Achievements in automatic evaluation of psychological quiz tests using pattern recognition

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ABSTRACT: In this paper we present the use and development of the pattern recognition techniques and their integration in an automatic system for assessing psychological tests. The presented theme aims at achieving pattern processing software that will facilitate a faster diagnosis of some psychological cases.
KEYWORDS: Pattern recognition, psychological tests, automatic evaluation, neural networks

Introduction

Image processing is a relatively recent domain, yet displaying a fast development. Its main application is to create intelligent software capable of discovering certain diseases, certain moods by analyzing and processing images.

The pattern recognition techniques have been developed in many scientific fields, aiming to obtain more information specific to images, and to capture and identify patterns in the processed images.

The present paper tries to introduce the image processing techniques in psychology. The interpretation of the repeated questionnaires having more subjects is quite laborious, requiring a great deal of answers to be interpreted in a short time. Thus, this situation is approached by creating automated psychological tests, in which responses will be interpreted, encoded and then stored in a database.

This encoding will be used, together with other factors – the rapidity of the response, the facial mimic, the intercorrelation of two answers, the checkpoints – in finding the diagnosis without a psychologist. The interpretation of the facial expression will be carried out through an image analysis software, which will be developed in the current research program.

Based on some previous interpretations of the subjects made by a psychologist, a learning set is build, which will be used in making diagnoses by using image processing and analyzing. The goal is to make the subjects' testing easier and to obtain a result closer to the truth in a short time.

The automatic processing of psychological tests is a research field that can use the methods of pattern recognition and image processing. For a quick assessment of the "subjects' " answers a "digital coding" and a high quality classifier (neural or statistical) will be used. The main problem of this strategy is represented by its efficiency.

The face pattern recognition application for the psychological tests involves the sequential processing of information and includes the following steps:

- *Image acquisition* with a computer equipped with video camera,
- *pre-processing* (detection and tracking of the important facial points),
- *extracting features* (ways of filtering, measurements of key facial areas - eyes, nose, mouth, eyebrows, chin),
- *analysis and classification* (setting the class to which a facial form, static classifiers, neural networks, rule-based systems),
- *post-processing* (decisions validation).

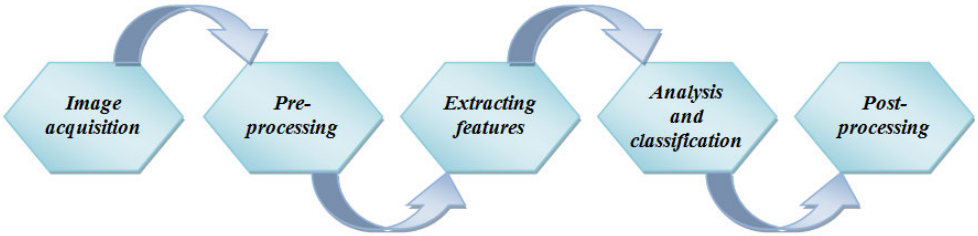

Figure 1. The sequential stages in processing facial information

1. Methods and materials

The interviews and psychological tests require a more complex procedure for processing the facial image information.

The "subject's" answers represent his feelings or opinions regarding a certain problem and cannot be classified as correct or incorrect. The assessment system must take into account some important features:

- The tests have many questions because they have to underline an overview of the subject's personality and his reaction to specific issues,
- The honesty in giving answer. For the answers given quickly, without understanding the question, the sincerity can be detected by using the correlation between questions, or certain key points introduced exactly in order to detect fraudulent or superficial answers.

In order to achieve such a system we took into consideration a number of rules needed to assess a subject: the significance of the answer, the value of each answer, the key points, the crossed correlations between certain questions, and the assessment different classes of additional parameters (answering speed, facial expression, gestures).

The solution proposed for encoding the answers is presented in Table 1.

Table 1. Answers encoding

Answer	Descriptor	Code
Yes	Y	11
Neutral/Not sure	O	10
Don't want to answer	R	01
No	N	00

The test created by a psychologist may have key point questions established by him/her in order to identify the value of the answers. In detecting insincere or superficial answers, the system can perform the automatic operation described in the equation 1:

$$if\ (R(Q_k) == (-R(Q_m))\ validate\ (R(Q_k)) \qquad (1)$$

where Q_k and Q_m are the questions that follow the same aspect, but the logic of the text is reversed. $R(Q_k)$ and $R(Q_m)$ are the answers to the questions Q_k and Q_m, while $-R(Q_m)$ performs the inverted logic for the second question.

The psychological testing involves two important steps of evaluation:

- searching the individual topic (each tested subject has different views and aspects),
- detecting the global situation.

The best way to do this is to build learning tests using answers from previously assessed individuals. The automatic facial image processing can use the procedure described in Figure 2:

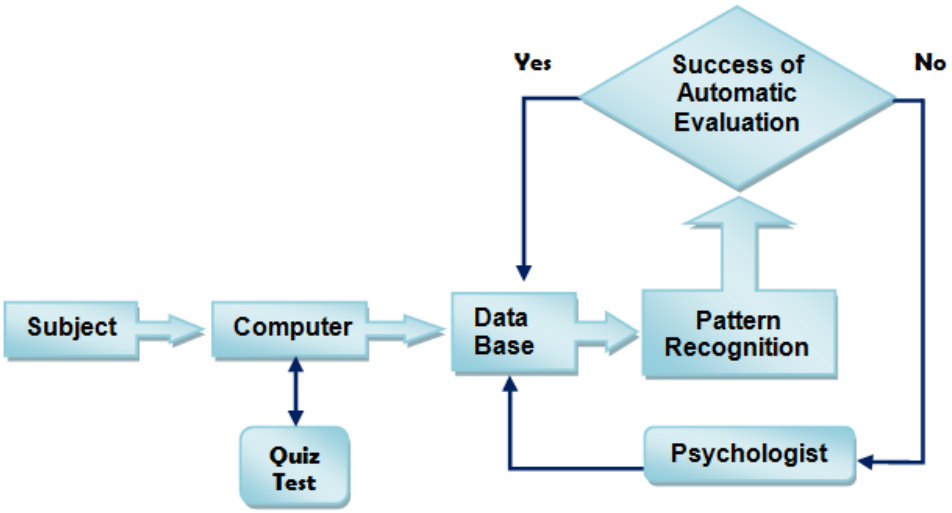

Figure 1. The procedure for the automatic evaluation of psychological quiz tests

As shown, the computer added evaluation have to include a step were the unsuccessful classifications (difficult or atypical cases) must be re-evaluated by a psychologist. This process suggests a method for building an expert system able to evaluate each subject's answers and determine his/her problems, if any.

2. The answers encoding

In this section we introduce the answers encoding and their use in obtaining a V_{Xj}, vector containing the subjects' encoded answers.

- $R(Q_p)$ R (Qp) - answers to common questions,
- $R(Q_k)$ R (QK) - answers to questions that have correlations for validation
- ChP_x ChPx - key points.

V_{Xj} =[$R(Q_1)$, $R(Q_2)$, $R(Q_3)$, …
0 if unvalidated,
$R(Q_k)$ if validated, …,
ChP_x , …, $R(Q_p)$, … , $R(Q_k)$, … , $R(Q_N)$]

where $1 \leq k, x, p \leq N$. The additional parameters (answering speed, facial expression, hand movement, etc.) can be added to some or all 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.

Initially, our goal was to use a standard classical classifier, but it proved rather difficult to establish an ideal model for each class of answers. Therefore, we tried to build a neural network as presented in Figure 3.

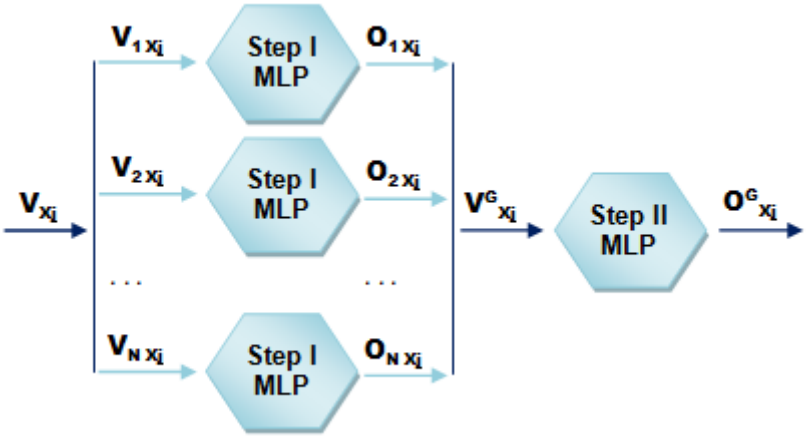

Figure 2. The tree of MLP networks

As stated before, the outcomes are also stored in the database in order to use them in the subsequent statistical procedures. The outcomes from Step I - O^P_{Xj} are used to build a vector $V^G_{Xj,}$ which supplies Step II of the network from which the final decision results.

Conclusions

The experimental results presented in Figure 4 show that if the designing of the neural network was done separately for each test section, the results can reach 94.12% accuracy (48 successful recognitions out of 51sections of the test sets).

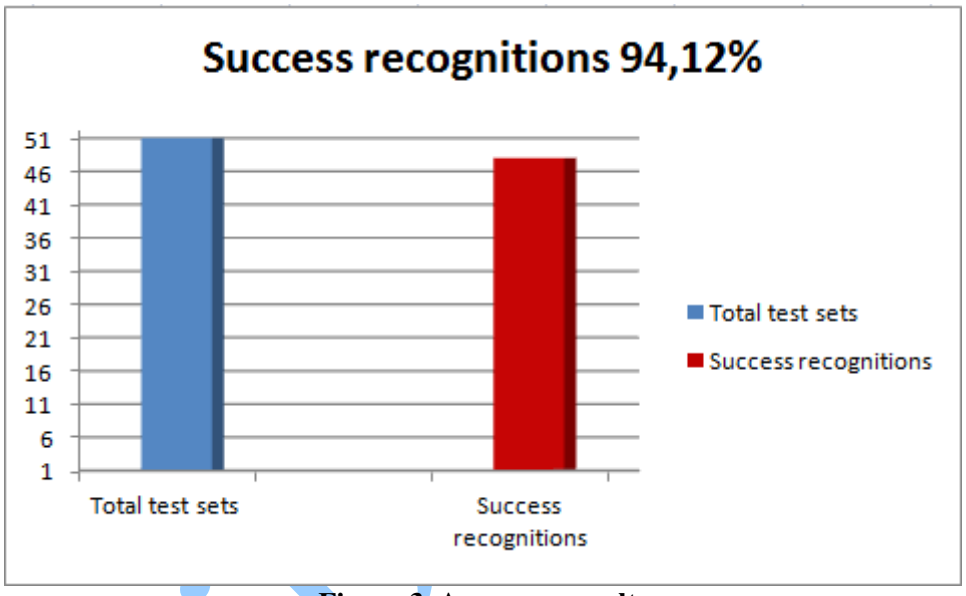

Figure 3. Accuracy results

Sometimes, the subjects are satisfied with almost all 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 automatic evaluation phase is only 82.35% (3 failed recognitions out of 17 sets of tests), a result that is not good enough.

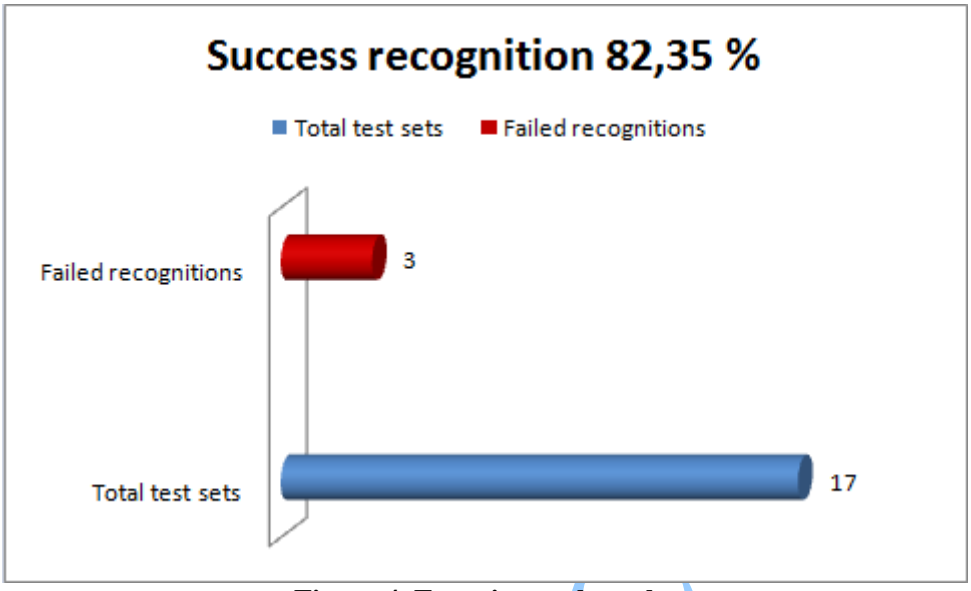

Figure 4. Experimental results

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

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References

[DHS01] **R.O. Duda, P. E. Hart, D.G. Stork** - *Pattern Classification,* 2nd edition, New York, John Wiley & Suns, 2001

[HT96] **T. R. Hastie, R. Tibishirani -** *Discriminant Adaptive Nearest Neighbor Classification, IEEE, Trans. on PAMI, Vol. 18(6), pp. 126-133, 1996*

[KL08] **T. M. Karnyanszky, D. L. Lacrămă** - *Teacher's Evaluation - a Component of Quality Assessment System, Anale. Seria Informatica,* vol.6, pp. 36-41, 2008

[PLV11] **F. Pintea, D. Lacrămă, V. Gui -** "*Automatic Evaluation of Psychological Quiz Tests*", Annals of DAAAM for 2011 & Proceedings of the 22nd International DAAAM Symposium "Inteligent Manufacturing &Automation" 23-26.11.2011 Vienna, Austria, pp. 1167-1168

[Sch09] **R. J. Schalkoff** - *Intelligent Systems: Principles, Paradigms and Pragmatics,* Sudbury, MA , 2009

[SC01] **M. Slaney, M. Covell** - *FaceSync: A linear operator for measuring synchronization of video facial images and audio tracks*, MIT Press, 2001

[V+ 09] **L. Vlăsceanu, M. G. Hâncean, B. Voicu, C. Tufiş -** *Statistical distribution, interpretation and options regarding higher education quality status, Quality Barometer*, Internal Report, Babes Bolyai University, Cluj-Napoca, 2009

[Y+ 10] **YuLi Xue, Xia Mao, C.D. Căleanu, ShanWei Lv. -** "*Layered Fuzzy Facial Expression Generation of Virtual Agent*", Chinese Journal of Electronics, Vol. 19, No.1, pag. 69-74, 2010.