Automated Cephalometric Analysis in Orthodontics Using Artificial Neural Network

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This work demonstrates the use of Neural Network approach, which is being developed to promote the automated identification and localization of cephelametric landmarks in orthodontics. Orthodontics is a specialty of dentistry that is concerned with the study and treatment of malocclusions (improper bites), which may be a result of tooth irregularity, disproportionate jaw improved bite (occlusion). Identification and localization of cephelametric landmarks has become an important clinical task in orthodontics. The conventional method of locating landmarks depends on manual tracing of the radiographic images. Since this is time consuming and error proven, the demand for completely automated analysis and diagnostic tasks has increased. In this respect, an intelligent cephalometric analysis is one of the main goals to be reached in orthodontics in near future.

This work critically reviews four major problems in cephelametric analysis namely; precision of landmark identification and localization, enormous time consumption, human errors and need for continuous support from experts. We argue that, issue of lack of autonomated solutions for cephelametric analysis has been the main problem.Conventional approaches lack generality, adaptability and flexibility, since it is difficult for them to learn the environment changes and they do not provide facilities to automate the analysis process to improve the accuracy of landmark detection.

There have been several previous attempts to automate cephalometric analysis with the use of hand crafted algorithms, mathematical or mtatistical models and artificial intelligence techniques such as neural networks, genetic algorithms and fuzzy logic. Nevertheless, in all cases accuracy was the same or worse than that of manual identification. Therefore this investigation aimed at proposing an Artificial Neural Network approach to computerize the cephalometric analysis. It is evident from the literature that, neural network approach can introduce very high level of autonomy and accuracy in modeling real world problems.

The proposed system automates cephalometric analysis along four dimensions; image acquisition: capturing and scanning cephalograms, image processing and computer vision: image analyzing, edge detecting and extracting landmarks, ANN training: classifying landmarks according to their geometrical specifications and pinpointing the land marks by calculating the center of gravity in each cluster. The users of the system would be orthodontists. This system has been implemented as a desktop application which automatically analyzes the cephelametric land marks according to their geometrical classifications.

Key words: Automated cephalometric analysis, Artificial neural network