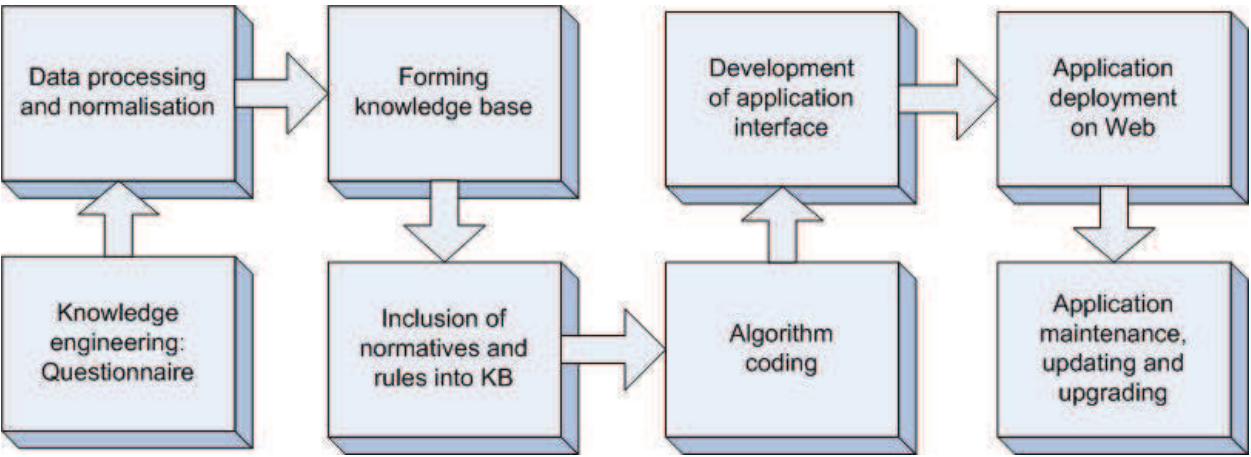

Fig. 1. Idea and development of the expert system.

As a first step, importance of each test for every sport has to be determined and stored in the knowledge base of the expert system. At this point, we have limited number of sports to 14 although using the approach that will be presented here, modular knowledge for other

Sport	Morphology				Motorical						Funct-ional
	MO1	MO2	M03	MO4	MT1	MT2	MT3	MT4	MT5	MT6	FU1
Gymnastics											
Swimming											
Athletics: sprint/jump											
Athletics: throwing											
Athletics: long dist. running											
Handball											
Football											
Basketball											
Volleyball											
Water polo											
Rowing											
Tennis											
Martial arts: pinning											
Martial arts: kicking											

Table 1. Example of a blank questionnaire handed to the kinesiology experts. Importance of each test has to be entered (0 - no importance, 10 - max. importance). Tests: MO1 – height; MO2 – weight; MO3 - Forearm girth; M04 - upper arm skin fold; MT1 - hand tapping; MT2 - long jump from a spot; MT3 - astride touch-toe; MT4 - backward polygon; MT5 - trunk lifting; MT6 - hanging endurance; FU1 - 3/6-minute running.

sports can easily be added to the knowledge base. Determination of the tests importance was based on the expert knowledge obtained from 97 kinesiology experts. A questionnaire presented by Table 1 was prepared and handed out to two groups of experts: general knowledge experts (kinesiology teachers in high and elementary schools) and experts in a particular sport (trainers and university professors).

Each expert had to fill the table with an integer importance factor from the interval [0,10] where 10 represents highest importance. Because of different scopes and depths of expert's knowledge, extensive data processing and adaptation of acquired knowledge was done after the answers to the questionnaire were given. An expert in the particular sport had to rate the importance of each test evaluating only the sport of his/her expertise while general knowledge experts evaluated test importance for all the sports. Test weight factors obtained by experts for particular sport (47 experts) have significantly more importance than test weight factors obtained by the general knowledge experts (52 experts), but the latter group's results were used as a correction factor because their accumulated knowledge provided more clear "big picture" than only partial image brought by the first group.

3. Knowledge processing

In this section calculation procedure for the person's adequacy for fourteen chosen sports will be explained in detail. Although in first implementation attempts fuzzy logic wasn't used, preliminary results have shown that fuzzy reasoning should be introduced for some specific tests.

3.1 Calculation of body fitness using fuzzy logic

Sport activities differ to a large extent in structure and content. Different sports are characterized by authentic kinesiological structures and specific anthropological features. The success of an individual in a certain sport activity depends mostly on the compatibility of his anthropological features, or the so-called anthropological model for the given sport (Katić et al., 2005). Therefore, in evaluation process, it is crucial to detect persons whose anthropological features match specific qualities of a certain kinesiological activity.

Measurements obtained by height and weight tests are used together in order to obtain body fitness for the particular sport. In kinesiology, this is an issue known as athletic body and this feature has its own membership grade instead of two separate ones for body weight and height. Importance factor of the indirect test equals sum of their individual weights. Evaluation of the tested person's body fitness for the particular sport is calculated using the rules with implemented fuzzy logic. In fact, athletic body of a person is represented by person's height and body mass index (BMI), so BMI, has to be calculated from height and weight of a person using the following equation:

$$BMI = \frac{w}{h^2} \tag{1}$$

where w is weight and h is height of a person.

After the analysis of the results from the filled and returned questionnaires and also with the comparison of the available national teams' anthropometric data, models of the ideal height and BMI were included into the expert system database.
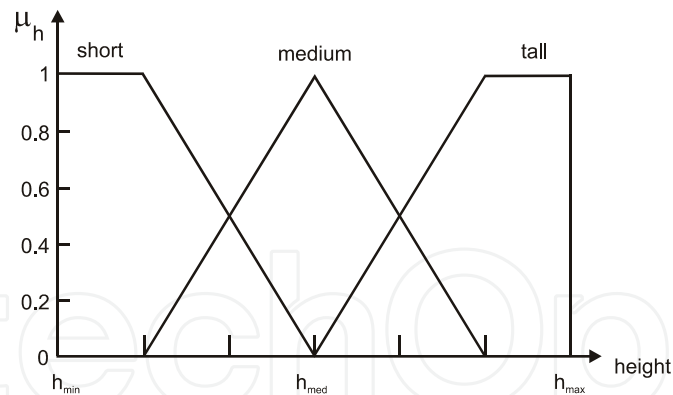
Fig. 2. Membership functions of the fuzzy sets "short", "medium" and "tall" used for the calculation of fuzzy membership grade for height.
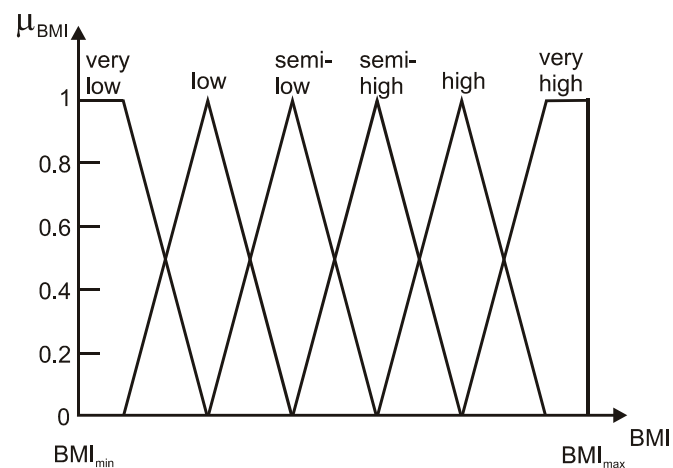

Fig. 3. Membership functions of the fuzzy sets "very low", "low", "semi-low", "semi-high", "high" and "very high" used for the calculation of fuzzy membership grade for BMI.

Fuzzification of the measured height and calculated BMI has been done according to the fuzzy sets presented in Figs. 2 and 3. Fuzzy grade vector for height (*FH*) can be presented as follows:

$$FH = \begin{bmatrix} FH_1 & FH_2 & FH_3 \\ \mu_{h1} & \mu_{h2} & \mu_{h3} \end{bmatrix}$$

where *FH₁*, *FH₂*, *FH₃* denote the fuzzy terms "short", "medium" and "tall", respectively, whereas μ_{hi} denote the membership value of the height belonging to the linguistic term *FHᵢ*, $\mu_{hi} \in [0,1]$, $1 \leq i \leq 3$.

Fuzzy grade vector for BMI (FB) can be presented as follows:

$$FB = \begin{bmatrix} FB_1 & FB_2 & FB_3 & FB_4 & FB_5 & FB_6 \\ \mu_{BMI1} & \mu_{BMI2} & \mu_{BMI3} & \mu_{BMI4} & \mu_{BMI5} & \mu_{BMI6} \end{bmatrix}$$

where *FB₁*, *FB₂*, *FB₃ FB₄*, *FB₅* and *FB₆* denote the fuzzy terms "very low", "low", "semi-low", "semi-high", "high" and "very high", respectively, whereas μ_{BMIi} denote the membership value of the BMI belonging to the linguistic term *FBᵢ*, $\mu_{BMIi} \in [0,1]$, $1 \leq i \leq 6$.

An example of a fuzzy rule matrix to infer the body model adequacy is presented in Table 1. Each sport has different rule matrix.

Based on the fuzzy grade vectors *FH*, *FB* and fuzzy rules which are partially shown in Table 2, fuzzy reasoning is performed in order to evaluate the athletic body adequacy for each sport.

Height	Body mass index (BMI)					
	Very low	Low	Semi-low	Semi-high	High	Very high
Short	$a_{1,1}(S_k)$	$a_{2,1}(S_k)$	$a_{3,1}(S_k)$	$a_{4,1}(S_k)$	$a_{5,1}(S_k)$	$a_{6,1}(S_k)$
Medium	$a_{1,2}(S_k)$	$a_{2,2}(S_k)$	$a_{3,2}(S_k)$	$a_{4,2}(S_k)$	$a_{5,2}(S_k)$	$a_{6,2}(S_k)$
Tall	$a_{1,3}(S_k)$	$a_{2,3}(S_k)$	$a_{3,3}(S_k)$	$a_{4,3}(S_k)$	$a_{5,3}(S_k)$	$a_{6,3}(S_k)$

Table 2. Fuzzy rule matrix for sport S_k. Possible linguistic values for $a_{i,j}(S_k)$ are: unmatched, semi-matched, matched.

Generally, we can write a fuzzy rule as follows:

IF the sport is S_k and the height is FH_i and BMI is FB_j THEN model is Ml

where Ml can have three linguistic values: M1 = "unmatched", M2 = "semi-matched" and M3 = "matched".

The triggering of each rule as a result gives the model membership grade. Linguistic value (Ml) in the consequent part of the rule determines which linguistic variable the membership grade relates to. Result of each rule is calculated as follows:

$$\mu_M^{''}(M_l) = w_H(S_k) \times \mu_{Hi} + w_{BMI}(S_k) \times \mu_{BMIj} \qquad (2)$$

where $w_H(S_K)$ and $w_{BMI}(S_K)$ denotes weight factor of the height and BMI test for a particular sport Sk, and Ml is the linguistic value in the consequent part of the rule. Other linguistic variables $M_j, j \neq l$ are not affected on the rule and their membership grades are zero.

Because of the simplicity, in the equation (2), sport verification is left out from the antecedent part of the rule. In fact, in the expert system database, rules are grouped by sports and only rules related to the particular sport will be fired. Model matrix (M) used for calculation of body model membership μ_M for each sport ($S_1, \ldots, S_P$) is obtained after the triggering of all the fuzzy rules and the aggregation of their output for each linguistic value M1, M2 and M3 by using the Max() function.

Matrix elements $\mu_{11}^{'}, \ldots, \mu_{p3}^{'}$ are fuzzy values obtained by evaluation of fuzzy rules.

$$M = \begin{array}{c} \\ S_1 \\ S_2 \\ \vdots \\ S_p \end{array} \overset{\begin{array}{ccc} M_1 & M_2 & M_3 \end{array}}{\begin{bmatrix} \mu_{11}^{'} & \mu_{12}^{'} & \mu_{13}^{'} \\ \mu_{21}^{'} & \mu_{22}^{'} & \mu_{23}^{'} \\ \vdots & \vdots & \vdots \\ \mu_{p1}^{'} & \mu_{p2}^{'} & \mu_{p3}^{'} \end{bmatrix}}$$

Each element $\mu_{ij}^{'}$ is calculated according to fuzzy rules as follows:

$$\mu_{ij}^{'} = Max\left\{\mu_{M,1}^{''}\left(M_j\right), \mu_{M,2}^{''}\left(M_j\right), \ldots \mu_{M,N}^{''}\left(M_j\right)\right\} \tag{3}$$

where N is a total number of rules that as an output have membership grade of the linguistic value M_j. Finally, the athletic body membership grade of the observed individual for particular sport is calculated as follows:

$$\mu_M\left(S_k\right) = Max\left(0.5 \times \mu_{k2}^{'}, \mu_{k3}^{'}\right). \tag{4}$$

3.2 Calculation of the total fitness for particular sport

Now, complete procedure for calculation of person's fitness for particular sport will be explained in details.

Assume that there is a series of sports $S_1, S_2, \ldots, S_p$ in sports domain S,

$$S = S_1, S_2, \ldots, S_p \tag{5}$$

where S_K denotes the k-th sport in S and $1 \leq K \leq p$. Now, let's assume that there is a series of test groups $G_1, G_2, \ldots, G_n$ in test group domain G,

$$G = G_1, G_2, \ldots, G_n \tag{6}$$

where G_i denotes the i-th test group in G and $1 \leq i \leq n$. Assume that test group G_i consists of m tests $T_{i1}, T_{i2}, \ldots, T_{im}$. We can define the input vector with the elements representing the measurement result R_{ij} for each conducted test T_{ij} of the observed individual:

$$R = \begin{bmatrix} R_{11} & R_{12} & \cdots & R_{1n} & R_{21} & \cdots & R_{2n} & \cdots & R_{mn} \end{bmatrix}^T$$

Next, the contribution of the test group G_i for the evaluation of a person's fitness for a particular sport (S_K) is defined as:

$$C_{S_K}\left(G_i\right) = \sum_{j=1}^{m} C_{S_K}\left(T_{ij}\right) = \sum_{j=1}^{m}\left(\mu_{ij}^{*} \times w_{ij}\left(S_K\right)\right) \tag{7}$$

where μ_{ij}^{*} denotes the membership grade of the test T_{ij}, $w_{ij}\left(S_K\right)$ denotes weight factor of the test T_{ij} for a particular sport S_K, $\sum$ denotes the algebraic sum and $\times$ denotes the algebraic product. Note: membership grades for height and weight tests are substituted with the athletic body membership grade calculated according to equation (4).

If the value of the membership grade is 0 ($\mu_{ij}^{*} = 0$), then the test T_{ij} result was poor, and maximal membership grade value ($\mu_{ij}^{*} = 1$) means that the test T_{ij} result was excellent. Total fitness index (TFI) for sport S_K is calculated as the algebraic sum of test group contributions:

$$TFI\left(S_K\right) = \sum_{i=1}^{n} C_{S_K}\left(G_i\right) \tag{8}$$

As it can be noticed, in order to compare TFI for different sports, normalization of weight factors has to be done. Normalization assumes that the maximum fitness index (MFI) that

can be obtained for each sport is equal which means that the following condition must be satisfied

$$MFI(S_K) = \sum_{i=1}^{n} M_{S_K}(G_i) = 1, \quad \forall S_K \in S \tag{9}$$

where maximum possible contribution of i-th test group for sport S_K is given by equation:

$$M_{S_K}(G_i) = \sum_{j=1}^{m} w_{ij}(S_K) \tag{10}$$

Membership grade μ_{ij}^{*} of the test T_{ij} needed for the equation (7) is calculated using the available test normative data for a particular gender and age. Each normative class (c_l) is defined by its minimal (n_1) and maximal value (n_2) and it can be expressed with the rule in the following form:

$$\mathbf{IF}\left(\text{test} = T_{ij}, \text{gender} = X, \text{age} = k\right)\mathbf{THEN}\left(c_{l,min} = n_1; c_{l,max} = n_2\right)$$

where $c_{l,min}$ and $c_{l,max}$ are the lower and upper boundary of the normative class l, respectively. Normative classes boundaries are directly associated with discrete membership grade values (Fig. 4).
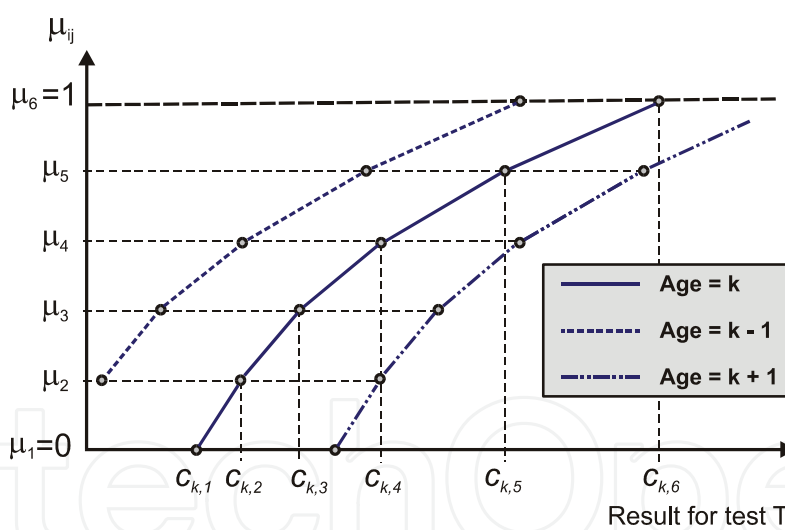
Fig. 4. Membership grade μ_{ij} of the test T_{ij} as a function of test normative classes for particular age (and gender).

For the measured or induced (in the case of height and BMI measurements) result (R_{ij}) of the test (T_{ij}), membership grade can be calculated using the equation

$$\mu_k = \frac{\mu_{k,l+1} - \mu_{k,l}}{c_{k,l+1} - c_{k,l}} \cdot \left(R_{ij} - c_{k,l}\right) + \mu_{k,l} \quad ; R_{ij} \in \left(c_{k,l}, c_{k,l+1}\right] \tag{11}$$

where k is age of the tested person (integer value), $c_{k,l}$ is the lower boundary of the normative class which includes measured value, and $\mu_{k,l}$ is a membership grade for the

normative class lower boundary value; $c_{k,l+1}$ is the upper boundary of normative class which includes measured value, and $\mu_{k,l+1}$ is membership grade for the normative class upper boundary value.

Because the age of the tested person (κ) is generally not an integer number (in years), an interpolation of normative classes and corresponding grades is done. In fact, two rules are fired – one with the nearest lower age in the antecedent part of the rule and another with the nearest upper age in the antecedent part of the rule. Final membership grade value can be calculated using the following equations:

$$
\begin{aligned}
c_l^* &= c_{k,l} + (\kappa - k) \cdot (c_{k+1,l} - c_{k,l}) \\
c_{l+1}^* &= c_{k,l+1} + (\kappa - k) \cdot (c_{k+1,l+1} - c_{k,l+1})
\end{aligned}
\tag{12}
$$

Membership grade indexes for particular age value can be simplified:

$$
\mu_{k,l} = \mu_{k+1,l} = \mu_l \,; \mu_{k,l+1} = \mu_{k+1,l+1} = \mu_{l+1} \,.
$$

Finally,

$$
\mu_{ij}^* = \frac{\mu_{l+1} - \mu_l}{c_{l+1}^* - c_l^*} \cdot \left(R_{ij} - c_l^* \right) + \mu_l
\tag{13}
$$

4. Implementation and development

Although entity names presented in Fig. 5 are descriptive and may differ to the table names in the database, structure that is presented gives the main relations between them.
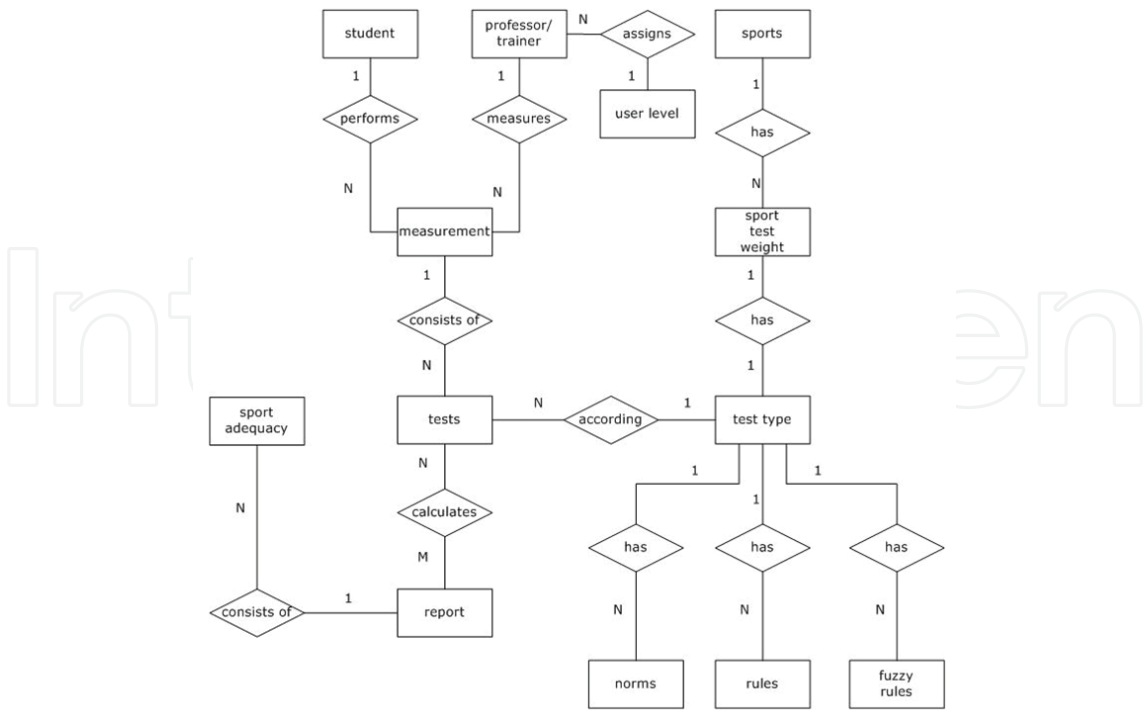

Fig. 5. Expert system structure. Expert knowledge is stored as rules, norms and test weights for each sport.

Knowledge engineering, forming of the knowledge base and coding of the stand-alone application lasted for about 12 months. After testing phase that lasted for about 3 months, fuzzy logic was introduced into the measurement evaluation and the migration of the code to the web application was done.

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 (Fig. 6).

The application consists of files with aspx extension made available via http using the Internet Information Service as web server. These files are containing both HTML and server-side code which is written in object pascal. HTML and server-side code is combined in order to create the final output of the page consisting of HTML markup that is sent to the client browser. User controls i.e. fully programmable objects (both code and presentation layer) of the asp.net (.ascx) web page were also done to provide full functionality of the application.
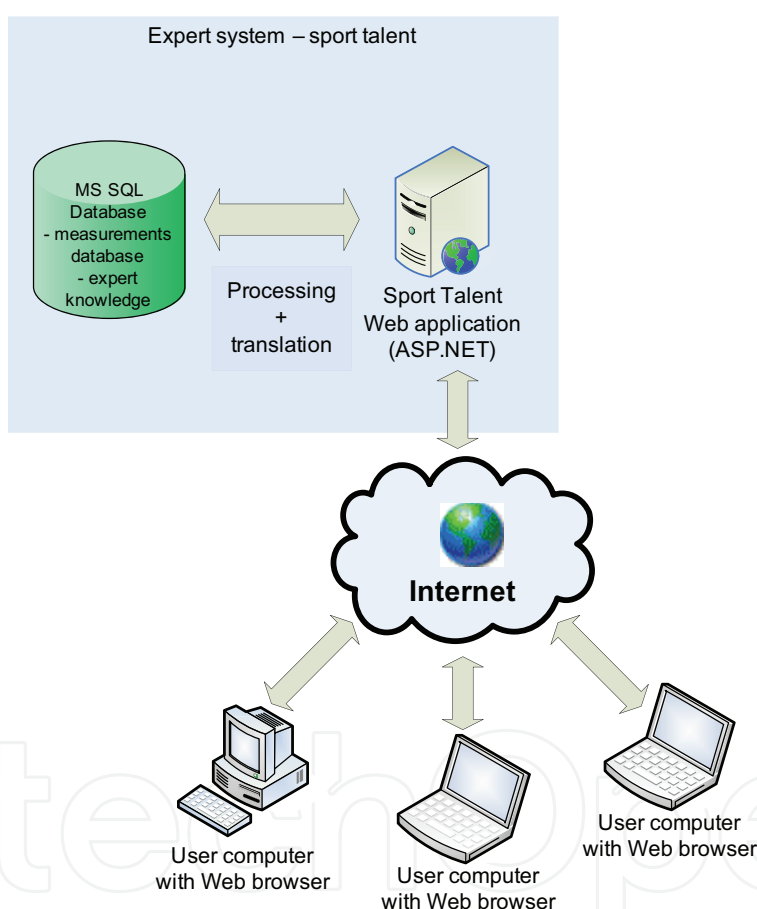

Fig. 6. Web server with application and user connection.

Since beginning of 2008, web version of the system along with the fuzzy module has been mounted on the web server. Chosen group of experts and school teachers has used the application since then and the database is growing daily.

Output generated by the expert system was compared with answers obtained by the human users and, in second test, prediction of the system based on the measurements of the successful athletes that are collected several years before they achieved elite level in sport. System evaluation results showed high reliability and high correlation with top experts in the field and the results for the second test also showed good match (Papić et al., 2009).

Within last year, quantitative contributions of certain motor abilities to the potential dance efficiency through expert knowledge were determined. Good metrical characteristics of the expert knowledge were determined, and after the experimental implementation of the results of research into the system, fine prognostic efficiency in recognising individuals engaged in dance activities was established (Srhoj, Lj. Et al., 2010).

5. Results and analysis

Typical output of the presented system consists of calculated percentages that are corresponding to the adequacy of the examinee for each sport that has needed data (norms, test weights) stored in the knowledge base (Fig. 7).
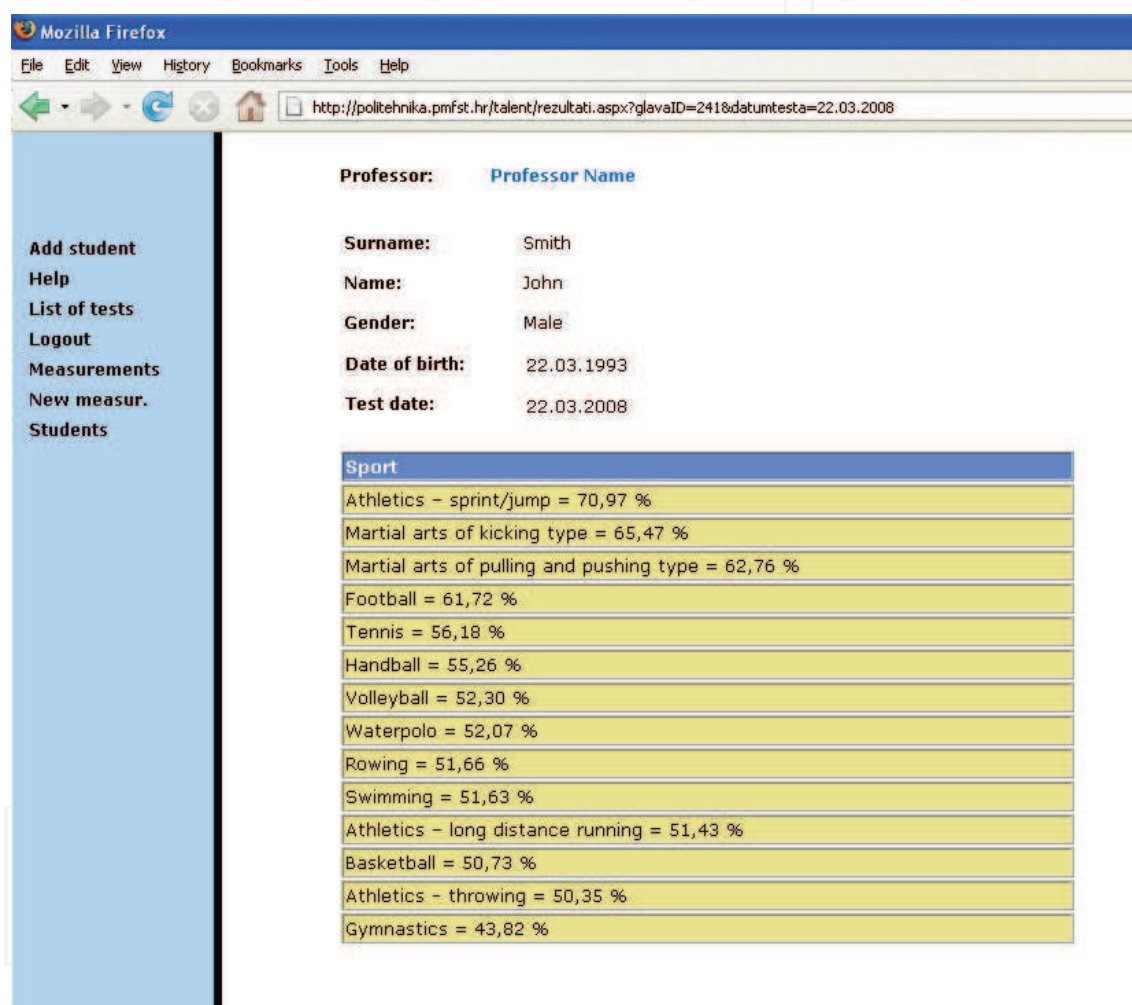
Fig. 7. Typical output of the expert system

In order to evaluate objectivity of the normative values and test weights stored in the knowledge base, average results for group of 106 examinees (45 female, 61 male) of various ages were analysed (Table 3). Combined results for both groups (female and male) are presented in Table 4.

Differences obtained between sports are generally small except maybe athletics – long distance running. This is indicating to unbalanced tests for this sport. In fact, this could be expected because of only one functional test in the tests battery. Also, almost 4% average differences between males and females indicate possible deviations of the present normative values.

Gender: Female, N = 46		Gender: Male, N = 61	
Sport	Average result (%)	Sport	Average result (%)
Athletics – long dist. running	60,50	Athletics – long dist. running	52,57
Martial arts – kicking	55,44	Athletics – sprint/jump	49,90
Athletics – sprint/jump	55,11	Martial arts – kicking	49,08
Football	49,94	Football	45,75
Tennis	46,44	Tennis	42,85
Martial arts – push/pull	45,33	Martial arts – push/pull	40,82
Gymnastics	44,99	Swimming	40,55
Water polo	44,20	Gymnastics	40,51
Handball	43,50	Water polo	40,51
Swimming	43,20	Handball	40,12
Rowing	41,29	Volleyball	38,69
Volleyball	39,73	Rowing	38,19
Basketball	39,15	Basketball	37,43
Athletics - throwing	38,61	Athletics - throwing	35,69
Total average:	46,25	Total average:	42,33

Table 3. Average output results for 106 examinees, female and male separately.

N = 106, Min: 3,54 ; Max: 95,01 ; STD: 15,85	
Sport	Average result (%)
Athletics – long dist. running	55,59
Athletics – sprint/jump	52,02
Martial arts – kicking	51,78
Football	47,42
Tennis	44,53
Martial arts – push/pull	42,75
Water polo	42,31
Gymnastics	42,14
Swimming	41,95
Handball	41,68
Rowing	39,75
Volleyball	39,32
Basketball	38,42
Athletics - throwing	37,07
Total average:	44,05

Table 4. Average output results for all examinees.

6. Conclusion and discussion

In this chapter we have presented an expert system for the selection and identification of an optimal sport for a child. This is the first expert system developed for this purpose that uses fuzzy logic and has wide Internet accessibility. Expert knowledge stored in the knowledge

base is the result of the knowledge acquired from 97 kinesiology experts. System evaluation results that were conducted during testing phase of the system showed high reliability and correlation with top experts in the field.

At present, measurements database has several hundreds measured children of various ages (primary and secondary schools) so updating of the normative data for the currently active tests is possible. Authors expect that it would further improve prediction reliability. It should be accented that presented system allows real time insight into the current anthropometric measures of the examinees.

As the consequence of using this system, the possibility of wrong selection and losing several years in training of an inappropriate sport should be 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 finances.

At the moment, the system stores normative data and weight factors information on fourteen sports. Recent research includes adding other sports into the domain of the presented expert system. First sport that is expected to be added is dance. Also, some sports such as basketball and athletics should be separated into new entities according to player's position (basketball) or specialization (athletics). Generation of output reports for the users are also part of the current work. Our intention is to make the reports more users friendly and to avoid output results in the terms of percentages. Automatic generation of linguistically rich and visually attractive report is expected to be more adequate for the users. Perhaps the most important issue that we are currently dealing with is the establishing new set of standard tests that are expected to have better metric characteristics than present one.

Present configuration is modular and that makes implementation of various modifications quite simple i.e. without the need to make some structural changes that could take time and would make the expert system unavailable for a longer period. As the authors see it, the main goal of this research is to make using this system mandatory to all school teachers and to allow trainers of various sports to have access to the measurement results as well. Only then, benefits of this expert system could be used up to its full potential.

7. Acknowledgment

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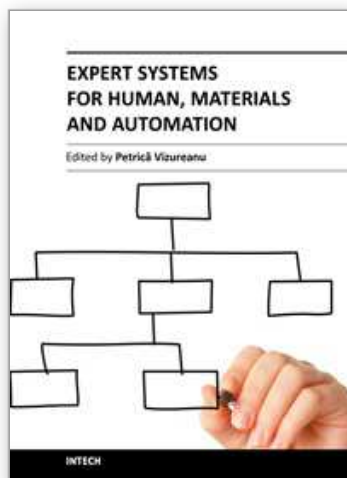
Expert Systems for Human, Materials and Automation

Edited by Prof. PetricÄƒ Vizureanu

The ability to create intelligent machines has intrigued humans since ancient times, and today with the advent of the computer and 50 years of research into AI programming techniques, the dream of smart machines is becoming a reality. The concept of human-computer interfaces has been undergoing changes over the years. In carrying out the most important tasks is the lack of formalized application methods, mathematical models and advanced computer support. The evolution of biological systems to adapt to their environment has fascinated and challenged scientists to increase their level of understanding of the functional characteristics of such systems. This book has 19 chapters and explain that the expert systems are products of the artificial intelligence, branch of computer science that seeks to develop intelligent programs for human, materials and automation.

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