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The Decision Support System for the Classification of Allergenic Pollen Types Based on Fuzzy Expert Data of Pollen Features on the Microscope Images

Vitalii B. Mokin[1], Oleksii M. Kozachko[2]
Department of Systems analysis, Computer monitoring and Engineering graphics
Vinnytsia National Technical University
Vinnytsia, Ukraine
[1]vbmokin@gmail.com
[2]lekoz80@gmail.com

Victoria V. Rodinkova[3], Olena O. Palamarchuk[4], Tetyana Y. Vuzh[5]
[3,4]Department of Pharmacy
[5]Department of Biophysics, Informatics and medical equipment
Vinnytsia National Pirogov Memorial Medical University
Vinnytsia, Ukraine
[3]vikarodi@gmail.com, [5]tasya_v@inbox.ru

***Abstract* — The article is devoted to the development of the decision support system for the classification of allergic pollen types based on fuzzy expert data of their features on the microscope images and the improvement of the identification method of this system. The genetic algorithm of the classifier training has been improved taking into account the spatial-temporal features of the distribution of pollen in the air, namely: adaptive fitness function for evaluating solutions, tournament selection with elitism and initialization of the initial population, allowing to improve the accuracy of classification. The example of the proposed system and method application based on real expert data of Vinnytsia monitoring station which is the part of European Aeroallergen Network is shown.**

Keywords* — *decision support system, allergenic pollen monitoring, microscope images, fuzzy knowledge base, fitness function

I. Introduction

Allergic disease is a key public health problem and it has increased significantly in recent decades in both developed and developing countries and is now recognized as a major global epidemic issue. The main cause of the allergic symptoms in sensitive individuals is a pollen of anemophilous plant species. It can cause seasonal allergenic rhinitis, rhinoconjunctivitis and, eventually, asthma. World Health Organization estimates 400 million people in the World suffer from the allergic rhinitis and 300 million from asthma. Within the Europe the prevalence of pollen allergy in the general population is estimated at 40% [1]. Plant pollen is an important allergen which affects sensitive individuals at the beginning of the pollination period and is a valuable pollinosis agent in Ukrainian population [2].

The only way to prevent the allergenic impact of pollen grains is an avoidance of the contact with the allergen and increase the public awareness of the allergy risks that individuals may experience [3]. Thus, the development and maintenance of the effective system of pollen control in the ambient air plays an essential role for pollinosis prevention [4].

Most commonly, pollen monitoring research involve impact samplers of Hirst type which allows to suck particles including pollen from the air and deposit them onto the sticky surface of the Melinex tape. This system of pollen monitoring is recognized by most air monitoring systems in the Europe and USA [5, 20].

The method involves time- and labor-consuming pollen count performed by researcher [6] who analyzes it under the light microscope. This classic counting method in in the aerobiological experiments is based on the experts assessment and requires a high degree of experience and concentration of a researcher, which cannot be always guaranteed [5]. On the other hand, pollen classification accuracy is essential while it underlies the precision of the pollen forecast for the further period which, in turn, enables allergy prevention.

To facilitate the manual process of air samples analyses, the automatic and semi-automatic approaches have been developed in the recent years. In the automatic one all the operations for sample scanning, recognition of pollen features, their classification and each type pollen count are performed by computer and special robot-assisted tools. Mixed or semi-automatic approach involves man-based sample scanning and recognition of pollen features. While these features processing, classification and calculation of pollen grain number are performed by computer.

Automatic approach is the most accurate but is very expensive and does not usually cover all existing types of pollen. Usually, it only allows accurate recognition of 3-6 pollen types [7, 8]. Manual pollen recognition allows to diagnose all the types in aerobiological sample. For example, 60 types of plant pollen and 20 types of fungi spores are diagnosed in Vinnytsia annually using the expert-based means. However, the pure manual approach is time-consuming, highly dependent on the experience and physical condition of an expert, usually performed on the space which hardly exceeds 12% of the total slide area.

Therefore, this approach is less accurate than the automatic one [9]. That is why, the semi-automatic pollen count might be considered as the optimal one which combines either the advantages of the experts' experience or possibilities of quick pollen count for further accurate pollen forecast [10].

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