USING PATTERN RECOGNITION TECHNIQUES FOR PSYCHOLOGICAL TESTS

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ABSTRACT: This paper presents the use and development of some techniques for the patterns recognition and their integration into a system of automatic evaluation of the psychological tests. The proposed theme is aimed at achieving a pattern processing program that will help diagnose psychological cases faster. Data gathered by the psychologist will be introduced in the processing program, the results being then compared, by following the effect of automatic interpretation.

KEYWORDS*:* Pattern recognition, neural networks, automatic evaluation, psychological test

I. INTRODUCTION

The computer technologies are in constant and rapid development. Image processing has greatly expanded in the medical field, where intelligent software that identifies certain diseases, by image processing, has been created.

The image processing requires a series of processes applied to an image: intensity adjustment, filter elements, morphological operation, segmentation [Tar10]. In [P+10] it is demonstrated the usefulness of image processing techniques in order to measure some relevant features of psychological test's images, Tree Drawing Test. Thus studies presents the segmentation of the tree from image's test and then the length and height of each part are measured, and the data are employed for the computations of the standard TDT formulas. This automatic process can be a real help for large groups of under aged children psychological screening.

The implementation of pattern recognition techniques was implemented in many scientific fields, creating the need to obtain as much information as possible about an image; therefore, capturing and identifying patterns of the processed images has become a central goal.

In medical science, pattern recognition is the basis for systems of computer-aided diagnosis (CAD). CAD describes a procedure that supports interpretations and conclusions of doctors. Other typical applications of pattern recognition techniques are automatic speech recognition, text classification in several categories, automatic recognition of handwritten postal codes on postal envelopes, automatic recognition of human faces images, or handwriting image extraction from medical forms [MG08]. In the last two examples of image analysis pattern recognition subtopic which deals digital images as input to pattern recognition systems [Bru09]. Image analysis is the extraction of significant information from images, predominantly of digital images using digital image processing techniques [SB10].

In psychology, pattern recognition, which makes sense and identify objects that we see is closely linked to perception, which explains how sensory inputs we receive significant. In psychology we know how laborious the interpretation of repetitive questionnaires with many subjects and a lot of answers can be. They must be resolved in a short time. Thus the idea of automated psychological testing, which saves the answers, encoded in a database, was a natural conclusion.

In time, they will be used together with other factors – the speed of response, the facial gestures, the intercorrelation between two answers, the points of control – in order to find the diagnosis without a psychologist. The interpretation of facial expression will be made with an image analysis program, to be developed in the current research program.

Based on previous diagnosis made by a psychologist, a learning set will be build and will be useful in diagnosis, using image analysis, in order to make the subjects' testing easier and to find a result closer to the truth in a shorter time.

The automatic processing of psychological tests is an research area in which the pattern recognition method scan is used in addition to their typical purpose, namely the image processing. A "numerical coding" and a high quality classifier (neural or statistical) may provide a useful tool able to give a rapid assessment of the "subjects'" answers. The main problem of this strategy is its efficiency.
The pattern recognition application for psychological tests includes the following steps [X+10]:

- image acquisition,
- pre-processing,
- learning - (how to implement classified statistics, neural networks),
- analysis (determination of the class to which a pattern belongs),
- post-processing (validating decisions).

II. METHODS AND MATERIALS

In psychological interviews, the subject's responses represent his opinions or his feelings over a certain matter and consequently cannot be classified as correct or incorrect. The estimation of subject's psychic abilities or troubles must be done using a complex procedure as the one described in Figure 1 [PLG11].

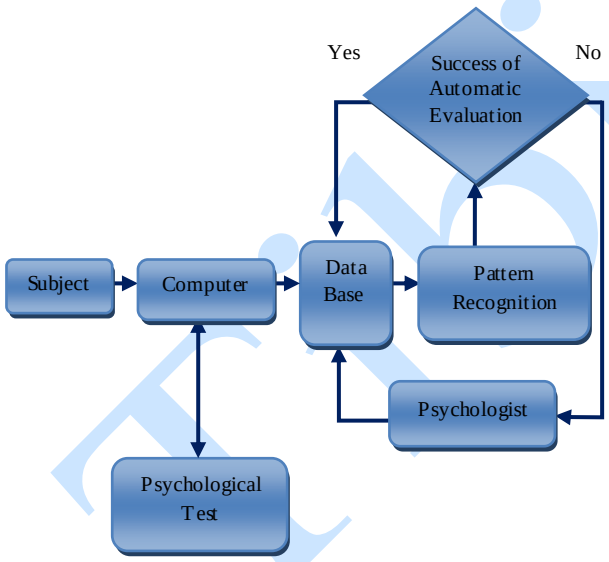

Figure 1. **The procedure for the automatic evaluation of psychological quiz tests [PLG11]**

In automatic evaluation systems it is very important that system must adapt to some important features of these psychological quizzes:

- Each separate topic of quiz's sections must be individually assessed and finally, all decisions are assembled into a final decision.
- Detection of dishonest or superficial answers.
- The neutral response must be among alternative answers to each question.
- Individual result from this type of questions can be put in a standard format such as conclusion: „yes", „no", „not sure" or „do not want to answer ..."

III. ENCODING THE ANSWERS

Automatic evaluation must include a step that contains classifications failed (difficult or series of typical cases) classifications that must be reassessed by a psychologist.
We propose a method for building an expert system able to evaluate each subject's answers and determine his/her problems if necessary.
Table 1 presents the solution proposed for encoding the answers.

Table 1. Answers encoding

Answers	Descriptor	Code
Yes	Y	11
No	N	00
Not sure	O	10
Do not want to answer	R	01

Cross-correlations are implemented as logical operations between answers. If, for example, questions Qm and Qn are looking for the same look, but logic or text is reversed, their comparison give a way to discover answers non-honest or superficial, the computer will perform the operation described in equation (1):

validate (A(Qm)), A(Qm)=A(Qn) (1)

Another important feature of this method is the possibility to introduce key point questions in the quiz. These key point questions are very useful in detecting superficial answers which can occur in the case of test given in order to obtain an opinion pool among a group of people. The detection of this kind of answers must be followed by their elimination from the final statistic of the pool.
This section presents the answers encoding and their utilization in order to obtain V_{Xj} a vector containing the subjects' encoded responses.

- A (CQ) – answers to common questions,
- A (QCV) – answers to questions that have correlations for validation
- KhPx – key points.

VXj = [A (Q1), A (Q2), A (Q3) …
0 if unvalidated,
A(Qk) if validated, …,
KhPx , …, A(Qp), … , A(Qk), … , A(QN)]
where $1 \leq k,x; p \leq N$.

The additional parameters can be added to some orall questions. This vector is used in a MLP neural network (Multi Layer Perceptron) which makes the classification into one of the predefined classes of the evaluated subjects.

This vector issued in a neural network MLP (Multi Layer Perceptron) that performs the classification in one of the classes predefined by the evaluated subjects.

The neural network architecture used for the implementation of the expert system is shown in Figure 2. It consists of a two floor MLP which can deliver the required classification in two steps.

- Step 1 Give classification for each subsection of the quiz in separate neural networks.
- Step 2 Gather the answers from Step 1 and compute the final answer

It is quite a delicate problem to weight the importance of each subsection and to intercorrelate them, thus the use of the second step MLP proved to be very usefull in finding correct final answer.

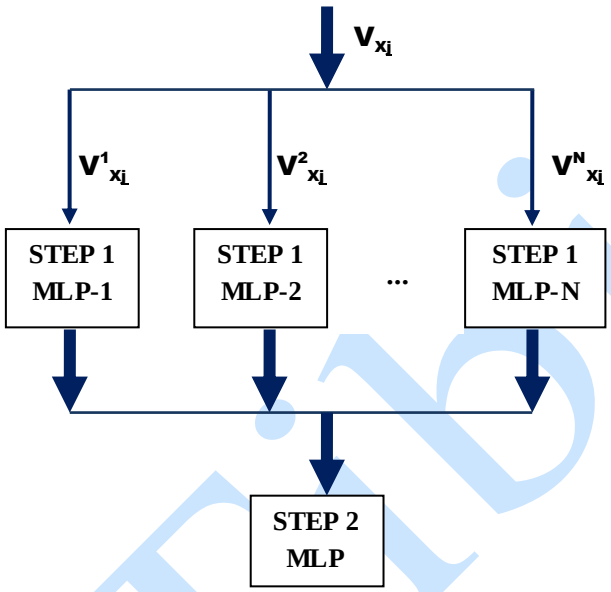

Figure 2. **The tree of MLP networks**

As stated before, the outcomes are also stored in the database in order to use them in the subsequent statistical procedures.

Thus the ability of the expert system to give correct evaluations grows as more work is done using it to obtain results to miscellaneous psychological tests performed to different groups of subjects and in different situations.

IV. CONCLUSIONS

The experimental results presented in Figure 3 show that if the neural network training was done separately for each test section, the result scan reach up to 94.11% accuracy (48 successful recognition of 51 test sets section).

Sometimes the subjects are satisfied with almost all the details, but there are some problems that prove to be particularly important to them, therefore their overall evaluation will be "unhappy". The success rate for this second stage of automatic evaluation presented in Fig.4 is only of 82.35%, (3 failed recognition of 17 sets of tests), a result that is not good enough.

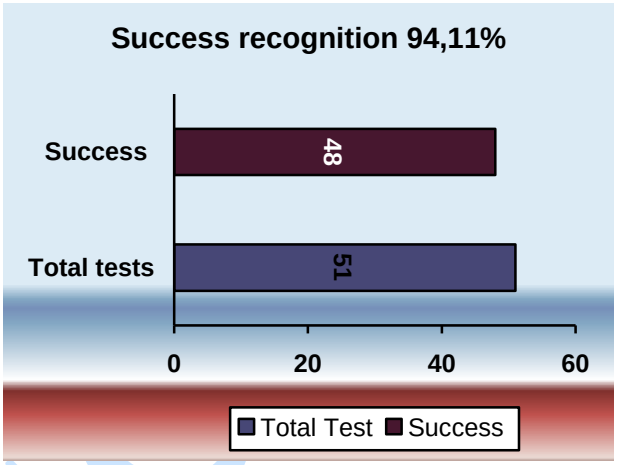

Figure 3. **Experimental results - successful recognition**

After a larger number of evaluations, we will be able to find a better model for the approximation of the relationship between assessments on sections and global decisions. This will help to establish the neural network architecture to achieve the desired result.

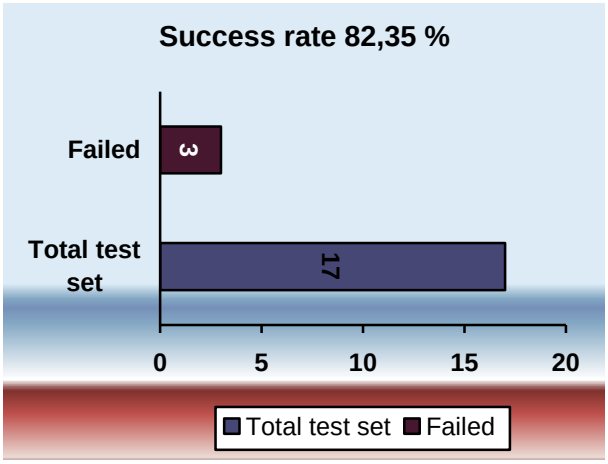

Figure 4. **Second stage of automatic evaluation**

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